UF | IFAS Extension
UNIVERSITY of FLORIDA

2023-2024

Vegetable Production Handbook of Florida

Peter Dittmar, Ph.D.
Associate Professor of Horticulture
UF/IFAS Horticultural
Sciences Department

Shinsuke Agehara Ph.D.
Assistant Professor of Horticulture
Gulf Coast REC – Balm

Nicholas S. Dufault, Ph.D.
Associate Professor of Plant Pathology
UF/IFAS Plant Pathology Department

Authors

Shinsuke Agehara, assistant professor, UF/IFAS Gulf Coast Research and Education Center – Wimauma
Julien Beuzelin, assistant professor, UF/IFAS Everglades Research and Education Center – Belle Glade
Nathan S. Boyd, professor, UF/IFAS Gulf Coast Research and Education Center – Wimauma
Johan Desaeger, assistant professor, UF/IFAS Gulf Coast Research and Education Center – Wimauma
Peter J. Dittmar, associate professor, UF/IFAS Horticultural Sciences Department – Gainesville
Nicholas S. Dufault, associate professor, UF/IFAS Plant Pathology Department – Gainesville
Michael D. Dukes, professor, UF/IFAS Department of Agricultural and Biological Engineering – Gainesville
Joshua H. Freeman, associate professor, UF/IFAS North Florida Research and Education Center – Quincy
Craig Frey, county Extension director and Extension agent II, UF/IFAS Extension Hendry County – Labelle
George Hochmuth, professor emeritus, UF/IFAS Department of Soil, Water, and Ecosystem Sciences – Gainesville
Ramdas Kanissery, assistant professor, UF/IFAS Southwest Florida Research and Education Center – Immokalee
Sriyanka Lahiri, assistant professor, UF/IFAS Gulf Coast Research and Education Center – Wimauma
Yuncong Li, professor, UF/IFAS Tropical Research and Education Center – Homestead
Guodong Liu, associate professor, UF/IFAS Horticultural Sciences Department – Gainesville
Xavier Martini, assistant professor, UF/IFAS North Florida Research and Education Center – Quincy
Eugene J. McAvoy, Extension agent IV emeritus, Southwest Florida Research and Education Center – Immokalee
Kelly T. Morgan, professor, UF/IFAS Department of Soil, Water, and Ecosystem Sciences – Gainesvill
Rao Mylavarapu, professor, UF/IFAS Department of Soil, Water, and Ecosystem Sciences – Gainesville
Mathews Paret, associate professor, UF/IFAS North Florida Research and Education Center – Quincy
Natalia Peres, professor, UF/IFAS Gulf Coast Research and Education Center – Wimauma
Jawwad Qureshi, associate professor, UF/IFAS Southwest Florida Research and Education Center – Immokalee
Richard N. Raid, professor, UF/IFAS Everglades Research and Education Center – Belle Glade
Pamela D. Roberts, professor, UF/IFAS Southwest Florida Research and Education Center – Immokalee
Germán Sandoya-Miranda, assistant professor, UF/IFAS Everglades Research and Education Center – Belle Glade
Dakshina R. Seal, scientist, UF/IFAS Tropical Research and Education Center – Homestead
Eric H. Simonne, distinguished professor, Office of District Extension Directors – Gainesville
Hugh A. Smith, associate professor, UF/IFAS Gulf Coast Research and Education Center – Wimauma
Crystal A. Snodgrass, county Extension director and Extension agent III, UF/IFAS Extension Manatee County – Palmetto
Gary E. Vallad, professor, UF/IFAS Gulf Coast Research and Education Center – Wimauma
Katia Viana Xavier, assistant professor, UF/IFAS Everglades Research and Education Center – Belle Glade
Qingren Wang, Extension agent III, UF/IFAS Extension Miami-Dade County – Homestead
Bonnie Wells, Extension agent II, UF/IFAS Extension Brevard County – Cocoa
Vance M. Whitaker, associate professor, UF/IFAS Gulf Coast Research and Education Center – Wimauma
Phillip Williams, assistant professor, UF/IFAS Southwest Florida Research and Education Center – Immokalee
Shouan Zhang, professor, UF/IFAS Tropical Research and Education Center – Homestead
Lincoln Zotarelli, assistant professor, UF/IFAS Horticultural Sciences Department – Gainesville

Cover Photo

Dr. Shinsuke Agehara

Handbook Design and Composition

Tracy Bryant, cover design

Hope Norman, graphic designer

Acknowledgments

The purpose of this book is to provide the best and most up-to-date information available to the primary users of this book—the Florida vegetable industry. This is possible because of the efforts of many University of Florida faculty in several locations around the state. The editors gratefully acknowledge their contributions. The editors also wish to acknowledge the contributions of the following faculty who have retired or are no longer involved in UF/IFAS Extension: Charles Barrett, Craig K. Chandler, Richard P. Cromwell, Kent E. Cushman, James P. Gilreath, Chad Hutchinson, Freddie Johnson, Thomas A. Kucharek, Mary L. Lamberts, Andrew MacRae, Donald N. Maynard, O. N. Nesheim, Joseph W. Noling, Stephen M. Olson, Monica Ozores-Hampton, Kenneth Pernezny, James Price, Richard N. Raid, Kenneth D. Shuler, Allen G. Smajstrla, William M. Stall, Phil Stansly, David Sui, Charles Vavrina, Susan Webb, and Philip Williams.

Contents

Crop Index

UF/IFAS Information

An Equal Opportunity Institution. UF/IFAS Extension, University of Florida, Institute of Food and Agricultural Sciences, Andra Johnson, dean for UF/IFAS Extension.

UF/IFAS Extension Offices

UF/IFAS Extension Alachua County
106 SW 140th Terr. Suite 3
Jonesville, FL 32669
PH: (352) 955-2402 | FAX: (352) 334-0122
EMAIL: Alachua@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/alachua

UF/IFAS Extension Baker
1025 West Macclenny Ave.
Macclenny, Florida 32063-9640
PH: (904) 259-3520 | FAX: (904) 259-9034
EMAIL: Baker@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/baker

UF/IFAS Extension Bay County
2728 E. 14th Street
Panama City, Florida 32401-5022
PH: (850) 784-6105 | FAX: (850) 784-6107
EMAIL: Bay@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/bay

UF/IFAS Extension Bradford County
2266 North Temple Avenue
Starke, Florida 32091-1612
PH: (904) 966-6224 | FAX: (904) 964-9283
EMAIL: Bradford@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/bradford

UF/IFAS Extension Brevard County
3695 Lake Drive
Cocoa, Florida 32926-4219
PH: (321) 633-1702 | FAX: (321) 633-1890
EMAIL: Brevard@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/brevard

UF/IFAS Extension Broward County
3245 College Ave
Davie, FL 33314
PH: (954) 357-5270 | FAX: (954) 357-8740
EMAIL: Broward@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/broward/

UF/IFAS Extension Calhoun County
20816 Central Ave. East Suite1
Blountstown, Florida 32424-2206
PH: (850) 674-8323 | FAX: (850) 674-8353
EMAIL: Calhoun@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/calhoun

UF/IFAS Extension Charlotte County
25550 Harbor View Road, Suite 3
Port Charlotte, Florida 33980-2503
PH: (941) 764-4340 | FAX: (941) 764-4343
EMAIL: Charlotte@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/charlotte

UF/IFAS Extension Citrus County
3650 West Sovereign Path, Suite 1
Lecanto, FL 34461-8070
PH: (352) 527-5700 | FAX: (352) 527-5749
EMAIL: citrus@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/citrus

UF/IFAS Extension Clay County
2463 SR 16W
P.O. Box 278
Green Cove Springs, Florida 32043-0278
PH: (904) 284-6355 | FAX: (904) 529-9776
EMAIL: Clay@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/clay

UF/IFAS Extension Collier County
14700 Immokalee Road
Naples, Florida 34120-1468
PH: (239) 252-4800 | FAX: (239) 252-4822
EMAIL: Collier@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/collier

UF/IFAS Extension Columbia County
971 W. Duval St., Ste 170
Lake City, FL 32055-3708
PH: (386) 752-5384 | FAX: (386) 758-2173
EMAIL: Columbia@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/columbia

UF/IFAS Extension Desosto County
2150 Northeast Roan Street
Arcadia, Florida 34266-5025
PH: (863) 993-4846 | FAX: (863) 993-4849
EMAIL: Desoto@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/desoto

UF/IFAS Extension Dixie County
99 Northeast 121st Street P.O. Box 640
Cross City, Florida 32628-0640
PH: (352) 498-1237 | FAX: (352) 498-1471
EMAIL: Dixie@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/dixie

UF/IFAS Extension Duval County
1010 North McDuff Ave.
Jacksonville, Florida 32254-2083
PH: (904) 255-7450 | FAX: (904) 387-8902
EMAIL: Duval@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/duval

UF/IFAS Extension Escambia County
3740 Stefani Road
Cantonment, Florida 32533-7792
PH: (850) 475-5230 | FAX: (850) 475-5233
EMAIL: Escambia@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/escambia

UF/IFAS Extension Flagler County
150 Sawgrass Road
Bunnell, Florida 32110-9503
PH: (386) 437-7464 | FAX: (386) 586-2102
EMAIL: Flagler@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/flagler/

UF/IFAS Extension Franklin County
66 Fourth Street
Apalachicola, Florida 32320-1775
PH: (850) 653-9337 | FAX: (850) 653-9447
EMAIL: Franklin@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/franklin

UF/IFAS Extension Gadsden County
2140 West Jefferson Street
Quincy, Florida 32351-1905
PH: (850) 875-7255 | FAX: (850) 875-7257
EMAIL: Gadsden@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/gadsden

UF/IFAS Extension Gilchrist County
125 East Wade Street
P.O. Box 157
Trenton, Florida 32693-0157
PH: (352) 463-3174 | FAX: (352) 463-3197
EMAIL: Gilchrist@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/gilchrist

UF/IFAS Extension Glades County
900 US 27
P.O. Box 1527
SW Moore Haven, Florida 33471-0549
PH: (863) 946-0244 | FAX: (863) 946-0629
EMAIL: Glades@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/glades

UF/IFAS Extension Gulf County
232 East Lake Ave.
P.O. Box 250
Wewahitchka, Florida 32465-0250
PH: (850) 639-3200 | FAX: (850) 639-3201
EMAIL: Gulf@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/gulf

UF/IFAS Extension Hamilton County
1143 NW US Highway 41
Jasper, Florida 32052-5856
PH: (386) 792-1276 | FAX: (386)792-6446
EMAIL: Hamilton@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/hamilton

UF/IFAS Extension Hardee County
507 Civic Center Drive
Wauchula, Florida 33873-9460
PH: (863) 773-2164 | FAX: (863) 773-6861
EMAIL: Hardee@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/hardee

UF/IFAS Extension Hendry County
1085 Pratt Blvd
P.O. Box 68
LaBelle, Florida 33975-0068
PH: (863) 674-4092 | FAX: (863) 674-4637
EMAIL: hendry@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/hendry

UF/IFAS Extension Hernando County
16110 Aviation Loop
Brooksville, Florida 34604
PH: (352) 754-4433 | FAX: (352) 754-4489
EMAIL: Hernando@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/hernando

UF/IFAS Extension Highlands County
4509 George Blvd.
Sebring, Florida 33875-5837
PH: (863) 402-6540 | FAX: (863) 402-6544
EMAIL: Highlands@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/highlands

UF/IFAS Extension Hillsborough County
5339 County Road 579
Seffner, Florida 33584-3334
PH: (813) 744-5519 | FAX: (813) 744-5776
EMAIL: Hillsborough@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/hillsborough

UF/IFAS Extension Holmes County
1169 East Hwy 90
Bonifay, Florida 32425-6012
PH: (850) 547-1108 | FAX: (850) 547-7433
EMAIL: Holmes@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/holmes

UF/IFAS Extension Indian River County
1800 27th Street
Vero Beach, Florida 32960-0310
PH: (772) 226-4330 | FAX: (772) 226-1743
EMAIL: Indian@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/indian-river/

UF/IFAS Extension Jackson County
2741 Pennsylvania Avenue, Suite 3
Marianna, Florida 32448-4022
PH: (850) 482-9620 | FAX: (850) 482-9287
EMAIL: Jackson@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/jackson

UF/IFAS Extension Jefferson County
2729 W. Washington Hwy. 90
Monticello, Florida 32344-5963
PH: (850) 342-0187 | FAX: (850) 342-3483
EMAIL: Jefferson@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/jefferson

UF/IFAS Extension Lafayette County
176 Southwest Community Circle, Suite D
Mayo, Florida 32066-4000
PH: (386) 294-1279 | FAX: (386) 294-2016
EMAIL: jessjohnson@ufl.edu
https://sfyl.ifas.ufl.edu/lafayette

UF/IFAS Extension Lake County
1951 Woodlea Road
Tavares, Florida 32778-4052
PH: (352) 343-4101 | FAX: (352) 343-2767
EMAIL: Lake@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/lake

UF/IFAS Extension Lee County
3410 Palm Beach Blvd.
Fort Myers, Florida 33916-3736
PH: (239) 533-7400 | FAX: (239) 485-2300
EMAIL: Lee@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/lee

UF/IFAS Extension Leon County
615 Paul Russell Road
Tallahassee, Florida 32301-7060
PH: (850) 606-5200 | FAX: (850) 606-5201
EMAIL: marcusb@ufl.edu
https://sfyl.ifas.ufl.edu/leon

UF/IFAS Extension Levy County
625 North Hathaway Avenue, Alt 27
P.O. Box 219
Bronson, Florida 32621-0219
PH: (352) 486-5131 | FAX: (352) 486-5481
EMAIL: Levy@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/levy

UF/IFAS Extension Liberty County
10405 Northwest Theo Jacobs Way
P.O. Box 369
Bristol, Florida 32321-0368
PH: (850) 643-2229 | FAX: (850) 643-3584
EMAIL: Liberty@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/liberty

UF/IFAS Extension Madison County
184 NW College Loop
Madison, Florida 32340-1412
PH: (850) 973-4138 | FAX: (850) 973-2000
EMAIL: Madison@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/madison

UF/IFAS Extension Manatee County
1303 17th Street West
Palmetto, Florida 34221-2998
PH: (941) 722-4524 | FAX: (941) 721-6608
EMAIL: Manatee@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/manatee

UF/IFAS Extension Marion County
2232 NE Jacksonville Rd.
Ocala, Florida 34470-3615
PH: (352) 671-8400 | FAX: (352) 671-8420
EMAIL: extensionservice@marioncountyfl.org
https://sfyl.ifas.ufl.edu/marion

UF/IFAS Extension Martin County
2614 S.E. Dixie Hwy.
Stuart, Florida 34996-4007
PH: (772) 288-5654 | FAX: (772) 288-4354
EMAIL: Martin@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/martin

UF/IFAS Extension Miami-Dade County
18710 SW 288th Street
Homestead, Florida 33030-2309
PH: (305) 248-3311 | FAX: (305) 246-2932
EMAIL: dade@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/miami-dade

UF/IFAS Extension Monroe County
1100 Simonton Street, # 2-260
Key West, Florida 33040-3110
PH: (305) 292-4501 | FAX: (305) 292-4415
EMAIL: Monroe@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/monroe

UF/IFAS Extension Nassau County
543350 US Hwy. 1
Callahan, Florida 32011-6353
PH: (904) 530-6353 | FAX: (904) 879-2097
EMAIL: Nassau@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/nassau

UF/IFAS Extension Okaloosa County
3098 Airport Rd.
Crestview, FL 32539-7124
PH: (850) 689-5850 | FAX: (850) 689-5727
EMAIL: austin.chisholm@ufl.edu
https://sfyl.ifas.ufl.edu/okaloosa

UF/IFAS Extension Okeechobee County
458 Hwy. 98 North
Okeechobee, Florida 34972-2303
PH: (863) 763-6469 | FAX: (863) 763-6745
EMAIL: jdorriety@co.okeechobee.fl.us
https://sfyl.ifas.ufl.edu/okeechobee

UF/IFAS Extension Orange County
6021 South Conway Road
Orlando, Florida 32812-3604
PH: (407) 254-9200 | FAX: (407) 850-5125
EMAIL: Orange@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/orange

UF/IFAS Extension Osceola County
1921 Kissimmee Valley Lane
Kissimmee, Florida 34744-6107
PH: (321) 697-3000 | FAX: (321) 697-3044
EMAIL: ci.gonzalez@ufl.edu
https://sfyl.ifas.ufl.edu/osceola

UF/IFAS Extension Palm Beach County
559 North Military Trail
West Palm Beach, Florida 33415-1311
PH: (561) 233-1700 | FAX: (561) 233-1768
EMAIL: Palmbeach@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/palm-beach

UF/IFAS Extension Pasco County
36702 SR 52
Dade City, Florida 33525-5198
PH: (352) 518-0156 | FAX: (352) 523-1921
EMAIL: greich@pascocountyfl.net
https://sfyl.ifas.ufl.edu/pasco

UF/IFAS Extension Pinellas County
12520 Ulmerton Road
Largo, Florida 33774-3602
PH: (727) 582-2100 | FAX: (727) 582-2149
EMAIL: gardenhelp@pinellascounty.org
https://sfyl.ifas.ufl.edu/pinellas

UF/IFAS Extension Polk County
1702 Highway 17-98 South
South Bartow, Florida 33830
P.O. Box 9005 Drawer HS03
Bartow, FL 33831-9005
PH: (863) 519-1041 | FAX: (863) 534-0001
EMAIL: Polk@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/polk

UF/IFAS Extension Putnam County
111 Yelvington Road, Suite 1
East Palatka, Florida 32131-2114
PH: (386) 329-0318 | FAX: (386) 329-1262
EMAIL: Putnam@ ifas.ufl.edu
https://sfyl.ifas.ufl.edu/putnam

UF/IFAS Extension Santa Rosa County
6263 Dogwood Drive
Milton, Florida 32570-3500
PH: (850) 623-3868 | FAX: (850) 623-6151
EMAIL: Santarosa@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/santa-rosa

UF/IFAS Extension Sarasota County
6700 Clark Road
Sarasota, Florida 34241-9328
PH: (941) 861-9900 | FAX: (941) 861-9886
EMAIL: Sarasota@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/sarasota

UF/IFAS Extension Seminole County
250 W. County Home Rd.
Sanford, Florida 32773-6189
PH: (407) 665-5556 | FAX: (407) 665-5563
EMAIL: extension@seminolecountyfl.gov
https://sfyl.ifas.ufl.edu/seminole

UF/IFAS Extension St. Johns County
3125 Agricultural Center Drive
St. Augustine, Florida 32092-0572
PH: (904) 209-0430 | FAX: (904) 209-0431
EMAIL: Stjohns@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/stjohns/

UF/IFAS Extension St. Lucie County
8400 Picos Road, Suite 101
Fort Pierce, Florida 34945-3045
PH: (772) 462-1660 | FAX: (772) 462-1510
EMAIL: dshalginewicz@ufl.edu
https://sfyl.ifas.ufl.edu/stlucie

UF/IFAS Extension Sumter County
7620 State Road 471, Suite 2
Bushnell, Florida 33513-8716
PH: (352) 569-6862 | FAX: (352) 569-6861
EMAIL: Sumter@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/sumter

UF/IFAS Extension Suwannee County
1302 11th Street SW
Live Oak, Florida 32064-3611
PH: (386) 362-2771 | FAX: (386) 364-1698
EMAIL: Suwannee@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/suwannee

UF/IFAS Extension Taylor County
203 Forest Park Drive
Perry, Florida 32348-6340
PH: (850) 838-3508 | FAX: (850) 838-3546
EMAIL: taylor@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/taylor

UF/IFAS Extension Union County
25 NE 1st Street
Lake Butler, Florida 32054-1701
PH: (386) 496-2321 | FAX: (386) 496-1111
EMAIL: Union@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/union

UF/IFAS Extension Volusia County
3100 E New York Ave.
Deland, Florida 32724-6497
PH: (386) 822-5778 | FAX: (386) 822-5767
EMAIL: Volusia@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/volusia

UF/IFAS Extension Wakulla County
84 Cedar Avenue
Crawfordville, Florida 32327-2063
PH: (850) 926-3931 | FAX: (850) 926-8789
EMAIL: Wakulla@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/wakulla

UF/IFAS Extension Walton County
732 North 9th Street
DeFuniak Springs, Florida 32433-3804
PH: (850) 892-8172 | FAX: (850) 892-8443
EMAIL: Walton@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/walton

UF/IFAS Extension Washington County
1424 Jackson Ave., Suite A
Chipley, Florida 32428-1602
PH: (850) 638-6180 | FAX: (850) 638-6181
EMAIL: Washington@ifas.ufl.edu
https://sfyl.ifas.ufl.edu/washington

Disclaimer

We appreciate the financial support of our sponsors in the production of this publication. The use of trade names and advertisements in this publication is solely for the purpose of providing specific information. It is not a guarantee or warranty of the products named, and does not signify that they are approved to the exclusion of others of similar composition. Use pesticides safely. The user must follow all rates and restrictions as per label directions. The label is a legally-binding contract between the user and the manufacturer. The Vegetable Production Handbook is intended for commercial vegetable growers who have to make numerous managerial decisions. Although the proper choice of the variety, pesticide, application, equipment, fertilizer, and cultural practice is the individual grower's responsibility, these recommendations should help facilitate decision-making.

Florida Pesticide Emergency Phone List

Call 911 for pesticide emergencies. For non-emergency pesticide questions or concerns, contact the following:

- National Pesticide Information Center (NPIC), 800-858-7378, 11 AM–3 PM Eastern Time, Monday through Friday.
- The Poison Center Emergency Telephone Service, 800-222-1222
- The manufacturer of the pesticide in question. Their phone number is listed on the pesticide label.

The information above was provided by the UF/IFAS Pesticide Information Office 352-392-4721.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS710

doi.org/10.32473/edis-cv100-2022

Chapter 1. Commercial Vegetable Production in Florida[1]

Peter J. Dittmar, Nicholas Dufault, and Shinsuke Agehara[2]

Vegetable production remains a tremendous industry for Florida in terms of acreage and value. Including vegetables, melons, potatoes, and strawberries, production occurred on approximately 251,011 acres and generated more than $1.34 billion in gross sales in 2016, which ranks second among all the states. Growing seasons are well defined by the peninsular geography, allowing Florida to serve as the main vegetable supplier during late fall, winter, and early spring months to the United States. Although more than 40 vegetable crops are commercially planted in the state, Florida ranks in the top three on production value of tomato, bell pepper, snap bean, squash, sweet corn, watermelon, cabbage, cucumber, and strawberry (Table 1).

The objective of this publication is to provide updated information on crop cultivars, pesticide labels, and certain practices for vegetable production in Florida. Suggested practices are guidelines for growers to plan farm activities and are always subject to review using the latest scientific data available.

Table 1. Vegetable production acreage and value in Florida.

Crop	Planted Acres	Value (million US$)	US Rank
Tomato	30,000	382.2	1
Strawberry	10,800	449.7	2
Bell pepper	13,500	209.7	2
Sweet corn	37,600	160.0	2
Potato	29,300	117.0	11
Snap bean	28,200	105.6	1
Watermelon	22,500	123.3	1
Squash	6,000	30.0	2
Cabbage	8,500	49.4	3
Cucumber	11,000	66.0	1

Source: Vegetables—2015–2016 summary, NASS, USDA.

Web Links to Additional Information on Vegetable Production Topics

UF/IFAS Extension provides information through the Electronic Data Information Source (EDIS) found at https://edis.ifas.ufl.edu. Below is a partial list of EDIS publications pertaining to vegetable production for further information beyond the *Vegetable Production Handbook of Florida*.

1. This document is HS710, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Peter J. Dittmar, associate professor, Horticultural Sciences Department; Nicholas S. Dufault, associate professor, Plant Pathology Department; and Shinsuke Agehara, assistant professor, Horticultural Sciences Department, UF/IFAS Gulf Coast Research and Education Center; UF/IFAS Extension, Gainesville, FL 32611.

Vegetable Crop Production

Complete *Vegetable Production Handbook*: https://edis.ifas.ufl.edu/publication/CV292

Commercial Transplant Production in Florida: https://edis.ifas.ufl.edu/publication/CV104

Introduction to Organic Crop Production: https://edis.ifas.ufl.edu/publication/CV118

Value Added Agriculture: Is It Right for Me?: https://edis.ifas.ufl.edu/publication/FE638

Farm to School: https://edis.ifas.ufl.edu/topic_farm_to_school

Row Covers for Commercial Vegetable Culture in Florida: https://edis.ifas.ufl.edu/publication/CV201

Fertility and Irrigation

Commercial Vegetable Fertilization Principles: https://edis.ifas.ufl.edu/publication/CV009

Soil and Fertilizer Management for Vegetable Production in Florida: https://edis.ifas.ufl.edu/publication/CV101

Controlled-Release and Slow-Release Fertilizers as Nutrient Management Tools: https://edis.ifas.ufl.edu/publication/HS1255

Cover Crops for South Florida Commercial Vegetable Producers: https://doi.org/10.32473/edis-ss461-2006

Principles and Practices of Irrigation Management for Vegetables: https://edis.ifas.ufl.edu/publication/CV107

Drip Irrigation: the BMP Era—an Integrated Approach to Water and Fertilizer Management for Vegetables Grown with Plasticulture: https://edis.ifas.ufl.edu/publication/HS172

Postharvest Quality and Handling Resources

UF/IFAS Postharvest Quality & Technology: https://irrec.ifas.ufl.edu/postharvest/

UF/IFAS EDIS (Electronic Data Information Source): https://edis.ifas.ufl.edu/topic_postharvest

Postharvest Technology: http://postharvest.ucdavis.edu

Marketing and Regulatory Resources

Florida Dept. of Agriculture & Consumer Services (FDACS): https://www.fdacs.gov/Divisions-Offices/Marketing-and-Development

US Grade Standards for Fruits and Vegetables: https://www.ams.usda.gov/standards

National Agricultural Statistics Service: https://www.nass.usda.gov/fl/

National Nutrient Database: https://www.ars.usda.gov

National Organic Program: https://www.ams.usda.gov/nop/indexIE.htm

Food Safety Resources

Food Safety on the Farm: An Overview of Good Agricultural Practices: https://edis.ifas.ufl.edu/publication/FS135

The Food Safety Modernization Act and the FDA Facility Registration Program: https://edis.ifas.ufl.edu/publication/FS231

UF/IFAS Food Safety: https://edis.ifas.ufl.edu/topic_food_safety/

CDC: Division of Foodborne, Waterborne, and Environmental Diseases: https://www.cdc.gov/ncezid/dfwed/

FDA: US Food and Drug Administration: https://www.fda.gov/food/guidanceregulation/fsma/default.htm

Fumigation

Maximizing the Efficacy of Soil Fumigant Applications for Raised-Bed Plasticulture Systems of Florida: https://journals.flvc.org/edis/article/view/118553

Pesticide Safety

Pesticide Provisions of the Florida Agricultural Worker Safety Act (FAWSA): https://edis.ifas.ufl.edu/publication/PI078

Pesticide Safety: https://edis.ifas.ufl.edu/publication/CV108

Pesticide Labels: Signal Words: https://edis.ifas.ufl.edu/publication/PI137

Minimizing Honey Bee Exposure to Pesticides: https://edis.ifas.ufl.edu/publication/IN1027

Pest Management

Integrated Disease Management for Vegetable Crops in Florida: https://edis.ifas.ufl.edu/publication/PP111

Florida Nematode Management Guide: https://edis.ifas.ufl.edu/entity/topic/nematode_management

Weed Management: https://doi.org/10.32473/edis-cv113-2006

Vegetable Pest Insects: https://edis.ifas.ufl.edu/topic_vegetable_pest_insects

UF | IFAS Extension
UNIVERSITY of FLORIDA

CV296

doi.org/10.32473/edis-cv296-2022

Chapter 2. Fertilizer Management for Vegetable Production in Florida[1]

Guodong Liu, Eric H. Simonne, Kelly T. Morgan, George Hochmuth, Shinsuke Agehara, Rao Mylavarapu, and Craig Frey[2]

Best Management Practices

With the passage of the Federal Clean Water Act (FCWA) in 1972, states were required to assess the negative impacts of agricultural fertilizer additions on surface and ground water quality. Upon identification of the impaired water bodies, Florida has established the numeric criteria specific for the waterbodies and the reductions in applied nutrients required as per the Basin Management Action Plan, where excess of nutrients is found to be from agricultural sources. For vegetable production regions, water quality indicators are concentrations of nitrate, phosphate, and total dissolved solids. Best Management Practices (BMPs) are specific cultural practices aimed at reducing the load of specific nutrients entering ground and surface water while sustaining economical yields. BMPs are intended to be economically sound, cost effective, and environmentally friendly based on science. It is important to recognize that BMPs do not aim at becoming an obstacle to vegetable production. Instead, they should be viewed as a means of achieving horticultural and environmental sustainability. The BMPs that will apply to vegetable production in Florida are described in *Water Quality/Quantity Best Management Practices for Florida Vegetable and Agronomic Crops*, produced by the Florida Department of Agriculture and Consumer Services (FDACS). This manual was developed through a cooperative effort between state agencies, water management districts, and commodity groups, and under the scientific leadership of the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS). The manual was adopted by reference in 2006 and by rule in Florida Statutes (5M-8 Florida Administrative Code) and was revised in 2015 (https://www.fdacs.gov/content/download/77230/file/vegAgCropBMP-loRes.pdf). Vegetable growers may contact their local UF/IFAS Extension agent for one-on-one consultation on (1) the benefits from joining the BMP program, (2) how to join it, (3) how to select the BMPs that apply to their operation, and (4) how to meet the requirements.

The vegetable BMP program has adopted the current UF/IFAS nutrient recommendations (*UF/IFAS Standardized Nutrient Recommendations for Vegetable Crop Production in Florida*, https://edis.ifas.ufl.edu/cv002), including irrigation management (see the new BMP manual on "Optimum Fertilizer Management"). At the field level, adequate fertilizer rates should be used together with proper irrigation-scheduling techniques, and crop nutritional status monitoring tools (leaf analysis, petiole sap testing) may also be employed as appropriate. In the BMP manual, adequate fertilizer rates may be achieved by combinations

1. This document is CV296, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 2015. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Guodong Liu, associate professor, Horticultural Sciences Department; Eric H. Simonne, distinguished professor, Horticultural Sciences Department, and district Extension director, UF/IFAS Extension Northeast District; Kelly T. Morgan, professor, Department of Soil, Water, and Ecosystem Sciences; George Hochmuth, professor emeritus, Department of Soil, Water, and Ecosystem Sciences; Shinsuke Agehara, assistant professor, Horticultural Sciences Department, UF/IFAS Gulf Coast Research and Education Center; Rao Mylavarapu, professor, Department of Soil, Water, and Ecosystem Sciences; and Craig Frey, county Extension director and Extension agent II, UF/IFAS Extension Hendry County; UF/IFAS Extension, Gainesville, FL 32611.

of UF/IFAS-recommended basal rates and supplemental nitrogen allowances to be added in case of leaching rainfall, when planting during cooler seasons, when tissue analysis shows any nutrient deficiency, or when the harvesting season is prolonged.

Soils

Vegetables are grown in various soil types throughout the state. These soil types include sandy and sandy loam soils, muck soils, and calcareous marl soils. Vegetables are produced predominantly on sandy soils throughout the Florida peninsula and on sandy and sandy loams in the Panhandle. Sandy soils have some advantages, such as ease of tillage, production of the earliest vegetable crops, and timely production operations, but also disadvantages, including the potential for leaching mobile nutrients such as nitrogen, potassium, and even phosphorus after heavy rains or excessive irrigation. For more information on soils, refer to *Agricultural Soils of Florida* (https://edis.ifas.ufl.edu/ss655). Therefore, sandy soils must be managed carefully regarding nutrient programs and irrigation scheduling. For more information, see *Soil and Fertilizer Management for Vegetable Production in Florida* (https://edis.ifas.ufl.edu/cv101).

Soil Preparation

A well-prepared planting bed is important for uniform stand establishment of vegetable crops. Previous crop residues and weeds should be plowed down well in advance of crop establishment. A 6-to-8-week period between plowing down of green cover crops and crop establishment is recommended to allow the decay of the residues. Freshly incorporated plant material promotes important levels of damping-off organisms, such as *Pythium* spp. and *Rhizoctonia* spp. Turning under plant residue well in advance of cropping reduces damping-off disease organisms. Land should be kept disked, if necessary, to keep new weed cover from developing prior to cropping.

In the Panhandle soils, chisel plowing may aid in breaking down subsurface hardpan in fields. For more information about soil preparation for commercial vegetable production, see *Soil Preparation and Liming for Vegetable Gardens* (https://edis.ifas.ufl.edu/vh024).

Liming

Current UF/IFAS recommendations call for maintaining soil pH between 6.0 and 6.5 (Table 1); further discussion is in *Soil pH Range for Optimum Commercial Vegetable Production* (https://edis.ifas.ufl.edu/hs1207). If soil pH is too low, liming will be needed to correct the pH to the target range. A frequent problem in Florida has been overliming, resulting in high soil pH tying up micronutrients and phosphorus, limiting uptake by plants. Overliming can also reduce the accuracy with which a soil test can predict the supplemental applications of fertilizer nutrients based on the Crop Nutrient Requirement (CNR) philosophy. For more information about liming, see *Liming of Agronomic Crops* (https://edis.ifas.ufl.edu/aa128). Liming can not only adjust soil pH but also provide calcium and magnesium if dolomite (i.e., calcium magnesium carbonate) is used.

Irrigation water from wells in limestone aquifers is an additional source of liming material. The combination of liming and use of alkaline irrigation water has resulted in soil pH greater than 7.0 for many sandy soils in Florida. To measure the liming effect of irrigation, a water sample must be analyzed for total bicarbonates and carbonates annually, with results converted to pounds of calcium carbonate per acre. Liming (Table 2), fertilization (Table 3), and irrigation programs are closely related to each other. To maximize overall production efficiency, soil and water testing in a critical BMP must be made a part of any nutrient management program. Elevated soil pHs can be adjusted to desired ranges by identifying the reason(s) behind the increases. More information on soil pH reduction can be found in *Lowering Soil pH to Optimize Nutrient Management and Crop Production* (https://edis.ifas.ufl.edu/ss651).

Bedding

Fields prone to flooding, where seepage irrigation is used or where the soil profile is too shallow, should be cropped using raised beds. Beds range from 3 to 8 inches in height, with high beds of 6 to 8 inches preferred where the risk of flooding is high. Raised beds dry faster than nonbedded soils and suppress the weeds. Raised beds promote early-season soil warming, especially when covered with black plastic mulch, resulting in early crops during cool seasons. Mulching requires a smooth, well-pressed bed for efficient heat transfer from black mulch to the soil. Adequate soil moisture is essential in forming a good bed for mulching using a bed press. Depending on the planting date and the sensitivity of the crop to heat stress, growers may consider using white or reflective plastic mulch instead of black mulch.

Fertilization

Commercial vegetable production requires intensive nutrient management for optimal production. Effective implementation of **4R** nutrient stewardship principles—**Right**

Source, Right Rate, Right Place, and **Right Time**—when applying nutrients to a crop is shown to enhance nutrient efficiencies and minimize nutrient loss to the environment. More information about the 4Rs is available in *What is 4R Nutrient Stewardship?* (https://edis.ifas.ufl.edu/hs1264) and *The Four Rs of Fertilizer Management* (https://edis.ifas.ufl.edu/ss624). For tomato production, more information is available in *Implementing the Four Rs (4Rs) in Nutrient Stewardship for Tomato Production* (https://edis.ifas.ufl.edu/hs1269).

Right Rate

Soil Testing

Soil testing is the #1 BMP for nutrient management. There are 17 elements essential to plant growth (Table 4). The crop nutrient requirement (CNR) for a particular nutrient is defined as the total amount in lb/A of that element needed by the crop to produce optimum economic yield. The CNR can be satisfied from many sources, including soil, water, air, organic matter, or fertilizer.

The CNR for a crop has been determined from field calibrations and validation. The CNR is equivalent to the nutrient rate above which no significant increase in yield is expected. The CNR values derived from such experiments consider factors such as the source, solubility, and availability in the soils. It is important to remember that nutrients are supplied to the crop from both the soil and fertilizers. Supplemental nutrients should be applied only when a properly calibrated soil test indicates a yield or quality response. Mehlich-3 is the standard soil extractant in Florida for all acid-mineral soils and calcareous soils of Miami-Dade County. For mineral soils with pH of ^{3}7.4, currently the ABDTPA procedure is used. For all vegetable production in muck soils, water extraction is used for phosphorus, and acetic acid is used for potassium, calcium, and magnesium. More information about Mehlich-3 is available in *Extraction of Soil Nutrients Using Mehlich-3 Reagent for Acid-Mineral Soils of Florida* (https://edis.ifas.ufl.edu/ss620).

Nitrogen recommendations are based on research data and not on a soil test. A standard soil test provides soil pH, lime requirement (if needed), P, K, Ca, Mg, S, Cu, Mn, and Zn in mg/kg (ppm), and the recommendations are generated based on the interpretation specific for the extractant. More information about soil testing can be found in *Developing a Soil Test Extractant: The Correlation and Calibration Processes* (https://edis.ifas.ufl.edu/ss622) and *Soil Testing for Plant-Available Nutrients—What Is It and Why Do We Use It?* (https://edis.ifas.ufl.edu/ss621).

Plant Tissue Analysis

Analysis of plant tissues (e.g., leaves or petioles) for nutrient concentrations provides a good tool for monitoring nutrient status of a crop during the growing season. There are two main approaches to plant tissue testing: standard laboratory analysis and the plant sap testing procedures. Standard laboratory analysis involves analyzing the most recently matured leaf of the plant for an array of nutrients. The resulting analyses are compared against published adequate ranges for that crop. Laboratory results that fall outside the adequate range for that nutrient may indicate either a deficiency or toxicity (especially in the case of micronutrients). The most recently matured leaf serves well for routine crop monitoring and diagnostic procedures for most nutrients. However, for immobile nutrients such as Ca, B, Zn, Fe, Mn, Cu, and Mo, younger leaves are preferred.

The second approach is to use plant sap quick-test kits that have been calibrated for N and K for several vegetables in Florida. These testing kits analyze fresh leaf petiole sap for N and K. Quick tests can be a valuable tool for on-the-spot monitoring of plant nutrient status. Diagnostic information for leaf and petiole sap testing can be found in *Plant Tissue Analysis and Interpretation for Vegetable Crops in Florida* (https://edis.ifas.ufl.edu/ep081) and *Petiole Sap Testing for Vegetable Crops* (https://edis.ifas.ufl.edu/cv004). However, standard plant tissue test at a laboratory is the primary tool for ground-truthing results to overcome inadequacies in field calibration of these alternate tools.

Understanding the "Per Acre" Rate of Fertilizer Recommendations

Most public (including Extension) and private soil testing laboratories express fertilizer rates as an amount per real-estate (gross) acre. The "per acre" expression in the context of crop fertilization often leads to confusion. Farming systems have different bed center spacing, different numbers of rows per bed, and different configuration of roads and irrigation/drainage ditches. These differences vary the amount of cropped area per gross acre for each system and must be accounted for when calculating fertilizer needs.

To standardize fertilizer recommendations for a crop across varying systems, UF/IFAS and the UF/IFAS Extension Soil Testing Laboratory (ESTL) use the Linear Bed Foot (LBF) system. LBF is defined as the linear distance of one foot measured along a bed, and the total number of LBF in a particular system is the cropped area expressed as the LBF per acre (LBF/acre).

To determine fertilizer application rates with the LBF system, a grower must know the "typical bed configuration" for the crop. This is based on traditional configuration of the crop and is the configuration that was used for much of the nutrient rate research. Table 12 illustrates the typical bed configuration for several vegetable crops and the associated LBF per acre. To calculate the LBF of an alternative configuration, use the following formulas:

Step 1:
Alternative[1] LBF per acre = 43,560 square feet per acre/ Alternative bed spacing (ft)

Step 2:
Alternative[2] LBF per acre = Alternative[1]LBF per acre × Alternative plant rows per bed/Typical plant rows per bed

To calculate the fertilizer application rate for an alternative configuration, use either of the following formulas, depending on fertilizer application methods used:

lternative fertilizer rate = Lab fertilizer rate × Alternative[2] LBF per acre/Typical LBF per acre

LBF rate = Alternative fertilizer rate/Alternative[2] LBF per acre

A thorough discussion of the LBF system and examples of calculations for various scenarios can be found in *Calculating Recommended Fertilizer Rates for Vegetables Grown in Raised-Bed, Mulched Cultural Systems* (https://edis.ifas.ufl.edu/publication/ss516). Note that this EDIS document illustrates the LBF concept for various configurationson a per 100 LBF basis.

Right Source

N, P, and K Sources

Nitrogen is the most limiting nutrient in agriculture. The amount of nitrogen required by vegetable plants must be applied each growing season because residual N is lost to the environment through several pathways. Nitrogen requirements vary among crops (Table 5) and are not dependent on soil test results. All other nutrients must be applied based on soil test results (as described above) to comply with the BMP guidelines. The interpretations of Mehlich-3 (low, medium, and high) are shown in Table 6. UF/IFAS standardized nutrient recommendations based on Mehlich-3 testing include P_2O_5 and K_2O (Table 7) and nutrient management using fertigation (Table 8). More information on Mehlich-3 can be found in *Extraction of Soil Nutrients Using Mehlich-3 Reagent for Acid-Mineral Soils of Florida* (https://edis.ifas.ufl.edu/ss620). Nutrient recommendations found in Tables 7 through 10 were determined in field rate studies considering a wide range of nutrient applications and various soil pH levels. Crop plant development, crop yield, and vegetable quality were considered in *determining* the optimum nutrient levels for UF/IFAS recommendations.

Nitrogen (N) can be supplied in both nitrate and ammoniacal forms. Because the mineralization rate of conversion is reduced in cold, fumigated, or strongly acidic soils, it is recommended that under such conditions 25% to 50% of the N be supplied from nitrate sources. This ratio is not critical for unfumigated or warm soils.

Phosphorus (P) can be supplied from several sources, such as diammonium phosphate (DAP), monoammonium phosphate (MAP), or monopotassium phosphate, based on the soil pH and other factors. Initial soil reaction pH with DAP is about 8.5, which favors ammonia production and volatilization. This produced ammonia causes seedling injury and inhibits root growth. Adequate separation of seed and DAP is needed to eliminate any seedling damage. DAP should not be used on calcareous or high-pH soils. MAP's reaction pH is 3.5, so it does not have the above problems and is better suited for acidic and lower-pH soils.

Potassium (K) can also be supplied from several sources, including potassium chloride (muriate of potash—60%), potassium sulfate (sulfate of potash—50%), potassium nitrate, and potassium-magnesium sulfate. If adhering to amounts of K fertilizer recommended by soil tests, there should be no concern about the K source or its relative salt index. However, when applying chloride-containing sources, crop sensitivities must be considered.

Ca, Mg, and S Sources

The secondary nutrients calcium (Ca), magnesium (Mg), and sulfur (S) are sufficient in Florida soils. Calcium is ubiquitous in Florida soils due to their genesis from limestone base. Depending on the location, Ca tends to occur remarkably close to or on the surface and typically within the root zone. Therefore, Ca is not interpreted on soil tests. Irrigation water also generally contains dissolved Ca, so maintaining optimum moisture levels in the soil via irrigation will ensure Ca supply to the roots. Calcium is not mobile in the plant; therefore, foliar sprays of Ca are not likely to correct deficiencies. It is difficult to place enough foliar-applied Ca at the growing point of the plant on a timely basis.

Magnesium deficiency may be a problem for vegetable production; however, when the Mehlich-3 soil-test index for Mg is below 20 ppm, 35 lb Mg/A will satisfy the crop Mg requirement. If lime is also needed, Mg can be added by using dolomite as the liming material. If no lime is needed, the Mg requirement can be satisfied through magnesium sulfate or Sul-Po-Mag. Blending of the Mg source with other fertilizer(s) to be applied to the soil is an excellent way of ensuring uniform application of Mg to the soil.

Although S deficiencies are not common in Florida soils, sulfur deficiency may occur in sandy soils low in organic matter. If a Mehlich-3 soil test determines that the S level is <6 mg/kg, or ppm, then S deficiency may be diagnosed and can be corrected by using S-containing fertilizers, such as magnesium sulfate, ammonium sulfate, potassium sulfate, or potassium-magnesium sulfate. Using one of these materials in the fertilizer blends at levels sufficient to supply 20 lb S/A or higher which should prevent S deficiencies.

Micronutrient Sources

It has been common in Florida vegetable production to routinely apply a micronutrient package. This practice was justified because these nutrients were inexpensive and because their application seemed to be insurance for high yields. In addition, there was little research data and a lack of soil-test calibrations to guide judicious application of micronutrient fertilizers. Confounding the problem has been the vegetable industry's use of micronutrient-containing pesticides for disease control.

Copper (Cu), manganese (Mn), and zinc (Zn) from pesticides have tended to accumulate in the soil. This situation forced some vegetable producers to overlime in an effort to reduce availability and avoid micronutrient toxicities. Table 10 provides guidelines for the above micronutrient on sufficiencies, toxicities, and soil pH dependencies. It is unlikely that micronutrient fertilizers will be needed on old vegetable land, especially where micronutrients are being applied regularly via recommended pesticides. A standard soil-test report includes micronutrients also.

Manures and Composts

Waste organic products, including animal manures and composted organic matter, contain nutrients that can be recovered by crops. These materials applied to the soil gradually decompose, releasing nutrients for vegetable crops to utilize. These materials must comply with food safety requirements, such as those of the Produce Safety Alliance (PSA). The key to proper use of organic materials as fertilizers comes in the knowledge of the nutrient content and the decomposition rate of the material. Growers contemplating using organic materials as fertilizers should have an analysis of the material before determining the rate of application. Sludge is not permitted for land application in vegetable production. Decomposition rates of organic materials are rapid in warm, sandy soils in Florida. Residual nutrient levels in soils after the crop season are limited. Usually, application rates of organic wastes are determined largely by the N content, which will result in inadvertent P applications too. Excessive rates of organic waste materials can contribute to groundwater or surface water pollution; therefore, it is important to understand the nutrient content and the decomposition rate of the organic waste material and the P-holding capacity of the soil. For more information about using manure for vegetable production, see *Using Composted Poultry Manure (Litter) in Mulched Vegetable Production* (https://edis.ifas.ufl.edu/ss506) and *Introduction to Organic Crop Production* (https://edis.ifas.ufl.edu/cv118).

As a soil amendment, compost improves soil's physical, chemical, and biological properties, thus making soil more productive. To eliminate or minimize human and plant pathogens, nematodes, and weed seeds, the composting temperature must be kept in a range from 131°F to 170°F for 3 days in an in-vessel or static aerated pile. The majority of nitrogen in compost is organic N. Thus, before being mineralized, compost N is not as readily bioavailable as synthetic N fertilizers. Compost N mineralization rate varies with feedstock, soil characteristics, and composting conditions. Compost N fertilizer releases only 5% to 30% bioavailable N to crops in the first year. Contrarily, compost P and K are as bioavailable as chemical fertilizers. Composting converts raw organic materials to humus-stable forms and hence minimizes possible adverse impacts on the environment.

Right Place

Fertilizer Placement

Fertilizer rate and placement must be considered together. Banding low amounts of fertilizer too close to plants can result in the same or greater amount of damage as broadcasting excessive amounts of fertilizer on the field. Because P is immobile in soils, it should be banded alongside the plant rows. Micronutrients can be broadcast with the P and incorporated in the bed area. In calcareous soils, micronutrients, such as Fe, Mn, and B, should be banded or foliar applied. Because N and K are easily prone to leaching in sandy soils, they must be managed properly to maximize crop uptake. Both N and K should be split in unmulched

production systems to minimize losses below the root zone. Hence, one-third to one-half of the N and K may be applied to the soil at planting or shortly thereafter. The remaining fertilizer can be applied in one or two applications during the early part of the growing season. Split applications also will help reduce the potential for fertilizer burn, which is defined as leaf scorch resulting from overfertilization. In mulched beds with fertigation, both N and K should be applied in 10–14 equal split installments for efficient uptake by plant roots and minimized leaching.

When using plastic mulch, fertilizer placement depends on the type of irrigation system (seepage or drip) and on whether drip tubing or the liquid fertilizer injection wheels are to be used. With seepage irrigation, all P and micronutrients should be incorporated in the bed. Apply 10% to 20% (but not more) of the N and K with the P. The remaining N and K should be placed in narrow bands on the bed shoulders, the number of which depends on the crop and number of rows per bed. These bands should be placed in shallow (2-to-2½-inch-deep) grooves. This placement requires that adequate bed moisture be maintained so that capillarity is not broken. Otherwise, fertilizer will not move to the root zone. Excess moisture can result in fertilizer leaching. Fertilizer and water management programs are linked. Maximum fertilizer efficiency is achieved only with close attention to water management.

In cases where supplemental side-dressing of mulched crops is needed, applications of liquid fertilizer can be made through the mulch with a liquid fertilizer injection wheel. This implement is mounted on a tool bar and, using 30 to 40 psi, injects fertilizer through a hole pierced in the mulch.

Right Time

Supplemental Fertilizer Applications and BMPs

In practice, supplemental fertilizer applications, when growing conditions require doing so, allow vegetable growers to stay within BMP guidelines while numerically applying fertilizer rates higher than the standard UF/IFAS-recommended rates. Conditions that may require supplemental fertilizer applications are leaching rain, cooler planting seasons, and extended harvest periods. Applying additional fertilizer under the following four circumstances is part of the current UF/IFAS fertilizer recommendations and thus BMPs: (1) If grown on bare ground with seepage irrigation, a 30 lb/A of N and/or 20 lb/A of K_2O supplemental application is allowed after a leaching rain, defined as when it rains at least 3 inches in 3 days or 4 inches in 7 days; (2) potatoes planted in cooler seasons may receive a supplemental application of 25 lb/acre P_2O_5; (3) if nutrient levels in the leaf or in the petiole fall below the sufficiency ranges, the supplemental amount allowed for bare-ground production is 30 lb/A of N and/or 20 lb/A of K_2O, and for drip-irrigated crops, 1.5 to 2.0 lb/A/day for N and/or K_2O for one week; or (4) for economic reasons, the harvest period has to be longer than the typical harvest period. When the results of tissue analysis or petiole testing are below the sufficiency ranges, a supplemental 30 lb/A N and/or 20 lb/A of K_2O may be made for each additional harvest for bare-ground production. For drip-irrigated crops, the supplemental fertilizer application is 1.5 to 2.0 lb/A/day for N and/or K_2O until the next harvest.

Fertigation

Common irrigation systems used for fertigation include drip, sprinkler, and pivot systems. Advantages of fertigation over conventional fertilizing methods are (1) more efficient delivery of nutrients, (2) more precise localized application, (3) more flexible control of application rate and timing, and (4) lower application cost. Liquid and water-soluble fertilizers are more commonly used for fertigation than dry fertilizers. The most common liquid N fertilizers for fertigation are ammonium nitrate (20-0-0), calcium ammonium nitrate (17-0-0), and urea ammonium nitrate (32-0-0). Complete fertilizers (e.g., 8-8-8 and 4-10-10) are also commonly used. For commercial vegetable production in south Florida, a formula of 4-0-8 or 3-0-10 is the most common in fertigation. To develop a more precise fertilizer application strategy, growers can request a custom blend at a local fertilizer dealer based on soil test results and crop nutrient requirements. For more information, consult *Fertigation Nutrient Sources and Application Considerations for Citrus* (https://journals.flvc.org/edis/article/view/108095).

The basic components for a fertigation system include a fertilizer tank, an injector, a filter, a pressure regulator, a pressure gauge, and a backflow prevention device. All components must be resistant to corrosion. In most situations, N and K are the nutrients injected through the irrigation tube. Split applications of N and K through the irrigation system offer a means to capture management potential and reduce leaching losses. Other nutrients, such as P, are usually applied to the soil rather than by injection. This is because chemical precipitation can occur with these nutrients and the high calcium carbonate content of our irrigation water in Florida.

Nutrient management through irrigation tubes involves precise scheduling of N and K applications. Application

rates are determined by crop growth and resulting nutrient demand. Demand early in the season is small, and thus rates of application are small, usually in the order of ½ lb to ¾ lb of N or K2O per acre per day. As the crop grows, nutrient demand increases rapidly, so that for some vegetable crops such as tomato the demand might be as high as 2 lb of N or K2O per day. Schedules of N and K application have been developed for most vegetables produced with drip irrigation in Florida (Table 7).

Irrigation water with high and alkaline pH can be acidified using injections of sulfuric acid, phosphoric acid, N-phuric acid, hydrochloric acid, urea-sulfate, etc.

Foliar Fertilization

Foliar fertilization should be used as the last resort for correcting a nutrient deficiency (Table 11). The plant leaf is structured so that it naturally resists fertilizer infiltration. Foliar fertilization is most appropriate for micronutrients but not appropriate for macronutrients, such as N, P, and K. In certain situations, temporary deficiencies of Mn, Fe, Cu, or Zn can be corrected by foliar application. For example, micronutrients should be foliar applied in the following situations: (1) In winter when soils are cool, and roots cannot extract adequate micronutrients; and (2) in high-pH soils (marl and Rockdale soils) that immobilize broadcast micronutrients. There is a fine line between adequate and toxic amounts of micronutrients. Indiscriminate application of micronutrients may reduce plant growth and yields because of the toxicity. The micronutrients can accumulate in the soil and may cause yield and economic losses in vegetable production. If you are not sure if your crop requires micronutrients or how much you should apply, contact your local UF/IFAS Extension agent.

The 5th R, Right Irrigation

Fertilization and irrigation go hand in hand, with fertilizers included in irrigation schedules and systems. Water is the solvent of all nutrients and the carrier of every pollutant. Keeping moisture and fertilizer primarily in the root zone by managing irrigation inputs and drainage minimizes nutrient-related impacts. Irrigating more than the soil's water-holding capacity leads to increased runoff or leaching and may result in greater production costs or smaller marketable yields. Similarly, insufficient water supply to crops can reduce nutrient bioavailability for vegetable production. Please read *Implementing the Five Rs of Nutrient Stewardship for Fertigation in Florida's Vegetable Production*, an EDIS publication, for more information at https://edis.ifas.ufl.edu/publication/HS1386.

Table 1. A general guideline to crop tolerance of mineral soil acidity.[1]

Slightly Tolerant (pH 6.8–6.0)		Moderately Tolerant (pH 6.8–5.5)		Very Tolerant (pH 6.8–5.0)
Beet	Leek	Bean, lima	Mustard	Endive
Broccoli	Lettuce	Bean, snap	Pea	Potato
Cabbage	Muskmelon	Brussels sprouts	Pepper	Shallot
Cauliflower	Okra	Carrot	Pumpkin	Sweet potato
Celery	Onion	Collard	Radish	Watermelon
Chard	Spinach	Corn	Squash	
		Cucumber	Strawberry	
		Eggplant	Tomato	
		Kale	Turnip	

[1] From Donald N. Maynard and George J. Hochmuth, *Knott's Handbook for Vegetable Growers*, 5th edition (2007). Reprinted by permission of John Wiley & Sons, Inc.

Table 2. Liming materials.

Material	Formula	Amount of Material to Be Used to Equal 1 Ton of Calcium Carbonate[1]	Neutralizing Value[2] (%)
Calcium carbonate, calcite, hi-cal lime	$CaCO_3$	2,000 lb	100
Calcium-magnesium carbonate, dolomite	$CaCO_3$, $MgCO_3$	1,850 lb	109
Calcium oxide, burnt lime	CaO	1,100 lb	179
Calcium hydroxide, hydrated lime	$Ca(OH)_2$	1,500 lb	136
Calcium silicate, slag	$CaSiO_3$	2,350 lb	86
Magnesium carbonate	$MgCO_3$	1,680 lb	119

[1] Calculate as (2000×100)/neutralizing value (%).
[2] The higher the neutralizing value, the greater the amount of acidity that is neutralized per unit weight of material.

Table 3. Effect of some fertilizer materials on soil pH.

Fertilizer Material	Approximate Calcium Carbonate Equivalent (lb)[1]
Ammonium nitrate	-1200
Ammonium sulfate	-2200
Anhydrous ammonia	-3000
Diammonium phosphate	-1250 to -1550
Nitrogen solutions	-759 to -1800
Normal (ordinary) superphosphate	0
Potassium chloride	0
Potassium nitrate	+520
Potassium sulfate	0
Potassium-magnesium sulfate	0
Sodium-potassium nitrate	+550
Triple (concentrated) superphosphate	0
Urea	-1700

[1] A minus sign indicates the number of pounds of calcium carbonate needed to neutralize the acid formed when one ton of fertilizer is added to the soil.

Table 4. Nutrient elements required by plants.

	Nutrient	Deficiency Symptoms	Occurrence
Macronutrients	Nitrogen (N)	Stems thin, erect, hard. Leaves small, yellow; on some crops (tomatoes), undersides are reddish. Lower leaves affected first.	On sandy soils especially after heavy rain or after overirrigation. Also on organic soils during cool growing seasons.
	Phosphorus (P)	Stems thin and shortened. Leaves develop purple color. Older leaves affected first. Plants stunted and maturity delayed.	On acidic soils or very basic soils. Also when soils are cool and wet.
	Potassium (K)	Older leaves develop gray or tan areas on leaf margins. Eventually a scorch appears on the entire margin.	On sandy soils following leaching rains or overirrigation.
Secondary nutrients	Calcium (Ca)	Growing-point growth restricted on shoots and roots. Specific deficiencies include blossom-end rot of tomato, pepper, and watermelon, brown heart of escarole, celery blackheart, and cauliflower or cabbage tip burn.	On strongly acidic soils, or during severe droughts.
	Magnesium (Mg)	Initially older leaves show yellowing between veins, followed by yellowing of young leaves. Older leaves soon fall.	On strongly acidic soils, or on leached sandy soils.
	Sulfur (S)	General yellowing of younger leaves and growth.	On very sandy soils, low in organic matter, especially following continued use of sulfur-free fertilizers and especially in areas that receive little atmospheric sulfur.
Micronutrients	Boron (B)	Growing tips die and leaves are distorted. Specific diseases caused by boron deficiency include brown curd and hollow stem of cauliflower, cracked stem of celery, blackheart of beet, and internal browning of turnip.	On soils with pH above 6.8 or on sandy, leached soils, or on crops with very high demand such as cole crops.
	Copper (Cu)	Yellowing of young leaves, stunting of plants. Onion bulbs are soft with thin, pale scales.	On organic soils or occasionally new mineral soils.
	Chlorine (Cl)	Deficiencies are rare.	Usually only under laboratory conditions.
	Iron (Fe)	Distinct yellow or white areas between veins on youngest leaves.	On soils with pH above 6.8.
	Manganese (Mn)	Yellow mottled areas between veins on youngest leaves, not as intense as iron deficiency.	On soils with pH above 6.4.
	Molybdenum (Mo)	Pale, distorted, narrow leaves with some interveinal yellowing of older leaves, e.g., whiptail disease of cauliflower. Rare.	On very acidic soils.
	Nickel (Ni)	Deficiencies are rare. This EDIS article has more at https://edis.ifas.ufl.edu/publication/HS1191	Usually only under laboratory conditions.
	Zinc (Zn)	Small reddish spots on cotyledon leaves of beans; light areas (white bud) of corn leaves.	

Table 5. Target pH and nitrogen (N) fertilization recommendations for selected vegetable crops in mineral soils of Florida.

Crops	Target pH	N (lb/acre)
Tomato, pepper, potato, celery, sweet corn, crisphead lettuce, endive, escarole, romaine lettuce, and eggplant	6.0 (potato) and 6.5	200
Snapbean, lima bean, and pole bean	6.5	100
Broccoli, cauliflower, brussels sprouts, cabbage, collards, Chinese cabbage, carrots, and strawberry	6.5	175
Radish and spinach	6.5	90
Cucumber, squash, pumpkin, muskmelon, leaf lettuce, sweet bulb onion, and watermelon	6.0 (watermelon) and 6.5	150
Southernpea, snowpea, English pea, and sweet potato	6.5	60
Kale, turnip, mustard, parsley, okra, bunching onion, leek, and beet	6.5	120

Table 6. Soil test interpretation for Mehlich-3 extractions for vegetable crops in Florida.

	Mehlich-3 Interpretations		
	Low	Medium	High
Nutrient	(parts per million soil)		
P	=25	26–45	>45
K	=35	36–60	>60
Mg[1]	=20	21–40	>40

[1] Up to 35 lb/A may be needed when soil test results are medium or lower.

Table 7. Phosphorus (P, expressed as P_2O_5) and potassium (K, expressed as K2O) fertigation recommendations for selected vegetable crops in mineral soils for Florida based on low, medium, and high soil-test index using the Mehlich-3 soil extractant method. (For details, refer to *UF/IFAS Standardized Nutrient Recommendations for Vegetable Crop Production in Florida*.)

	P_2O_5			K_2O		
	Low	Medium	High	Low	Medium	High
	(lb/A/crop season)			(lb/A/crop season)		
Celery	150–200	100	0	150–250	100	0
Eggplant	130–160	100	0	130–160	100	0
Broccoli, cauliflower, brussels sprouts, cabbage, collards, Chinese cabbage, carrots, kale, turnip, mustard, parsley, okra, muskmelon, leaf lettuce, sweet bulb onion, watermelon, pepper, sweet corn, crisphead lettuce, endive, escarole, strawberry, and romaine lettuce	120–150	100	0	120–150	100	0
	120–150	100	0	125–150	100	0
Cucumber, squash, pumpkin, snapbean, lima bean, pole bean, beet, radish, spinach, and sweet potato	100–120	80	0	100–120	80	0
Bunching onion and leek	100–120	100	0	100–120	100	
Potato[1]	120	100	0	150	--	--
Southern pea, snowpea, and English pea	80	80	0	80	60	0

[1] Potatoes planted in cool soils might respond to up to 25 lb P_2O_5 applied as starter fertilizer in the furrow with the seed pieces. See also Footnote 253 in Table 4 in *UF/IFAS Standardized Nutrient Recommendations for Vegetable Crop Production in Florida* (https://edis.ifas.ufl.edu/cv002). On October 25, the UF/IFAS Plant Nutrient Oversight Committee (PNOC) announced its memorandum: "The P fertilizer application rate for potato may be determined independent of a preplant soil test of P. Therefore, P fertilizer may be applied up to the maximum UF/IFAS recommended rate for potato of 120 lb/acre P2O5 regardless of the soil test P value. . . . It will remain in effect throughout the 2022–2023 commercial potato growing season."

Table 8. Fertigation[1] and supplemental fertilizer[1] recommendations for selected vegetable crops grown on mineral soils testing low in potassium (K_2O) based on the *Mehlich-3 soil extraction method*.

	Preplant[2] (lb/A)	Injection rate[3] (lb/A/day)					Low Plant Content[4,5]	Extended Season[4,6] (lb/A/day)
Eggplant								
Wk after transplanting[7]		1–2	3–4	5–10	11–13			
N	0–70	1.5	2.0	2.5	2.0		1.5–2.0	1.5–2.0
K_2O	0–55	1.0	1.5	2.5	1.5		1.5–2.0	1.5–2.0
Okra								
Wk after transplanting		1–2	3–4	5–12	13			
N	0–40	1.0	1.5	2.0	1.5		1.5–2.0	1.5–2.0
K_2O	0–50	1.0	1.5	2.0	1.5		1.5–2.0	1.5–2.0
Pepper								
Wk after transplanting		1–2	3–4	5–11	12	13		
N	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0
K_2O	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0
Tomato[8]								
Wk after transplanting		1-2	3–4	5–11	12	13		
N	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0
K_2O	0–70	1.5	2.0	2.5	2.0	1.5	1.5–2.0	1.5–2.0

[1] A=7,260 linear feet per acre (6-foot bed spacing); for soils testing "low" in Mehlich-3 potassium (K2O), seeds and transplants may benefit from applications of a starter solution at a rate no greater than 10 to 15 lb/A for N and P_2O_5 and applied through the plant hole or near the seeds.
[2] Applied using the modified broadcast method (fertilizer is broadcast where the beds will be formed only, and not over the entire field). Preplant fertilizer cannot be applied to double/triple crops because of the plastic mulch; hence, all fertilizer must be injected.
[3] This fertigation schedule is applicable when no N and K_2O are applied preplant. Reduce schedule proportionally to the amount of N and K_2O applied preplant. Fertilizer injections may be done daily or weekly. Inject fertilizer at the end of the irrigation event and allow enough time for proper flushing afterwards.
[4] Plant nutritional status may be determined with tissue analysis or fresh petiole-sap testing, or any other calibrated method. The "low" diagnosis needs to be based on UF/IFAS interpretative thresholds.
[5] Plant nutritional status must be diagnosed every week to repeat supplemental fertilizer application.
[6] Supplemental fertilizer applications are allowed when irrigation is scheduled following a recommended method (see *Evapotranspiration-Based Irrigation Scheduling for Agriculture* at https://edis.ifas.ufl.edu/ae457). Supplemental fertilizations are to be applied in addition to base fertilization when appropriate. Supplemental fertilization is not to be applied "in advance" with the preplant fertilizer.
[7] For standard 13-week-long transplanted tomato crop.
[8] Some of the fertilizer may be applied with a fertilizer wheel through the plastic mulch during the tomato crop when only part of the recommended base rate is applied preplant. Rate may be reduced when a controlled-release fertilizer source is used.

Table 9. Fertigation recommendations for strawberry grown on mineral soils testing low in potassium (K2O) based on the *Mehlich-3 soil extraction method*.

Nutrient	Injection rate[1] (lb/A/day)							Low Plant Content[2]
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	
N[3]	1.5–2.0	1.0–2.0	1.0–1.5	0.75–1.0	0.5–1.0	0.5–0.75	0.5–0.75	1.5–2.0
K_2O	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8	0.6–0.8

[1] Planting date of October 1 and end-of-harvesting date of April 30. Recommendations are for bare-root transplants with no preplant N or K. The total N rate may increase or decrease, depending on the length of the growing season. Growers may choose to omit N fertilization when sprinkler irrigation is used for the establishment of transplants (typically 10 to 12 days after transplanting). If preplant N and K are to be applied, growers are encouraged to use controlled-release or slow-release fertilizers to minimize the risk of nutrient leaching or runoff.
[2] Plant nutritional status may be determined with tissue analysis or fresh petiole-sap testing, or any other calibrated method. The "low" diagnosis needs to be based on UF/IFAS interpretative thresholds.
[3] The target total season N rate is 175 lb/A. Plants on high-organic matter soils may require less N, whereas plants on sandy soils, prone to leaching, may require slightly more, but no more than 200 lb/A. Extra seasonal N applications should depend on plant leaf or petiole sap testing, leaching rainfall, or extended-season needs. The optimum N rate also varies among strawberry cultivars. Growers should choose N rates that are appropriate for the particular cultivar and soil within the ranges shown in the table.

Table 10. Soil test guidelines for micronutrients.

	Soil pH (Mineral Soils Only)		
	5.5–5.9	6.0–6.4	6.5–7.0
	(parts per million)		
Test level below which there may be a crop response to applied copper	0.1–0.3	0.3–0.5	0.5
Test level above which copper toxicity may occur	2.0–3.0	3.0–5.0	5.0
Test level below which there may be a crop response to applied manganese	3.0–5.0	5.0–7.0	7.0–9.0
Test level below which there may be a crop response to applied zinc	0.5	0.5–1.0	1.0–3.0
When soil tests are low or known deficiencies exists, apply per acre 5 lb Mn, 2 lb Zn, 4 lb Fe, 3 lb Cu and 1.5 lb B (higher rate needed for cole crops).			

Table 11. Foliar fertilizer sources and rates for vegetable production in Florida.

Nutrient	Source	Foliar Application (lb Product/A)
Boron	Borax[1] Solubor	2 to 5 1 to 1.5
Copper	Copper sulfate	2 to 5
Iron	Ferrous sulfate Chelated iron	2 to 3 0.75 to 1
Manganese	Manganous sulfate	2 to 4
Molybdenum	Sodium molybdate	0.25 to 0.50
Zinc	Zinc sulfate Chelated zinc	2 to 4 0.75 to 1
Calcium	Calcium chloride Calcium nitrate	5 to 10 5 to 10
Magnesium	Magnesium sulfate	10 to 15
[1] Mention of a trade name does not imply a recommendation over similar materials.		

Table 12. Typical bed spacing and number of rows per bed for some vegetable crops.

Vegetable crop	Typical bed spacing (ft)[1]	No. of LBF per acre	Number of rows of plants on a bed	Vegetable crop	Typical bed spacing (ft)[1]	No. of LBF per acre	Number of rows of plants on a bed
Bean: Snap, Lima	2.5	17424	1	Muskmelon	5	8712	1
Broccoli	6	7260	2	Okra	6	7260	2
Brussels sprouts	6	7260	2	Onion	6	7260	4
Cabbage	6	7260	2	Pea	2.5	17424	1
Carrot	1	43560	3	Pepper	6	7260	2
Cauliflower	6	7260	2	Potato	3.5	12446	1
Celery	4	10890	2	Radish	6	7260	6
Collards	6	7260	2	Spinach	6	7260	4
Cucumber	6	7260	2	Squash, summer	6	7260	2
Eggplant	6	7260	1	Squash, winter	6	7260	2
Greens: Mustard, Turnip	6	7260	4	Strawberry	4	10890	2
Herbs: Parsley, Cilantro	6	7260	4	Sweet Corn	3	14520	1
Kale	6	7260	2	Tomato	6	7260	1
Lettuce	4	10890	2	Watermelon	8	5445	1
[1] The bed spacing is measured from the center of one bed to the center of the adjacent bed.							

UF | IFAS Extension
UNIVERSITY of FLORIDA

CV297

doi.org/10.32473/edis-cv297-2022

Chapter 3. Principles and Practices of Irrigation Management for Vegetables[1]

Lincoln Zotarelli, Michael D. Dukes, and Eric H. Simonne[2]

This section contains basic information on vegetable water use and irrigation management, along with some references on irrigation systems. Proper water management planning must consider all uses of water, from the source of irrigation water to plant water use. Therefore, it is very important to differentiate between crop water requirements and irrigation or production-system water requirements. Crop water requirements refer to the actual water needs for evapotranspiration (ET) and plant growth, and they primarily depend on crop development and climatic factors, which are closely related to climatic demands. Irrigation requirements are primarily determined by crop water requirements, but they also depend on the characteristics of the irrigation system, management practices, and the soil characteristics in the irrigated area.

Best Management Practices (BMP) for Irrigation

BMPs have historically been focused on nutrient management and fertilizer rates. However, because rainfall or irrigation water is the vector of off-site nutrient movement of nitrate in solution and phosphate in sediments as well as other soluble chemicals, proper irrigation management directly affects the efficacy of a BMP plan. The irrigation BMPs in the *Water Quality/Quantity Best Management Practices for Florida Vegetable and Agronomic Crops* manual (accessible at https://www.floridaagwaterpolicy.com) cover all major aspects of irrigation, such as irrigation system design, system maintenance, erosion control, and irrigation scheduling.

Uses of Irrigation Water

Irrigation systems have several uses in addition to water delivery for crop ET. Water is required for a preseason operational test of the irrigation system to check for leaks and to ensure proper performance of the pump and power plant. Irrigation water is also required for field preparation, crop establishment, crop growth and development, within-season system maintenance, delivery of chemicals, frost protection, and other uses, such as dust control.

Field Preparation

Field preparation water is used to provide moisture to the field soil for tillage and bed formation. The water used for field preparation depends on specific field cultural practices, initial soil moisture conditions, the depth to the natural water table, and the type of irrigation system. Drip-irrigated fields on sandy soils often require an additional irrigation system for field preparation because drip tubes are not installed until after the beds have been formed. Thus, many drip-irrigated vegetable fields may also require an overhead or subirrigation system for field preparation. For example,

1. This document is CV297, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 2015. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Lincoln Zotarelli, associate professor, Horticultural Sciences Department; Michael D. Dukes, professor, Department of Agricultural and Biological Engineering, and director, Center for Land Use Efficiency; and Eric H. Simonne, distinguished professor, UF/IFAS Horticultural Sciences Department, and district Extension director, UF/IFAS Extension Northeast District; UF/IFAS Extension, Gainesville, FL 32611.

many strawberry production fields have sprinkler irrigation systems already installed for frost protection. These systems are also used for field preparation and may apply one or more inches of water for this purpose. Subirrigated (seepage) fields use the same system for field preparation as for crop establishment, plant growth needs, and frost protection. Subirrigation water management requirements depend on the soil characteristics within the irrigated field and surrounding areas. Sufficient water must be provided to raise the water table level as high as 18 to 24 inches below the soil surface. Water is required to fill the pores of the soil and to satisfy evaporation and subsurface runoff requirements. As a rough guide, 1.0 to 2.5 inches of water are required for each foot of water table rise. For example, a field with a preirrigation water table 30-inches deep may need about 2 inches of water to raise the water table to 18 inches, while a preirrigation water table at 48 inches may require 5 inches of water for the same result.

Crop Establishment

Vegetables that are set as transplants, rather than direct seeded, require irrigation for crop establishment in excess of crop ET. Establishment irrigations are used either to keep plant foliage wet by overhead sprinkler irrigation (to avoid desiccation of leaves) or to maintain high soil moisture levels until the root systems increase in size and plants start to actively grow and develop. Establishment irrigation practices vary among crops and irrigation systems. Strawberry plants set as bare-root transplants may require 7 to 14 days of frequent intermittent overhead irrigation for establishment prior to irrigation with the drip system. Practices like intermittent irrigation, use of low-volume sprinklers, and use of crop protectants can reduce the volume of irrigation water required for establishment of strawberries. The amount of water required for crop establishment can range widely depending on crop, irrigation system, and climate demand. Adequate soil moisture is also needed for the uniform establishment of direct-seeded vegetable crops.

Crop Growth and Development

Irrigation requirements to meet the ET needs of a crop depend on the type of crop, field soil characteristics, irrigation system type and capacity, and crop growth stage. Crops vary in growth characteristics that result in different relative water-use rates. Soils differ in texture and hydraulic characteristics such as available water-holding capacity (AWHC) and capillary movement. Because sands generally have very low AWHC values (3% to 6% is common), a 1% change in AWHC affects irrigation practices.

Water Application (Irrigation Requirement)

Irrigation systems are generally rated with respect to application efficiency (Ea), which is the fraction of the water that has been applied by the irrigation system and that is available to the plant for use (Table 1). Applied water that is not available to the plant may have been lost from the crop root zone through evaporation or wind drifts of spray droplets, leaks in the pipe system, surface runoff, subsurface runoff, or deep percolation within the irrigated area. Irrigation requirements (IR) are determined by dividing the desired amount of water to provide to the plant (ETc) by the Ea as a decimal fraction (Eq. [1]). For example, if it is desired to apply 0.5 inches to the crop with a 75% efficient system, then 0.5/0.75 = 0.67 inches would need to be pumped. Hence, when seasonal water needs are assessed, the amount of water needed should be based on the irrigation requirement and all the needs for water, not only on the crop water requirement. For more information, consult *Field Evaluation of Microirrigation Water Application Uniformity* (https://edis.ifas.ufl.edu/ae094). Catch cans can be used in the field to measure the actual amount of water applied.

Eq. [1] Irrigation requirement = Crop water requirement / Application efficiency

IR = ETc/Ea

Fertigation/Chemigation

Irrigation systems are often used for delivery of chemicals such as fertilizers, soil fumigants, or insecticides. The crop may require nutrients when irrigation is not required (e.g., after heavy rainfall). Fertilizer injection schedules based on soil test results are provided in chapter 2 of this production guide. Fertigation should not begin until the system is pressurized. It is recommended to always end a fertigation/chemigation event with a short flushing cycle with clear water and/or to rinse crop foliage to avoid the accumulation of fertilizer or chemical deposits in the irrigation system. The length of the flushing cycle should be 10 minutes longer than the travel time of the fertilizer from the irrigation point to the farthest point of the system.

System Maintenance

Irrigation systems require periodic maintenance throughout the growing season. These activities may require system operation during rainy periods to ensure that the system is ready when needed. In addition, drip irrigation systems may require periodic maintenance to prevent clogging

and system failure. Typically, cleaning agents are injected weekly, but in some instances more frequent injections are needed.

Frost Protection

For some crops, irrigation is used for frost protection during winter growing seasons. For strawberry production, sprinkler irrigation is primarily used with application rates of about 0.25 inches per hour during freeze events. Water freezes at 32°F, while most plant tissues freeze at lower temperatures. Overhead freeze protection is efficient for air temperatures as low as 26°F–28°F, but seldom below. For vegetable fields with subirrigation systems, the relatively higher temperature of groundwater can be used for cold protection. Growers may also irrigate to raise the water table throughout the field. Frost protection water requirements vary depending on the severity and duration of freeze events, the depth to the existing water table level, and field hydraulic characteristics. For more information, consult *Microsprinkler Irrigation for Cold Protection of Florida Citrus* (https://edis.ifas.ufl.edu/ch182) and *Citrus Cold Weather Protection and Irrigation Scheduling Tools Using Florida Automated Weather Network (FAWN) Data* (https://edis.ifas.ufl.edu/ss509).

Other Uses

Other irrigation uses vary according to the type of crop, system characteristics, and field location. Some examples include periodic overhead irrigation for dust control, wetting of dry row middles to settle dust and prevent sand from blowing during windy conditions, and wetting of roadways and drive aisles to provide traction for farm vehicles.

Irrigation Scheduling

Irrigation scheduling consists simply of applying water to crops at the *right* time and in the *right* amount, and it is considered an important BMP. The characteristics of the irrigation system, crop needs, soil properties, and atmospheric conditions must all be considered to properly schedule irrigations. Poor timing or insufficient water application can result in crop stress and reduced yields from inappropriate amounts of available water or nutrients. In sandy soils, excessive water applications may reduce yield and quality and increase the risk of nutrient leaching.

A wide range of irrigation scheduling methods is used in Florida, with corresponding levels of water management (Table 2). The recommended method (level 5) for scheduling irrigation (drip or overhead) for vegetable crops is to combine the crop water requirement method, which takes into account plant stage of growth associated with measurements of soil water status, with guidelines for splitting irrigation (see below). A typical irrigation schedule contains (1) a target crop water requirement adjusted to growth stage and actual evaporative demand, (2) adjustment of irrigation application based on soil moisture, (3) a rule for splitting irrigation, (4) a method to account for rainfall, and (5) recordkeeping (Table 3). For seepage irrigation, the water table should be maintained near the 18-inch depth (measured from the top of the bed) at planting and near the 24-inch depth when plants are fully grown. Water tables should be maintained at the proper level to ensure optimum moisture in the bed without leading to oversaturation of the root zone and potential losses of nutrients. Water tables can be monitored with a section of PVC pipe sunk in the soil with a calibrated float inside the PVC pipe. The calibrated float can be used to determine the exact level of the water table. For more information on observation well construction, consult *Water Table Measurement and Monitoring for Flatwoods Citrus* (https://doi.org/10.32473/edis-ch151-2002).

Soil Water Status, Soil Water Tension, and Soil Volumetric Water Content

Generally, two types of sensors may be used for measurements of soil water status: those that measure soil water potential (also called tension or suction) and those that measure volumetric water content. Soil water tension (SWT) represents the magnitude of the suction (water potential, negative pressure) the plant roots have to create to free soil water from the attraction of the soil and move it into the root cells. The drier the soil, the higher the suction needed, and hence the higher SWT. SWT is commonly expressed in centibars (cb) or kilopascals (kPa; 1 cb = 1 kPa; 7 kPa = 1 psi). For most vegetable crops grown on the sandy soils of Florida, SWT in the rooting zone should be maintained between 6 (slightly above field capacity) and 15 cb. Because of the low AWHC of Florida soils, most full-grown vegetable crops will need to be irrigated daily. During early growth, irrigation may be needed only two to three times weekly. SWT can be measured in the field with moisture sensors or tensiometers. For more information on SWT measuring devices, consult *Using Tensiometers for Vegetable Irrigation Scheduling in Miami-Dade County* (https://edis.ifas.ufl.edu/tr015).

Within the category of volumetric sensors, capacitance-based sensors have become common in recent years due to a decrease in cost of electronic components and increased reliability of these types of sensors. However, sensors

available on the market have substantially different accuracies, responses to salts, and costs. Soil moisture sensors are detailed in the publication *Field Devices for Monitoring Soil Water Content* (https://edis.ifas.ufl.edu/ae266). All methods under this definition estimate the volume of water in a sample volume of undisturbed soil (ft^3/ft^3 or percentage). This quantity is useful for determining how saturated the soil is (i.e., what fraction of total soil volume is filled with the soil aqueous solution). When it is expressed in terms of depth (volume of water in soil down to a given depth over a unit surface area [inches of water]), it can be compared with other hydrologic variables like precipitation, evaporation, transpiration, and deep drainage.

Practical Determination of Soil Field Capacity Using Volumetric Soil Moisture Sensors

It is very important that the irrigation manager understands the concept of "field capacity" to establish an irrigation strategy that provides optimum soil moisture for plant growth, productivity, and reduction of fertilizer nutrient leaching. Figure 1 represents volumetric soil water content (VWC) at a depth of 0–6 inches measured by a capacitance sensor over a period of 4 days. For the soil field capacity point determination, it is necessary to apply an irrigation depth (or observe a rainfall event) that resulted in saturation of the soil layer, in this particular case 0–6 inches. The depth of irrigation applied in a single irrigation event was 4,645 gal/A (equivalent to 0.17 inches for overhead or seepage irrigation, or 34 gal/100 ft for drip irrigation with 6-foot bed centers in plasticulture). Right after the irrigation events, there was a noticeable increase in soil moisture content. The degree to which the VWC increases, however, is dependent upon volume of irrigation, which is normally set by the duration of irrigation event. For plastic-mulched drip irrigation in sandy soils, long irrigation events result in a relatively large increase in soil moisture in the area below the drip emitter. The spike in soil moisture appears to only be temporary, because the irrigation water rapidly drains down beyond the 6-inch zone (observed by the decrease in VWC). This rapid spike in soil water content indicates that the VWC rapidly reaches a point above the soil water-holding capacity, and the water percolated down to deeper soil layers. For sandy soils, the change in the slope of drainage and extraction lines, in other words, changing from "rapid" to "slower" decrease in soil water content, can be assumed as the "field capacity point." At this time, the water has moved out from the large soil pores (macropores), and its place has been taken by air. The remaining pore spaces (micropores) are still filled with water and will supply the plants with needed moisture. Between the end of day 1 and day 3, the VWC declined at a constant rate as a result of drainage, but most of the water extraction was due to evapotranspiration during the day.

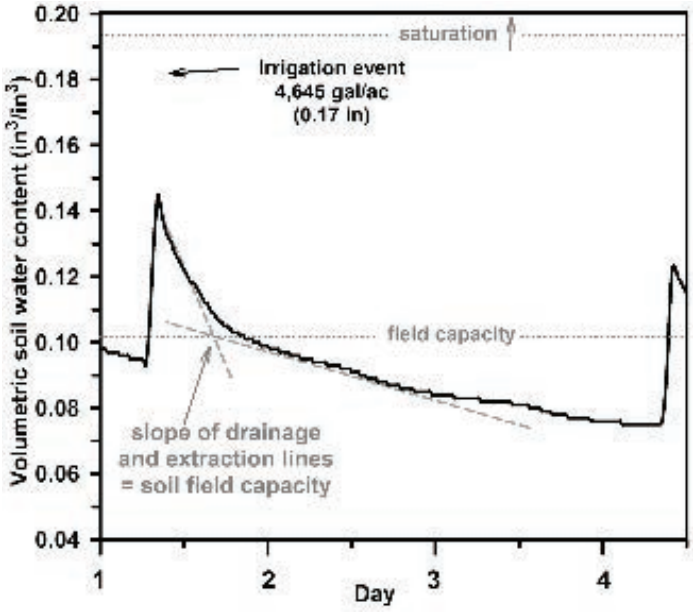


Figure 1. Example of practical determination of soil field capacity at 0–6 inches soil depth after irrigation event using soil moisture sensors.

Examples of Irrigation Scheduling Using Volumetric Soil Moisture Sensor Devices

In this section, two examples of irrigation management of vegetable crops in sandy soils using soil moisture sensor readings are provided: one example with excessive ("over") irrigation (Figure 2) and one with adequate irrigation (Figure 3) using plasticulture. In Figure 2, the irrigation events consisted of the application of a single daily irrigation event of 4,718 gal/A (equivalent to 0.18 inches for overhead or seepage irrigation, or 36 gal/100 ft for drip irrigation with 6-foot bed centers in plasticulture). After each irrigation event, there was an increase in the soil water content followed by rapid drainage. Large rainfall events may lead to substantial increases in soil moisture content. On day 2, right after the irrigation, a large rainfall of 0.44 inches occurred, which resulted in a second spike of soil water content in the same day. The following irrigation (day 3) started when the volumetric soil water content was above the soil field capacity. In this case, the irrigation event of the day 3 could have been safely skipped. Between day 3 and 6, no irrigation was applied to the crop. The volumetric water content decreased from 0.14 to 0.08 in^3/in^3. Due to the very low water-holding capacity of the sandy soils, skipping irrigation for several days could lead to unneeded crop water stress, especially during very hot or very windy days (when high evapotranspiration rates may occur), or during flowering/fruit development stage. Between day 6 and 10,

large daily irrigation events were repeated, exceeding the "safe irrigation zone" and leading to more water drainage and nutrient leaching.

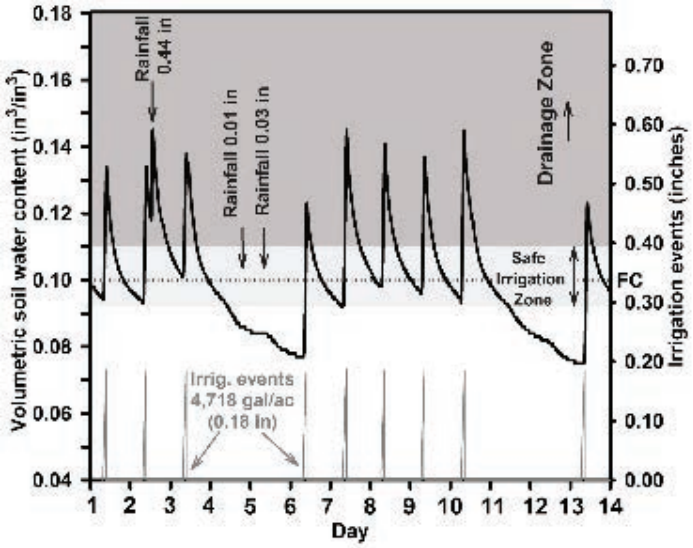


Figure 2. Example of excessive ("over") irrigation of the upper soil layer (0–6 inch depth) moisture content for drip irrigation under plastic-mulched conditions for sandy soils. The black line indicates volumetric soil water content using soil moisture sensors. The gray line indicates irrigation events, each single daily irrigation event having a volume application of 65 gal/100 ft (0.18 in). The dotted line indicates soil field capacity line. Arrows indicate rainfall events.

Conversely, Figure 3 shows "adequate" irrigation applications for a 10-day period. In this case, the irrigation event started exclusively when the volumetric soil water content reached a set threshold. The soil field capacity was known, so the irrigation events started when the volumetric soil moisture content reached values below field capacity (0.09 in^3/in^3). However, to maintain the soil volumetric water content in the "safe irrigation zone," a previous determination of the length of the irrigation is necessary to avoid overirrigation. Additional information about irrigation depths can be obtained in *Microirrigation in Mulched Bed Production Systems: Irrigation Depths* (https://edis.ifas.ufl.edu/ae049).

The example in Figure 3 received irrigation of 943 gal/A (equivalent to 0.03 inches for overhead or seepage irrigation, or 6 gal/100 ft for drip irrigation with 6-foot bed centers in plasticulture). This irrigation depth was sufficient to increase the volumetric water content to a given moisture without exceeding the "safe irrigation zone." On average, the volumetric soil water content was maintained close to the field capacity, keeping water and nutrients in the root zone. For this particular example, there was no deep water percolation. In addition, with the information of the soil water status, the irrigation manager might decide to not irrigate if the soil moisture content is at a satisfactory level.

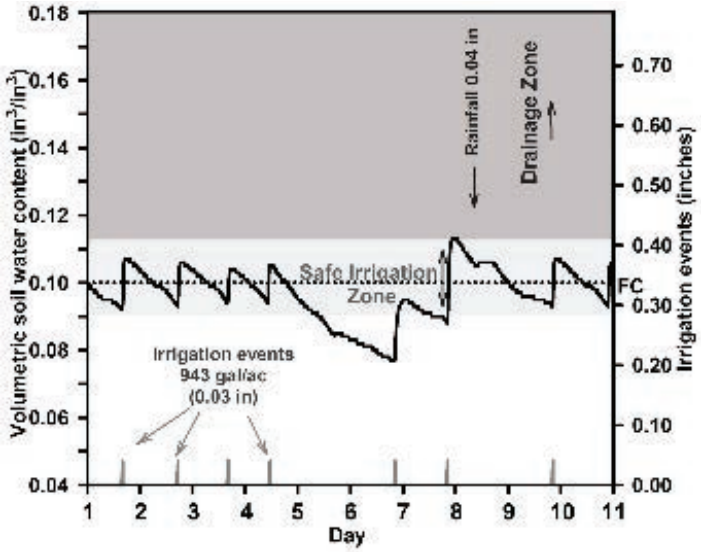


Figure 3. Example of adequate irrigation management using soil moisture sensors for monitoring the volumetric soil moisture content in the upper soil layer (0–6 inch depth) on drip irrigation under plastic-mulched conditions for sandy soils. The black line indicates volumetric soil water content using soil moisture sensors. The gray line indicates irrigation events, each single daily irrigation event having a volume application of 943 gal/A (0.03 in). The dotted line indicates the soil field capacity line. Arrows indicate rainfall events.

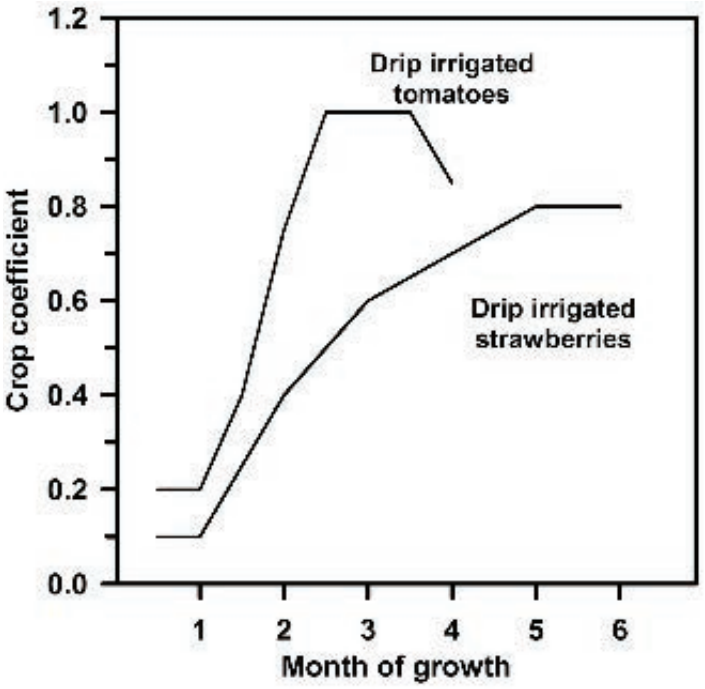


Figure 4. Crop coefficient of drip-irrigated tomato and strawberry.

On day 8, due to a rainfall event of 0.04 inches, there was no need for irrigation because the soil moisture was above the field capacity, and therefore the irrigation event of day 8 was skipped. This "precise" irrigation management still requires very close attention by the irrigation manager. For a given reason (such as pump issue), the irrigation was ceased on day 5 and it was resumed late in day 6. As a result, soil water storage decreased below the safe irrigation

zone, and if the water shortage was prolonged, the plants could become water-stressed.

Installation and Placing of Soil Moisture Sensor Devices

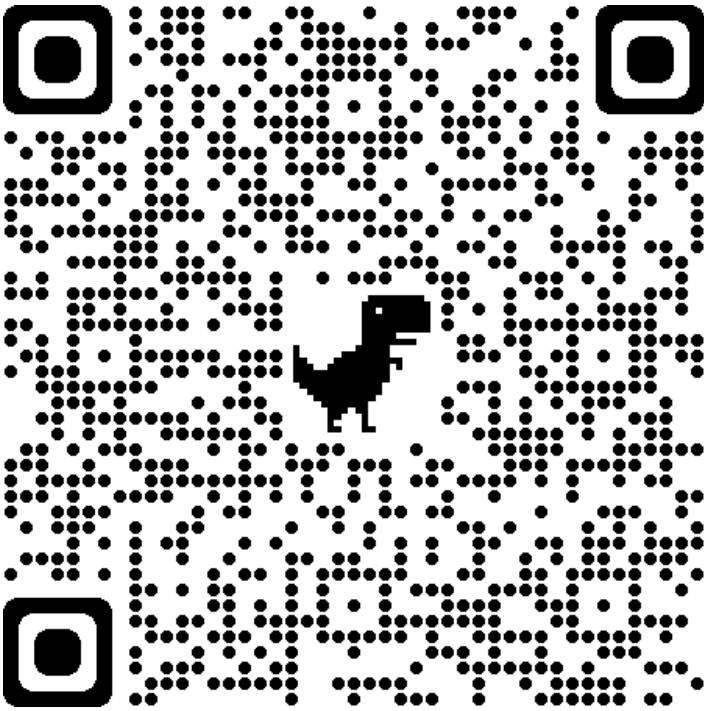
The use of soil moisture monitoring devices (volumetric or soil water tension) has potential to save irrigation water in a given vegetable area by reducing the number of unnecessary irrigation events. However, the effectiveness of these sensors depends on proper installation in representative locations within vegetable fields. These sensors may be used to monitor water table levels in seepage irrigation.

Sensors should be installed in the root zone of the plants to be irrigated. Most of the vegetable crops have 80% to 90% of the root zone in the upper 12 inches, which generally is the soil layer with higher water depletion by evapotranspiration. For vegetable crops cultivated in rows and irrigated by drip tapes, the sensors should be installed 2–3 inches away from the plant row. For single-row crops (such as tomato, eggplant, or watermelon), the sensor should be placed on the opposite side from the drip tape; for double-row crops (pepper, squash), the sensors should be placed in between the drip tape and plant rows.

Sensors need to be in good contact with the soil after installation; there should be no air gaps surrounding the sensor. Soil should be packed firmly but not excessively around the sensor. Alternatively, sensors can be installed in a slurry of wetted soil that was removed for the sensor install. Using a slurry, the consistency of cake batter, can also provide the user with an initial calibration of the sensor for the determination of field capacity seen in Figure 1. In plasticulture, after the installation, the area above the sensor should be re-covered with plastic and sealed with tape.

Soil Moisture Sensor Data Interpretation

Soil moisture sensors can provide information on the depth of an irrigation or rainfall event, at what depth and in what quantity crop roots are extracting water from the soil, when irrigation is necessary, and more. However, this information is not always intuitive without some guidance. For a closer look at various soil moisture sensors and their data interpretation, visit the UF/IFAS North Florida Research and Education Center–Suwannee Valley YouTube channel and view the soil moisture sensor playlist (https://www.youtube.com/playlist?list=PLn-umAc9HXgDyMWN-dstplSR9QWUiU9H8).



Crop Water Requirement (ET)

Crop water requirements depend on crop type, stage of growth, and evaporative demand. Evaporative demand is termed evapotranspiration (ET) and may be estimated using historical or current weather data. Generally, reference evapotranspiration (ETo) is determined for use as a base level. By definition, ETo represents the water use from a uniform green cover surface that is actively growing and well-watered (such as turf or a grass-covered area).

Historical daily averages of Penman-method ETo values, expressed in units of acre-inches and gallons per acre, are available for six Florida regions (Table 4). While these values are provided as guidelines for management purposes, actual values may vary above and below these values, requiring individual site adjustments. Actual daily values may be as much as 25% higher on days that are hotter and drier than normal or as much as 25% lower on days that are cooler or more overcast than normal. Real time ETo estimates can be found at the Florida Automated Weather Network (FAWN) internet site (https://fawn.ifas.ufl.edu). For precise management, SWT or soil moisture should be monitored daily in the field.

Crop water use (ETc) is related to ETo by a crop coefficient (Kc), which is the ratio of ETc to the reference value ETo (Eq. [2]). Because different methods exist for estimating ETo, it is very important to use Kc coefficients that were derived using the same ETo estimation method as will be used to determine the crop water requirements. Also, Kc values for the appropriate stage of growth (Tables 5 and 6;

Figure 3) and production system (Tables 7 and 8) must be used.

With drip irrigation where the wetted area is limited and plastic mulch is often used, Kc values are lower to reflect changes in row spacing and mulch use. Plastic mulches substantially reduce evaporation of water from the soil surface. Associated with the reduction of evaporation is a general increase in transpiration. Even though the transpiration rates under mulch may increase by an average of 10%–30% over the season as compared to no-mulch systems, overall water-use values decrease by an average of 10%–30% due to the reduction in soil evaporation. ETo may be estimated from atmometers (also called modified Bellani plates) by using an adjustment factor. During days without rainfall, ETo may be estimated from evaporation from an ET gauge (Ea) as ETo = Ea/0.89. On rainy days (>0.2 in) ETo = Ea/0.84.

Eq. [2] Crop water requirement = Crop coefficient × Reference evapotranspiration

ETc = Kc × ETo

Soil Water-Holding Capacity and the Need to Split Irrigations

Appropriate irrigation scheduling and matching irrigation amounts with the water-holding capacity of the effective root zone may help minimize the incidence of excess leaching associated with overirrigation. In Florida sandy soils, the amount of water potentially available to the plants that can be stored in the root zone is limited. Usually, it is assumed that approximately 0.75 inches of water can be stored in every foot of the root zone. Only half of that should be used before the next irrigation to avoid plant stress and yield reduction. (This will help maintain SWT below 15 cb.) Any additional water will be lost by deep percolation below the root zone.

Table 8 gives the approximate amount of water that can be applied at each event in Florida sandy soil under different production systems. When the calculated volume of water to be applied in one day exceeds the values in Table 7, then it is necessary to split applications. The number of split irrigations can be determined by dividing the irrigation requirement (Eq. [1]) by the numbers in Table 8 and rounding up the result to the nearest whole number. Splitting irrigation reduces risks of water loss through deep percolation and nutrient leaching. Sandy soil with the available water-holding capacity of 0.75 in/ft was assumed in these calculations. If a soil contains more clay or organic matter, the amount of water applied during one irrigation event and stored in the root zone can be increased. To ensure that the water is not lost from the roots, it is recommended to check the depth of wetting after irrigation by digging out a perpendicular profile to the drip line and observing the wetted pattern.

Example

As an example, consider drip-irrigated tomatoes on 6-foot center beds, grown under a plastic mulch production system in the central west area (sandy soils). For plants in growth Stage 5 the crop coefficient is 0.85 (Table 7). If this period of growth had occurred in May, the corresponding ETo value would be 4,887 gal/A/day (Table 4). Daily crop water use would be estimated as

ETcrop = (0.85) × (4,887 gal/A/day) = 4,153 gal/A/day

If the drip irrigation system can apply water to the root zone of the crop with an application efficiency of 80%, the irrigation requirement would be

Irrigation Requirement = (4,153 gal/A/day) / (0.80) = 5,192 gal/A/day

If the maximum water application in one irrigation event for this type of soil is 1,700 gal/A/irrigation, then the irrigation will have to be split:

Number of events = (5,292 gal/A/day) / (1,700 gal/A/day/irrigation event) = 3.1, rounded up to 4 irrigation events each of 5,292/4 = 1,323 gal/A

Therefore, in this example, four irrigations of 1,323 gal/A each would be needed to replace ETc without exceeding the soil water-holding capacity. This amount of water would be a good estimate for scheduling purposes under average growth and average May climatic conditions. However, field moisture plant status should also be monitored to determine if irrigation levels need to be increased or reduced. While deficit irrigation will reduce fruit size and plant growth, excessive irrigation may leach nutrients from the active root system. This may also reduce plant growth and yield.

Table 1. Application efficiency for water delivery systems used in Florida.

Irrigation System	Application Efficiency (Ea)
Overhead	60%–80%
Seepage[1]	20%–70%
Drip[2]	80%–95%

[1] Ea greater than 50% is not expected unless tailwater recovery is used.
[2] With or without plastic mulch.

Table 2. Levels of water management and corresponding irrigation scheduling method.

Water Mgt. Level	Irrigation Scheduling Method
0	Guessing (irrigate whenever); not recommended
1	Using the "feel-and-see" method
2	Using systematic irrigation (Example: 0.75 inches every 4th day, or 2 hr every day)
3	Using a soil water tension measuring tool or soil moisture sensor to start irrigation
4	Scheduling irrigation and apply amounts based on a budgeting procedure and checking actual soil water status
5a	Adjusting irrigation to plant water use (ETo), and using a dynamic water balance based on a budgeting procedure and plant stage of growth, together with using a soil water tension measuring tool or soil moisture sensor

[a] Recommended method

Table 3. Summary of irrigation scheduling guidelines for vegetable crops grown in Florida.

Irrigation Scheduling Component	Irrigation System[1]	
	Seepage[2]	Drip[3]
1—Target water application rate	Keep water table between 18- and 24-inch depth.	Historical weather data or crop evapotranspiration (ETc) calculated from reference ET or Class A pan evaporation
2—Fine-tune application with soil moisture measurement	Monitor water table depth with observation wells.	Maintain soil moisture level in the root zone between 8 and 15 cbar (or 8% and 12% available soil moisture)
3—Determine the contribution of rainfall	Typically, 1 inch of rainfall raises the water table by 1 foot.	Poor lateral water movement on sandy and rocky soils limits the contribution of rainfall to crop water needs to (1) foliar absorption and cooling of foliage and (2) water funneled by the canopy through the plan hole.
4—Rule for splitting irrigation	Not applicable. However, a water budget can be developed.	Irrigations greater than 12 and 50 gal/100ft (or 30 min and 2 hr for drip tapes with medium flow-rate) when plants are small and fully grown, respectively, will likely push the water front below the root zone
5—Recordkeeping	Irrigation amount applied and total rainfall received[4] Days of system operation	Irrigation amount applied and total rainfall received[4] Daily irrigation schedule

[1] Efficient irrigation scheduling also requires a properly designed and maintained irrigation system.
[2] Practical only when a spodic layer is present in the field.
[3] On deep sandy soils.
[4] Required by the BMPs.

Table 4. Historical Penman method reference evapotranspiration (ETo) for six Florida regions expressed in (A) inches per day and (B) gallons per acre per day.[1]

Month	Northwest	Northeast	Central	Central West	Southwest	Southeast
Inches per day (A)						
Jan	0.06	0.07	0.07	0.07	0.08	0.08
Feb	0.07	0.08	0.10	0.10	0.11	0.11
Mar	0.10	0.10	0.12	0.13	0.13	0.13
Apr	0.13	0.14	0.16	0.16	0.17	0.17
May	0.16	0.16	0.18	0.18	0.18	0.18
Jun	0.17	0.16	0.18	0.18	0.18	0.17
Jul	0.17	0.16	0.17	0.17	0.18	0.18
Aug	0.15	0.15	0.17	0.16	0.17	0.16
Sep	0.13	0.13	0.14	0.14	0.15	0.14
Oct	0.09	0.10	0.11	0.11	0.12	0.12
Nov	0.07	0.07	0.08	0.08	0.09	0.09
Dec	0.05	0.06	0.06	0.07	0.07	0.07
Gallons per acre per day[2] (B)						
Jan	1629	1901	1901	1901	2172	2172
Feb	1901	2172	2715	2715	2987	2987
Mar	2715	2715	3258	3530	3530	3530
Apr	3530	3801	4344	4344	4616	4616
May	4344	4344	4887	4887	4887	4887
Jun	4616	4344	4887	4887	4887	4616
Jul	4616	4344	4616	4616	4887	4887
Aug	4073	4073	4616	4344	4616	4344
Sept	3530	3530	3801	3801	4073	3801
Oct	2444	2715	2987	2987	3258	3258
Nov	1901	1901	2172	2172	2444	2444
Dec	1358	1629	1629	1629	1901	1901

[1] Assuming water application over the entire area, i.e., sprinkler or seepage irrigation with 100% efficiency. See Table 1 for conversion for taking into account irrigation system efficiency.

[2] Calculation: for overhead or seepage irrigation, (B) = (A) × 27,150. To convert values for drip irrigation (C) use (C) = (B) × bed spacing/435.6. For example, for 6-foot bed spacing and single drip line, C in southwest Florida in January is C = 2,172 × 6/435.6 = 30 gal/100 ft/day.

Table 5. Description of growth stages (plant appearance and estimated number of weeks) for most vegetable crops grown in the spring in Florida.[1]

Crop	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Expected Growing Season (Weeks)
Bean	Small plants 2–3	Growing plants 3–4	Pod enlargement 2–3	Pod maturation 2–3		9–10
Cabbage, cauliflower, Chinese cabbage	Small plants 2–3	Growing plants 5–6	Head development 3–4			10–12
Cantaloupe (muskmelon)	6-inch vine 1–2	12-inch vine 3–4	First flower 3–4	Main fruit production 2–3	Late fruit production 2–3	11–12
Carrot	Small plants 1–2	Growing plants 3–4	Root development 5–7	Final growth 1–2		10–13
Cucumber	6-inch vine 1–2	12-inch vine 2–3	Fruit production 6–7	Late season 1–2		10–12
Eggplant	Small plants 2–3	Growing plants 2–3	Fruit production 6–7	Late season 2–3		12–13
Potato	Small plants (after hilling) 2–4	Large plants (vegetative growth) 4–6	First flower (tube initiation and bulking) 3–5	Maturation (top dies) 2–4		12–14
Okra	Small plants 2–3	Growing plants 2–3	Pod production 7–8	Late season 1–2		12–13
Onion	Small plants 2–4	Growing plants 4–5	Bulb development 6–8	Maturation (top falls) 1–2		13–16
Pepper	Small plants 2–3	Growing plants 2–3	Pod production 7–8	Last bloom 1–2	Last harvest 1	13–15
Potato	Small plants (after hilling) 2–4	Large plants (vegetative growth) 4–6	First flower (tube initiation and bulking) 3–5	Maturation (top dies) 2–4		12–14
Pumpkin (bush)	Small plant 2–3	First flower 2–3	Fruit enlargement 5–6	Harvest 1–2		9–11
Pumpkin (vining)	6-inch vines 2–3	12-inch vines 2–3	Small fruit 3–4	Large fruit 2–3	Harvest 1–2	13–15
Radish	Small plants 1–2	Rapid growth 2–4				3–5
Strawberry	Young plants October	Growing plants November	Early harvest December–January	Main harvest period February–March	Late harvest April	23–30
Summer squash (crookneck, straightneck, zucchini)	Small plants 1–2	Growing plants 2–3	Fruit production 3–4	Late fruit production 1		7–9
Sweet corn	Small plants 3–4	Large plants 5–8	Ear development 2–3			10–15
Sweetpotato	Early vine growth 2–3	Expanding vines 5–6	Storage root enlargement 6–10		Late season	13–17
Tomato	Small plants 2–3	1st bloom 2–3	2nd, 3rd bloom 6–7	Harvest 1–2	Late harvest 1–2	12–14
Watermelon	6-inch vines 2–3	12-inch vines 2–3	Small fruit 3–4	Large fruit 2–3	Harvest 1–2	13–15

[1] Same growth stages used for irrigation and fertilizer schedules; for south Florida, each stage may be 30% longer because of winter planting during short days.

Table 6. Crop coefficient estimates for use with the ETo values in Table 4 and growth stages in Table 5 for unmulched crops. (Actual values will vary with time of planting, soil conditions, cultural conditions, length of growing season and other site-specific factors.)

Crop	Growth Stage	Crop Coefficient[1]
All field-grown vegetables	1 2	0.20[2] to 0.40[3] Stage 1[4] value to Stage 3 value (see Figure 4)
Beet	3 4	1.00 0.90
Carrot	3 4	1.00 0.70
Celery	3 4	1.00 0.90
Cole crops: broccoli, brussels sprouts, cabbage, cauliflower	3 4	0.95 0.80[5]
Cole crops: collards, kale, mustard, turnip	3 4	0.90[5] 1.00[5]
Cucurbits: cucumber, cantaloupe, pumpkin, squash, watermelon	3 4	0.90 0.70
Legumes: sandbean, lima bean, and southernpea	3 4	0.95[5] 0.85[5]
Lettuce, endive, escarole	3 4	0.95 0.90
Okra	3 4	1.00[5] 0.90[5]
Onion (dry)	3 4	0.95 0.75
Onion (green)	3 and 4	0.95
Parsley	3	1.00[5]
Potato	3 4	1.10 0.70
Radish	3 4	0.80 0.75
Spinach	3 4	0.95 0.90
Sweet corn	3 4	1.10 1.00
Sweetpotato	3 4	1.10[5] 0.70[5]

[1] adapted from Doorenbos, J., and W. O. Pruitt. 1977. "Crop Water Requirements." Irrigation and Drainage Paper No. 24, (rev.) Food and Agriculture Organization (FAO), Rome; and Allen, R. G., L. S. Pereira, D. Raes, and M. Smith. 1998. "Crop Evapotranspiration: Guidelines for Computing Crop Water Requirements." FAO, Rome.
[2] low plant population; wide row spacing.
[3] high plant population; close row spacing.
[4] 0.30 or Kc value from Stage 1.
[5] values estimated from similar crops.

Table 7. Crop coefficient estimates (Kc) for use with ETo values in Table 4 and growth stages in Table 5 for selected crops grown in a plasticulture system.[1]

Crop	Growth Stage	Crop Coefficient (Kc)
Cantaloupe[1]	1	0.35
	2	0.6
	3	0.85
	4	0.85
	5	0.85
Cucumber[1]	1	0.25
	2	0.5
	3	0.9
	4	0.75
Summer squash[1]	1	0.3
	2	0.55
	3	0.9
	4	0.8
Strawberry (4-foot bed centers)[2]	1	0.4
	2	0.5
	3	0.6
	4	0.8
	5	0.8
Tomato (6-foot bed centers)[3]	1	0.4
	2	0.75
	3	1.0
	4	1.0
	5	0.85
Watermelon (8-foot bed center)[1]	1	0.3
	2	0.5
	3	0.7
	4	0.9
	5	0.8

[1] Adapted from Tables 12 and 25 in Allen, R.G., L. S. Pereira, D. Raes, and M. Smith. 1998. "Crop Evapotranspiration: Guidelines for Computing Crop Water Requirements." Food and Agriculture Organization of the United Nations, Rome.
[2] Adapted from Clark et al. 1993. "Water Requirements and Crop Coefficients for Tomato Production in Southwest Florida." Southwest Florida Water Management District, Brandon, FL.
[3] Adapted from Clark et al. 1996. "Water Requirements and Crop Coefficients of Drip-Irrigated Strawberry Plants." *Transactions of the ASAE* 39:905–913.

Table 8. Maximum water application (in gallons per acre and in gallons/100 ft) in one irrigation event for various production systems on sandy soil (available water-holding capacity 0.75 in/ft and 50% soil water depletion). Split irrigations may be required during peak water requirement.

Wetting Width (ft)	Gal/100 ft to Wet Depth of 1 ft	Gal/100 ft to Wet Depth of 1.5 ft	Gal/100 ft to Wet Depth of 2 ft	Bed Spacing (ft)	Vegetable Crop	Bed Length (100 lb/ Acre)	Gal/Acre to Wet Depth of 1 ft	Gal/Acre to Wet Depth of 1.5 ft	Gal/Acre to Wet Depth of 2 ft
1.0	24	36	48	4 5 6 8	Lettuce, strawberry Muskmelon Broccoli, cabbage, cauliflower, eggplant, okra, pepper, pumpkin (bush), summer squash, tomato Pumpkin (vining), watermelon	109 87 73 55	2,600 2,100 1,700 1,300	3,800 3,100 2,600 1,900	5,100 4,100 3,500 2,600
1.5	36	54	72	4 5 6 8	Lettuce, strawberry Muskmelon Broccoli, cabbage, cauliflower, eggplant, okra, pepper, pumpkin (bush), summer squash, tomato Pumpkin (vining), watermelon	109 87 73 55	3,800 3,100 2,600 1,900	5,800 4,700 3,900 3,000	7,600 6,200 5,200 3,900

UF | IFAS Extension
UNIVERSITY of FLORIDA

CV298

doi.org/10.32473/edis-cv298-2022

Chapter 4. Integrated Pest Management[1]

Peter J. Dittmar, Nicholas S. Dufault, Johan Desaeger, Jawwad Qureshi, Nathan S. Boyd, and Mathews L. Paret[2]

Disease Management

The health of vegetable crops is best maintained through management practices that integrate different techniques. When making management decisions, it is important to consider the economics of the crop; the cost of the management practice; the history of the production area; weather and climatic conditions; and potential risk for a disease to develop. Integrated management strategies are more likely to successfully control diseases than nonintegrated ones because they reduce disease risk through multiple techniques, often before infection begins. Nonintegrated strategies can also adequately manage a disease; however, producers must limit expectations about the probability that they will see significant economic return from a crop. Ultimately, integrated management strategies provide a means for producers to reduce the risk that they will have significant economic losses from a disease.

Economics

Often the top priority of any producer is the economic benefit they will see from the application of a specific management strategy. These benefits will depend upon the market price of the crop as well as the cost of the specific management strategy. Typical costs include the price of a cultivar, labor, machinery, fuel, and various materials (e.g., fungicides) used in an integrated disease management strategy. All of these costs are variable, and it is up to a producer to assess the inputs required for managing specific diseases so they can calculate the economic returns from their decisions, if any.

Disease Identification

Proper management of any plant disease starts with an accurate identification of the pathogen or pest causing the problem. Many different types of pathogens (i.e., fungi, bacteria, viruses, and nematodes) are involved in diseases of vegetable crops, which can require very different management strategies. In order to assess which management

1. This document is CV298, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 2015. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Peter J. Dittmar, associate professor, Horticultural Sciences Department; Nicholas S. Dufault, associate professor, Plant Pathology Department; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast Research and Education Center; Jawwad Qureshi, associate professor, Entomology and Nematology Department, UF/IFAS Southwest Florida REC; Nathan S. Boyd, associate center director and professor, Horticultural Sciences Department, UF/IFAS Gulf Coast REC; and Mathews Paret, associate professor, Plant Pathology Department, UF/IFAS North Florida REC; UF/IFAS Extension, Gainesville, FL 32611.

strategy is most appropriate, there needs to be information about the pathogen present in a field. This information can be gained by assessing the crop either yourself or with the aid of a professional. Many guides and applications are available for disease identification; however, proper identification often requires the use of a microscope to identify key structures or use of a more complex test (e.g., DNA/RNA-based and serological). Many printed and electronic (e.g., EDIS, UF/IFAS Extension) resources are available for disease identification, but if a producer is unsure about how to identify a disease, they should contact their county UF/IFAS Extension office or nearest UF/IFAS Plant Diagnostic Clinic for help.

Disease Risk

Once a pathogen has been identified, monitoring of the disease is critical to collecting the information needed to make a beneficial management decision. The distribution of a disease within a field can inform a producer about where and when the disease may be a problem. Monitoring is also critical to determining the risk of a producer's crop experiencing significant economic impacts from a disease. For example, if a disease is affecting only 5% of a production area, it is likely that a combination of multiple low-cost strategies will effectively manage the disease. However, if a disease is causing a problem in 50% or more of the field, then different management strategies likely will be needed to adequately reduce its impact.

Many integrated management methods are available for disease control, and many of these methods are often chosen even before the crop is planted. Three important preplant tools are site determination and preparation, crop rotation, and cultivar selection. Site determination and crop rotation are two excellent methods for reducing a pathogen population within a specific site. For example, fields with a history of a disease are more likely to have that disease again, especially if it has been continually planted with susceptible host plants. Removal of debris through tillage or the planting of a nonhost plant can limit the pathogens present and thus reduce a disease's overall impact. Cultivar selection is also critical to determining how likely a disease is to continue developing and spread within a field. Resistant cultivars will most likely require less inputs than susceptible cultivars after disease establishment.

Multiple postplant management options are also available to producers. These include, but are not limited to, weed control, irrigation management, nutrient management, soil amendments, sanitation practices, and canopy regulations (e.g., staked tomatoes). These management options are aimed at reducing plant stresses and limiting mechanical movement of the pathogen within a field site. For instance, weeds can serve as alternate hosts for a pathogen and can stress plants by competing for essential nutrients such as calcium. Stressed plants are more prone to pathogen infections, and alternate weed hosts create local inoculum sources that can cause problems under the right environmental conditions. These management strategies provide better results when used as prevention methods, and they are even more useful when combined with preplant methods.

Inoculum is the pathogen propagule that can cause infection in vegetable crops. The amount of inoculum present is critical to the development and spread of disease. Monitoring provides producers with an initial assessment of the pathogen's inoculum; however, the production of further inoculum is highly dependent on the environment. Environmental conditions that are conducive for pathogen development vary, but with proper identification, one can assess the risk of continued inoculum production. Many disease models and decision support systems (e.g., for strawberry) are available to evaluate disease risk based on environmental conditions. When determining the risk of further disease development, it is important to consider the environment and the likelihood that disease will continue to develop. Biological and chemical products are an important component of many disease management programs. These products provide postinfection management options; however, they should be integrated with all other techniques mentioned in this chapter. The efficacy of these products will vary depending on timing of the application and the physical mode of action of the product. Often these products will be more efficacious when applied early in a disease epidemic, before the pathogen has produced significant amounts of inoculum. All of these products should be used following recommended rates and application frequencies, and within all labeled requirements. It is important to consider the cost of these products and what average yield savings will equal the cost of a product application. In general, product application is costliest when there is no disease present or when a product does not affect the disease afflicting the crop. However, preventative applications can be beneficial, particularly when the disease risk is high. Thus, proper disease assessment is critical for any management strategy.

Three key factors for successful integrated pest management:

- ***Economics:*** successful programs are not only effective but also cost-effective.

- ***Diagnosis:*** proper disease identification is a critical first step to determining proper management.
- ***Disease risk:*** management strategies will be more effective in high-risk situations.

Summary

Successful disease management starts with assessing the economics of the cropping system and understanding the disease risk. Diagnosis of the disease is the first step in any management plan because it can affect the techniques that can be used in the current growing season as well as in the future. Many pre- and postplanting management techniques that can be used to reduce disease risk are available to producers. Ultimately, integrated plant disease management strategies provide producers with the tools to obtain acceptable yields with adequate economic returns that are more sustainable than the results achievable with a single management method.

Detailed Source: https://edis.ifas.ufl.edu/pp111

Pest Management

The management and control of insect and mite pests can be challenging even under optimum conditions. Integrated pest management (IPM) is a useful approach for protecting vegetables from multiple pests. It involves integration of cultural, physical, biological, and chemical methods to maximize productivity in a way that is ecologically sound and safe. Often, but not always, it means limiting the use of broad-spectrum insecticides and miticides. IPM implies management of all crop pests, including insects, mites, diseases, nematodes, and weeds; however, only insects and mites will be considered here. Where possible, the effects of measures to control diseases and weeds should enhance or, at least, not interfere with the management of insects and mites.

Many of the general IPM principles and tactics that apply to the control of plant diseases apply to the management of insects and mites. These include regular scouting or monitoring for problems, identifying pests and their life stages, keeping good records of pest management practices, using exclusion techniques, practicing good sanitation, testing soil or plants for nutrients, using biological controls when possible, and using selective pesticides, properly timed and applied.

Crop Scouting and Monitoring

In order to detect pests and the damage they cause before a problem becomes serious, growers must visually inspect plants once or twice a week. As a first step, growers should observe the overall plant, looking for speckling or bronzing on leaves, holes and other damage caused by chewing insects, distorted growth, and fruit damage. The next step is to carefully inspect all plant parts from ground- or stem-level up to the growing tip. Some insects will feed on roots, others on stems, leaves, flower blossoms, and fruit. The grower must become proficient at quickly examining these plant parts and recognizing the presence of pests and the damage they cause. Workers engaged in cultural practices should be trained to recognize insects and the damage they cause.

Both the upper and lower leaf surfaces must be thoroughly inspected. Many insects, as well as some diseases, begin their infestation or infection from the lower side of the leaf. Many insects and mites only feed on the underside of the leaf and may never move to the upper leaf surface or other plant parts until populations become so great that overcrowding forces movement. Attention should be given to the midrib area under the leaf and along large, lateral, lower-leaf veins. The leaf axils, growing tips, and terminal buds should be carefully inspected. Often weeds serve as hosts for insects, mites, and diseases that can move to vegetable crops, and they should be removed (see section on Sanitation).

Some insects, particularly thrips, will be found within the blossoms, so these should be included in the inspection. Tap the blossoms over a white pan or card to see these tiny insects. The area under the calyx or stem end of tomatoes and cucumbers can also be an attractive hiding place for insects. Generally speaking, insects inhabit secluded areas of the plant that provide protection.

Yellow sticky traps are useful for monitoring the adult (flying) stages of many insects. Blue is more attractive to thrips, but yellow works well also. Traps are usually placed vertically at or just above the plant canopy. Some insects, such as thrips and leafminers, can be caught just above the surface of the growing medium. One recommendation is to use one to three cards per 1000 sq ft. Traps should be inspected weekly and replaced regularly. A system of numbered traps can facilitate sampling and simplify recordkeeping. Yellow sticky tape can be used on a larger scale to reduce insect populations by trapping. Yellow sticky traps and tape are available from many online distributors.

Many of the arthropod pests that infest vegetable crops are very small. Mites are 1/50–1/60 of an inch long. Thrips, aphids, whitefly crawlers, and the eggs of other harmful insects are not much larger. Growers should have at least a

10x hand lens (jeweler's hand lens) to examine, but a 16x–20x is preferred. With a hand lens, a grower can quickly identify many of the arthropod pests that are otherwise difficult to see. If possible, growers should buy and learn to use a common dissecting microscope. These microscopes can be purchased either as a monocular (one-barrel) or binocular (two-barrel) type. They have approximately 10x–200x magnification. With a microscope, a grower can see small mites, such as broad mites, and disease lesions clearly. This tool can be very helpful in detecting and diagnosing problems early.

Identification of Insects and Mites

Proper identification of insects and mites and the damage they cause is critical. If the grower knows exactly which pests are present, proper chemical or biological controls can be selected and steps taken to exclude or limit further introductions and spread. In Florida, UF/IFAS Extension offices in each county can help with pest identification (to find an office near you, visit https://sfyl.ifas.ufl.edu/find-your-local-office/). Workshops may be offered on pest scouting and identification, and many publications and online resources are available (see https://ipm.ifas.ufl.edu).

Recordkeeping

Good records can help growers see trends in pest infestations, keep track of the success or failure of control efforts, and determine how the environment affected the crop. Of course, pesticide application records are essential and should include the product name, EPA registration number, active ingredient, amount used, target pest, effectiveness, and the time and date of application. Some variables that general records should include are daily minimum and maximum temperatures, measurements of plant growth and development, the pH of the growing medium, soluble salts, general root health, and other specific crop observations. Insect counts from monitored plants and sticky cards are also useful for identifying trends over time and for determining the effectiveness of control efforts. Over several seasons, it may be possible to see that certain problems occur at the same time each year. Details of releases of beneficial insects and mites should be recorded.

Management Strategies and Tactics

Exclusion

Growers need to make every effort from the beginning of a crop until the final harvest to prevent the introduction of insect and mite pests into the vegetable crop. Highly reflective or metalized plastic mulches have been used in agriculture for many purposes, but the primary use has been to repel certain insects. Metalized mulches are effectively used in field production by covering the narrow raised beds in a full-bed polyethylene mulch production system.

Sanitation

Sanitation is closely related to exclusion and should be practiced for managing insects and mites as well as diseases. The following practices are strongly recommended:

- Burning, burying, or hauling away all leftover roots and other plant parts so that there is no chance that insects in the egg, larval, nymphal, pupal, or adult stages could remain in the greenhouse. Crop residues must be removed immediately after the final harvest.
- Sanitation must be practiced not only during preplant times but also throughout the growing period. Workers should immediately dispose of plant parts generated by pruning, such as leaves and stems. Culls (undesirable) or overripe fruit should be removed from the greenhouse and surrounding areas. Insects are often attracted to and can live for long periods on these plant materials.
- Weeds should not be allowed to grow around or within the greenhouse. A 10-to-30-foot vegetation-free zone around the greenhouse can be created with a heavy-duty geotextile weed barrier material typically used in the container nursery industry as a groundcover.
- A clean transplant program will aid in keeping pests out. Plants coming from other locations should be carefully inspected for insects, mites, and diseases and temporarily quarantined until it is clear that the plants are free of pests. Workers should avoid wearing yellow clothing because it is highly attractive to insects which may hitch rides into the greenhouse or from one greenhouse to another.

Biological Control

Biological control in the greenhouse environment means providing or releasing insect or mite predators, parasitoids (specialized parasites that ultimately kill their hosts), nematodes, or disease-causing organisms (fungi, bacteria, and viruses) that attack insect pests. Some biological controls cannot be used with most insecticides. Reducing or eliminating chemical pesticides leads to a safer working environment, can reduce production costs, and, in the case of organic production, can result in premium prices for the crop. Biological control, however, is much more management-intensive than conventional insecticides and

miticides; it requires a greater knowledge of pest biology and pest numbers. Many factors contribute to the success or failure of biological control: type and quality of the natural enemy selected, release rates, timing, placement, temperature and humidity, and the previous use of insecticides and miticides.

Suppliers can provide technical advice on the optimum use of their products. Some have detailed websites. In general, releases must be made when or before the pest population is first detected. High pest populations will be difficult to control biologically. Some predators and parasitoids are better adapted to particular temperature and humidity conditions than others, and some do better on some crops than others. The life span of the parasitoid or predator will determine how often it has to be reintroduced. It is important to note that if all the pests are eliminated, the natural enemies will also be eliminated. Providing nectar sources (flowering plants) may prolong the life of parasitoid wasps. Yellow sticky cards may have to be temporarily removed to avoid trapping predators and parasitoids.

Insecticides and Miticides

Even when a good biological control program has been established, there may be times when a conventional insecticide or miticide is needed. Biorational insecticides, such as insecticidal soaps, oils, neem products, and *Bacillus thuringiensis* (Bt) can be much less harmful to beneficial insects, although active against pest species. Systemic insecticides, insect growth regulators, and pheromones used for mating disruption also fall into this category. Some products are harmful to some stages of some beneficial insects and not others. Oils, for example, are toxic to lacewing eggs and adult parasitoid wasps, but they have relatively little effect on adult lady beetles and lacewings. Soaps are toxic to young lady beetle larvae. Neem and Bt products are generally safe for use with natural enemies. Other advantages of biorational insecticides are shorter reentry intervals and safety for workers.

Conventional insecticides and miticides also have a place in IPM if it is not feasible to use biological controls and if biorational insecticides do not offer sufficient control. However, these options are limited to only a few registered pesticides. The development of resistance to insecticides is more likely if a product is used repeatedly. Therefore, pesticides with different modes of action should be used in a sequence that will help prevent resistance.

The following steps are suggested when using any pesticide:

Step 1: Choose the right insecticide or miticide.

Only after the grower has properly identified the pest can the best insecticide or miticide be selected. Insecticides and miticides are sometimes effective against one pest but useless against other closely related pests. Also, one pesticide may be effective against a specific developmental stage, while others may be effective against a different stage, or even against all developmental stages. Properly identifying the pest and understanding its biology and life cycle allow the grower to make wiser decisions when choosing an insecticide or miticide. Growers should consult UF/IFAS Extension resources, pesticide companies and dealers, published literature, and, ultimately, the pesticide label for helpful information.

Step 2: Use the correct amount of pesticide.

After choosing the pesticide, the grower must carefully read the label to determine the correct amount to use. Sometimes this decision will be based on the size or stage of the pest and whether the population is high or low. For example, small caterpillars may require the lowest recommended label rate, while large ones may require the highest.

It is critical that the quantity of pesticide be accurate; growers should buy a set of graduated cylinders that are marked in ounces (oz) and milliliters (cc or mL), as well as a set of good-quality measuring cups. Plastic syringes (minus the needles) are very useful for measuring thick liquids, such as suspension concentrate (SC) formulations. These are available in several sizes from suppliers of animal feed. A scale is essential for weighing dry flowables, wettable granules, and other dry formulations. Measuring devices, such as graduated cylinders, should have pouring lips and graduated markings that enable accurate measurements. Plastic is generally safer than glass. Accurate measurement is essential for efficacy against the target pest, a safe range of pesticide residues on the crop, efficient use of chemicals and money, and the reduction or elimination of phytotoxicity (burning).

Proper measuring devices also play an important role in the overall safety and handling of pesticides. They aid in preventing spills of concentrated materials. Pesticide concentrates are usually handled when the sprayer is loaded and diluted sprays are being prepared. Special handling precautions are necessary at this time. The applicator must be particularly careful in handling finished sprays but even more so in dealing with the more dangerous concentrated

material. Workers must be mindful and cautious and use all pesticides according to the label.

If applicators use too much pesticide, the following problems can result:

- The crop can have more residue than the law allows, which can pose health hazards to consumers and could prevent the crop from entering the market until it has undergone special cleaning.
- The crop can be confiscated by authorities for excessive residues and destroyed without any compensation to the grower. Resulting negative publicity can harm the future markets for that commodity.
- Reentry by workers into overdosed areas could be dangerous and lead to illnesses, medical costs, and liability to the grower.
- Production costs could increase without the benefit of added profits.
- Phytotoxicity is more likely to occur.

It is important not to exceed the label rates. If the maximum labeled rate is not achieving the desired results, look for other reasons for failure, such as poor coverage or resistance to the insecticide in the target insect population.

Step 3: Apply pesticides at the right time.

The chosen pesticide should be applied at the correct time. This is one of the most difficult tasks any grower faces. Determining the best time to apply chemical control is a very dynamic undertaking. Failure to treat at or near the correct time is one of the major reasons for unsuccessful pest management.

- Growers should regularly and thoroughly inspect the crop so that they are aware of the presence of insects and mites as well as any increase in numbers.
- Growers should know the pest, its behavior, and its ability to damage the crop.
- Growers should be aware of the number of insects or mites that constitute an economic or action threshold. Thresholds for each pest where information is available are discussed later in this document.
- Growers should know the biology of the pest so that insecticide or miticide application can be aimed at the weakest, most vulnerable stage or size. Some stages of insects and mites, such as the egg stage, can seldom be controlled. Young larval or nymphal stages are more easily controlled and require less insecticide or miticide than older stages. Pesticides generally do not affect pupae (large larvae nearing this stage are also difficult to control).

It is generally best to apply pesticides in the late afternoon or evening hours when temperatures start to decrease. This also allows for maximum exposure before "airing" out the sprayed area for employees. Also, many insects are most active at night. The risk of phytotoxicity is greater when applications are made during the middle of the day when temperatures are high. However, it has been reported that better mite control can be achieved by spraying early in the morning hours. As a rule, insecticide or miticide applications should be made while temperatures are low. Pesticides should not be applied when plants are water-stressed.

Step 4: Apply pesticides correctly.

There are many factors and components that add up to proper application of pesticides.

Timing is one of the most important steps in pest control efforts. It does little good to complete the first three steps properly and then fail to deliver the material to the target area at proper time. Spray equipment must be properly calibrated. A calibration mistake can result in applying too little pesticide and not achieving control, or applying too much, which is wasteful and illegal.

Growers should purchase the proper type of equipment to meet the needs of the operation and use equipment designed for the target pest. Each pest differs in habits and behavior, and a single piece of equipment may not meet all needs.

High-volume sprayers are popular and have been used for years. They can accommodate a wide range of pesticide types and offer flexibility in their operation. However, high-volume sprayers require a great deal of labor, are time-consuming to use, and are considered to be low in application efficiency. It has been estimated that less than 10% of the active ingredient reaches the actual target when using high-volume systems. However, most insecticides and miticides are labeled for high-volume application.

For best results, knowledge about the pest and its biology should be coupled with the capabilities of the equipment. To reach the bottom sides of the leaves in thick canopy crops, a driving, directed spray may be required. If the crop canopy is thin, a rolling fog, atomizer, or electrostatic applicator may be very effective. Many insecticides can produce vapors that aid in controlling insects even when

the coverage is less than desired. However, proper coverage can further enhance their fumigating properties.

Another consideration when correctly applying insecticides and miticides is the proper maintenance of spray equipment. Many spray operations are hampered and their effectiveness drastically reduced because the spray cannot be delivered at the proper pressure, droplet size, or pattern due to excessive wear, improper adjustment, or broken or improperly working parts. Growers should regularly check nozzles and discs for wear and tear and replace them when they do not meet specifications. Discs and nozzles wear fast when flowables, suspensions, and wettable powder formulations are used. Workers should be aware of spray pressure and have accurate gauges. Inaccurate pressure—even small errors—can result in improper droplet size and failure to deliver the desired coverage. Equipment upkeep also factors heavily in the overall success of spray operations. Most insecticides are highly corrosive and will react with hoses, lines, nozzles, tanks, and other components. The resulting corrosion affects the spray patterns and leads to the formation of foreign particles that clog the equipment. Applicators should use the spray as soon as it is mixed and thoroughly clean and rinse the equipment as soon as they are finished spraying.

Workers must mix only the spray that is needed for the job. Leftover spray allowed to sit in the sprayer can quickly destroy it and other sprayer parts, lines, and components. Leftover spray also must be carefully and legally disposed of by application to a labeled site. Disposal of pesticides is a growing concern, with liability becoming more of a problem. Therefore, growers need to plan carefully for the amount of pesticide they need, use what is mixed, and clean up properly afterward.

Spray equipment must be properly stored after cleaning to keep it free of dust, dirt, and other foreign materials. Rust particles, pieces of rubber lines, and other unwanted particles can quickly stop up a system or cause poor spray patterns, particularly when pressure is applied.

Clean water should be used for spraying. Water is the most commonly used diluent (carrier) for pesticide sprays. Water frequently contains dirt, sand, or corrosion from the pipes or lines that may enter the spray tank. Loading hoses or pipes can be dirty. These contaminants can cause severe operational problems. Growers should filter water as many times as possible to ensure freedom from contamination. Filters should be used between the source of water, the spray tank, and where the water enters the tank. Filters are also needed between the tank and the final nozzle. This allows the spray to flow and be delivered in the pattern needed to meet the capabilities of the equipment.

Pesticides should be used as soon as they are mixed. Once mixed with water, the pesticide begins to change. The effective life of certain pesticides can be only hours once they are mixed with water. Water with a pH over 7.0, which is neutral, can be particularly detrimental to many pesticides. Generally speaking, the higher the pH, the faster the pesticide is broken down and rendered useless. Under Florida conditions, where underground water is frequently high in calcium carbonate with resulting water pH of 8.0 to 8.5, it is even more important not to allow finished spray to sit any longer than necessary.

Weed Management

Weeds compete with vegetable crops for light, water, and nutrients. This competition decreases plant vigor, yield, and crop quality. It also interferes with hand harvest and can complicate or prevent machine harvest. Weeds also serve as alternative hosts for diseases, viruses, and nematodes. EDIS documents with lists of weed hosts for viruses and plant pathogens include ENY863, *Common Weed Hosts of Insect-Transmitted Viruses of Florida Vegetable Crops* (https://edis.ifas.ufl.edu/in931), and HS1335, *Weeds as Reservoirs of Plant Pathogens Affecting Economically Important Crops* (https://edis.ifas.ufl.edu/hs1335). There are also a range of books and EDIS documents that can help identify weeds in Florida, such as *Weeds of the South* and *Weeds of the Northeast*.

The first step in weed management is frequent and proper scouting. Fields should be scouted frequently early in the production year when the crop is more susceptible to competition. Keep in mind that weed populations tend to be patchy, are greater along the edges of fields, and will vary within and between fields due to small changes in site characteristics, such as increased soil moisture or changes in soil type. Scouting should be completed in a zigzag pattern that covers the entire field area. Be sure to include locations with known differences that might lead to increased weed incidence, such as low-lying areas and areas with a history of weeds. All observations should be recorded in a field manual for future reference.

Proper identification and an understanding of the life cycle is important for selecting the correct method and timing of weed control. Weeds may be annuals, biennials, or perennials. Annual weeds emerge from seed, grow, and flower within a single year. Summer annuals emerge in the spring and grow through the heat of the summer months. Summer

annuals include pigweed, morning glory, crabgrass, pusley, and goosegrass. Winter annuals emerge during the fall and grow during the winter months. Biennial weeds emerge from seed and typically form rosettes but do not flower and produce seeds until after a dormancy period. Biennial weeds include wild carrot, cutleaf evening primrose, and common mullen. Perennial weeds can grow and produce flowers for multiple years. Perennial weeds produce vegetative structures, such as stolons, rhizomes, tubers, or large roots, that generate new plants. Perennial weeds include nutsedge, Bermuda grass, Brazil pusley, and creeping beggarweed.

Weed management practices can be separated into five categories: preventative, cultural, mechanical, biological, and chemical. The most successful weed management programs will incorporate more than one type of weed control.

Preventative Control

The first step is site selection. Select a field with low weed populations and treat problem areas, such as poor drainage, prior to crop establishment. Control or mow the weeds at the edges of fields or irrigation furrows to prevent seed formation. Seeds can move on equipment, on wind, on animals, and in water, and they may spread throughout the field. Weed seed can also move between fields on tractors, blades of cultivators, heads of harvest equipment, and other items. All equipment should be cleaned after completing a task in a field with a high weed population. When possible, limit travel in the field to periods when weed seeds are not mature, and when possible, work your cleanest fields first and move toward the ones with the greatest weed populations. Purchase crop and cover-crop seed from reputable sources to limit the amount of weed-seed contamination. When possible, prevention of weed seed production will help reduce weed seedbanks over time and reduce future problems. Keep in mind that seeds can mature on a weed in some situations after it has been hand-pulled.

Cultural Control

A healthy crop is a better competitor with weeds. Use healthy transplants or seeds with excellent germination to ensure quick canopy closure when possible. Plants stressed by diseases/nematodes or improper watering (too wet or too dry) are less competitive. Proper nutrition is important; minimize fertilizer in the row middles, where crops will not benefit but weeds will. Select the proper row spacing that will allow for quicker canopy closure.

Crop and variety selection has an impact on weed growth. Crops that are tall or have large leaves shade the soil surface and prevent weed seed germination. Crops such as cabbage, bean, and corn are very competitive crops. Onions and carrots allow more light to the soil surface and are less competitive. The same principle of light penetration to the soil surface can be applied to crop varieties—a variety that is compact or smaller in growth will be less competitive compared to other varieties.

Multiple vegetable crops are grown with polyethylene mulch. The horticultural benefits of plasticulture are reduced water loss, improved nutrient management, and increased fumigant retention. Plastic mulches also prevent light penetration to the soil surface and inhibit weed seed germination. Weeds can germinate under clear or white plastic mulches that allow light to reach the soil surface. If white mulch is desired, select one that has a black underside to prevent light penetration. When plastic mulches are used, grass and broadleaf weed emergence is limited to the crop hole and row middle. Minimizing the size of the planting hole can reduce the number of weeds that emerge. Yellow and purple nutsedge are the only species that pierce the plastic mulch and can rapidly spread within a mulched bed.

Crop rotation is an effective weed management tool. Growing the same crop repeatedly with the same weed management practices can select for difficult-to-control weed species as well as other pests and diseases. Properly designed rotations typically include a range of (1) crop types, preferably with a mix of row and agronomic crops; (2) planting dates; (3) agrochemical inputs; and (4) weed management tools. Choose a rotation based on crop competitiveness, use of mulch or cultivation, and different herbicide modes of action. The inclusion of cover crops can be an effective weed management tool. Care must be taken to observe plant-back restrictions for herbicides, or injury may occur in subsequent crops.

Cover crops should be included in any crop rotation. Cover crops shade the soil surface and prevent weed germination. Some cover crops such as rye have allelopathic compounds, which are plant chemicals that prevent seed germination. Additional information can be found under the Ask IFAS "Crops Management" topic (https://edis.ifas.ufl.edu/entity/topic/crops_management).

Mechanical Control

Mechanical weed control includes plows, cultivators, mowers, hoes, and hand-weeding. Chisel and moldboard

plows are used at the beginning of the season and cultivate deep into the soil profile. This process buries weed seeds below the germination zone. Light cultivation with a field cultivator controls small weeds by cutting them and is shallow to prevent weed seeds from being brought to the soil surface. A single cultivation provides excellent control of annual weeds; however, cultivation may break apart pieces of perennial weeds and cause the weed to spread. Repeated cultivation is important for perennial weed control because it encourages repeated growth and can reduce the carbohydrates in the storage structure of the weed, which can reduce the population over time.

Basket, tine, or finger cultivators lightly disturb the soil surface and control small weeds by breaking roots or foliage. Basket cultivators will provide control in the row middles; however, weed control in the crop row will be minimal (Figure 4). Tine or finger cultivators may provide better weed control in the crop row.

Use mechanical weed control only when it will be most effective because mechanical weed control degrades soil structure, dries the soil surface, and prunes crop roots.

Biological Control

Biological control relies on the use of one or more biological agents to damage a weed species. This method uses plant pathogens, insects, or other animals. Several control agents are host-specific, controlling certain weed species (e.g., tropical soda apple leaf beetle and tropical soda apple, Pakistani hydrilla tuber weevil and hydrilla). Because these organisms have narrow feeding habits, this method is typically used in natural and aquatic areas for a single invasive species. Biological control is not used in vegetable production due to the multiple weed species in the field; however, research is being conducted and new techniques may emerge in the future.

Chemical Control

Proper herbicide selection can be an effective weed control tool. Herbicides are classified by their mode of action, which is how they affect plant growth. Herbicides are separated by application placement, selectivity, and translocation.

Application placement includes foliar-applied or soil-applied herbicides. Foliar-applied herbicides control the weeds after emergence above the soil surface (postemergence). Proper coverage of the foliage is important for foliar-applied herbicides, and a surfactant is often required for proper absorption of the herbicide. Soil-applied herbicides control the weeds before emergence above the soil surface (preemergence). Soil-applied herbicides are applied to the soil surface or require incorporation into the soil surface. Incorporation reduces vaporization of certain herbicides or places the herbicide closer to the weed seed. Incorporation tactics include irrigation, rainfall, or light cultivation. Poor incorporation will result in reduced efficacy.

Herbicide selectivity results in control of a specific type of weed, such as broadleaf or grass weeds only. Auxin herbicides (2,4-D, clopyralid) control broadleaf weeds only and thus are commonly used in grass crops or turfgrass. Carfentrazone and certain sulfonylureas have excellent control of broadleaf weeds and cause low to no injury to grass crops. Grass-only herbicides (clethodim, sethoxydim, fluazifop) control only grass weeds and can be applied over the top of broadleaf weeds.

Herbicides can be grouped as translocating or contact herbicides. Translocating herbicides (glyphosate, halosulfuron) move from the contact point to another part of the plant. This is important when controlling perennial weeds, which require root death for complete control. Contact herbicides (carfentrazone, paraquat) kill the area around the contact point; complete coverage is important for these herbicides.

Herbicide-resistant weed species have become more problematic. Paraquat-resistant American black nightshade, paraquat-resistant goosegrass, and glyphosate-resistant Palmer amaranth have been documented or observed in Florida vegetable crops. To prevent resistance, growers should incorporate nonchemical methods, rotate modes of action, use products with multiple modes of action, use correct rates, and maintain constant monitoring.

Nematode Management

Plant-parasitic nematodes are some of the most difficult pests or pathogens that growers in Florida face. They are hard to recognize, are often confused with other biotic or abiotic problems, and can cause total crop loss in many fruits and vegetables. This is especially true in Florida's warm and sandy soils, where nematodes, such as root-knot (*Meloidogyne* spp.) and sting (*Belonolaimus longicaudatus*), can build up rapidly to high and damaging levels. In Florida, much more than anywhere else, managing nematodes is not only an option but a must.

Life Cycle

Plant-feeding nematodes go through 6 stages—an egg stage, 4 immature stages, and an adult stage. Many species

can develop from egg to egg-laying adult in as little as 21 to 28 days during warm summer months. Immature males and females and adult males are long, slender worms. Mature adult females of some species, such as the root-knot nematode, change to a swollen, pear-like shape, whereas females of other species, such as the sting nematode, remain slender worms. Nematodes are too small to be seen without a microscope. It is believed the root-knot nematode survives from season to season primarily as eggs in the soil. After the eggs hatch, the second-stage juveniles invade roots, usually at root tips, causing some of the root cells to enlarge where the nematodes feed and develop. The male nematodes eventually leave the roots, but the females remain embedded, laying their eggs into a jellylike mass that extends through the root surface and into the soil.

Damage

Root-knot nematodes usually cause distinctive swellings, called galls, on the roots of infected plants. Infestations of these nematodes are fairly easy to identify: dig up a few plants with symptoms, wash or gently tap the soil from the roots, and examine the roots for galls. Gall size can vary significantly and depends on the crop and nematode species. On cucurbits and tomato, they can grow as large as 1 inch in diameter; on pepper, eggplant, and strawberry, they are always much smaller. On the roots of grasses and certain legumes, root-knot nematodes can reproduce without causing galling. The formation of these root galls reduces uptake of water and nutrients. Also, galls can crack and facilitate the entry of soilborne pathogens. Root-knot nematode galls are true swellings and can't be rubbed off the roots as can the beneficial, nitrogen-fixing nodules on the roots of legumes. Aboveground symptoms of a root-knot nematode infestation include stunted plants, wilting during the hottest part of the day (even when soil is moist), loss of vigor, yellowing leaves, and other symptoms similar to those associated with a lack of water or nutrients. Infested vegetable plants grow more slowly than neighboring, healthy plants, beginning in early to midseason. Plants produce fewer and smaller leaves and fruits, and ones heavily infested early in the season can die. Damage is most serious in warm, irrigated, sandy soils. Symptoms are often wrongly attributed to lack of fertilizer or water, soil insect or disease damage, or plugged drip tapes. In fumigated fields, nematode symptoms often show up at the bed ends when the fumigant rig was pulled up too early or inserted too late.

Root injury from other nematode species can produce aboveground symptoms similar to those from root-knot nematodes. However, the actual injury to the roots is more difficult to detect. Roots can be short and stubby-looking and have slightly swollen root tips, as can be the case with sting nematodes, or show dark spots or necrosis, which can be caused by lesion nematodes (as well as certain soil pathogens). In all such cases, nematode infestation should be confirmed by collecting soil and root samples and sending the material to a laboratory for positive identification.

Nematicides

Nematicides can be separated into fumigant and nonfumigant nematicides. Fumigants will be discussed in the next section in this chapter. Until recently, nonfumigant nematicides were either organophosphate or carbamate insecticides/nematicides, such as ethoprophos (Mocap), terbufos (Counter) and oxamyl (Vydate). Other similar nematicides, like fenamiphos (Nemacur) and aldicarb (Temik), are no longer registered due to their generally high toxicity and environmental risk. Recently, some new products—fluensulfone (Nimitz) and fluopyram (Velum)—have become available. These new nematicides are less toxic than the older nematicides, having a caution label instead of a danger label. They also more specifically target nematodes and should not be considered fumigant replacements. Unlike fumigants, which will control all or most soilborne pests and diseases, nonfumigant nematicides will only or mostly target nematodes, and additional measures need to be taken to manage soilborne diseases and weeds.

Whereas fumigants need to be applied several weeks before planting, nonfumigant nematicides are typically applied shortly before or at planting of the crop. In-crop (postplant) applications are allowed for Vydate, Velum, and most of the biological nematicides (see Chapter 19).

Crop destruction practices and using end-of-season nematicides or fumigants can also help to reduce nematode levels. Plant-feeding nematode populations in annual crops are always low at the start of the season because nematodes are dormant and often hiding in deeper soil layers, waiting for new roots to feed on. Populations will gradually increase during the cropping season and tend to be at their highest at the end of the crop.

Applying a nematicide at that time would likely kill nematodes at the peak of their population: while they are still active and feeding and are thus more exposed. Nematodes are much more difficult to target during the off-season, especially in the middle of summer in Florida, when they tend to move deeper into the soil waiting for the next crop to be planted. In such cases, deep injection of fumigants (about 18" deep) can be done to target nematodes hiding in

deeper soil layers; especially in heavily infested fields, deep injection can make a big difference (see Fumigant section).

Other Nematode Management Options

Ideally, nematode management should adopt a year-round approach, from seedling production, through field preparation and while growing the crop, to off-season nematode management. Nematodes usually are introduced into new areas with infested soil or plants. The first approach is to prevent nematodes from entering the field by using only nematode-free plants. To prevent the spread of nematodes, avoid moving plants and soil from infested parts of the field. Do not allow irrigation water from around infested plants to run off, because this also spreads nematodes. Nematodes can also be present in soil attached to farm equipment, tires, and boots.

Field preparation in Florida often includes soil fumigation. It can also include compost, manure, or other organic amendment applications. These may not directly kill nematodes but will stimulate soil biology and may increase nematode predators, parasites, and antagonists. Organic amendments also will increase the water- and nutrient-holding capacity of the soil, especially in sandy soils. Because nematodes will cause more damage to plants that are water-stressed, this can lessen the effects of nematode injury without actually reducing levels of damaging nematodes. During the growing season, biostimulants, compost teas, and other organic materials can be applied as well and may help for the same reasons.

For certain crops, such as tomato, cultivars resistant to root-knot nematodes are available, and they have been shown to provide good protection against most root-knot nematode species in Florida. Although even resistant tomato varieties can still exhibit some root galling under high nematode levels, they usually maintain their yield. An additional benefit of growing a resistant variety is that the nematode levels in the soil decline rather than increase, making it more feasible to grow a susceptible crop the following season, i.e., a double crop.

Growing a crop on which, the nematode cannot reproduce is a good way to help manage some nematodes. Unfortunately, rotation is not as easy for managing root-knot and sting nematodes, because so many vegetable crops and weeds are hosts for these nematodes. However, if a rotation schedule can be found, rotation in combination with fallowing and other available practices can reduce root-knot nematode numbers. Annual crops that are useful in a rotation plan for reducing root-knot nematode populations include small grains and resistant tomato varieties. Fallowing is the practice of leaving the soil bare; it tends to be more effective when the soil is kept moist, which induces nematode eggs to hatch and emerging nematodes to starve because there is no food source. It is also important to control weeds on which nematodes can survive during the fallow period. During the off-season, frequent tillage can also reduce nematode populations by bringing nematodes to the surface and exposing them to the sun. Solarization, covering the soil with clear plastic for 4–6 weeks, is another method that can be used, although nematode control tends to be limited to the upper soil layers.

Cover crops are always a good tool to include in a nematode management plan. Cover crops can have multiple benefits, from soil improvement and weed suppression to disease and nematode control. Florida's climate allows for a wide range of cover crops to be planted. A common summer cover crop in Florida is sunn hemp (*Crotalaria juncea*), which not only fixes nitrogen in the soil but is also a poor host for many nematodes, including root-knot nematodes (there are several EDIS publications on cover crops and nematodes). Certain plants, such as marigolds (*Tagetes* spp.), also have direct nematicidal properties and could also be used in rotations or as intercrops.

Fumigation

Soil fumigation is a preplant chemical treatment of soil, using a pesticide product (typically a liquid) that converts to form a volatile gas once released into soil. The gas is able to diffuse through open pore space throughout the soil to provide pest and disease control. All of the fumigants are phytotoxic to plants, and the fumigant gases must dissipate from soil, usually taking from a few days to well over a month (depending on environmental conditions), before seeding or transplanting can occur without risk of crop injury. They are used globally on a wide range of annual and perennial crops and can be used alone or in combination to expand control of a wide range of soil-inhabiting pest species, including various insects, nematodes, fungi, and weeds. Because of their wide range of pesticidal activity, they are often called "multipurpose" or "broad-spectrum" fumigants.

In Florida, soil fumigants are most commonly used in high-value cropping systems to protect investment in crops where pest pressure is so high that it would be economically unfeasible to grow a crop without the use of a fumigant. As such, preplant soil fumigants have had a profound influence on production agriculture in Florida and have catalyzed the development of many high-value, raised-bed, and

plasticulture cropping systems. Fumigants are also used in a variety of other lower-value fruit, vegetable, and agronomic crops such as potatoes, sweet corn, brassicas, melons, and other cucurbit crops to manage nematodes and other soilborne pests and diseases. In some cases, fumigants have been adopted almost to the exclusion of all other soil pest management strategies because of their superior broad-spectrum pest control efficacy and consistent enhancement of crop growth, uniform development, fruit quality, and yield.

Methods of Application

Fumigants are formulated and applied to soil in a number of different ways. Liquid fumigants can be applied either by directly injecting them into the soil using shanks or chisels or via direct injection into the irrigation system (drip fumigation). The portion of the field that is fumigated can also vary. For example, in the production of some crops, the entire field is treated, and this represents an overall or broadcast treatment. In other situations, fumigants are only applied in the plant row or raised plant bed. In this situation, only a portion of the field is treated; this is termed a strip, band, or in-row treatment. Most liquid fumigants with high vapor pressure are shanked or knifed into the soil. As liquids with relatively high vapor pressure, they are usually stored and applied as liquids (under pressure) and begin to vaporize shortly after injection in the soil. Narrow knifelike shanks are tractor-drawn through the soil at the required depth to inject the fumigant into soil. Metal delivery tubes attached to the trailing edges of the shanks provide the conduit for injection to soil. Delivery tubes release the fumigant in the bottom of the furrow made when pulling the shank through the soil. Fumigant flow rate to the soil shanks is regulated using various combinations of pressure, metering valves, nozzle orifices, shank spacing, and speed of travel. Errors in field application are typically attributed to mistakes in calculation of treated acreage, metering, and calibrated flow rates through properly sized delivery lines.

For many of the fumigants, a special EC (emulsified concentrate) formulation is required for drip application. Metam sodium, metam potassium, allyl isothiocyanate, and emulsified concentrate formulations of 1,3-dichloropropene, chloropicrin, and dimethyl disulfide can be metered and applied through a low-volume trickle or drip irrigation system. Drip fumigation (chemigation) is the most common method of application for some fumigants like metam sodium, metam potassium, or allyl isothiocyanate. Once these fumigants are applied to soil in the presence of water, they decompose to form MITC or AITC. Because of the slow and limited diffusion of MITC or AITC gases and high affinity for the water phase, continuous delivery in irrigation water following premixing has generally resulted in more uniform soil distribution with enhanced nematode control and crop yield for these products when compared with conventional chisel injection methods. MITC distribution in soil initially follows the water distribution patterns, but unlike with other fumigants, the distribution patterns do not change over time. Moreover, MITC and AITC disappear from the soil gaseous phase at faster rates than most other fumigants.

The proximity of the plant to the drip tube has also been demonstrated to be very important in defining pest control efficacy and plant growth response with a drip-chemigated fumigant. Given the sandy nature of most Florida soils, narrower bed widths, drip tubes with closer drip emitter spacing (mostly in the range of 8–12 inches), and planting practices that place plants closer to the drip tube are needed to more effectively utilize the drip tape for chemigational purposes.

Soils and grower production practices differ markedly, and these differences in soil type, compaction, and depth to restrictive layers can all affect water movement and the final distribution of chemicals within beds and soil profile. The presence of a shallow compacted traffic layer severely restricts downward penetration of drip water and fumigants contained within it. In general, the average depth, width, and cross-sectional area wetted by drip-irrigation water increases with total water volume applied. For a given water volume, the use of two tapes per bed increases spatial distribution of irrigation water simply because of the spacing between drip tubes and the increased number of emission points along the bed. Drip fumigant users are encouraged to consult with county agricultural Extension personnel regarding specific drip fumigation recommendations on delivery system, application rates, product concentrations in irrigation water, water volumes, and optimal injection periods to maximize movement and proportions of treated bed volumes for their farm locations.

Other formulations, like those marketed for shank applications of chloropicrin, dimethyl disulfide, and 1,3-dichloropropene, are premixed and sold in compressed gas cylinders. In most cases, these fumigants are shank-injected into the soil 8 to 15 inches deep using a positive-pressure closed system in which the fumigant cylinders are pressurized with nitrogen. Nitrogen is an inert gas used to propel liquid flow from the cylinder through the metering systems and through armored lines to the rear shanks or chisels, exiting through a steel delivery tube welded to the back side of the

shank or chisel. Deep placement is not only a requirement of the fumigant label but is essential for prolonged fumigant retention in soil. In general, the closer to the soil surface a fumigant is applied, the faster the outgassing or escape from soil, and in general the poorer the pest control response. A plastic polyethylene tarp may be laid down over the soil immediately behind the injection equipment to provide a diffusion barrier for containment of the fumigant.

Recent studies have demonstrated the barrier properties of a traffic pan to shank-applied fumigants. The traffic pan is a layer of compacted soil occurring just below the level of deepest tillage implement used in the field. Fumigant gases applied above the traffic pan do not provide control of nematodes occurring below the traffic pan. Recent studies have determined that high population densities of plant-parasitic nematodes can be broadly distributed to depths 3 feet below the plant bed surface. Subsequent studies have demonstrated the importance of deep shank fumigant applications, which destroy the traffic pan and place fumigants within deeper soil horizons, where upwardly mobile nematodes reside. The physical and practical challenge that remains to be resolved is how to achieve fumigant movement in lethal concentration to the lowest soil depths where nematodes reside.

The Importance of Fumigant Placement

Proper fumigant placement is another critical element that must be considered when using any of the different soil fumigant compounds, because of the large difference in vapor pressure (Table 1). In some instances, application depth and placement varies with the formulation of the fumigant product, giving the grower the opportunity to choose between a drip or shank application. For the 3-Way system approach that utilizes 1,3-D, chloropicrin, and metam, there are essentially three different locations to consider for fumigant placement. Placement of pre-bed applications of Telone II are made on the flat to a soil depth that places the fumigant 12–15 inches from the top of the bed or nearest soil interface. If fumigants are placed at this depth and used in conjunction with a seepage irrigation system, growers should ensure that the soil is not wet at this depth. Otherwise, poor nematode control and longer aeration times and crop plant-back intervals may be observed. Chloropicrin, applied over the top of the Telone treatment, is then applied 8 to 10 inches deep into soil as the beds are being formed and compressed. Metam sodium (Vapam) or metam potassium (K-Pam) should be applied 4 inches from the top of the bed and 4 inches apart using multiple coulters or shanks. After application, the bed must be recompressed and mulched immediately to prevent rapid escape of volatilizing gases. The primary objective for such shallow placement is to achieve maximum control of weeds. Most other fumigants should be placed 8–12 inches deep with shanks no further than 9–12 inches apart.

While methyl bromide rapidly diffuses as a gas across a bed, many of the currently proposed alternatives lack the vapor pressure or chemical properties to move as fast and effectively throughout the bed. Their movement in the bed is clearly limited and must be accounted for in fumigant placement. For example, if the shanks are not close enough together for some fumigants, an overlap in the area between shanks may not occur, leaving streaks of pests down the length of the bed. Many products are formulated for shank or drip applications. To maximize efficacy via drip application, proper placement of the fumigant generally mandates two drip tapes per bed to improve bed coverage.

The vertical and horizontal distribution of diseases, weeds, and nematodes in correlation with spatial movement of soil fumigants from their points of injection are now being considered as some of the primary causes of fumigant treatment inconsistency and origins of bed-recolonizing populations of pests. For example, current field research is demonstrating that additional streams of fumigant placed under the tuck areas of the plastic mulch at the bed shoulders results in a significant reduction of Fusarium wilt incidence and severity within the tomato planted row compared with the standard in-the-row grower application practice. Additional streams of fumigants deeply shanked below the mulch-covered plant bed and traffic pan are also demonstrating significant reductions in plant damage by nematodes and improvements to crop yield.

In most field surveys, a compacted zone (traffic pan) occurs just below the base of the raised bed. The presence of subsurface traffic pans (a dense, highly compacted soil layer) was shown to unavoidably cause changes in the downward percolation of water, permeability and diffusion to fumigant gases, and root penetration into soil. In practical terms, the compaction zone occurs just below the depth of the deepest tillage operation or implement used in the field. Other fumigant placement studies are showing the benefits to crop production of fumigants placed under the traffic pan: this placement allows fumigant gases to make contact with deep-dwelling nematodes within the field. Because the traffic pan almost completely restricts downward diffusion in soil of a fumigant when it is applied above the restrictive layer, application below the layer reduces damaging populations of nematodes, which would have otherwise survived the fumigant bed treatment.

Physical and Chemical Properties

After application, the fumigants penetrate the soil and quickly become partitioned in liquid, gas, and adsorbed soil phases. Immediately after soil injection, fumigant movement in soil is driven by density and pressure gradients from a narrow, linear band of concentrated product deposited directly below the chisel path. As the fumigant's partial pressure falls, soil movement via mass flow becomes less important than simple gas diffusion processes. Fumigant persistence, volatility, and degradation are influenced by many factors, including chemical properties, soil properties, and environmental conditions. A partial listing of some of the physical and chemical properties of the primary soil fumigants available in Florida is provided in Table 1.

Volatilization continues as long as the fumigant remains in soil and upward movement of the fumigant occurs as long as a concentration difference exists between the soil surface and soil atmosphere. Vapor pressure is a measure of the tendency of a fumigant compound to change into the gaseous or vapor state. The temperature at which the vapor pressure at the surface of a liquid becomes equal to the pressure exerted by the surroundings is called the boiling point of the liquid. The lower the boiling point, the more volatile the fumigant compound. Note the differences between methyl bromide and all the other fumigants listed. Hot and dry soil conditions favor more rapid escape of fumigants like methyl bromide and chloropicrin, particularly within surface soil horizons. Fumigant products with high solubility and low vapor pressures are typically better suited for drip application rather than shank, which is why metam sodium, potassium, and allyl isothiocyanate are described as being better suited for drip fumigation.

Mode of Action and Lethal Dose

Fumigant mode of action refers to the lethal action of a chemical on vital life processes of an organism. For example, a broad-spectrum fumigant can penetrate the body wall of a nematode directly and does not have to be eaten to be effective. Once inside the body cavity of the nematode, different internal organs are affected, because they are bathed by body fluids containing the fumigant compound. Metam sodium and potassium are very soluble compounds that become activated in water. The fumigants and their products interfere with many different vital processes, including enzymatic, nervous, and respiratory systems. Death of the nematode is rapid under these conditions, and development of tolerant or resistant populations of nematodes to the chemical is unlikely because so many integral bodily functions are simultaneously affected. This is not to say that all organisms are equally affected, because in fields with a history of repeated applications, metam sodium can disappear rapidly and fail to provide a lethal dose following application, indicating the key role of microorganisms in accelerated degradation of the product. In general, however, the fumigant concentrations within internal body fluids of nematodes frequently reach equilibrium with soil concentrations within about 30 minutes to 4 hours. In some cases, fumigant concentration may accumulate to much greater levels within the nematode than in soil.

In general, the lethal effect of a fumigant is determined by two components. The first is concentration (C) of the fumigant in soil air or soil solution, usually expressed as parts per million (PPM). The second is the length of time (T) the pest organism is exposed, expressed in minutes, hours, or days. The level of pest control is then related to dosage, the amount of fumigant pesticide placed in the environment of the soilborne pest for a known length of exposure time (concentration × time). Total exposure is the sum of CT products. Computed in this way, the cumulative dosage, or concentration-time index (CT), is often used as a criterion with which to evaluate the effectiveness of soil fumigation. For most organisms, there is a concentration level below which kill is not obtained regardless of the length of exposure. For most nematodes, long exposures to low concentrations of fumigant nematicides above the minimum concentration seem to be more effective than short exposures to higher concentrations.

Fumigants move through soil air, dissolve in the soil water and kill in the soil water. Fumigants are volatile substances and change into gases upon injection into the soil as liquids. The vapors can only move through continuous soil air space. Pest and disease organisms normally exist within surface films of water surrounding soil particle grains. Even as fumigants move through open air passages, fumigant molecules dissolve into these surface water films and establish a dynamic equilibrium, moving back and forth from the air to the water phase as the fumigant diffuses through the soil mass. The portion of the fumigant dissolved in the soil water establishes the concentrations responsible for the kill of most soilborne organisms.

In practice, fumigants are commonly injected through a series of uniformly spaced shanks into soil. As the liquid volatilizes, gases begin moving in mass flow, diffusing outward in all directions from the point of injection. Because diffusion is greater in air above the soil surface, upward mass flow and diffusion is usually greater than downward movement, and much of the gas may escape the soil and enter the atmosphere. As the fumigant front moves through soil, gaseous molecules are adsorbed to

soil particle surfaces, redissolve into soil solution, and fill empty air spaces between soil particles. Maximum fumigant concentration decreases, as do the sums of CT products, with distance from the point of injection. Eventually, with time and distance, concentrations fall below an immediate killing level. The number of pests or disease propagules killed by fumigant treatment within these areas depend on the number of CT units that develop within the fumigant treated zone. The relationship between fumigant application rate and pest control efficacy is therefore not only a measure of fumigant toxicity but of chemical dispersion as well. If dispersal is good, increases in fumigant application rates will result in higher CT values and provide control to a greater soil volume. If dispersal is poor, increases in application rates will not provide control to a larger soil volume. Reducing volatilization losses from soil is an effective way to increase CT values and improve fumigant pest control efficacy. It is for this reason that water seals and impermeable plastic mulches (VIF, TIF) are used to increase fumigant diffusion resistance near the soil surface. This serves both to promote downward diffusion of the fumigant and to enhance residence time and gas phase persistence in soil.

Pest Control Efficacy

Since their introduction to Florida agriculture, many different soil fumigants have been evaluated in field research trials to characterize pest control efficacy and crop yield response. The results from many of these research trials, particularly those to evaluate methyl bromide alternatives, have provided the basis for overall generalization of pesticidal activity for the various fumigant chemicals (see Table 2). In general, this research has repeatedly demonstrated methyl bromide to be very effective against a wide range of soilborne pests, including nematodes, diseases, and weeds. Chloropicrin has proved very effective against diseases but seldom nematodes or weeds. Although fumigants provide some bacterial pathogen suppression, they have not been satisfactorily controlled by any of the soil fumigants. Historically, most of the research conducted to evaluate 1,3-dichloropropene (Telone) has repeatedly demonstrated consistently effective nematode control with little or no control provided for soilborne disease or weeds. Metam sodium, metam potassium, and Dazomet are all nonselective preplant soil fumigants that provide measures of fungicidal, herbicidal, insecticidal, and nematicidal activity. Pest control efficacy of metam sodium and metam potassium has proved inconsistent, earning good to excellent ratings in some trials, but poor in others. Field research continues to evaluate modification of rate, placement, and improved application technology to resolve problems of fumigant inconsistency with these compounds. Metam sodium and metam potassium can provide good control of weeds when placed properly in the bed; however, research to evaluate modification of rate, placement, and improved application technology have not resolved all problems of inconsistent pest control. Dimethyl disulfide (DMDS) has demonstrated good to excellent control of nematodes, disease, and weeds when coapplied with chloropicrin, but as of 2020 the product is no longer registered in the US. AITC, the newest entry to registered fumigants in Florida, has shown promise in preliminary trials but is still under field assessment in a variety of crops and plant pathogens.

Because of their target pest specificity, many of the soil fumigants are formulated together or coapplied to increase their overall level and spectrum of pest control. For example, chloropicrin is used both as a stand-alone soil fumigant, as a chemical warning agent in formulation with methyl bromide, and in formulation with 1,3-D to increase its disease control effectiveness. Examples of coformulated or sequential application include 1,3-dichloropropene plus chloropicrin formulated together as Telone C17 or Telone C35, or sequential applications involving a broadcast or pre-bed application of 1,3-dichloropropene, followed later by chloropicrin and/or metam sodium in separate soil applications. Given the general lack of herbicidal activity associated with many of the fumigants, separate application of one or more herbicides may be required to achieve effective weed control.

Much of the current field research in Florida continues to focus on evaluations of chloropicrin coapplied with additional fumigants. In this coapplication approach, chloropicrin has clearly been shown to be an integral foundation component of any alternative chemical approach to providing broad-spectrum pest control activity. Of the chloropicrin combinations, Telone C-35, a combination of 1,3-dichloropropene and 35% chloropicrin, has been the most extensively evaluated in Florida field trials since 1994. DMDS in combination with chloropicrin (21%) has also been extensively studied in west central and south Florida field trials and has proven very effective for soil pest control. All DMDS formulations and applications now require that Totally Impermeable Film (TIF) be used for field application and odor abatement.

Research conducted in Florida and areas of the Southeast appear to support the general conclusion that reasonably consistent soilborne pest and disease control can be obtained with in-row or pre-bed applications of Telone C35 (35 gal/A) or Telone II, applied at 12 gallons per treated acre, followed by chloropicrin applied in the bed at 150

pounds per treated acre. In combination with Telone II, Telone C35, or chloropicrin, use of a high barrier or Virtually Impenetrable Film (VIF) or totally impermeable mulch film will generally improve fumigant performance and reduce soil gas emissions. Currently, the EPA only recognizes use of specific high-barrier VIF or TIF mulch films where the film's permeability (mass transfer coefficients) to the different fumigant gases has been measured and meets EPA-approved emission reductions to qualify for buffer-zone-reducing credits. With use of the more impermeable plastic TIF or VIF mulches, fumigant rates can be reduced 25% to 40% from maximum labeled application rates. Due to use restrictions for all Telone products in Dade County, either metam sodium or metam potassium at 75 and 60 gallons per acre, respectively, in combination with shank injections of chloropicrin (150 pounds per treated acre) and appropriate herbicide(s) are currently defined as the best alternatives to methyl bromide.

Given the general lack of herbicidal activity associated with the alternative fumigants, weed control is usually assigned the highest pest management priority for most methyl bromide alternative chemical systems. Regardless of crop, separate application of one or more herbicides is a requirement for effective weed control with any of the different fumigants. In general, weed control with these different fumigants (including Vapam or KPam) plus herbicides is reportedly as good as or better than with methyl bromide. There are, however, numerous examples of less than ideal herbicide performance in which various grasses and broadleaf weeds were not effectively controlled. The problems incurred usually demonstrate the importance of soil conditions, incorporation method, and proper rate calibration for good weed control.

Herbicide Partners

In addition to Telone II plus chloropicrin, Telone C35, or PicClor 60, additional applications of appropriate herbicides will be necessary to provide weed control for any CUE crop (Table 3). For tomato, follow the fumigant pre-bed application of Telone C35 or Telone II and chloropicrin with a tank mix of napropamide (2 pounds per treated acre) and S-metolachlor (0.95 pounds per treated acre); apply the tank to the top of the raised bed at plastic laying for weed control. An additional application of halosulfuron (0.024 pounds) as a postemergent, directed spray for nutsedge control may be necessary. For strawberry, the fumigant application of Telone C35 is supplemented by an herbicide tank mix of oxyfluorfen (0.5 pounds per treated acre) plus napropamide (4 pounds per treated acre) to the raised bed surface at plastic laying. (Note: a minimum 30-day interval is required before transplanting when using oxyfluorfen.) In pepper, an herbicide tank mix of napropamide (2 pounds) and S-metolachlor (0.71 pounds, 3rd party label obtained through FFVA) per treated acre is applied for weed control after the Telone II pre-bed and chloropicrin injection to the raised bed at plastic laying. Recent research on soil application technologies in Florida and Georgia have demonstrated improved nutsedge control with metam sodium or potassium applied through a series of minicoulters to the established plant bed just before installation of the plastic mulch.

Avoiding Plant Phytotoxicity

All the fumigants, including the gas and water phases of these fumigants, are toxic to plants. Soil dissipation and the persistence of toxic residues is strongly influenced by environmental conditions. Any change in soil condition that promotes a cooler and/or wetter soil condition will typically delay dissipation of a fumigant compound from soil. As a result, soil applications must always be made well in advance of a seeding or planting date to ensure sufficient time for dissipation of fumigant residues from soil. The problem is usually most severe with fumigants of low vapor pressure, where longer-term planning horizons must be adopted to avoid problems of phytotoxicity or to avoid long unscheduled delays in planting after the plants have arrived from the nursery. Growers who use fumigants typically adopt planning horizons that consider beginning field preparation and soil application two to three weeks earlier than normal. This early consideration helps growers avoid problems of potential phytotoxicity that may result from use of impermeable mulches or from unexpected cold fronts or storms producing abundant rainfall. Recent studies have also demonstrated that the addition of chloropicrin in the fumigant mix can destroy microbial populations in soil that digest fumigants like DMDS, thereby contributing to longer persistence in soil and potential delays in plant-back into the bed than would have occurred with DMDS alone.

High-Barrier/Gas-Impermeable Plastic Mulch Films (VIF, TIF)

Fumigant Containment

Historically, most of the field research conducted to evaluate the use of soil fumigation has repeatedly demonstrated effective soilborne pest and disease control when applications were made under optimal soil conditions, uniformly applied at the appropriate dosage and depth, and using containment systems that prevented rapid escape of gases

from soil. Any system designed to provide containment of fumigant gases must first ensure immediate closure and seal of chisel traces as they are produced behind the tractor moving across the field. Left undisturbed, the chisel traces act as chimney vents for volatilizing fumigant gases. This can be accomplished with press wheels behind the chisel or chisel injections immediately in front of bed-forming equipment. The treated field area may also be rolled to compact surface soil, so as to increase soil density and reduce air passage size and volume. Irrigation is also often applied over the top of the treated area and/or rolled surface to form a surface water seal to further inhibit fumigant outgassing from soil. In some instances, repeated irrigations may be necessary to manage fumigant containment and off-site movement of fumigant gases.

After a fumigant is applied, the treated soil may also be tarped with a plastic polyethylene mulch to provide an additional measure of fumigant containment to soil. The plastic mulches, often a prerequisite for fumigant use, are not only a barrier in themselves but also act as a condensation surface for the formation of water droplets, which redeposit to soil as a water layer, adding another barrier to soil volatilization loss. A range of different mulches can be used to reduce fumigant emissions from soil. Low-density polyethylene (LDPE) or high-density polyethylene (HDPE) tarps have been extensively used in combination with soil fumigation as a soil covering to reduce fumigant emissions from soil. Unfortunately, the barrier properties of LDPE and HDPE to fumigant gases is quite poor, and depending on the fumigant, much of it may quickly escape the soil. In general, the permeability of a plastic mulch to a fumigant gas is directly related to its thickness, density, and chemical composition. Significant resistance to fumigant outgassing has been achieved with use of virtually impermeable mulch films (VIF) and totally impermeable mulch films (TIF). VIF mulches are typically manufactured as multilayer films that are composed of barrier polymers such as ethylene vinyl alcohol (EVOH) or polyamide (nylon) sandwiched between other polymer layers (typically LDPE), or that have metallized coatings to reduce the amount of fumigant that can move through the film and into the atmosphere. A VIF film thus is typically defined as a 5-layer film where the outer two layers are LDPE. The innermost layer is nylon and is surrounded by a bridging layer on each side. TIF films are generally manufactured similarly to VIF, except the center layer that produces the barrier is made of EVOH instead of nylon.

Compared to LDPE, certain VIF and TIF films are over 20,000 times less permeable to fumigant compounds and, as a result, significantly increase the residence time of fumigants in soil. Because of their excellent barrier properties, fumigant application rates can often be reduced as much as 30% to 50% without loss of pest control activity or crop yield. These mulches, although not completely impervious to fumigant gases, reduce the dissipation rate of gases into the air, thus increasing the overall efficacy of the treatment by subjecting soil pests to greater cumulative dosage levels of the fumigant. With such efficient and near-complete retention of gases to soil, these same mulch films are known for causing plant-back issues, often requiring extended periods to allow for soil water and air concentrations to fall below levels phytotoxic to seedlings and transplants. To use the high-barrier mulch technology, plantings may have to be delayed to ensure soil residues have dissipated and plant injury will not occur. A monitoring program using colorimetric detector tubes (GasTek, Kitagawa, Sensidyne) or MiniRae-type VOC meters to assess residual fumigant gases in soil should be considered before a commitment to planting is made.

Due to increased environmental and regulatory scrutiny, VIF or TIF high-barrier plastic mulch films are now mandated for use with some fumigants to receive buffer-zone-reducing credits (20%–60%) to allow fumigant applications within certain proximities of human-occupied structures. They are also extensively used to allow for reduced-rate applications of the different fumigants without compromising concentration and time dosages, thereby maintaining pest control efficacy. Today, over a hundred different manufacturers or product lines can be identified with high-barrier, VIF, or TIF status with current EPA approval for buffer-zone credit. Additional information regarding EPA-approved tarps can be found at https://www.epa.gov/soil-fumigants/tarps.

Reduced-Rate Application Technologies

Currently, soil injection equipment for many of the different fumigant compounds is designed to dispense as much as 20 to 40 gallons of a liquid fumigant compound through armored lines from the gas cylinder to the flow meter and rear manifold, and then through each of three chisels per bed. The system is designed and calibrated to do this while moving at 3½ to 5 mph, uniformly dispensing multiple liquid streams of fumigant within 7,260 to 10,890 linear feet of row per acre. With such high rates, the flow lines are full, with liquids moving as continuous streams without in-line voids or bubbles. At 30% to 50% reduced rates of application, such as those demanded for use with high-barrier TIF or VIF film, the situation may be vastly different, particularly if metered flow rates are low and do not exceed the

total capacity of the delivery tubing and manifold system. With reduced flow and presence of bubbles or even voids in flow within lines, a significant loss of back pressure occurs at the chisel orifices. The dramatic fall in back pressure with reduced rate prevents accurate and uniform flow of the fumigant between chisels. This occurs at the point where total internal volume (flow capacity) of 9 chisel tubes, typically ¼ inch in diameter, exceeds the flow capacity of a ¾-inch armored delivery hose from the flow meter. When the outflow potential is greater than inflow, there is a significant loss of pressure, and without back pressure the system becomes one of gravity flow. With the existing on-farm systems, accuracy cannot be achieved at such low volumes and without significant back pressure. To resolve the back-pressure problem, it is extremely important to reduce total line volume and/or diameter of the delivery tubes from the manifold to the chisels so as to guarantee adequate back pressure at the point of fumigant release. With a high-barrier mulch, reducing the field application rate of a fumigant results in a greatly reduced rate of liquid flow. Some chisels are so reduced in flow that accuracy and uniformity of application along and between the rows was compromised along with pest control efficacy.

In all probability, use of these more gas-retentive mulches will require changes in field application and soil injection equipment to ensure accurate and uniform dispensing of such low fumigant application rates (10 to 15 gallons per acre). These required changes include smaller delivery tubing size (1/8- to 1/16-inch diameter), installation of sight gauges to monitor flow uniformity among chisel streams, and installation of a low-pressure gauge upstream of the flow divider to monitor overall back pressure (at least 15 psi) at the flow divider (Table 4).

Table 1. Physical and chemical properties of various soil fumigants.

Fumigant Compound & Physical State	*Boiling Point (°C)*	*Vapor Pressure (mm/Hg)*	*Soil Degradation Half-Life (d)*	*Solubility (mg L^{-1})*
1,3–Dichloropropene	120	28	3–5	2250
Chloropicrin	112.4	18	1–2	2270
Methyl bromide	3.6	1420	12–20	13400
Dimethyl disulfide (DMDS)	110	28.7		3000
Metam sodium	112	0.4	4–5	578290
Metam potassium	114	24	4–5	complete
Allyl isothiocyanate (AITC)	112	20		89400

Table 2. Generalized summary of maximum use rate and relative effectiveness of various soil fumigant alternatives to methyl bromide for nematode, soilborne disease, and weed control in Florida.

Fumigant Chemical[1]	**Maximum Use Rate**	**Relative Pesticidal Activity**		
		Nematode	**Disease**	**Weed**
Chloropicrin	300 lb	None to poor	Excellent	Poor
Metam sodium (Vapam)	75 gal	Erratic	Erratic	Erratic
Telone II	18 gal	Good to excellent	None to poor	Poor
Telone C17	26 gal	Good to excellent	Good	Poor
Telone C35	35 gal	Good to excellent	Good to excellent	Poor to fair
Pic-Clor 60	300 lb	Good to excellent	Good to excellent	Fair to good
Potassium N methyldithiocarbamate (Kpam)	60 gal	Poor to good	Poor to good	Poor to good

[1] All currently within EPA Fumigant Reregistration review with potential for new restrictions and applicator requirements.
[2] Broad-spectrum pest control achieved when coapplied with chloropicrin (21% wt./wt.), the product is no longer available in the US as of 2020.

Table 3. Recommended fumigant and herbicide treatment regimens for Florida1 fruit and vegetable growers for fields in which nematodes are considered a major pest. All rates are expressed per treated acre. Other pre- and postemergent herbicides may be required for weed control. To achieve maximum weed control an application of metam sodium (Vapam®—75 gal/A) or metam potassium (Kpam®—60 gal/A) should be considered as a supplemental herbicide treatment using a minicoulter applicator or through a drip application using double drip tapes.

Fumigant Product, Rate, Application Sequence and Procedure		***Possible Supplemental Herbicide***	
Broadcast	**Pre-bed**		**In-Row during Bedding**
Deep Shank Telone® II (12–15 gal/A) (12–15" deep) *Applied to the flat and soil sealed with tillage and rolling.*	-	Telone® C35 (35 gal/A) ***or*** Pic-Clor 60 (300–350 lb/A) ***or*** Chloropicrin(150 lb/A) *Applied in-bed under LDPE, High-Barrier VIF or TIF Mulch Film*[3]; applied 3–5 weeks before transplanting	Napropamide (Devrinol®) S-metolachlor (Dual Magnum®) Postemergent halosulfuron (Sandea®) Oxyfluorfen (Goal®) Vapam® HL Kpam® HL
	Deep Shank Telone® II (12–15 gal/A) (12–15" deep) *Applied pre-bed*[2] to the flat, under LDPE, High-Barrier VIF or TIF Mulch Film[3]; applied 3–*5 weeks before transplanting*	Telone® C35 (35 gal/A) ***or*** Pic-Clor 60 (300–350 lb/A) ***or*** Chloropicrin (150 lb/A) *Applied in-bed under LDPE, High-Barrier VIF or TIF Mulch Film*[3]; applied 3–5 weeks before transplanting	

[1] Crop recommendations for Pic-Clor 60, Telone® II,and Telone® C35 do not apply to the Homestead, Dade County production region of south Florida or where certain soil types, absence of impermeable layers, and water tables currently prohibit product use.
[2] Inject Telone® II, Telone® C35, or Pic-Clor 60 to flat soil prior to any soil mounding or bed operation (pre-bed) to a depth of at least 12 inches below the final bed top.
[3] In combination with fumigant, one must use an EPA-approved high-barrier, virtually impermeable (VIF), or totally impermeable (TIF) mulch film. Fumigant rates can be reduced 25% to 40% from the maximum pesticide labeled application rate, depending on the selected impermeable film.
For some crop uses of S-metolachlor®, a third-party label obtained through FFVA must be in the hands of the user.

Table 4. Summary of recommended fumigant injection equipment modifications required for use of high-barrier TIF and VIF mulches and reduced-rate applications of soil fumigants.

(1) Replace tubing from manifold to chisels with smaller-diameter poly tubing to compensate for the new reduced flow capacity requirement and to increase line back pressure needed to ensure accurate, uniform flow among all chisel streams.
(2) To the manifold-flow divider, install individual sight gauges to observe uniformity of fumigant liquid flow to each chisel outlet.
(3) Install a low-pressure gauge (0–30 psi) immediately upstream of the manifold or flow divider to insure at least 15 psi of back pressure.
(4) Ensure that the flow meter registers a minimum of 10% flow.

UF | IFAS Extension
UNIVERSITY of FLORIDA

CV301

doi.org/10.32473/edis-cv301-2022

Chapter 5. Ethnic Vegetable Production[1]

Guodong Liu, Bonnie Wells, Yuncong Li, Qingren Wang, and Johan Desaeger[2]

Ethnic vegetable production in Florida has shown great potential and contributed significantly to the market and diversity of the state's agricultural industry. More than 40 types of ethnic/Asian vegetables are commercially grown each year across Florida. In recent years, the increasing demand for these crops has resulted in a rapid expansion of Asian or ethnic vegetable production from northeast to south Florida. The acreage is rapidly increasing because of the demand and the niche market. Though availability, profitability, and competitiveness have increased, one of the concerns creating confusion between producers and consumers is that many of the ethnic vegetable crops have different names from different countries and cultures. Another concern is that, for many of these crops, there are no science-based production recommendations available for Asian or ethnic vegetable producers to follow. This unavailability of recommendations may limit the production of these crops as local growers attempt to determine crop requirements with limited guidance. However, before specific recommendations are developed for these specialty crops, ethnic vegetable growers should follow recommendations that are available for crop species closely related to these Asian or ethnic vegetables. This is especially important for pest control and pest management because it is usually very difficult to find pesticides labeled specifically for certain Asian or ethnic vegetable species.

The objectives of this publication are to (1) provide various names of some ethnic/Asian vegetable crops with EDIS publications available to readers; (2) list related chapters in this handbook, which provide recommendations for crops close to these ethnic vegetables grown in Florida; and (3) list EDIS publications currently available for these crops. We strongly encourage growers of ethnic vegetables to follow the UF/IFAS recommendations for closely related crop types or species until UF/IFAS recommendations for specific ethnic vegetables have been established. In addition, some EDIS publications focusing on Asian or ethnic vegetable crops in recent years may be of help to relevant growers.

Web links for these EDIS publications are available for ethnic/Asian vegetable growers in Florida:

1. *Bitter Melon—an Asian Vegetable Emerging in Florida*. https://edis.ifas.ufl.edu/hs1271
2. *Bok Choy, an Asian Leafy Green Vegetable Emerging in Florida.* https://edis.ifas.ufl.edu/hs1337
3. *Chayote—a Potential Vegetable Crop for Florida*. https://edis.ifas.ufl.edu/publication/HS1454
4. *Chinese Mustard Cultivation Guide for Florida*. https://edis.ifas.ufl.edu/hs1402
5. *Daikon Radish Cultivation Guide for Florida*. https://edis.ifas.ufl.edu/hs1370

1. This document is CV301, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date July 2017. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Guodong Liu, associate professor, Horticultural Sciences Department; Bonnie Wells, Extension agent II, UF/IFAS Extension Brevard County; Yuncong Li, professor, Department of Soil, Water, and Ecosystem Sciences, UF/IFAS Tropical Research and Education Center; Qingren Wang, Extension agent III, UF/IFAS Extension Miami-Dade County; and Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; UF/IFAS Extension, Gainesville, FL 32611.

6. *Fingered Citron—A Fragrant, Ornamental Citrus Tree for Florida.* https://edis.ifas.ufl.edu/publication/HS1427

7. *Florida Cultivation Guide for Malabar Spinach.* https://edis.ifas.ufl.edu/hs1371

8. *Goji Berry—a Novel Nutraceutical "Superfruit" for Florida Master Gardeners.* https://edis.ifas.ufl.edu/publication/HS1391

9. *Leek Cultivation Guide for Florida.* https://edis.ifas.ufl.edu/hs1388

10. *Long Bean—an Asian Vegetable Emerging in Florida.* https://edis.ifas.ufl.edu/hs1268

11. *Long Squash—an Asian Vegetable Expanding in Florida.* https://edis.ifas.ufl.edu/hs1272

12. *Luffa—an Asian Vegetable Emerging in Florida.* https://edis.ifas.ufl.edu/hs1285

13. *Production Guide for Choy Sum—an Emerging Asian Vegetable in Florida.* https://edis.ifas.ufl.edu/publication/HS1380

14. *Production Guide of Vegetable Amaranth for Florida.* https://edis.ifas.ufl.edu/publication/HS1407

15. *Tong Hao—an Asian Vegetable Emerging in Florida.* https://edis.ifas.ufl.edu/hs1276

16. *Waterleaf, a Potential Leafy Vegetable for Florida.* https://edis.ifas.ufl.edu/publication/HS1434

17. *Yacon, a Potential Tuberous Crop for Florida.* https://edis.ifas.ufl.edu/publication/HS1435

Table 1. Common name and botanical classification for selected Asian or ethnic vegetables.

Vegetable Type	Common Name	Other Names	Family Name	Related Crop Grown in Florida
Root	Daikon radish	Long white radish, Oriental radish, white radish, winter radish	Brassicaceae (Cruciferae)	Radish (Chapter 15)
	Galangal	Galanga, galangale, laos, and blue ginger	Zingiberaceae	Unknown
	Ginger	Canton ginger, stem ginger, red ginger, ginger pop, Zingiber officinale, ginger ale, flavourer	Zingiberaceae	Unknown
	Lobok radish	Chinese radish	Brassicaceae (Cruciferae)	Radish (Chapter 15)
	Turmeric	Western ginger	Zingiberaceae	Root crops (Chapter 15)
Corm	Indian taro	Dasheen, yautia, eddo and kalo, giant elephant ear	Araceae	Unknown
	Yacon	Peruvian ground apple	Asteraceae	Unknown
Leafy	A choy	Taiwanese lettuce	Asteraceae (Compositae)	Lettuce (Chapter 9)
	Callaloo	Callalloo, calalloo, calaloo, kallaloo, Xian choy, amaranth, taro, Xanthosoma	Amaranthus (Amaranthaceae)	Lettuce (Chapter 9)
	Long napa	Peking cabbage, celery cabbage	Brassicaceae (Cruciferae)	Cabbage (Chapter 6)
	Malabar spinach	Vine spinach, red vine spinach, climbing spinach, creeping spinach, buffalo spinach, Ceylon spinach	*Basella alba* (Basellaceae)	Lettuce (Chapter 9)
	Napa	Napa cabbage	Brassicaceae (Cruciferae)	Cabbage (Chapter 6)
	Shalihon	Xue li hong, mustard green	Asteraceae (Compositae)	Lettuce (Chapter 9)
	Shanghai bok choy	Bok choy, pak choi, bok choi, pok choy	Brassicaceae (Cruciferae)	Cabbage (Chapter 6)
	Taiwan cabbage	Taiwan flat cabbage, Li Sun cabbage, flathead cabbage	Brassicaceae (Cruciferae)	Cabbage (Chapter 6)
	Thai Basil	Chi neang vorng, anise basil, licorice basil	Lamiaceae	Unknown
	Tong Hao	Tahn ho, Shungiku, crown daisy, garland daisy, edible chrysanthemum, garland chrysanthemum, chrysanthemum greens	Asteraceae (Compositae)	Lettuce (Chapter 9)
	Tossa Jute	Jew's mallow, bush okra, nalta jute, jute mallow	Malvaceae	Unknown
	U choy	Yu choy, Chinese greens	Brassicaceae (Cruciferae)	Cabbage (Chapter 6)
	Vietnamese coriander	hot mint, Vietnamese cilantro, phak phai, Cambodian mint	Polygonaceae	Unknown
	Wawa choy	Baby Chinese cabbage	Brassicaceae (Cruciferae)	Cabbage (Chapter 6)
Flower	Gailon	Chinese broccoli (Kale)	Brassicaceae (Cruciferae)	Broccoli (Chapter 6)
Fruit/pod	Chinese eggplant	Aubergine, brinjal	Solanum (Solanaceae)	Eggplant (Chapter 8)
	Fuzzy squash	Hairy gourd, fuzzy melon	Cucurbitaceae	Cucumber (Chapter 7)
	Indian eggplant	Brinjal	Solanum (Solanaceae)	Eggplant (Chapter 8)
	Kabocha	Japanese pumpkin, Kabocha squash, Kent pumpkin	Cucurbitaceae	Cucumber (Chapter 7)
	Lablab beans	Hyacinth bean, bonavist bean/pea, dolichos bean, seim bean, Indian bean, cluster bean	*Lablab purpureus* (Fabaceae)	Cluster bean (Chapter 11)
	Long bean, dark green	Asparagus bean, Chinese long bean, long-podded cowpea, yardlong bean	Fabaceae	Legume (Chapter 10)

Vegetable Type	Common Name	Other Names	Family Name	Related Crop Grown in Florida
	Long bean, white	Chinese long bean, haricot asperge, pea bean, dow gauk	Fabaceae	Legume (Chapter 10)
	Long squash	Po Gua, Poo Gua, Hu Gua, Opo squash, birdhouse gourd, bottle gourd, calabash gourd, hard-shelled gourd, dolphin gourd, long melon, opo squash, trumpet gourd, white-flower gourd	Cucurbitaceae	Cucumber (Chapter 7)
	Luffa	Loofa, Loofah, Chinese okra, angled loofah, dishcloth sponge	Cucurbitaceae	Cucumber (Chapter 7)
	Thai eggplant	Thai purple, Thai green, Thai yellow, Thai white	Solanum (Solanaceae)	Eggplant (Chapter 8)

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS724

doi.org/10.32473/edis-cv122-2022

Chapter 6. Cole Crop Production[1]

Bonnie Wells, Hugh A. Smith, Lincoln Zotarelli, Peter J. Dittmar, Nicholas S. Dufault, Johan Desaeger, and Qingren Wang[2]

Botany and Planting

Broccoli—*Brassica oleracea* Italica group, Brassicaceae (Cruciferae).

Cabbage—*Brassica oleracea* Capitata group.

Cauliflower—*Brassica oleracea* Botrytis group.

Chinese broccoli—Gailan or gai lan/kalian or kai lan/flowering kale—*Brassica oleracea* var. *alboglabra*.

Chinese cabbage—Napa (tight headed), chi-hili (semi-loose headed)—*Brassica rapa* var. *pekinsis*.

Chinese mustard—Bok choi, shanghai choi, baby bok choi, yuchoi, yuchoy, u-choi, choy sum—*Brassica rapa* subsp. *chinensis*.

Collards—*Brassica oleracea* Acephala group.

Kohlrabi—*Brassica oleracea* var. *gongylodes*.

Mustard—*Brassica juncea*.

Oriental radish—Daikon (Japanese), lobok or lo bok (Chinese)—*Raphanus sativus* var. *longipinnatus*.

Turnip—*Brassica rapa* Rapifera group.

1. This document is HS724, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Bonnie Wells, Extension agent II, UF/IFAS Extension Brevard County; Hugh A. Smith, associate professor, associate professor, Entomology and Nematology Department, UF/IFAS Gulf Coast Research and Education Center; Lincoln Zotarelli, associate professor, Horticultural Sciences Department; Peter J. Dittmar, associate professor, Horticultural Sciences Department; Nicholas S. Dufault, associate professor, Plant Pathology Department; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; and Qingren Wang, Extension agent III, UF/IFAS Extension Miami-Dade County; UF/IFAS Extension, Gainesville, FL 32611.

Table 1. Planting information for cole crops.

Planting Dates	Broccoli	Brussels Sprouts	Cabbage[1]	Cauliflower[1]
North Florida	Aug–Feb	Aug–Feb	Aug–Feb	Aug–Feb
Central Florida	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb
South Florida	Oct–Jan	Oct–Jan	Sept–Jan	Sept–Jan
Planting Information				
Distance between rows (in)	24–40	24–40	24–40	24–40
Distance between plants (in)	10–15	16–24	9–16	12–18
Seeding depth (in)	0.25–0.5	0.25–0.5	0.25–0.5	0.25–0.5
Seeding per acre for field (lb)	1–2	1–2	1–2	1–2
Seeding per acre for transplant (lb)	1.25–1.5	1.25–1.5	1	1.25–1.5
Days to maturity from seed	75–90	120–140	85–110	75–90
Days to maturity from transplant	50–70	90–120	70–90	50–70
Plant populations (acre)	10,400–26,000	Up to 15,500	Up to 29,400	Up to 29,000
Planting Dates	**Collards**	**Kale**	**Mustard**	**Turnip**
North Florida	Aug–Feb	Aug–Feb	Aug–Feb	Aug–Feb
Central Florida	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb
South Florida	Sept–Jan	Sept–Jan	Sept–Jan	Sept–Jan
Planting Information				
Distance between rows (in)	24–36	18–24	12–36	12–36
Distance between plants (in)	12–24	8–12	5–10	2–6
Seeding depth (in)	0.25–0.5	0.25–0.5	0.25–0.5	0.25–0.5
Seeding per acre for field (lb)	2–4	2–4	3–5	2–3
Seeding per acre for transplant (lb)	1.25–1.5	N/A[2]	N/A[2]	N/A[2]
Days to maturity from seed	70–90	50–70	40–50	40–60
Days to maturity from transplant	50–70	—	—	—
Plant populations (acre)	Up to 21,800	Up to 43,500	Up to 116,200	Up to 261,400

[1] Can be planted in double rows (15–24 in between rows; 10–12 in within rows; 40–60 in bed centers).
[2] Direct seeded.

Cultivars

Table 2. Cabbage cultivars.

Green	Red	Savoy
Botran (H)	Cairo (H)	Clarissa (H)
Bravo (H)	Garnet (H)	Melissa (H)
Bronco (H)	Red Dynasty (H)	Savoy Ace (H)
Bruno (H)	Red Hawk (H)	Savoy King (H)
Capture (H)	Red Jewel (H)	
Cheers (H)	Rio Grande (H)	
Expat (H)		
Grand Vantage (H)		
Ramada (H)		
Superstar (H)		

Table 3. Broccoli, cauliflower, collard, kale, mustard, and turnip cultivars.

Broccoli	Brussels Sprout	Cauliflower	Collards	Kale	Mustard	Turnip	Turnip Greens
Abrams (H)	Dagan (H)	Alcala (H)	Bull Dog (H)	Blue Ridge (H)	Florida Broad Leaf	Just Right (H)	All Top (H)
Burney (H)	Marte (H)	Bermeo (H)	Flash (H)	Darkibor (H)	Green Wave	Purple Top	Top Star (H)
DuraPak 19 (H)*		Flamenco (H)	Georgia	Oldenbor (H)	Red Giant	Royal Crown (H)	Topper (H)
Eastern Crown (H)		Majestic (H)	Hi Crop (H)	Starbor (H)	Southern Giant Curled	Southern Green	
Emerald Crown (H)		Whistler (H)	Top Bunch (H)	Vates	Tendergreen		
Green Magic (H)		White Passion (H)	Vates	Winterbor (H)			
Imperial (H)							
Packman (H)							

H = hybrid, * = for northeast Florida

Asian Crucifers

The term "Asian crucifers" is a broad category that encompasses Asian crucifer vegetables grown in the countries that comprise Asia and those eaten mainly by people of Asian extraction or who like Asian cuisine. Because many of the Asian crucifers described in this chapter belong to the crucifer family, which is covered in depth in chapter 5, "Ethnic Vegetable Production," that information will not be duplicated elsewhere. However, there are still some overlaps between these two chapters.

This group of Asian crucifer vegetable species includes crops with edible leaves, like cabbage, broccoli, and bok choi, but also kohlrabi, which has edible swollen stems or tubers, and daikon, which is an edible root. These crops can be grown on raised beds with or without mulch and with drip, overhead, or subsurface irrigation. Fertilizer recommendations for these crops can be found in chapter 2, "Fertilizer Management for Vegetable Production in Florida," as general information. For pest-control products, these crops are included under this chapter, with the exception of daikon, for which refer to information on radish in chapter 15, "Root Crop Production in Florida."

Table 4. Planting information for Asian crucifers.

Planting Dates	Chinese Broccoli	Chinese Cabbage	Chinese Mustard	Daikon
North Florida	Aug–Feb	Aug–Feb	Aug–Feb	Sept–Mar
Central and south Florida	Sept–Apr	Sept–Apr	Sept–Apr	Sept–Apr
Planting Information				
Number of rows/ 44-inch wide beds (6-ft centers)	3–4	2–3	4	3 (fall/spring) 4 (winter)
Distance between rows (in)	11	14 or 24	14–mustard 11–others (below)	11
Distance between plants (in)	3–5	14–18	12–18 (mustard) 8–12 (Shanghai/choy sum) 6–10 (baby bok choy) 2–4 (u-choy)	6–9
Seeding depth (in)	0.25–0.5	0.25–0.5	0.25–0.5	0.25
Plant populations (acre)	116,160	18,671	29,040 (mustard) 43,560 (Shanghai/choy sum) 58,080 (baby bok choy) 174,240 (u-choy)	58,080

Table 5. Asian crucifer cultivars.

Bok Choy	Chinese Broccoli	Chinese Cabbage—Napa (tight head)	Chinese Cabbage—Chihili (semi-loose head)	Chinese Mustard	Kohlrabi	Oriental Radish
Bopak	Dark Green Gailan	Blues Hybrid (H)	Green Rocket (H)	Canton Choice	Green Beauty	April Cross
Joy choi	Green Jade	China Express	Jade Pagoda	Ching-Chiang	Kolibri	Daikon (Japanese)
	Green Lance (H)	China Pride	Michihili	Crown Jewel	Kolibri Hybrid (H)	Everest
	Kaliburi	Emiko	Monument	Dwarf	Peking Purple	Green Meat
	Kichi	Minuet	Rubicon	Dynasty	Purple Vienna	Mantanghong Hybrid (H)
	Suiho	Pacifiko	Tainong Nanjing	Extra Dwarf	Winner	Mikura Cross
	Te You	SF-65		Fortune King		Mino Early
		WR-70 days (H)		Long White		Minowase
				Lucky Choi		Red Meat
				Mei Quing Choi		Relish Lobok/lo bok (Chinese)
				San Fran		Shunko
				Shanghai Green		

H = hybrid

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 6. Herbicides approved for managing weeds in cole crops. Contact: Peter Dittmar, UF/IFAS Horticultural Sciences Department.

Active Ingredient lb a.i./acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.				
***** PREEMERGENCE/PRETRANSPLANT *****				
Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Head & stem and leafy brassica	Annual broadleaf and grass weeds. Fair to poor control of lambsquarter, purslane, and some amaranth. Mechanically incorporate 1 to 2 in or irrigate 2 to 4 in deep within 36 hours.
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Head & stem and leafy brassica	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Clomazone 0.25 0.25–0.38	(Command) 3ME direct seeded: 0.67 pt transplanted: 0.67–1.0 pt	13	Cabbage	Annual broadleaf and grass weeds. On coarse soils, use lower rates. Only one application per season. PHI 45 days.
Flumioxazin 0.096	(Zaltus SX)	14	Broccoli, brussels sprouts, cabbage, Chinese cabbage, napa cabbage, cauliflower	Broadleaf weeds. Do not apply more than 3 oz per acre in a single application. No more than 6 oz per year. Row middles only between plastic-covered rows. Beds should be at least 4 in tall and 24 in wide. Apply with a covered sprayer to limit contact to the bottom inch of the bed prior to planting.
Glyphosate	(various formulations) consult label	9	Head & stem and leafy brassica	Actively growing broadleaf and grass weeds. Use as a preplant burndown.
Napropamide 2	(Devrinol DF-XT) 4 lb (Devrinol 2-XT) 4 qt	15	Broccoli, brussels sprouts, cauliflower, cabbage	Annual broadleaf and grass weeds. Apply in transplanted crops. Irrigate within 24–72 hr to a soil depth of 4–8 in. Do not exceed 2 lb a.i./A per season.
Oxyfluorfen 0.25–0.5	(Galigan, Goal 2XL) 2 EC 1–2 pt (Galigan, GoalTender) 4 E 0.5–1.0 pt	14	Broccoli, cauliflower, cabbage	Certain annual broadleaf weeds. Transplants less than 5 weeks old or in containers less than 1 sq in may result in more crop injury. Injury will occur as leaf cupping or crinkling. DO NOT apply in fields where acentanilde herbicides (Dual Magnum, Lasso, or Ramrod) have been applied in the same growing season.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Broccoli, cabbage, cauliflower, cavolo broccoli, Chinese cabbage, turnip	Emerged broadleaf and grass weeds. Use as a preplant burndown. Crop plants that have emerged will be injured.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Broccoli, cabbage, cauliflower, collards, kale, mustard/turnip greens	Emerged broadleaf and grass weeds. Use as a preplant burndown.
Pyraflufen ethyl 0.0008–0.003	(ET Herbicide/Defoliant) 0.5–2.0 fl oz	14	Cole crops	Broadleaf and grass weeds. Burndown preplant application 1 day before planting. Include a NIS or COC in the spray solution. Allow 30 days between applications. Do not exceed 3 applications or 5.5 fl oz/A per season.

Active Ingredient lb a.i./acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
S-metolachlor mineral: 0.64–1.91 muck: 1.91	(Dual Magnum) 7.62 EC mineral: 0.80–4.0 pt muck: 4.0 pt.	15	Head & stem brassica	Annual broadleaf and grass control. Apply immediately after planting. Label is a Third Party Registration by TPR, Inc., and grower must sign an indemnification agreement. Use a higher rate on fine-textured soils or high in organic matter. Do not apply more than 1.91 lb a.i./A of Dual Magnum per crop on sandy soils. Chinese varieties are more sensitive to Dual Magnum injury. PHI 60 days.
Sulfentrazone 0.07–0.09	(Willowwood sulfentrazone) 4SC 2.25–3.0 fl oz	14	Brassica head & stem, brassica leafy greens	Broadleaf and grass weed control, nutsedge suppression. Do not apply on sands with less than 1% organic matter. Do not apply more than 6.4 fl oz/A within a 12-month period. Should be trialed on a small area to find suitable rate for the soil type in your area.
Trifluralin 0.5–0.75	(Treflan HFP, Trifluralin, Trilin) 4 EC 1.0–1.5 pt (Treflan) 4 L 1.0–1.5 pt	3	Broccoli, brussels sprouts, cabbage, cauliflower	Annual broadleaf and grass weeds. Incorporate or irrigate 4 in within 8 hours. Results in Florida are erratic on soils with low organic matter and clay contents.
***** POSTEMERGENCE/POSTTRANSPLANT *****				
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz (Aim) 1.9 EC up to 2 fl oz	14	Head & steam and leafy brassica	Emerged broadleaf weeds. Apply with a hooded sprayer to row middles. Do not exceed 4.1 fl oz/A in season as a row-middle application. PHI 0 days.
Clethodim 0.09–0.13 0.07–0.25	(Select) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Head & steam and leafy brassica	Emerged grass weeds. Include crop oil concentrate at 1% v/v in finished spray volume. Head & stem brassica PHI 30 days. Leafy brassica PHI 14 days.
Clopyralid 0.09–0.19	(Stinger) 3 EC 0.25–0.5 pt	4	Cabbage, Chinese cabbage (bok choy, napa), Chinese mustard cabbage	Broadleaf weeds. Do not apply more than 0.5 pt/A per year. Check plant-back dates. PHI 30 days.
Glyphosate	(various formulations) consult label	9	Head & steam and leafy brassica	Broadleaf and grass weeds. Use a hooded sprayer and direct to row middles only.
Paraquat 0.3–0.5	(Gramoxone) 2 SL 1.2–1.9 pt	22	Cabbage	Emerged broadleaf and grass weeds. Direct spray solution to row middles only. Do not allow spray to contact crop because injury or excessive residues may result. Outer leaves should be stripped at the time of harvest. Do not apply where paraquat products have been used as preplant application.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Broccoli, cabbage, cauliflower, collards, kale, mustard/turnip greens	Emerged broadleaf and grass weeds. Apply as hooded spray to row middles only. Include a residual herbicide to broaden spectrum of weed control.
Pendimethalin 0.48–0.71	(Prowl H20) 3.8 1.0–1.5 pt	3	Broccoli, brussels sprouts, cabbage, cauliflower	Broadleaf and grass weeds. Apply after crop emergence (2- to 4-leaf stage) or after transplanting (1 to 3 days) and prior to weed emergence. Direct the spray to the base of the plant to limit contact to the foliage. PHI 60 days. PHI 7 days for cabbage and head & stem brassica.

Active Ingredient lb a.i./acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
Sethoxydim 0.28	(Poast) 1.5 EC 1.5 pt	1	Broccoli (including Chinese and raab), brussels sprouts, cabbage (bok choy, Chinese mustard, napa), cauliflower, collards, kale, kohlrabi, mustard/rape greens	Annual and perennial weeds. Include a crop oil concentrate or methylated seed oil in spray solution. Maximum rate of 3.0 pt/A per season. PHI 30 days.

Table 7. Insecticides labeled for management of pests of cole crops. Contact: Bonnie Wells, UF/IFAS Extension Brevard County.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1B	***Dibrom 8 EC** (naled)	1 pt	48	1	Apply no more than 1 pt per acre in Florida. Do not apply more than 5 pt per acre per season. **Broccoli, cabbage, cauliflower, brussels sprouts, kale, and collards.**
	1B	**Dimethoate 4 EC** (dimethoate)	Broccoli, cauliflower: 0.5–1 pt Kale, mustard greens, turnip: 0.5 pt	48	Broccoli, cauliflower: 7 Kale, mustard greens, turnip: 14	Highly toxic to bees. **For broccoli, cauliflower, kale, turnip greens and roots, and mustard greens only.**
	1B	***Lorsban Advanced** (chlorpyrifos) and other generic products	**Preplant, at-plant, postplant soil application:** See label. **Foliar:** 1–2 pt	24 Cauliflower: 72	**Preplant:** 30 **Foliar:** 21	See label for crop-specific instructions; pre- or postplant soil application for root aphids only. **Foliar:** Do not make more than 3 applications of products containing chlorpyrifos.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1–2 ptCollards, kale, mustard greens: 1.6 pt **8F:** 1.25 pt Collards, kale, mustard greens: 1 pt	48 Collards, kale, and mustard greens: 12	Head and stem brassica except cabbage: 2 Greens and cabbage: 7	See label for limitations on number of applications per season—varies by crop.
	1B	***MSR Spray Concentrate** (oxydemeton-methyl)	1.5–2 pt	7 days	7	**Broccoli, broccolini, broccoflower, cabbage, cauliflower**—see label for restrictions.
	3A	***Ambush 25W3** (and generics)	3.2–6.4 oz Cabbage and Chinese cabbage only: 3.2–12.8 oz	12	1	Do not apply more than 51.2 oz/acre per season. **Head and stem brassica crops only.**
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Do not apply more than 0.4 lb a.i./acre for leafy or 0.5 lb a.i./acre for head and stem.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A	**Pyganic 5.0** (pyrethrins)	4.5–18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 fl oz	24	3	Highly toxic to bees exposed to direct treatment or residues on blooming crops. **Head and stem brassica only.**
	4A	**Actara** (thiamethoxam)	1.5–5.5 oz	12	Head and stem: 0 Leafy: 7	Foliar application. Do not use if other 4A insecticide has been applied.
	4A	**Admire Pro** (imidacloprid) (see appropriate labels for other brands)	**Soil:** 4.4–10.5 fl oz **Foliar:** 1.3 fl oz	12	**Soil:** 21 **Foliar:** 7	**Most effective as a soil application.** Do not apply more than 10.5 fl oz per acre per crop season as a soil application or 6.5 fl oz as foliar applications. Do not apply to both soil and foliage.
	4A	**Assail 30SG** (acetamiprid)	Head and stem cole crops: 2.0–4.0 oz Leafy cole crops and turnip greens: 2.0–5.3 oz	12	Head and stem: 7 Leafy cole crops and turnip greens: 3	Susceptibility may vary with aphid species. Do not apply more than 5 times per season for head and stem cole crops or 4 times per season for leafy cole crops, or apply more often than every 7 days. Turnip roots cannot be used for food/feed.
	4A	**Belay Insecticide 50 WDG** (clothianidin)	**Insecticide:** **Soil:** 9–12 fl oz **Foliar:** 3–4 fl oz **50 WDG:** **Soil:** 4.8–6.4 oz **Foliar:** 1.6–2.1 oz	12	**Insecticide:** **Soil:** apply at planting **Foliar:** 7 **50 WDG:** 7	**Insecticide: Soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **Foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb a.i./acre regardless of application method (or a total of 12 fl oz of this formulation).
	4A	**Platinum** **Platinum 75SG** (thiamethoxam)	**Platinum:** 5.0–11 fl oz **Platinum 75SG:** 1.66–3.67 oz	12	30	Soil application.
	4A	**Venom Insecticide** **Scorpian 35SL Insecticide** (dinotefuran)	Soil and foliar rates differ; check label.	12	**Foliar:** 1 **Soil:** 21	Use one application method, not both (soil or foliar). **For head and stem brassica only.** **Foliar:** Do not apply more than 0.268 lb a.i. per acre per season.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	12	30	Soil application. May be applied via one of several different applications methods. One application per season within 28 days of plant emergence or transplanting.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	12	Head and stem: 3 Leafy brassica greens: 7	Foliar application. Highly toxic to bees exposed to direct treatment or residues on blooming crops.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	1	Soil or foliar application. Maximum per crop season: 28 fl oz/acre. Maximum crop seasons per year: 3.
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Apply when aphids first appear. Maximum of 2 applications per crop.
	9B	**PQZ** (pyrifluquinazon)	**Soil only:** 2.4 to 3.2 fl oz	12	7	7 days before reapplication. Maximum of 9.6 fl oz rate per season.
	23	**Movento** (spirotetramat)	4–5 fl oz	24	1	Limited to 10 oz/acre per season. Only use a spreading-penetrating adjuvant known to be safe for the target crop.
	28	**Exirel** (cyazypyr)	13.5–20.5 fl oz	12	1	Do not apply more than 0.4 lb a.i./acre of cyazypyr- or cyantraniliprole-containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
	28	**Verimark** (cyazypyr)	6.75–13.5 fl oz	4	N/A—applied at planting	See label for diamondback moth resistance management.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Compatible as a tank mix with some fungicides.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	-	**Grandevo** (Heat-killed *Chromobacterium subtsugae* strain PRAA4-1 and spent fermentation)	2.0–3.0 lb	4	0	Can be used in organic production. OMRI-listed. Broad spectrum, repels, reduces fecundity. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Compatible as a tank mix with some fungicides.
	-	**Saf-T-Side, others** (oil, insecticidal)	1–2 gal/100 gal	4	up until day of harvest	Saf-T-Side is OMRI-listed.[2]
	-	**Suffoil-X** (mineral oil)	1%–2% v/v	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.[2]
	-	**Venerate** (Heat-killed *Burkholderia rinoiensis* strain A396)	2.0–4.0 qt	4	0	Can be used in organic production. OMRI-listed. Broad spectrum, degrades exoskeleton, interferes with molting. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
Caterpillars (including diamondback moth, cabbage looper, imported cabbageworm, corn earworm, cross-striped cabbageworm, cabbage webworm, armyworms)	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5–3.0 pt **SP:** 0.5–1 lb	48	Cabbage: 1 Broccoli and cauliflower: 3 Others: 10	Do not make more than 10 applications per crop (8 for collards, kale, mustard and turnip greens). **For use on broccoli, cabbage, cauliflower, Chinese cabbage, fresh market collards, kale, mustard and turnip greens.**
	1A	**Sevin 80S XLR Plus, 4F** (carbaryl)	**80S:** 0.625–2.5 lb **XLR, 4F:** 0.5–2 qt	12	3 or 14, depending on specific crop	Apply no more than 7.5 lb/acre of 80S or 6 qt of 4F or Plus per crop. **See label for specific crops.**

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	1B	***Diazinon AG-500 *50 W** (diazinon)	**AG500 preplant:** 1–4 qt **50W:** 2–8 lb	96	preplant	**Root maggot, cutworms only. Broccoli, cabbage, cauliflower, collard, kale, mustard greens.** See label for depth to incorporate.
	1B	***Dibrom 8 EC** (naled)	1 pt	48	1	Apply no more than 1 pt per acre in Florida. Do not apply more than 5 pt per acre per season. **Broccoli, cabbage, cauliflower, Brussels sprouts, kale, and collards.**
	1B	***Lorsban Advanced** (chlorpyrifos)	**Preplant, at-plant, postplant soil application:** See label. **Foliar:** 1–2 pt	24 Cauliflower: 72	**Preplant:** 30 **Foliar:** 21	**Preplant for root maggot, cutworms, and symphylans only.** See label for crop-specific instructions. **Foliar:** Do not make more than 3 applications of products containing chlorpyrifos. Will not control organophosphate-resistant diamondback moth.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1–2 pt Collards, kale, mustard greens: 1.6 pt **8F:** 1.25 pt Collards, kale, mustard greens: 1 pt	48 Collards, kale, and mustard greens: 12	Head and stem brassica except cabbage: 2 Greens and cabbage: 7	See label for limitations on number of applications per season—varies by crop.
	3A	***Ambush 25W** (permethrin)	3.2–6.4 oz Cabbage and Chinese cabbage only: 3.2–12.8 oz	12	1	Do not apply more than 51.2 oz/acre per season. **Head and stem brassica crops only.**
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	Head and stem brassicas: 2.9–9.6 fl oz Collards: 5.8–9.6 fl oz	12	Head and stem: 3 Collards, mustard greens: 7	Do not apply more than 0.4 lb a.i./acre per season for head and stem brassica or 0.2 lb a.i./acre per season for collards and mustard greens.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz Mustard greens: 9.6 fl oz	12	0	Maximum per crop season: 12.8 fl oz/A.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Do not apply more than 0.4 lb a.i./acre for leafy or 0.5 lb a.i./acre for head and stem.
	3A	***Capture LFR** (bifenthrin)	3.4–8.5 fl oz	12	at planting	For mixing directly with liquid fertilizer to control soil insect pests.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	3A	***Danitol** (fenpropathrin)	10.67–16 fl oz	24	7	Do not apply more than 42.67 fl oz per acre per season. **Head and stem brassica only.**
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	1	First and second instars only. **Head and stem brassica only.** Do not apply more than 12.3 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A	**Pyganic 5.0** (pyrethrins)	4.5–18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	1	Do not apply more than 0.24 lb a.i./acre or 15.36 fl oz of product/acre per season. 1st and 2nd instar only. **For head and stem brassica only.**
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	12	30	May be applied via one of several different soil applications methods. One application per season within 28 days of plant emergence or transplanting.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	12	Head and stem: 3 Leafy brassica greens: 7	Highly toxic to bees exposed to direct treatment or residues on blooming crops.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Do not apply to seedlings grown for transplant. Do not make more than two consecutive applications of Group 5 insecticides. Recommended to reserve for thrips where they are a problem.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	Head and stem: 7 Leafy: 14	Do not make more than 2 sequential applications without rotating to another product with a different mode of action. Do not apply by aircraft. **Not for turnips grown for roots.**

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	11A	**DiPel DF and other products** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. See label for rates for specific pests. Good coverage is essential. OMRI-listed.[2] Can be used in greenhouses.
	11A	**Xentari DF and other products** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83 EC** (novaluron)	6–12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem brassica only.**
	18	**Intrepid 2F** (methoxyfenozide)	4–10 fl oz, depending on pest.	4	1	Do not apply more than 64 oz per acre per season.
	22	**Avaunt 30 WG** (indoxacarb)	2.5–3.5 oz	12	3	Do not apply more than 14 oz per acre per crop. Add a wetting agent to improve coverage. Do not use in greenhouse or in crops grown for transplant.
	22	**Avaunt eVo** (indoxacarb)	2.5–3.5 oz	12	3	No more than 4 applications per year.
	28	**Coragen** (rynaxypyr)	3.5–7.5 fl oz	4	3	For best results, use an adjuvant when using as a foliar spray. Can be applied to soil at planting or by drip chemigation. See label for diamondback moth resistance management.
	28	**Exirel** (cyazypyr)	13.5–20.5 fl oz	12	1	Do not apply more than 0.4 lb a.i./acre of cyazypyr- or cyantraniliprole-containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Checkmate DBM-F** (pheromone)	3.1–6.2 fl oz	0	0	For mating disruption of diamondback moth. Does not affect larvae and eggs already on plants. Do not exceed 23 fl oz per acre per year.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1.0–3.0 lb	4	0	Can be used in organic production. OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	8 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Prokil Cryolite** (cryolite)	8–16 lb	12	7	**For broccoli, brussels sprouts, and cauliflower only.** Do not apply more than 96 lb per season or more often than every 7 days.
Fire ants	3A	**Pyganic 5.0** (pyrethrins)	4.5–18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]
	7A	**Extinguish** (S-methoprene)	1.0–1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after 3 weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb	12	1	Apply when ants are actively foraging. Do not exceed 0.134 lb a.i. per acre per season.
Flea beetles	1A	**Sevin 80S XLR Plus, 4F** (carbaryl)	**80S:** 0.625–2.5 lb **XLR, 4F:** 0.5–2 qt	12	3 or 14, depending on specific crop.	Apply no more than 7.5 lb/acre of 80S or 6 qt of 4F or XLR Plus per crop. **See label for specific crops.**
	1B	***Lorsban Advanced** (chlorpyrifos)	**Preplant, at-plant, postplant soil application:** See label. **Foliar:** 1–2 pt	24 Cauliflower: 72	**Preplant:** 30 **Foliar:** 21	See label for crop-specific instructions. **Foliar:** Do not make more than 3 applications of products containing chlorpyrifos.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1–2 pt Collards, kale, mustard greens: 1.6 pt **8F:** 1.25 pt Collards, kale, mustard greens: 1 pt	48 Collards, kale, and mustard greens: 12	Head and stem brassica except cabbage: 2 Greens and cabbage: 7	See label for limitations on number of applications per season—varies by crop.
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	Head and stem brassicas: 2.9–9.6 fl oz Collards: 5.8–9.6 fl oz Mustard greens: 9.6 fl oz	12	Head and stem: 3 Collards, mustard greens: 7	Do not apply more than 0.4 lb a.i./acre per season for head and stem brassica or 0.2 lb a.i./acre per season for collards and mustard greens.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum per crop season: 12.8 fl oz/A.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Do not apply more than 0.4 lb a.i./acre for leafy or 0.5 lb a.i./acre for head and stem.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	1	First and second instars only. **Head and stem brassica only.** Do not apply more than 12.3 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A	**Pyganic 5.0** (pyrethrins)	4.5–18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]
	3A	***Warrior II and generics** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	1	Do not apply more than 0.24 lb a.i./acre or 15.36 fl oz of product/acre per season. 1st and 2nd instar only. For head and stem brassica only.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 fl oz	24	3	Highly toxic to bees exposed to direct treatment or residues on blooming crops. **Head and stem brassica only.**
	4A	**Actara** (thiamethoxam)	1.5–5.5 oz	12	Head and stem: 0 Leafy: 7	Do not use if other 4A insecticide has been applied.
	4A	**Belay Insecticide 50 WDG** (clothianidin)	**Insecticide:** **Soil:** 9–12 fl oz **Foliar:** 3–4 fl oz **50 WDG:** **Soil:** 4.8–6.4 oz **Foliar:** 1.6–2.1 oz	12	**Insecticide:** **Soil:** apply at planting **Foliar:** 7 **50 WDG:** 7	**Insecticide: Soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **Foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb a.i./acre regardless of application method (or a total of 12 fl oz of this formulation).
	4A	**Platinum** **Platinum 75SG** (thiamethoxam)	5.0–11 fl oz **75G:** 1.66–3.67 oz	12	30	Soil application.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	4A	**Venom Scorpion Insecticide** (dinotefuran)	Soil and foliar rates differ; check label.	12	**Foliar:** 1 **Soil:** 21	Use one application method, not both (soil or foliar). **For head and stem brassica only.** **Foliar:** Do not apply more than 0.268 lb a.i. per acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	12	30	May be applied via one of several different soil application methods. One application per season within 28 days of plant emergence or transplanting.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	12	Head and stem: 3 Leafy brassica greens: 7	Highly toxic to bees exposed to direct treatment or residues on blooming crops.
	15	**Rimon 0.83 EC** (novaluron)	6–12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem brassica only.**
	28	**Exirel** (cyazypyr)	13.5–20.5 fl oz	12	1	Do not apply more than 0.4 lb a.i./acre of cyazypyr- or cyantraniliprole-containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
	28	**Verimark** (cyazypyr)	5–13.5 fl oz	4	N/A—applied at planting	See label for diamondback moth resistance management.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**Prokil Cryolite** (cryolite)	8–16 lb	12	7	**For broccoli, brussels sprouts, and cauliflower only.** Do not apply more than 96 lb per season or more often than every 7 days.
Grasshoppers	3A	***Asana XL (0.66 EC)** (esfenvalerate)	Head and stem brassicas: 2.9–9.6 fl oz Collards: 5.8–9.6 fl oz Mustard greens: 9.6 fl oz	12	Head and stem: 3 Collards, mustard greens: 7	Do not apply more than 0.4 lb a.i./acre per season for head and stem brassica or 0.2 lb a.i./acre per season for collards and mustard greens.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 fl oz	24	3	Highly toxic to bees exposed to direct treatment or residues on blooming crops. **Head and stem brassica only.**
Harlequin bug, stink bug, plant bugs	1A	**Sevin 80S XLR Plus, 4F** (carbaryl)	**80S:** 0.625–2.5 lb **XLR, 4F:** 0.5–2 qt	12	3 or 14, depending on specific crop	Apply no more than 7.5 lb/acre of 80S or 6 qt of 4F or XLR Plus per crop. **See label for specific crops.**
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum per crop season: 12.8 fl oz/A.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Do not apply more than 0.4 lb a.i./acre for leafy or 0.5 lb a.i./acre for head and stem.
	3A	***Danitol** (fenpropathrin)	10.67–16 fl oz	24	7	Do not apply more than 42.67 fl oz per acre per season. **Head and stem brassica only.**
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	1	First and second instars only. **Head and stem brassica only.** Do not apply more than 12.3 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A	**Pyganic 5.0** (pyrethrins)	4.5–18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	1	Do not apply more than 0.24 lb a.i./acre or 15.36 fl oz of product/acre per season. First and second instar only. **For head and stem brassica only.**
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 fl oz	24	3	Highly toxic to bees exposed to direct treatment or residues on blooming crops. **Head and stem brassica only.**

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	4A	**Assail 30SG** (acetamiprid)	Head and stem cole crops: 2.0–4.0 oz Leafy cole crops and turnip greens: 2.0–5.3 oz	12	Head and stem: 7 Leafy cole crops and turnip greens: 3	Begin applications for whiteflies when first adults noticed. Do not apply more than 5 times per season for head and stem cole crops or 4 times per season for leafy cole crops, or apply more often than every 7 days. Turnip roots cannot be used for food/feed.
	4A	**Belay Insecticide 50 WDG** (clothianidin)	**Insecticide:** **Soil:** 9–12 fl oz **Foliar:** 3–4 fl oz **50 WDG:** **Soil:** 4.8–6.4 oz **Foliar:** 1.6–2.1 oz	12	**Insecticide:** **Soil:** apply at planting **Foliar:** 7 **50 WDG:** 7	**Insecticide: Soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **Foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb a.i./acre regardless of application method (or a total of 12 fl oz of this formulation).
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 1 **Soil:** 21	**Head and stem brassica only.** Do not use more than 10.5 fl oz when applying to foliage or 21 fl oz when applying to soil. Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6 oz	12	**Foliar:** 1 **Soil:** 21	Use one application method, not both (soil or foliar). **For head and stem brassica only.** **Foliar:** Do not apply more than 0.268 lb a.i. per acre per season.
	15	***Dimilin 2L** (diflubenzuron)	2–4 fl oz	12	7	Not effective against adult stage. No more than 4 applications per season. May be applied only to turnip varieties that do not produce a harvestable root.
	15	**Rimon 0.83 EC** (novaluron)	6–12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem brassica only.**

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
Leafminers	4A	**Belay Insecticide 50 WDG** (clothianidin)	**Insecticide:** **Soil:** 9–12 fl oz **Foliar:** 3–4 fl oz **50 WDG:** **Soil:** 4.8–6.4 oz **Foliar:** 1.6–2.1 oz	12	**Insecticide:** **Soil:** apply at planting **Foliar:** 7 **50 WDG:** 7	**Insecticide: Soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **Foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb a.i./acre regardless of application method (or a total of 12 fl oz of this formulation).
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 1 **Soil:** 21	**Head and stem brassica only.** Do not use more than 10.5 fl oz when applying to foliage or 21 fl oz when applying to soil. Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6 oz	12	**Foliar:** 1 **Soil:** 21	Use one application method, not both (soil or foliar). **For head and stem brassica only.** **Foliar:** Do not apply more than 0.268 lb a.i./acre per season.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Do not apply to seedlings grown for transplant. Do not make more than two consecutive applications of Group 5 insecticides.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	Head and stem: 7 Leafy: 14	Do not make more than 2 sequential applications without rotating to another product with a different mode of action. Do not apply by aircraft. Not for turnips grown for roots.
	15	**Rimon 0.83 EC** (novaluron)	6–12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem brassica only.**
	17	**Trigard** (cyromazine)	2.66 oz	12	7	Limited to 6 applications. **Includes turnip greens, not grown for roots.**

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	28	**Exirel** (cyazypyr)	13.5–20.5 fl oz	12	1	Do not apply more than 0.4 lb a.i./acre of cyazypyr- or cyantraniliprole-containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
	28	**Verimark** (cyazypyr)	6.75–13.5 fl oz	4	N/A—applied at planting	See label for diamondback moth resistance management.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	IGR and feeding repellant. Greenhouse and field. OMRI-listed[2].
	-	**Saf-T-Side, others** (oil, insecticidal)	1–2 gal/100 gal	4	up to day of harvest	Saf-T-Side is OMRI-listed[2].
	-	**Suffoil-X** (mineral oil)	1%–2% v/v	4	0	OMRI-listed[2].
Whitefly	4A	**Actara** (thiamethoxam)	1.5–5.5 oz	12	Head and stem: 0 Leafy: 7	Do not use if other 4A insecticide has been applied.
	4A	**Admire Pro** (imidacloprid) (see appropriate labels for other brands)	**Foliar:** 1.3 fl oz **Soil:** 4.4–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Do not apply more than 10.5 fl oz per acre per crop season as a soil application or 6.5 fl oz as foliar applications. Do not apply to both soil and foliage.
	4A	**Assail 30SG** (acetamiprid)	Head and stem cole crops: 2.0–4.0 oz Leafy cole crops and turnip greens: 2.0–5.3 oz	12	Head and stem: 7 Leafy cole crops and turnip greens: 3	Begin applications for whiteflies when first adults are noticed. Do not apply more than 5 times per season for head and stem cole crops or 4 times per season for leafy cole crops, or apply more often than every 7 days. Turnip roots cannot be used for food/feed.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	4A	**Belay Insecticide 50 WDG** (clothianidin)	**Insecticide:** **Soil:** 9–12 fl oz **Foliar:** 3–4 fl oz **50 WDG:** **Soil:** 4.8–6.4 oz **Foliar:** 1.6–2.1 oz	12	**Insecticide:** **Soil:** apply at planting **Foliar:** 7 **50 WDG:** 7	**Insecticide: Soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **Foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb a.i./acre regardless of application method (or a total of 12 fl oz of this formulation).
	4A	**Platinum Platinum 75SG** (thiamethoxam)	5.0–11 fl oz **75G:** 1.66–3.67 oz	12	30	Soil application.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 1 **Soil:** 21	**Head and stem brassica only.** Do not use more than 10.5 fl oz when applying to foliage or 21 fl oz when applying to soil. Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6 oz	12	**Foliar:** 1 **Soil:** 21	Use one application method, not both (soil or foliar). For head and stem brassica only. **Foliar:** Do not apply more than 0.268 lb a.i./acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	12	30	May be applied via one of several different soil application methods. One application per season within 28 days of plant emergence or transplanting.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	12	Head and stem: 3 Leafy brassica greens: 7	Highly toxic to bees exposed to direct treatment or residues on blooming crops.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	1	Maximum per crop season: 28 fl oz/acre. Maximum crop seasons per year: 3.
	7C	**Knack** (pyriproxyfen)	8–10 fl oz	12	7	Immatures only. Apply when nymphs first appear. Limited to 2 applications per season.
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Apply when aphids and whiteflies first appear. Provides suppression of whiteflies. Maximum of 2 applications per crop.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	9B	**PQZ** (pyrifluquinazon)	**Soil only:** 2.4 to 3.2 fl oz	12	7	7 days before reapplication. Maximum of 9.6 fl oz rate per season.
	15	**Rimon 0.83 EC** (novaluron)	6–12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem brassica only.**
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	12	1	Immatures only. Do not make more than 2 applications per crop cycle or 4 applications per year.
	23	**Movento** (spirotetramat)	4–5 fl oz	24	1	Limited to 10 oz/acre per season. Only use a spreading-penetrating adjuvant known to be safe for the target crop.
	23	**Oberon 2 SC** (spiromesifen)	7.0–8.5 fl oz	12	7	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications. **Not for turnip greens.**
	28	**Exirel** (cyazypyr)	13.5–20.5 fl oz	12	1	Do not apply more than 0.4 lb a.i./acre of cyazypyr- or cyantraniliprole-containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
	28	**Verimark** (cyazypyr)	6.75–13.5 fl oz	4	N/A—applied at planting	See label for diamondback moth resistance management.
	29	**Beleaf 50 SG** (flonicamid)	2.8 oz	12	0	Suppression only.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Compatible as a tank mix with some fungicides.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2 % v/v	12	0	OMRI-listed.[2]

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	IGR and feeding repellant. Greenhouse and field. OMRI-listed.[2]
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2–4 qt	4	0	Apply before pests reach damaging levels.
	-	**Saf-T-Side, others** (oil, insecticidal)	1–2 gal/100 gal	4	up to day of harvest	Saf-T-Side is OMRI-listed.[2]
	-	**Suffoil-X** (mineral oil)	1%–2% v/v	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.[2]
Wireworms	1B	***Diazinon AG-500 *50 W** (diazinon)	**AG500 preplant:** 1–4 qt **50W:** 2–8 lb	96	preplant	**Broccoli, cabbage, cauliflower, collard, kale, mustard greens.** See label for depth to incorporate.
	1B	**Lorsban 75WG** (chlorpyrifos)	**Foliar:** 0.67–1.33 lb **Preplant soil:** 2.66 lb for cauliflower, 3.00 lb for all others **At plant or post planting:** 0.8–2.15 oz/1000 feet of row. Specific rate depends on the crop.	24 Cauliflower: 72	21; pre- or at planting	Do not make more than 3 applications of products containing chlorpyrifos. Will not control organophosphate-resistant diamondback moth. **Preplant:** Incorporate preplant applications 2–4 inches deep.
	3A	***Capture LFR** (bifenthrin)	3.4–8.5 fl oz	12	at planting	For mixing directly with liquid fertilizer to control soil insect pests.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2, March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

***Restricted use insecticide.**

Table 8. Cole crop fungicides ordered by disease and FRAC group according to mode of action. Contact: Nicholas S. Dufault, UF/IFAS Plant Pathology Department.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
COLE CROPS: Head and Stem Crops: Broccoli, Brussels Sprouts, Cauliflower, Chinese Broccoli, and Chinese Cabbage; Leafy Crops: Collard, Kale, Mustard, and Turnip; and Watercress							
Alternaria blight (*Alternaria* spp.)	3 + 11	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential applications.
	7	**Endura** (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Not labeled for watercress. Limit is 2 applications/crop.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	0.5	No more than 2 aerial applications in a year.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants.
Alternaria leaf spot (*Alternaria* spp.)	M1	(copper compounds) **Many brands available:** AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champion++, Champ WG, Copper-Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide, MasterCop, Nordox, Nordox 75WG, Nu-Cop 30 HB, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	Mancozeb or maneb enhances bactericidal effect of fix copper compounds. Some reddening on older broccoli leaves at higher rates and flecking on wrapper leaves of cabbage may occur.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Praiz	**SEE INDIVIDUAL LABELS**		7	1–2	See individual labels for crop subgrouping.
	2	**Iprodione 4L AG** **Rovral 4F** **Enclosure 4** **Nevado 4F** (iprodione)	1 pt	4 pt	10	-	Only labeled for Chinese mustard. Limit is 4 applications for mustard.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	**Monsoon** **Orius 3.6F** **TebuStar 3.6L** **Tebuzol 3.6F** **Toledo 3.6F** (tebuconazole)	4 fl oz	16 fl oz	7	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infection when environmental conditions are favorable.
	3	**Procure 480 SC** (triflumizole)	8 fl oz	18 fl oz	1	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infection and repeat sprays at a 14 day interval.
	3	**Rhyme** (flutriafol)	7 fl oz		7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	4 + M5	**Ridomil Gold Bravo** **Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	1.5 lb	See label	7	2	Not labeled for leafy cole crops or watercress. Limit is 4 applications per crop.
	7	**Endura** (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Not labeled for watercress. Limit is 2 applications/crop.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.
	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	0.5	No more than 2 aerial applications in a year.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development, and continue on a 7–10 day interval. Make no more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 sequential applications before rotating to a different mode of action for at least 2 applications; 30-day plant-back for off-label crops.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications/stem and head crop.
	11	**Quadris EquationSC Satori** (azoxystrobin)	15.5 fl oz	92.3 fl oz	0	4 hr	No more than 2 sequential applications. Different seasonal application limits for head and stem, and leafy green brassica subgroups.
	11	**Reason 500 SC** (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Do not make more than 1 sequential application.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential application. Limit of 4 applications per season.
	11 + 3	**Quilt** (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more the 3 applications in a season.
	29	**Omega 500F** (fluazinam)	15.25 fl oz	See label	See label	0.5	The REI is 2 days for workers conducting handset irrigation activities.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	40 fl oz	160 fl oz	7	0.5	Limit is no more than 2 sequential applications. Max of 4 applications per year.
Anthracnose (*Colletotrichum* spp.)	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development and continue on a 7–10 day interval. Make no more than 2 sequential applications before rotating to another effective fungicide with a different mode of action. Do not exceed 80 fl oz per season.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications/stem and head crop.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential applications.
	11 + 3	**Quilt** (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications in a season.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Black leg (*Leptosphaeria maculans*)	2	**Iprodione 4L AG** **Rovral 4F** **Enclosure 4** **Nevado 4F** (iprodione)	2 pt	4 pt	0	-	Only labeled for broccoli. Limit is 2 applications for broccoli.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	Head and stem: 0	4 hr	No more than 2 sequential applications/stem and head crop.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more than 3 applications in a season. Do not apply to turnip greens or roots.
Black rot (*Xanthomonas campestris*)	M1	(copper compounds) **Many brands available.**	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	Mancozeb or maneb enhances bactericidal effect of fix copper compounds.
	P	**Actigard 50 WG** (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Apply preventatively; limit is 4 applications/crop on a 7-day schedule. Suppression only.
Cercospora leaf spot (*Cercospora brassicicola*)	3	**Monsoon** **Orius 3.6F** **TebuStar 3.6L** **Tebuzol 3.6F** **Toledo 3.6F** (tebuconazole)	4 fl oz	16 fl oz	7	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infection when environmental conditions are favorable.
	3	**Rhyme** (flutriafol)	7 fl oz		7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	3	**Tilt** (propiconazole)	4 fl oz	12 fl oz	7	0.5	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	0.5	No more than 2 aerial applications in a year.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development, and continue on a 7–10 day interval. Make no more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants. Suppression only.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications/stem and head crop.
	11	**Quadris** **Equation SC** **Satori** (azoxystrobin)	15.5 fl oz	46 fl oz	0	4 hr	Labelled for leafy brassica. No more than 2 sequential applications.
	11	**Reason 500SC** (fenamidone)	8.2 oz	24.6 fl oz	2	0.5	Limits are no more than 1 sequential application. Suppression only.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential application.
	11 + 3	**Quilt** (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz		7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications in a season.
Club root (*Plasmodiophora brassicae*)	21	**Ranman** (cyazofamid)	**SEE LABEL**		-	0.5	Applied as a transplant soil drench.
	29	**Omega 500F** (fluazinam)	**Soil:** 41.6 fl oz **Transplant drench:** 6.45 fl oz/100 gal	3.85 pt	Leafy: 20 Head and stem: 50	2	Not labeled for watercress. Treated turnip roots are not fit for human or livestock consumption.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Downy mildew (*Perenospora parasitica*)	M1	(copper compounds) **Many brands available:** AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champion++, Champ WG, Copper-Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide, MasterCop, Nordox, Nordox 75WG, Nu-Cop 30 HB, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	Mancozeb or maneb enhances bactericidal effect of fix copper compounds.
	M3	(mancozeb) **Many brands available:** Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	**SEE INDIVIDUAL LABELS**		10	1	Not labeled for collards, mustard, turnip or watercress. See labels for restrictions and details.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Praiz	**SEE INDIVIDUAL LABELS**		7	2	Not labeled for leafy cole crops or watercress.
	4	**Ridomil Gold SL** (mefenoxam)	**Foliar:** 0.25 pt	**Foliar:** 1 pt	7	2	Not labeled for watercress. Use only in a tank mix with another effective fungicide (non-FRAC code 4).
	4 + M5	**Ridomil Gold Bravo** **Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	1.5 lb	See label	7	2	Not labeled for leafy cole crops or watercress. Limit is 4 applications per crop.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications/stem and head crop.
	11	**Quadris** **Equation SC** **Satori** (azoxystrobin)	15.5 fl oz	92.3 fl oz	0	4 hr	Labelled for head and stem brassicas. No more than 2 sequential applications.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Reason 500SC** (fenamidone)	8.2 oz	24.6 oz	2	0.5	Limits are no more than 1 sequential application.
	21	**Actigard 50 WG** (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Apply preventatively; limit is 4 applications/crop on a 7-day schedule. Suppression only.
	21	**Ranman** (cyazofamid)	2.75 fl oz	39.5 fl oz	0	0.5	This product can be applied as a transplant soil drench. Do not make more than six applications.
	29	**Omega 500F** (fluazinam)	15.25 fl oz	See label	See label	0.5	The REI is 2 days for workers conducting handset irrigation activities.
	33	**Aliette** (aluminum tris)	5 lb	-	3	-	Do not exceed 7 applications per season.
	40	**Acrobat** (dimethomorph)	6.4 oz	32 oz	0	0.5	Not labeled for head and stem cole crops. Only 5 applications per season. See supplemental label for restrictions and details.
	40	**Forum** (dimethomorph)	6 oz	30 oz	0	0.5	Not labeled for turnip or watercress. Only 5 applications per season.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Not labeled for turnip or watercress. Limit is no more than 2 sequential applications or 4 total applications.
	43	**Presidio** (fluopicolide)	4 fl oz	16 fl oz	2	0.5	Not labeled for watercress. Limit is no more than 2 sequential applications or 4 total applications per season.
	45 + 40	**Zampro** (ametoctradin + dimthomorph)	14 fl oz	42 fl oz	0	0.5	Limit is no more than 2 sequential applications.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	40 fl oz	160 fl oz	7	0.5	Limit is no more than 2 sequential applications. Max of 4 applications per year.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz	1	4 hr	Limit is no more than 2 sequential applications. Max of 4 applications per year.
Fusarium soilborne diseases (*Fusarium* spp.)	12	**Maxim 4FS** (fludioxonil)	0.08 to 0.16 fl oz/100 lb of seed	See label	-	0.5	Seed treatment only; not labeled for turnip or watercress.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Gray mold (*Botrytis cinerea*)	7	**Endura** (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Not labeled for watercress; Limit is 2 applications/crop.
	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	7+11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development. No more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
Powdery mildew (*Erysiphe cruciferarum [syn. Erysiphe polygoni]*)	M2	(sulfur) **Many brands available:** Cosavet DF, Cosavet DF Edge, Crusade DF, Kumulus DF, Microfine Sulfure, Micro Sulf, Microthiol Disperss, Suffa, Sulfur 90W, Thiolux	**SEE INDIVIDUAL LABELS**		0	-	Products are available for most cole crops; see labels for restrictions and details.
	3	**Monsoon** **Orius 3.6F** **TebuStar 3.6L** **Tebuzol 3.6F** **Toledo 3.6F** (tebuconazole)	4 fl oz	16 fl oz	7	0.5	Not labeled for watercress or head and stem (tebuconazole) cole crops. Apply prior to infection when environmental conditions are favorable.
	3	**Procure 480 SC** (triflumizole)	8 fl oz	18 fl oz	Leafy: 0	0.5	Not labeled for watercress or head and stem brassicas. See label for restrictions and details.
	3	**Rhyme** (flutriafol)	7 fl oz		7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	3	**Tilt** (propiconazole)	4 fl oz	12 fl oz	7	0.5	
	7	**Endura** (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Limit is 2 applications/crop. Suppression only.
	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	0.5	No more than 2 aerial applications in a year.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development and continue on a 7–10 day interval. Make no more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 sequential applications before rotating to a different mode of action for at least 2 applications; 30-day plant-back for off-label crops.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 3	4 hr	No more than 2 sequential applications/stem and head crop.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential application.
	11 + 3	**Quilt** (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz		7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more the 3 applications in a season.
Pythium & phytophthora diseases (soil)	4	**Apron XL** (mefenoxam)	**SEE LABEL**		-	2	Seed treatment only; not labeled for watercress. See label for details.
	4	**Ridomil Gold SL** (mefenoxam)	2 pt (soil)	2 pt (soil)	7	2	Not labeled for watercress; use only in a tank mix with another effective fungicide (non-FRAC code 4).
	4	**Ultra Flourish** (mefenoxam)	4 pt	4 pt	-	2	Soil applied as a preplant treatment or following transplanting.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Pythium damping-off (*Pythium* spp.)	4	**Allegiance-FL** (metalaxyl)	**SEE LABEL**		-	2	Seed treatment only. Primarily for commercial seed treatment.
	4	**MetaStar 2E AG** (metalaxyl)	**SEE LABEL**		-	2	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants.
	4 + 11	**Uniform** (mefenoxam + azoxystrobin)	0.34 fl oz/100 ft of row	1.0 lb a.i.	-	-	Only one application per season.
	43	**Presidio** (fluopicolide)	4 fl oz	16 fl oz	2	-	Not labeled for watercress. Limit is no more than 2 sequential applications or 4 total applications per season.
***Phytophthora* spp.**	4	**MetaStar 2E AG** (Metalaxyl)	**SEE LABEL**		-	2	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants.
	43	**Presidio** (fluopicolide)	4 fl oz	16 fl oz	2	-	Not labeled for watercress. Limit is no more than 2 sequential applications or 4 total applications per season.
Rhizoctonia rot and blight (syn: Wirestem) (*Rhizoctonia solani*)	4 + 11	**Uniform** (mefenoxam + azoxystrobin)	0.34 fl oz/100 ft of row	1.0 lb a.i.	-	-	Not labeled for leafy cole crops or watercress.
	7	**Endura** (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Limit is 2 applications/crop. Suppression only.
	7	**Moncut SC** (flutolanil)	26 fl oz	52 fl oz	45	0.5	Limit is 2 applications.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	See label	4 hr	No more than 2 sequential applications/stem and head crop. Labeled only for suppression in leaf greens.
	11	**Quadris EquationSC Satori** (azoxystrobin)	0.40 to 0.80 fl oz/100 row feet	46 fl oz	0	4 hr	Labeled only for the soilborne control on leaf green brassicas. See label for details on soilborne applications. Dynasty seed treatment is also available; check label for more information.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	Only one application per season.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	12	**Maxim** (fludioxonil)	0.08 to 0.16 fl oz/100 lb of seed		-	0.5	Seed treatment only. Not labeled for turnip or watercress.
	14	**Blocker 4F** **Terraclor 400** **Terraclor 75WP** **Terraclor FL** (PCNB)	See label	30 lb a.i.	-	0.5	Not labeled for leafy cole crops or watercress.
Ring spot (*Mycosphaerella brassicicola*)	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	4 hr	Not labeled for collards, kale, mustard, or watercress; no more than 2 sequential applications/stem and head crop.
	11 + 3	**Quilt** (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	7	0.5	
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more the 3 applications in a season.
Sclerotinia rot (*Sclerotinia* spp.)	7	**Endura** (boscalid)	9 oz	18 oz	Head and stem: 0 Leafy: 14	0.5	Not labeled for watercress; limit is 2 applications/crop.
	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.6 fl oz	0	0.5	No more than 2 sequential applications.
White leaf spot (*Psuedocercosporella capsellae*)	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	4 hr	Not labeled for collards, kale, mustard, or watercress; no more than 2 sequential applications/stem and head crop.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications in a season.
White rust (*Albugo candida*)	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	Head and stem: 0 Leafy: 14	4 hr	No more than 2 sequential applications.
	11	**Quadris** **Equation SC** **Satori** (azoxystrobin)	15.5 fl oz	46 fl oz	0	4 hr	Not labeled for watercress; No more than 1 sequential application.
	11	**Reason** (fenamidone)	8.2 oz	24.6 oz	2	0.5	Limits are no more than 1 sequential application.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz		7	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant is recommended.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	0.5	No more than 2 sequential applications. No more than 3 applications in a season.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 9. Nonfumigant nematicides for crucifer/cole crops in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Mocap 15G (a.i. ethoprop)	Apply 13 pounds per acre (36-inch row spacing) or 0.9 pounds per 1,000 linear feet of row in a band of 15 inches wide on the row at-planting. Mix with the top 2–4 inches of soil with mechanical equipment right after application. If broadcast, apply 34 lb/acre from 1 week before planting to at planting time and mix with 2–4 inches of soil. *Do not* use as a seed furrow treatment or allow granules to contact the seed. Only 1 application per season.
Mocap EC (a.i. ethoprop)	Apply in 12–15 in band on the row, and incorporate 2–4 in deep immediately following treatment. Do not use as a seed furrow treatment or allow spray to contact the seed, because phytotoxicity may occur.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints (56.0 to 80.0 fl oz) per acre a minimum of thirty days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop and no more than 112 fl oz of product per acre per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/acre using only chemigation into root-zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Observe minimum 5-day interval between soil applications. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.

Mocap is an insecticide/nematicide; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations for how to best apply them (see specific label recommendations). When nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.

Table 10. Fumigant nematicides for crucifer/cole crops in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19 to 31.5 gal	57 to 90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.

[1]Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new product label details for additional use restrictions based on soil characteristics, buffer zones, requirements for personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations.
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named and similar products of other brand names when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS725

doi.org/10.32473/edis-cv123-2022

Chapter 7. Cucurbit Production[1]

Mathews L. Paret, Craig Frey, Nathan S. Boyd, Qingren Wang, Johan Desaeger, Jawwad Qureshi, Anna Meszaros, and Xavier Martini[2]

Botany and Planting

Angled or ridged luffa (silk squash, Chinese okra)—*Luffa acutangula*

Bittermelon (Chinese and Indian types)—*Momordica charantia*

Butternut squash—*Cucurbita moschata*

Cantaloupe—*Cucumis melo*

Chayote—*Sechium edule*

Chinese cucumber—*Trichosanthes kirilowii*

Cucumber—*Cucumis sativus,* Cucurbitaceae

Fuzzy melon (immature fruit) and **Winter melon**—*Benincasa hispida*

Long gourd (oopoh)—*Lagenaria siceraria*

Pumpkin (jack-o-lantern is *C. pepo*; some processing pumpkins are *C. maxima* and *C. moschata*)

Smooth luffa—*Luffa aegyptica* (cylindrical)

Snake gourd—*Trichosanthes cucumerina*

Summer squash (crookneck and straight-neck yellow squash)—*Cucurbita pepo*

Tropical pumpkin (calabaza)—*Cucurbita moschata*

Watermelon—*Citrullus lanatus*

Winter squash—*Cucurbita maxima*

Zucchini—*Cucurbita pepo*

1. This document is HS725, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Mathews L. Paret, associate professor, Plant Pathology Department, UF/IFAS North Florida Research and Education Center; Craig Frey, county Extension director and Extension agent II, UF/IFAS Extension Hendry County; Nathan S. Boyd, associate center director and professor, Horticultural Sciences Department, UF/IFAS Gulf Coast REC; Qingren Wang, Extension agent III, UF/IFAS Extension Miami-Dade County; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; Jawwad Qureshi, associate professor, Entomology and Nematology Department, UF/IFAS Southwest Florida REC; Anna Meszaros, Extension agent II, UF/IFAS Extension Palm Beach County; and Xavier Martini, assistant professor, Entomology and Nematology Department, UF/IFAS North Florida REC, Quincy; UF/IFAS Extension, Gainesville, FL 32611.

Table 7.1. Planting information for cucurbits.

Planting Dates	Cucumber	Cantaloupe	Pumpkin	Squash		Watermelon
North Florida	Feb–Apr; July–Aug	Feb–Apr	Early July	Feb–Apr; Aug–Sept		Feb–Apr
Central Florida	Jan–Mar; Sept	Jan–Mar	Mid-July	Jan–Apr; Aug–Sept		Jan–Mar
South Florida	Sept–Feb	Dec–Mar	Early August	Aug–Mar		Dec–Mar
Planting Information				**Bush**	**Vining**	
Distance between rows (in)	48–60	60–72	60–108	36–48	60–108	60–108
Distance between plants (in)	6–12	20–36	36–60	12–24	36–60	24–48
Seeding depth (in)	0.5–0.75	0.5–1.0	1.5–2.0	1.0–1.5	1.5–2.0	1.5–2.0
Seed per acre (lb)	2–4	1–2	4–5	2–3	1–1.5	1–3
Days to maturity from seed	40–65	85–110	80–100	40–50	85–120	80–100
Days to maturity from transplant	NR	70–90	NR	NR		60–90
Plant populations (acre)	21,780	4,356	2,904	11,616	2,904	1,815

NR = Not Recommended

Cultivars

Table 7.2. Cultivars for cantaloupe.

Eastern Shipper			Harper Type		Calabaza (Tropical Pumpkin)
Accolade (H)	Athena (H)	Avatar (H)	Caribbean Gold (H)	Timeless Gold (H)	Agriset 9001 (vining type)
Ariel (H)	Atlantis (H)		Infinite Gold (H)	Damaris (H)	La Estrella (compact plant)

H=hybrid

Table 7.3. Cultivars for cucumber.

Pickling			Slicing		
Calypso (H) (GY)	Jackson Classic (H) (GY)	Supremo (H)	Bristol	Mamba (H) (GY)	SV4719CS* (H) (GY)
Deli King	Jackson Supreme		Cobra (H) (GY)	Mongoose (H) (GY)	
Deli Star	Maxi Pack (H)		Diamondback (H)	Python (H)	
Excursion	Maxi Pick (H)		Dominator (H) (GY)	Speedway (H) (GY)	
Expedition (H)	Powerpak (H) (GY)		Impact (H) (GY)	SV3462CS* (H) (GY)	

Table 7.4. Cultivars for Halloween pumpkin (north Florida only).

Miniature: < 1 lb	Small: 1–5 lb	Medium: 5–10 lb		Large: 10–20 lb		Giant: 25–80 lb
Bumpkin (H)	Hybrid Pam (H)	Autumn Gold (H)	Merlin (H)	Apogee (H)	Magician (H)	Dill's Atlantic Giant
Gold Dust (H)	Pick-A-Pie (H)	Goose Bumps II (H)	October (H)	Connecticut Field	Magic Wand (H)	Prizewinner (H)
Jill-Be-Little	Small Sugar	Jack of All Trades (H)		Early Giant (H)		
Wee-Be-Little (PVP)		Knucklehead (H)		Early King (H)		

PVP=Plant Variety Protection; H=hybrid

Table 7.5. Cultivars for squash.

Summer (yellow)		Acorn	Butternut	
Conqueror III (H) (SN)*	Gold Star (H) (CN)	Mesa Queen (H)	Atlas (H)	Quantam (H)
Enterprise (H) (SN)	Grand Prize (H) (SN)	Royal Ace (H)	Avalon (H)	Ultra (H)
Fortune (H) (SN)	Lazor (H) (SN)	Table Ace (H)	Canesi (H)	Waltham
Gentry (H) (CN)	Lioness (H) (SN)	TayBelle PM (H)	Early Butternut (H)	Zenith (H)
Goldprize (H) (SN)	Smooth Criminal (H) (SN)		Polaris (H)	
Summer (zucchini)				Summer (yellow zucchini)
Cash Machine	Paycheck (H)	Respect (H)	Spineless Perfection (H)	Golden Delight (H) (SN)
Everglades (H)	Payload (H)	Senator (H)		Golden Glory (H) (SN)
Green Machine (H)	Payroll (H)	Spineless Beauty (H)		Goldrush (H) (SN)
Pascola (H)	Renegade (H)	Spineless King (H)		

H=hybrid; type: CN=crookneck, SN=straightneck.
*Biotech: Specific requirements and restrictions apply to these products.

Table 7.6. Cultivars for watermelon.

Diploid		Triploid (seedless, large)			
Estrella (H)	Stargazer (H)	ACX 6177 (H)	Excursion (H)	Road Trip (H)	Sugar Heart (H)
Jamboree (H)	Summer Flavor 720	Black Jack (H)	Fascination (H)	Secretariat (H)	Sweet Gem (H)
Mardi Gras (H)	Summer Flavor 790 (H)	Bottle Rocket (H)	Joy Ride (SV 8298) (H)	SS 7167 (H)	Sweet Polly (H)
Sangria (H)	Summer Flavor 800 (H)	Captivation (H)	Kingman (H)	SS 7177 (H)	Talca (H)
Sentinel (H)	Summer Flavor 8490 (H)	Crisp N' Sweet (H)	Melody (H)	SS 7187 (H)	Traveler (H)
SSX 8585 (H)	Summer Flavor 860	Crunchy Red (H)	Red Amber (H)	SS 7197 (H)	Troubadour (H)
Starbrite (H)	Top Gun (H)	Embassy (H)	Red Garnet (H)	Sugared (H)	Warrior (nun 1009) (H)
	Exclamation (H)				
Nonharvestable Pollenizer		Triploid (seedless, mini)			
Ace Plus	Polimax SP-7	Ana (H)	Extazy (H)	Promesa (H)	
Co-Pilot	Premium Wildcard Plus	Belmont (H)	Leopard (H)	Sirius (H)	
Minipol	SP-6 Wingman	Excite (H)	Ocelot (H)		

H=hybrid

Asian Cucurbits

This group includes cucurbit fruits that can be eaten immature like several other vegetables with edible tender stems and leaves. Matured luffa are not edible, but after peeling off their skin and drying them, they can be used as durable scrubs for dishwashing or showering. All these Asian cucurbits can be grown on raised beds, with or without plastic mulch, and with drip, overhead, or subsurface irrigation. Most of them are well trellised to support the long vines and fruits, primarily to maximize space and sufficient sunlight, to minimize bud drop and fruit rot caused by overshading and exposure to soil moisture and pathogens, and to promote straight fruit. Winter melon is the exception because it is generally too heavy to trellis. Fertilizer recommendations for cucumbers are applicable for fuzzy melon, long gourd, both luffas, Chinese cucumber, bittermelon, and snake gourd. There are two types of bittermelon: Indian and Chinese. The Indian type has smaller fruit with dark-green color and soft, prickled skin, and the Chinese type has longer, larger fruit with light-green color and smooth skin. The Indian type tastes more bitter than the Chinese type. Chinese cucumber, though rarely commercially available, has fruit more than 1 foot long with dark-green color, very thin and rough skin, and crisp texture, similar to European cucumber, but crunchier. Recommendations for watermelon should be followed for winter melon and chayote. With the exception of chayote, where the entire fruit is planted, these crops are started from seed and grown as transplants prior to being set in the field.

Table 7.7. Planting information for Asian cucurbits.

Planting Dates	Bittermelon	Long Gourd	Angled Luffa	Smooth Luffa
North Florida	Feb–Apr; July–Aug	Feb–Apr; July–Aug	Feb–Apr; July–Aug	Feb–Apr; July–Aug
Central Florida	Jan–Mar; Sept	Jan–Mar; Sept	Jan–Mar; Sept	Jan–Mar; Sept
South Florida	Sept–Feb	Sept–Feb	Sept–Feb	Sept–Feb
Planting Information				
Distance between rows (in)	60–72	60–72	60–72	60–72
Distance between plants (in)	36–60	36–60	36–60	36–60
Days to maturity from seed	80–100			
Plant populations (acre)	2904	2904	2904	2904
Planting Dates	**Fuzzy Melon**	**Snake Gourd**	**Chayote**	**Winter Melon**
North Florida	Feb–Apr; July–Aug	Feb–Apr; July–Aug	NR	Feb–Apr
Central Florida	Jan–Mar; Sept	Jan–Mar; Sept	NR	Jan–Mar
South Florida	Sept–Feb	Sept–Feb	Sept–Feb	Dec 15–Mar 1
Planting Information				
Distance between rows (in)	60–72	60–72	60–72	72–108
Distance between plants (in)	36–60	36–60	36–60	36–72
Seeding depth (in)	1.5–2.0	1.5–2.0	Whole fruit is used: cover halfway	1.5–2.0
Seed per acre			2904—whole fruit	
Plant populations (acre)	2904	2904	2904	1452–2420
NR = Not Recommended				

Table 7.8. Cultivars for Asian cucurbits.

Bittermelon (Chinese)*	Bittermelon (Indian)*	Winter Melon	Snake Gourd*	Angled Luffa*
Hong Kong Green	Hybrid India Star	Giant Wax	Buag Ngu	Bonanza
Hybrid Bangkok Large	India Green Long	Hybrid Red Doll	Extra Long Dancer	Buam Liam Hybrid
Japan Green Sprindle	India Green Queen	Hybrid Small Round	Hybrid Snaky	Hybrid Green Glory
Taiwan Large	Palee	Hybrid Wonder Wax	Long EX	Lucky Boy
		Round Tong Gwa	Polo	Summer Long
Smooth Luffa*	**Long Gourd***	**Fuzzy Melon***	**Chayote***	
Dok Hybrid	Bitter Gourd Long	Chiang Shin Joker	The seed is the viviparous fruit itself. There is some debate as to whether varieties remain true. Fruit purchased from grocery stores may not sprout.	
Hybrid Smooth Beauty	Hybrid Asia Short	Mokwa		
Smooth Boy	Hybrid India Long	Mokwa Long		
		Seven Star Long		
* Should be trellised				

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture Extension agents. A list of local UF/IFAS Extension county offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 7.9. Herbicides approved for managing weeds in cucurbit crops. Contact: Nathan S. Boyd, UF/IFAS Gulf Coast Research and Education Center.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.				
		*****PREEMERGENCE*****		
Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	All cucurbits	Annual broadleaf and grass control. Incorporate or irrigate 1 to 2 in. within 36 hr of application. Nonlabeled crops should not be planted within 120 days of application.
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	All cucurbits	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Clomazone 0.15–0.38	(Command) 3 ME 0.4–1 pt	13	Cucumber	Annual broadleaf and grass weeds. Use lower rates on coarse soils. Read label for additional restrictions. 30-day PHI.
Clomazone 0.15–0.25	(Command) 3 ME 0.4–0.67 pt	13	Muskmelon, watermelon	Annual broadleaf and grass weeds. Use lower rates on coarse soils. Read label for additional restrictions.
Clomazone 0.25–0.5	(Command) 3 ME 0.67–1.33 pt	13	Summer squash	Annual broadleaf and grass weeds. Broadcast for bare-ground production; row middles only if growing on plastic. 30-day PHI.
Clomazone 0.25–0.75	(Command) 3 ME 0.67–2 pt	13	Winter squash	Annual broadleaf and grass weeds. Broadcast for bare-ground production; row middles only if growing on plastic. Read labels for cultivar restrictions. 45-day PHI.
Ethalfluralin + Clomazone 0.4–0.6 + 0.13–0.19	(Strategy) 2–3 pt	3 + 13	Cucumbers, melons, summer & winter squash, pumpkin, watermelon	Annual broadleaf and grass control. Must be applied no later than 2 days after seeding. Overhead irrigation or rainfall of 0.5 in. within 5 days. Do not apply under plastic mulch or over top of plants.
Flumioxazin up to 0.125	(Chateau) 51 WDG up to 4 oz	14	Cucumber, muskmelon, watermelon, pumpkins, summer & winter squash	Broadleaf and grass control. Row middles only. Do not apply after crops are transplanted/ seeded. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.
Glyphosate	(various formulations) consult labels	9	All cucurbits	Controls emerged broadleaf, grass weeds, and nutsedge. Consult individual labels for restrictions.
Halosulfuron 0.024	(Sandea) 75 DG 0.5 oz	2	Cantaloupe, cucumber, crenshaw, honeydew	Yellow and purple nutsedge and broadleaf control. Apply after seeding but before soil cracking on bare ground or prior to laying the plastic mulch. Apply uniformly with ground equipment in a minimum of 15 gallons of water/A.
Halosulfuron 0.024–0.036	(Sandea) 75 DG 0.5–0.75 oz	2	Watermelon	Yellow and purple nutsedge and broadleaf control. May be applied preemergence to seeded watermelon on bare ground or preseeding to mulch-cultured watermelon. Transplanting should be no sooner than 7 days after application. Use lighter rates on sandy soils with low organic matter.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
Halosulfuron 0.024–0.036	(Sandea) 75 DG 0.5–0.75 oz	2	Pumpkin, winter squash	Yellow and purple nutsedge and broadleaf control. Apply before soil cracking or pretransplant. Transplanting should not be made sooner than 7 days after application. May be applied POST over the top when plants reach the 4–5 true-leaf stage, but before first female flowers appear.
Paraquat 0.63–0.94	(Gramoxone) 2 SL 2–4 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Cucumber, muskmelon, cantaloupe, pumpkin, squash, watermelon	Controls emerged weeds. Apply prior, during, or after planting, but before crop emergence. Use a nonionic surfactant. Consult label for new restrictions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	All cucurbits	Controls emerged weeds. Apply before emergence of crop. Product is a contact, nonselective, foliar-applied herbicide. There is no residual activity. May be tank-mixed with soil residual herbicides.
Pendimethalin 1	(Prowl H20) 2.1 pt	3	Cantaloupe, citron melon, muskmelon, watermelon	Annual broadleaf and grass weeds. Apply to the row middles only. May be applied as a sequential application with 2.1 pt/A before and 2.1 pt/A after transplanting or seeding, with 21 days between applications. Do not exceed 4.2 pt/A per season.
S-metolachlor 0.95–1.26	(Brawl, Dual Magnum) 1.0–1.33 pt	15	Pumpkin	Annual broadleaf and grass weeds and nutsedge control. Apply as inter-row or inter-hill application. Leave a 1-foot untreated area over the seeded row (6 in. on either side of the row). Use lower rates on lighter soils. Apply before weeds emerge.
***** POSTTRANSPLANT/POSTEMERGENCE *****				
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	All cucurbits	Emerged broadleaf control. Post-direct hooded application to row middles for burndown of emerged broadleaf weeds. Use crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
Clethodim 0.09–0.13 0.07–0.13	(Arrow, Intensity, Select) 2 EC 6–8 oz (Select Max) 1 EC 9–16 fl oz	1	Cucumber, squash, melons, and all commodities in crop group	Annual and perennial grass control. Use a crop oil concentrate at 1% v/v spray volume. Use nonionic surfactant in Select Max. PHI 14 days.
Ethalfluralin + Clomazone	(Strategy) 2–3 pt	3 + 13	Cucumber, melon, summer & winter squash, pumpkin, watermelon	Annual broadleaf and grass control. After transplanting, apply to row middles only. Does not control emerged weeds. PHI 45 days.
Glyphosate	(various formulations) consult labels	9	All cucurbits	Control emerged broadleaf and grass weeds. Apply to row middles only. Use a hooded sprayer to reduce drift. Consult individual labels for restrictions.
Halosulfuron 0.04–0.05	(Sandea) 75 DF 0.5–1 oz	2	Cucumber, cantaloupe, honeydew, crenshaw melon	Apply after the 3–5 true leaf stage (no sooner than 14 days after transplanting) but before the first female flower. Spot spray a POST application if a PRE application was made. Cucumber PHI 30 days. Cantaloupe, honeydew, crenshaw 57 days.
Halosulfuron 0.02–0.05 0.02–0.04	(Sandea) 75 DF 0.5–1.0 oz 0.5–0.75 oz	2	Watermelon, summer squash Pumpkin, winter squash	Nutsedge and broadleaf weeds. Apply to the row middles only. Include a NIS in the spray solution. PHI 57 days in watermelon. PHI 30 days for summer/winter squash and pumpkin.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
Imazosufuron 0.19–0.3	(League) 75 WG 4–6.4 oz	2	Muskmelon, watermelon	Nutsedge and broadleaf weeds. No more than 6.4 oz/A/yr. One application per years. Surfactant is needed if weeds are emerged. Row middles only. PHI 45 days.
Paraquat 0.47–0.93	(Gramoxone) 2 SL 1.88–3.72	22	Cucumber, muskmelon, cantaloupe, pumpkin, squash, watermelon	Controls emerged weeds. Row middles only. Limit of 3 applications per year. Gramoxone SL is a supplemental label consult labels for other paraquat formulations. Consult label for new restrictions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Cucumber, gourd, muskmelon, cantaloupe, pumpkin, squash, watermelon	Controls emerged weeds. Row middles only. Use a shielded sprayer directed to the row middles to reduce drift to the crop.
Pendimethalin 1	(Prowl H20) 2.1 pt	3	Cantaloupe, citron melon, muskmelon, watermelon	Annual broadleaf and grass weeds. Apply to the row middles only. Apply 2.1 pt/A after transplanting or seeding and before vines are off the bed and in the spray area. If a preplant application was applied, do not exceed 4.2 pt/A per season. PHI 35 days.
Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	All cucurbits	Growing grass weeds. Include a crop oil concentrate. Efficacy is decreased if weeds are under stress. Use 1 pt for seedling grasses and 1.5 pt on perennial grasses. PHI 14 days.
S-metolachlor 0.95–1.26	(Brawl, Dual Magnum) 7.62 EC 1.0–1.33 pt	15	Pumpkin	Annual broadleaf and grass weeds and nutsedge. Apply as inter-row or inter-hill application. Leave a 1-foot untreated area over the plant (6 in. on either side of the row). Use lower rates on lighter soils. Apply before weeds emerge. PHI 30 days.
Terbacil 0.1–0.2	(Sinbar) 80 WP 2–4 oz	5	Watermelon	Annual broadleaf weeds. Apply to row middles only. Do not allow contact with plant foliage. Do not exceed 4 oz per year. PHI 70 days.
Trifluralin	(Treflan) 4 EC 1.0 pt (Treflan) TR 10 5 lb	3	All cucurbits	Annual broadleaf and grass control. Apply after crop is 3–4 true leaf stage. Row middles only. PHI 30 days except for watermelon 60 days.
***** POSTHARVEST *****				
Diquat 0.25	(Reglone Dessicant) 1.0 pt	22	Cantaloupe	Minimum of 35 gal/A. Include an NIS. Thorough coverage is required.
Diquat 0.38	(Reglone Dessicant) 1.5 pt	22	Cucumber, watermelon, squash (except acorn)	Minimum of 35 gal/A. Include an NIS. Thorough coverage is required.
Diquat 0.5	(Reglone Dessicant) 2.0 pt	22	Squash (acorn)	Minimum of 35 gal/A. Include an NIS. Thorough coverage is required.

Table 7.10. Insecticides labeled for management of arthropod pests of cucurbit crops. Contact: Xavier Martini, UF/IFAS North Florida Research and Education Center–Quincy.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Aphids	1A	***Lannate LV** (methomyl)	1.5–3 pt	18 pt	48	3	No more than 12 applications per year.
	1A	***Lannate SP** (methomyl)	0.5–1 pt	6 pt	48	3	No more than 12 applications per year.
	1A	***Vydate L** (oxamyl)	2–4 pt	16 pt	48	1	Minimum retreatment interval is 7 days.
	1B	**Dimethoate 4 EC** (dimethoate)	Melons: 1 pt Watermelons: 0.5–1 pt	2 pt per year	48	3	Highly toxic to bees. **Not for squash or cucumber.**
	1B	**Malathion 5EC** **Malathion 8** (malathion)	**5EC:** Cucumber: 1.5–2.8 pt Summer squash: 2.0–2.8 pt Winter squash: 1.6 pt Watermelon: 1.5–2.5 pt Melon: 1.6 pt **8:** Summer squash, winter squash, cucumber: 1.75 pt	**5EC:** Cucumber: 5.6 pt Summer squash: 8.4 pt Winter squash: 4.8 pt Watermelon: 5 pt **8:** Cucumber: 3.5 pt Summer squash, winter squash: 5.25 pt	24	1	**5EC:** Maximum number of applications per year is 2. **8: Squash and cucumbers only.**
	3A	***Athena** (bifenthrin)	7–17 fl oz	51 fl oz	12	7	Do not make more than 2 consecutive applications. Do not apply more than 2 applications after bloom.
	3A	***Brigade 2 EC** (bifenthrin)	2.6–6.4 fl oz	19.2 fl oz	12	3	Do not make more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees. Can be a tank mix with 3–4 oz of Belay insecticide.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4–10.3 oz	41.2 oz	12	3	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	19 fl oz	24	1	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	57 fl oz	12	7	Minimum retreatment interval is 7 days.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	11.0 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	**Admire Pro** (imidacloprid) (see appropriate labels for other brands)	7–10.5 oz **Planthouse:** 0.44 fl oz/10,000 plants	10.5 fl oz	12	**Soil:** 21	**Planthouse:** One application to transplants. See label for use on mature greenhouse cucumbers.
	4A	**Assail 30SG** (acetamiprid)	2.5–4 oz	20.0 oz	12	0	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.
	4A	**Belay Insecticide** (clothianidin)	**Foliar:** 3.0–4.0 fl oz **Soil:** 9.0–12.0 fl oz	12 fl oz	12	**Foliar:** Do not make application after 4th true leaf on main stem is unfolded. **Soil:** 21	Do not apply when plants are blooming.
	4A	**Platinum 75SG** (thiamethoxam)	5–11 fl oz **75SG:** 1.66–3.67 oz	11 fl oz **75SG:** 3.67 oz	12	30	For most crops that are not on the label, a 120-day plant-back interval must be observed. Highly toxic to foraging bees.
	4A	**Safari 20 SG** (dinotefuran)	3.5–7.0 oz	1.34 lb	12		For transplants in greenhouse only.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	1	
	4C	**Closer SC** (sulfoxaflor)	1.5–2.0 fl oz	17 fl oz	12	1	**Highly toxic against pollinators:** Notify known beekeepers within 1 mile of the treatment area. Limit application to times when managed bees and native pollinators are least active.
	4D	**Sivanto Prime** (flupyradifurone)	**Foliar:** 7–14 fl oz **Soil:** 21–28 fl oz	**Foliar:** 28 fl oz **Soil:** 28 fl oz per crop season	4	**Foliar:** 1 **Soil:** 21	**Foliar:** Minimum application interval: 7 days **Soil:** Soil maximum: no more than 3 crop seasons per year.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	10 fl oz	20 fl oz	24	7	Restrictions exist for this product because of risk to pollinators.
	9B	**Fulfill** (pymetrozine)	2.75 oz	5.5 oz	12	0	Minimum of 7 days between applications.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	9.6 fl oz	12	7	7 days before reapplication
	9D	**Sefina** (afidopyropen)	3.0 fl oz	28 fl oz	12	0	Minimum of 7 days between applications. Do not make more than 2 consecutive applications of Sefina. Maintain a 10-foot vegetative filter strip of permanent vegetation between the field edge and aquatic habitat.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	61.6 fl oz	12	1	Do not apply a total of more than 0.4 lb a.i. per acre of cyazypyr- or cyantraniliprole-containing products per crop, either as foliar or soil applications.
	28	**Verimark** (cyantraniliprole)	**At planting:** 10–13.5 fl oz **Drip chemigation:** 10 fl oz	**At planting:** 13.5 fl oz **Drip chemigation:** 20 fl oz (or 10 fl oz if at-plant also used)	4	1	Both at plant and drip chemigation. Do not apply more than 2 drip chemigation applications (one if at-plant application used).
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	8.4 oz	12	0	Begin applications before pests reach damaging levels.
	-	**Azaguard** (azadirachtin)	10–16 fl oz		4	0	Use in combination with 0.25%–1.0% nonphytotoxic crop oil. OMRI-listed.[2]
	-	**Azatin O** (azadirachtin)	10–16 fl oz	16 fl oz	4	0	Antifeedant, repellant, insect growth regulator. Rate depends on pest—see label.
	-	**Grandevo** (*Chromobacterium subtsugae*)	2–3 lb		4	0	OMRI-listed. Can be tank-mixed with a contact insecticide for improved control of targeted pests.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v		12	0	OMRI-listed.[2] Do not apply to stressed plants (high heat or drought conditions).
	-	**SunSpray 98.8%; Ultra-Fine; JMS Stylet Oil; Saf-T-Side; Others** (oil, insecticidal)	1–2 gal/100 gal **JMS:** 3–6 qt/100 gal		4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed.[2]

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Venerate** (*Burkholderia rinojensis*)	2–4 lb		4	0	OMRI-listed. Can be tank-mixed with a contact insecticide for improved control of targeted pests.
Beetles (incl. cucumber beetle and flea beetle)	1A	**Lannate LV** (methomyl)	1.5–3 pt	18 pt	48	3	No more than 12 applications per year.
	1A	**Lannate SP** (methomyl)	0.5–1 pt	12 pt	48	3	No more than 12 applications per year.
	1A	**Sevin 4F, XLR** (carbaryl)	0.5–1.0 qt	6 qt	12	3	Do not apply when plants are wet. Use of carbaryl has been reported to flare (increase) mites. Do not apply to plants in bloom.
	1B	**Malathion 5EC** **Malathion 8** (malathion)	**5EC:** Cucumber: 1.5–2.8 pt Summer squash: 2.0–2.8 pt Winter squash: 1.6 pt Watermelon: 1.5–2.5 pt Melon: 1.6 pt **8:** Summer squash, winter squash, cucumber: 1.75 pt	**5EC:** Cucumber: 5.6 pt Summer squash: 8.4 pt Winter squash: 4.8 pt Watermelon: 5 pt **8:** Cucumber: 3.5 pt Summer squash: 5.25 pt Winter squash: 5.25 pt	24	1	**5EC:** Maximum number of applications per year is 2. **8: Squash and cucumbers only**
	3A	***Baythroid XL** (beta-cyfluthrin)	2.4–2.8 fl oz	11.2 fl oz	12	0	Can be used on all cucurbits in Crop Group 9. Highly toxic to foraging bees.
	3A	***Brigade 2 EC** (bifenthrin)	2.6–6.4 fl oz	19.2 fl oz	12	3	Do not make more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	***Capture LFR** (bifenthrin)	6.8–8.5 fl oz, at planting	8.5 fl oz	12	N/A—applied at planting	At planting, banded over open furrow or in-furrow with seed or transplant.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	76.8 oz Cantaloupe: 51.2 oz	12	0	Use high rate for aphids and squash bug. Highly toxic to foraging bees.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	11.5 fl oz	24	1	Do not apply to blooming crops.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19 oz	24	1	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A + 6	***Gladiator** (avermectin B1 + zeta-cypermethrin)	19 fl oz	57 fl oz	12	7	
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz	24	1	
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	11.0 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	**Admire Pro** (imidacloprid) (see appropriate labels for other brands)	7–10.5 oz	10.5 fl oz	12	21	**Not for planthouse.**
	4A	**Assail 30SG** (acetamiprid)	2.5–5.3 oz	26.5 oz	12	0	No more than 5 applications per season. Toxic to foraging bees.
	4A	**Belay Insecticide** (clothianidin)	**Foliar:** 3.0–4.0 fl oz **Soil:** 9.0–12.0 fl oz	12 fl oz	12	**Foliar:** Do not make application after 4th true leaf on main stem is unfolded. **Soil:** 21	Do not apply when plants are blooming.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	**Foliar:** 10.5 fl oz **Soil:** 21 fl oz	12	**Foliar:** 1 **Soil:** 21	Use only one application method (soil or foliar). Highly toxic to foraging bees for more than 38 hours after application. See label.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz	6 oz	12	**Foliar:** 1	Highly toxic to foraging bees. Use only foliar application for beetles. Note that pests controlled differ depending on application method.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	1	
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	36 fl oz	12	1	Do not apply more often than every 14 days.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	61.6 fl oz	12	1	Do not apply a total of more than 0.4 lb a.i. per acre of cyazypyr- or cyantraniliprole-containing products per crop, either as foliar or soil applications.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Grandevo** (*Chromobacterium subtsugae*)	2–3 lb		4	0	
	-	**Venerate** (*Burkholderia rinojensis*)	2–4 lb		4	0	
Caterpillars (incl. armyworms, cabbage looper, corn earworm, cutworm, melonworm, pickleworm)	1A	**Lannate LV** (methomyl)	1.5–3 pt	18 pt	48	3	No more than 12 applications per year.
	1A	**Lannate SP** (methomyl)	0.5–1 pt	12 pt	48	3	No more than 12 applications per year.
	1A	**Sevin 4F, XLR** (carbaryl)	0.5–1.0 qt	6 qt	12	3	Do not apply when plants are wet. Use of carbaryl has been reported to flare (increase) mites. Do not apply to plants in bloom. Pickleworm and melonworm only.
	1B	**Malathion 5EC** **Malathion 8** (malathion)	**5EC:** Cucumber: 1.5–2.8 pt Summer squash: 2.0–2.8 pt Winter squash: 1.6 pt Watermelon: 1.5–2.5 pt Melon: 1.6 pt **8:** Summer squash, winter squash, cucumber: 1.75 pt	**5EC:** Cucumber: 5.6 pt Summer squash: 8.4 pt Winter squash: 4.8 pt Watermelon: 5 pt **8:** Cucumber: 3.5 pt Summer squash, winter squash: 5.25 pt	24	1	**5EC:** Maximum number of applications per year is 2. **8: Squash and cucumbers only.**
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	1.2 lb Cantaloupe: 0.8 lb	12	0	Do not apply more than 8 applications at the highest rate per season. Highly toxic to bees.
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	5.8–9.6 fl oz	48 fl oz	12	3	Do not apply more than 5 applications at high rate. For cucumber, melons, pumpkin, summer and winter squash. Highly toxic to foraging bees.
	3A	***Athena** (bifenthrin)	7–17 fl oz	51 fl oz	12	7	Do not make more than 2 consecutive applications. Do not apply more than 2 applications after bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	11.2 fl oz	12	0	Can be used on all cucurbits in Crop Group 9. Highly toxic to foraging bees.
	3A	***Brigade 2 EC** (bifenthrin)	2.6–6.4 fl oz	19.2 fl oz	12	3	Do not make more than 2 applications after bloom. Highly toxic to foraging bees.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Capture LFR** (bifenthrin)	3.4–6.8 fl oz, at planting	8.5 fl oz	12	N/A—applied at planting	At planting, banded over open furrow or in-furrow with seed or transplant.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4 -10.3 oz	41.2 oz	12	3	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	***Mustang** (zeta-cypermethrin)	3.0–4.3 oz	25.8 fl oz	7	12	Do not make applications less than 7 days apart.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	76.8 oz Cantaloupe: 51.2 oz	12	0	Use high rate for aphids and squash bug. Highly toxic to foraging bees.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	11.5 fl oz	24	1	Do not apply to blooming crops.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4–4.5 fl oz	19 fl oz	24	1	
	3A + 6	***Gladiator** (avermectin B1 + zeta-cypermethrin)	19 fl oz	57 fl oz	12	7	
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz	24	1	No more than 4 applications per year.
	4A	**Assail 30SG** (acetamiprid)	2.5–5.3 oz	26.5 oz	12	0	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	1	
	5	**Radiant SC** (spinetoram)	5–10 fl oz	34 fl oz	4	3 Cucumbers: 1	No more than 6 applications. Toxic to bees for up to 3 hours following application.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	6	***Proclaim** (emamectin benzoate)	3.0–4.8 fl oz	14.4 fl oz	12	7	Apply this product diluted in a minimum volume of 10 gal/A. No more than 2 consecutive applications.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz	24	7	Restrictions exist for this product because of risk to pollinators.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb		4	0	Apply when larvae are small for best control. OMRI-listed.[2]
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.[2]
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	Use high rate for armyworms. Treat when larvae are young. Genetically engineered strain of *Bt*-containing toxins from both *Bt kurstaki* and *Bt aizawai* strains. Not for organic production.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb		4	0	Use higher rates for armyworms. OMRI-listed.[2]
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	Treat when larvae are young. Good coverage is essential. For organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.50 lb		4	0	Treat when larvae are young. Thorough coverage is essential. Use higher rates for armyworms. OMRI-listed.[2]
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb		4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	12 fl oz	36 fl oz	12	1	Do not apply more often than every 14 days.
	18	**Intrepid 2F** (methoxyfenozide)	4–10 fl oz	64 fl oz	4	3	Do not make more than 4 applications per season.
	22	**Avaunt** (indoxacarb)	2.5–6.0 oz	24 oz	12	3	Highly toxic to foraging bees. Do not apply this product or allow it to drift to blooming crops or weeds while bees are foraging in the treatment area. The minimum interval between sprays is 5 days.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	28	**Coragen** (chlorantraniliprole)	**Drip:** 2.0–7.5 fl oz **Soil at planting:** 3.5–7.5 **Foliar:** 2.0–7.0	15.4 fl oz **Combined at-plant and drip chemigation soil application:** 10 fl oz	4	1	May be applied through drip (chemigation), as well as to soil at planting, or as a foliar spray.
	28	**Exirel** (cyantraniliprole)	7.0–13.5 fl oz	61.6 fl oz	12	1	Do not apply a total of more than 0.4 lb a.i. per acre of cyazypyr- or cyantraniliprole-containing products per crop, either as foliar or soil applications.
	28	**Verimark** (cyantraniliprole)	**At planting:** 6.75–13.5 fl oz **Drip chemigation:** 5–10 fl oz	**At planting:** 13.5 fl oz **Drip chemigation:** 20 fl oz (or 10 fl oz if at-plant also used)	4	1	Both at-plant and drip chemigation. Do not apply more than 2 drip chemigation applications (one if an at-plant application is used).
	-	**Grandevo** (*Chromobacterium subtsugae*)	2–3 lb		4	0	OMRI-listed.[2] Can be tank-mixed with a contact insecticide for improved control of targeted pests.
	-	**Venerate** (*Burkholderia rinojensis*)	2–4 lb		4	0	OMRI-listed.[2] Can be tank-mixed with a contact insecticide for improved control of targeted pests.
Fire ants	6	**Clinch** (abamectin)	1 lb in broadcast application or 5 tablespoon per mount	4 lb		0	Do not apply if rainfall may occur in the next 6 hours. Ants need to be actively foraging.
	7A	**Extinguish** (S-methoprene)	0.75 lb		4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb	2.0 lb	12	1	Apply when ants are actively foraging.
Leafminers	1A	**Vydate L** (oxamyl)	2–4 pt	12 pt	48	1	Minimum retreatment interval is 7 days.
	1B	**Dimethoate 4 EC** (dimethoate)	Melons: 1 pt Watermelons: 0.5–1 pt	2 pt per year	48	3	Highly toxic to bees. **Not for squash or cucumber.**
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	1.2 lb Cantaloupe: 0.8 lb	12	0	Do not apply more than 8 applications at the highest rate per season. Highly toxic to bees.
	3A	***Athena** (bifenthrin)	13.5–17 fl oz	51 fl oz	12	7	Do not make more than 2 consecutive applications. Do not apply more than 2 applications after bloom.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.
	3A + 6	***Gladiator** (avermectin B1 + zeta-cypermethrin)	19 fl oz	57 fl oz	12	7	
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz	24	1	No more than 4 applications per year
	4A	**Belay Insecticide** (clothianidin)	**Foliar:** 3.0–4.0 fl oz **Soil:** 9.0–12.0 fl oz	12 fl oz	12	**Foliar:** Do not make application after 4th true leaf on main stem is unfolded. **Soil:** 21	Do not apply when plants are blooming.
	4A	**Safari 20 SG** (dinotefuran)	3.5–5.0 fl oz	1.34 lb			For transplants in greenhouse only.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	**Foliar:** 10.5 fl oz **Soil:** 21 fl oz	12	**Foliar:** 1 **Soil:** 21	Use only one application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for more than 38 hours after application. See label.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–7.5 oz	**Foliar:** 6 oz **Soil:** 12 oz	12	**Foliar:** 1 **Soil:** 21	Highly toxic to foraging bees. Use only one application method (soil or foliar). Note that pests controlled differ depending on application method.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	34 fl oz	4	3 Cucumbers: 1	No more than 6 applications. Toxic to bees for up to 3 hours following application.
	6	***Agri-Mek SC** (abamectin)	1.75–3.50 fl oz	10.25 fl oz	12	7	No more than 2 sequential applications. **Must** be mixed with an adjuvant—see label for types. Highly toxic to foraging bees.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz	24	7	Restrictions exist for this product due to risks for pollinators. Apply as soon as leafminers are observed on the leaves.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	36 fl oz	12	1	Do not apply more often than every 14 days.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	17	**Trigard** (cyromazine)	2.66 oz	15.96 oz	12	0	Do not make more than six applications.
	28	**Coragen** (chlorantraniliprole)	**Drip:** 2.0–7.5 fl oz **Soil at planting:** 3.5–7.5 fl oz **Foliar:** 2.0–7.0 fl oz	15.4 fl oz **Combined at-plant and drip chemigation soil application:** 10 fl oz	4	1	May be applied through drip (chemigation), as well as to soil at planting, or as a foliar spray.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	61.6 fl oz	12	1	Do not apply a total of more than 0.4 lb a.i. per acre of cyazypyr- or cyantraniliprole-containing products per crop, either as foliar or soil applications.
	28	**Verimark** (cyantraniliprole)	**At planting:** 6.75–13.5 fl oz **Drip chemigation:** 5–10 fl oz	**At planting:** 13.5 fl oz **Drip chemigation:** 20 fl oz (or 10 fl oz if at-plant also used)	4	1	Both at plant and drip chemigation. Do not apply more than 2 drip chemigation applications (one if an at-plant application is used).
	-	**Azaguard** (azadirachtin)	10–16 fl oz		4	0	Use in combination with 0.25%–1.0% nonphytotoxic crop oil. OMRI-listed.[2]
Mites	1B	**Malathion 5EC** **Malathion 8** (malathion)	**5EC:** Cucumber: 1.5–2.8 pt Summer squash: 2.0–2.8 pt Winter squash: 1.6 pt Watermelon: 1.5–2.5 pt Melon: 1.6 pt **8:** Summer squash, winter squash, cucumber: 1.75 pt	**5EC:** Cucumber: 5.6 pt Summer squash: 8.4 pt Winter squash: 4.8 pt Watermelon: 5 pt **8:** Cucumber: 3.5 pt Summer squash, winter squash: 5.25 pt	24	1	**5EC:** Maximum number of applications per year is 2. **8: Squash and cucumbers only.**
	3A	***Athena** (bifenthrin)	13.5–17 fl oz	51 fl oz	12	7	Do not make more than 2 consecutive applications. Do not apply more than 2 applications after bloom.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	10.3 oz	41.2 oz	12	3	Do not make more than 4 applications per season. Do not make applications less than 10 days apart
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	6	***Agri-Mek SC** (abamectin)	1.75–3.50 fl oz	10.25 fl oz	12	7	No more than 2 sequential applications. **Must** be mixed with an adjuvant—see label for types. Highly toxic to foraging bees.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	20 fl oz	24	7	Restrictions exist for this product because of risk to pollinators. Apply as soon as mites are observed.
	10B	**Zeal** (etoxazole)	2.0–3.0 oz	3.0 oz Cucumbers: 6 oz	12	7	Apply when populations are low. One application per season, except two for cucumbers (supplemental label).
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	62 fl oz	12	1	Do not apply more than twice per season. Do not apply by air. **Melons, watermelon, and cucumbers only.**
	20D	**Acramite-50WS** (bifenazate)	0.75–1.0 lb	1.0 lb	12	3	One application per season.
	21A	**Portal XLO** (fenpyroximate)	1.0–2.0 pt	4.0 pt	12	3 Cucumbers: 1	**All melons, watermelon, and cucumbers.** Two applications per season. Effective for broad mite control.
	23	**Oberon 2SC** (spiromesifen)	7.0–8.5 fl oz	25.5 fl oz	12	7	No more than 3 applications. See label for plant-back intervals.
	-	**Azaguard** (azadirachtin)	10–16 fl oz		4	0	Use in combination with 0.25%–1.0% nonphytotoxic crop oil. OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae*)	2–3 lb		4	0	OMRI-listed. Can be tank-mixed with a contact insecticide for improved control of targeted pests.
	-	**Venerate** (*Burkholderia rinojensis*)	2–4 lb		4	0	OMRI-listed. Can be tank-mixed with a contact insecticide for improved control of targeted pests.
Squash bug, leaf-footed bug	1A	**Sevin 4F, XLR** (carbaryl)	0.5–1.0 qt	6 qt	12	3	Do not apply when plants are wet. Use of carbaryl has been reported to flare (increase) mites. Do not apply to plants in bloom.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	1.2 lb Cantaloupe: 0.8 lb	12	0	Do not apply more than 8 applications at the highest rate per season. Highly toxic to bees.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8–9.6 fl oz	48 fl oz	12	7	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Athena** (bifenthrin)	13.5–17 fl oz	51 fl oz	12	7	Do not make more than 2 consecutive applications. Do not apply more than 2 applications after bloom.
	3A	***Brigade 2 EC** (bifenthrin)	2.6–6.4 fl oz	19.2 fl oz	12	3	Do not make more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–16 fl oz	42.67 fl oz	24	7	Highly toxic to foraging bees.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.0–10.3 oz	41.2 oz	12	3	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	76.8 oz Cantaloupe: 51.2 oz	12	0	Use high rate for aphids and squash bug. Highly toxic to foraging bees.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	11.5 fl oz	24	1	Do not apply to blooming crops.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	19 fl oz	24	1	
	3A + 6	***Gladiator** (avermectin B1 + zeta-cypermethrin)	19 fl oz	57 fl oz	12	7	
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	31 fl oz	24	1	No more than 4 applications per year.
	4A	**Assail 30SG** (acetamiprid)	5.3 oz	26.5 oz	12	0	No more than 5 applications per season. Do not use with other group 4A insecticides. Application for squash bug are most effective against newly laid eggs and nymphs. Toxic to foraging bees.
	4A	**Belay Insecticide** (clothianidin)	**Foliar:** 3.0–4.0 fl oz **Soil:** 9.0–12.0 fl oz	12 fl oz	12	**Foliar:** Do not make application after 4th true leaf on main stem is unfolded. **Soil:** 21	Do not apply when plants are blooming.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	**Foliar:** 10.5 fl oz **Soil:** 21 fl oz	12	**Foliar:** 1 **Soil:** 21	Use only one application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for more than 38 hours after application.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6 oz	**Foliar:** 6 oz **Soil:** 12 oz	12	**Foliar:** 1 **Soil:** 21	Highly toxic to foraging bees. Use only one application method (soil or foliar). Note that pests controlled differ depending on application method.
	4D	**Sivanto Prime** (flupyradifurone)	**Foliar:** 7–14 fl oz **Soil:** 21–28 fl oz	**Foliar:** 28 fl oz **Soil:** 28 fl oz per crop season	4	**Foliar:** 1 **Soil:** 21	**Foliar:** Minimum application interval: 7 days **Soil:** Soil maximum: no more than 3 crop seasons per year.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	36 fl oz	12	1	Do not apply more often than every 14 days.
Thrips (check label for species controlled)	1A	**Vydate L** (oxamyl)	2–4 pt	12 pt	48	1	Minimum retreatment interval is 7 days
	1B	**Dimethoate 4 EC** (dimethoate)	Melons: 1 pt Watermelons: 0.5–1 pt	2 pt per year	48	3	Highly toxic to bees. **Not for squash or cucumber.**
	4A	**Admire Pro** (imidacloprid) (see appropriate labels for other brands)	7–10.5 oz	10.5 fl oz	12	**Soil:** 21	Do not use with other Group 4A insecticides. **Not for planthouse.** Only for foliage feeding thrips; will not control thrips feeding on flowers.
	4A	**Platinum 75SG** (thiamethoxam)	5–11 fl oz **75SG:** 1.66–3.67 oz	11 fl oz **75SG:** 3.67 oz	12	30	For most crops that are not on the label, a 120-day plant-back interval must be observed. Highly toxic to foraging bees.
	4A	**Safari 20 SG** (dinotefuran)	3.5–5.5 fl oz	1.34 lb	12		For transplants in the greenhouse only.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	**Foliar:** 10.5 fl oz **Soil:** 21 fl oz	12	**Foliar:** 1 **Soil:** 21	Use only one application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for more than 38 hours after application. See label.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–7.5 oz	**Foliar:** 6 oz **Soil:** 12 oz	12	**Foliar:** 1 **Soil:** 21	Highly toxic to foraging bees. Use only one application method (soil or foliar). Note that pests controlled differ depending on application method.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13 fl oz	12	30	
	5	**Entrust SC** (spinosad)	6–8 fl oz	29 fl oz	1	4	No more than 5 applications per year. OMRI-listed.
	5	**Radiant SC** (spinetoram)	6–10 fl oz	34 fl oz	4	3 Cucumbers: 1	No more than 6 applications. Toxic to bees for up to 3 hours following application.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	61.6 fl oz	12	1	Do not apply a total of more than 0.4 lb a.i. per acre of cyazypyr- or cyantraniliprole-containing products per crop, either as foliar or soil applications.
	-	**Azaguard** (azadirachtin)	10–16 fl oz		4	0	Use in combination with 0.25%–1.0% nonphytotoxic crop oil. OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae*)	2–3 lb		4	0	OMRI-listed. Can be tank-mixed with a contact insecticide for improved control of targeted pests.
	-	**Venerate** (*Burkholderia rinojensis*)	2–4 lb		4	0	OMRI-listed. Can be tank-mixed with a contact insecticide for improved control of targeted pests.
Whitefly	1B	***Diazinon AG500 50W** (diazinon)	**AG500:** 2–4 qt **50W:** 4–8 lb	**AG500:** 4 qt **50W:** 8 lb	72	preplant	**Melons and watermelons only.** Not for squash or cucumbers. One application per year.
	3A	***Athena** (bifenthrin)	13.5–17 fl oz	51 fl oz	12	7	Only for adults. Do not make more than 2 consecutive applications. Do not apply more than 2 applications after bloom.
	3A	***Brigade 2 EC** (bifenthrin)	2.6–6.4 fl oz	19.2 fl oz	12	3	Do not make more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	***Capture LFR** (bifenthrin)	3.4–8.5 fl oz, at planting	8.5 fl oz	12	N/A—applied at planting	At planting, banded over open furrow or in-furrow with seed or transplant.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	10.3 oz	41.2 oz	12	3	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Actara** (thiamethoxam)	1.5–5.5 oz	11.0 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	**Admire Pro** (imidacloprid) (see appropriate labels for other brands)	7–10.5 oz **Planthouse:** 0.44 fl oz/10,000 plants	10.5 fl oz	12	Soil: 21	Do not use with other Group 4A insecticides. **Planthouse:** One application to transplants. See label for use on mature greenhouse cucumbers.
	4A	**Assail 30SG** (acetamiprid)	2.5–5.3 oz	26.5 oz	12	0	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.
	4A	**Platinum 75SG** (thiamethoxam)	5–11 fl oz **75SG:** 1.66–3.67 oz	11 fl oz **75SG:** 3.67 oz	12	30	For most crops that are not on the label, a 120-day plant-back interval must be observed. Highly toxic to foraging bees.
	4A	**Safari 20 SG** (dinotefuran)	3.5–5.5 fl oz	1.34 lb	12		For transplants in the greenhouse only.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	**Foliar:** 10.5 fl oz **Soil:** 21 fl oz	12	**Foliar:** 1 **Soil:** 21	Use only one application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for more than 38 hours after application. See label.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–7.5 oz	**Foliar:** 6 oz **Soil:** 12 oz	12	**Foliar:** 1 **Soil:** 21	Highly toxic to foraging bees. Use only one application method (soil or foliar). Note that pests controlled differ depending on application method.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	13 oz	12	30	
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz	12	1	
	4C	**Closer SC** (sulfoxaflor)	4.25–4.5 fl oz	17 fl oz	12	1	**Highly toxic against pollinators:** Notify known beekeepers within 1 mile of the treatment area. Limit application to times when managed bees and native pollinators are least active.
	4D	**Sivanto Prime** (flupyradifurone)	**Foliar:** 10.5–14 fl oz **Soil:** 21–28 fl oz	**Foliar:** 28 fl oz **Soil:** 28 fl oz per crop season	4	**Foliar:** 1 **Soil:** 21	**Foliar:** Minimum application interval: 7 days. **Soil:** Soil maximum: no more than 3 crop seasons per year.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	10 fl oz	20 fl oz	24	7	Restrictions exist for this label because of risks to pollinators.
	7C	**Knack IGR** (pyriproxyfen)	8–10 fl oz	20 fl oz	12	7	Immatures only. Apply when nymphs first appear. Do not apply more than twice per growing season.
	9B	**Fulfill** (pymetrozine)	2.75 oz	5.5 oz	12	0	Minimum of 7 days between applications.
	9B	**PQZ** (pyrifluquinazon)	3.2 fl oz	9.6 fl oz	12	7	7 days before reapplication
	9D	**Sefina** (afidopyropen)	14 fl oz	28 fl oz	12	0	Minimum of 7 days between applications. Maintain a 10-foot vegetative filter strip of permanent vegetation between the field edge and aquatic habitat.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	36 fl oz	12	1	Do not apply more often than every 14 days.
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	7	Immatures only. Insect growth regulator. Do not make more than 2 applications per season per crop or 4 per year.
	23	**Oberon 2SC** (spiromesifen)	7.0–8.5 fl oz	25.5 fl oz	12	7	No more than 3 applications.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	61.6 fl oz	12	1	Do not apply a total of more than 0.4 lb a.i. per acre of cyazypyr- or cyantraniliprole-containing products per crop, either as foliar or soil applications.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	**At planting:** 13.5 fl oz **Drip chemigation:** 20 fl oz (or 10 fl oz if at-plant also used)	4	1	Both at-plant and drip chemigation. Do not apply more than 2 drip chemigation applications (one if at-plant application is used).
	-	**Grandevo** (*Chromobacterium subtsugae*)	2–3 lb		4	0	OMRI-listed. Can be tank-mixed with a contact insecticide for improved control of targeted pests.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v		12	0	OMRI-listed.[2] Do not apply to stressed plants (high heat or drought conditions).
	-	**Venerate** (*Burkholderia rinojensis*)	2–4 lb		4	0	OMRI-listed. Can be tank-mixed with a contact insecticide for improved control of targeted pests.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2, March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet. [2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.							
***Restricted use insecticide.**							

Table 7.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Mathews L. Paret, UF/IFAS North Florida Research and Education Center–Quincy.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Alternaria leaf spot/blight	M1	(copper compounds) **Many brands available:** AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, BluLogic, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Grotto, Instill, Kalmor, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCu, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75WG, Nu-Cop 30 HB, Nu-Cop 3L, Nu-Cop 50 DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	See label	See label	1	Varies from 4 hr to 2 days	Check label for specific guidelines.
	M1 + M3	**ManKocide** (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.
	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75 WDG, Koverall, Mancozeb 75 WDG, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for specific guidelines.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6 L, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot and other environmental conditions as indicated on the label.
	M5 + 27	**Ariston** **Cymbol Advance** (chlorothalonil + cymoxanil)	3 pt	17.5 pt/ year	3	0.5	Apply preventatively when conditions are favorable for disease outbreak. Do not apply to mature watermelons under dry, hot, or other environmental conditions as indicated on the label.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/year	0	0.5	Check label for additional guidelines. Make no more than 2 sequential applications before rotating to a fungicide with different mode of action.
	P4	**Vacciplant** (laminarin)	22 fl oz	See label	0	4 hr	Initiate as preventative application.
	3	**Mettle 125 ME** (tetraconazole)	8 fl oz	24 fl oz/ year	1	0.5	Make no more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3 + 9	**Inspire Super** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz/ year	7	0.5	Do not make more than two consecutive applications. Greenhouse use only for cucumber.
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	Limit is 4 appl./crop
	7	**Endura** (boscalid)	6.5 oz	26 oz/ year	0	0.5	
	7	**Fontelis** (penthiopyrad)	16 fl oz	67 fl oz/ year	1	0.5	Maximum rate is for year. Do not make more than 2 appl. sequentially with any FRAC 7 containing fungicide. See label for rates for greenhouse use.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz/ year	0	0.5	See label for guidelines.
	7 + 3	**Luna Experience** (fluopyram + tebuconazole)	17 fl oz	34 fl oz/ year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz/ year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz/ year	0	0.5	See label.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	18.5 oz	74 oz/year	0	0.5	See label.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz/ year	1	0.5	Do not make more than two applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.
	9	**Vango WG** (cyprodinil)	7 oz	28 oz/year	1	0.5	Alternate with fungicide in another FRAC group after 2 applications.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	9 + 12	**Alterity 62.5** **Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz/year	1	0.5	Do not make more than two consecutive applications.
	11	(azoxystrobin) **Many brands available:** Acadia 2 SC, Aframe, Arius 250, A-Zox 25SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxyzone, AZteroid FC, AZteroid FC 3.3, Cadera, Dexter SC, Gold Rush, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	Limit is 4 appl./crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	**Evito 480 SC** **Tepera** (fluoxastrobin)	See label	See label	See label	See label	
	11	**Reason 500 SC** (fenamidone)	5.5 fl oz	22 fl oz/ year	14	0.5	Do not make more than one application of Reason 500 SC Fungicide before alternating with a fungicide from a different resistance management group.
	11 + M3	**Dexter Max** (mancozeb + azoxystrobin)	3.2 lb	12.8 lb/year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank mixing. Do not apply more than one application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	11 + M5	**Arius ADV** **Quadris Opti** (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl./crop for all QoI fungicides. Do not make more than one consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on label.
	11 + 3	**Acadia ESQ** **Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz/ year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	**Mural** (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	12	**Emblem** **Spirato** (fludioxonil)	7 fl oz	28 fl oz/ year	1	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	19	**Affirm WDG** **PH-D** (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2 lb	16 lb/year	5	2	Limit is 8 appl./crop. Some cantaloupes are sensitive. See label.
	22 + M5	**Zing** (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	See label	3	0.5	Limit is 4 appl./crop. Must tank-mix with a contact fungicide.
	29	**Lektivar 40 SC** **Omega 500 F** **Orbus 4 F** **Omavo** **Oxelid 4 F** (fluazinam)	24 fl oz	See label	See label	0.5	See label for crop-specific guidelines.
	33	**K-Phite** **Fungi-Phite** **Reliant** (phosphorous acid and salts)	See label	See label	0	4 hr	Check label for guidelines on foliar and aerial application, as well as preventative and control programs. Do not apply at less than 3 days interval. Check label to see whether it is suppression of disease only.
Angular leaf spot	M1	(copper compounds) **Many brands available:** AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, BluLogic, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Grotto, ET-F, Instill, Kalmor, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCu, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75WG, Nu-Cop 3L, Nu-Cop 30 HB, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto, Stretch	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. See label for details.
	P1	**Actigard 50WG** (acibenzolar-S-methyl)	1 oz	8 oz/year	0	0.5	Apply preventatively prior disease development. Suppression of disease.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Anthracnose	M1	(copper compounds) **Many brands available:** AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, BluLogic, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, C-O-C-S WDG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Grotto, ET-F, Instill, Kalmor, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCu, KOP-5, Kop-Hydroxide, MasterCop, Nordox 50WP, Nordox 75WG, Nu-Cop 3L, Nu-Cop 30 HB, Nu-Cop 50 DF, Nu-Cop HB, Nu-Cop XLR, Previsto, Stretch	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. See label for details.
	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.
	M3 + 11	**Dexter Max** (mancozeb + azoxystrobin)	3.2 lb	12.8 lb/year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank mixing. Do not apply more than one application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions indicated on the label.
	M5 + 4	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	Limit is 4 appl./crop.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M5 + 27	**Ariston Cymbol Advance** (chlorothalonil + cymoxanil)	3 pt	17.5 pt/ year	3	0.5	Spraying on mature watermelon may cause sun burn.
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/year	0	0.5	Check label for additional guidelines. Make no more than 2 sequential applications before rotating to a fungicide with different mode of action.
	1	(thiophanate-methyl) **Many brands available:** 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85 WDG, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP, Talaris 4.5F, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label. Check label for additional guidelines.
	3 + 9	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	80 fl oz/ year	7	0.5	Do not make more than two consecutive applications. See label for greenhouse use only for cucumber.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz/ year	0	0.5	See label for guidelines.
	7 + 3	**Luna Experience** (fluopyram + tebuconazole)	17 fl oz	34 fl oz/ year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz/ year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz/ year	0	0.5	See label.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	18.5 oz	74 oz/year	0	0.5	See label.
	11	(azoxystrobin) **Many brands available:** Acadia 2 SC, Aframe, A-Zox 25 SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxyzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	Limit is 4 appl./crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplant production. See label for details.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Evito 480 SC** **Tepera** (fluoxastrobin)	See label	See label	See label	See label	
	11 + M5	**Arius ADV** **Quadris Opti** (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl./crop for all QoI fungicides. Do not make more than one consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on label.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz/ year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	**Mural** (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	19	**Oso 5% SC** (polyoxin D zinc salt)	13.0 fl oz	See label	0	4 hr	
	22 + M5	**Zing** (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	See label	3	0.5	Limit is 4 appl./crop. Must tank-mix with a contact fungicide. See label.
Bacterial fruit blotch	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 53, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Grotto, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCu, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75 WG, Nu-Cop, Nu-Cop 3L, Nu-Cop 30HB, Nu-Cop 50 DF, Nu-Cop 50 WP, Nu-Cop HB, Previsto, Stretch	See label	See label	1	Varies from 4 hr to 2 days	Suppression only. Check label for crop-specific guidelines.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. See label for details.
	P1	**Actigard 50WG** (acibenzolar-S-methyl)	1 oz	8 oz/year	0	0.5	Apply preventatively prior disease development. Suppression of disease.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	27 + 11	**Tanos** (cymoxanil + famoxadone)	10 oz	See label	3	0.5	Limit is 4 appl./crop. Must tank-mix with a contact fungicide. Bacterial fruit blotch disease suppression only.
Belly rot	M3 + 11	**Dexter Max** (mancozeb + azoxystrobin)	3.2 lb	12.8 lb/year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank mixing. Do not apply more than one application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	1	(thiophanate-methyl) **Many brands available:** 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85WDG, Miramar, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP, Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz/ year	0	0.5	See label for guidelines.
	7 + 3	**Luna Experience** (fluopyram + tebuconazole)	17 fl oz	34 fl oz/ year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz/ year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	11	(azoxystrobin) **Many brands available:** Acadia 2 SC, Aframe, A-Zox 25SC, Azoxy 2 SC, Azoxy 2SC Prime, AzoxyStar, Azoxyzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	Limit is 4 appl./crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	**Evito 480 SC** **Tepera** (fluoxastrobin)	See label	See label	See label	See label	
	11 + M5	**Arius ADV** **Quadris Opti** (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl./crop for all QoI fungicides. Do not make more than one consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on label.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz/ year	1	0.5	Must be rotated with a non-Qol-containing fungicide.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	19	**PH-D** (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	
Cercospora leaf spot	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.
	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.
	M3 + 11	**Dexter Max** (mancozeb + azoxystrobin)	3.2 lb	12.8 lb/year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank mixing. Do not apply more than one application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions indicated in the label.
	M5 + 4	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	Limit is 4 appl./crop.
	M5 + 27	**Ariston Cymbol Advance** (chlorothalonil + cymoxanil)	3 pt	17.5 pt/ year	3	0.5	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/year	0	0.5	Check label for additional guidelines. Make no more than 2 sequential applications before rotating to a fungicide with different mode of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	**Mettle 125 ME** (tetraconazole)	8 fl oz	24 fl oz/ year	1	0.5	Make no more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3 + 9	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	80 fl oz/ year	7	0.5	Do not make more than two consecutive applications. See label for greenhouse use only for cucumber.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz/ year	0	0.5	See label for guidelines.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz/ year	0	0.5	See label.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	18.5 oz	74 oz/year	0	0.5	See label.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz/ year	1	0.5	Do not make more than two applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.
	11	(azoxystrobin) **Many brands available:** Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxyzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	Limit is 4 appl./crop & alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	**Evito 480 SC** **Tepera** (fluoxastrobin)	See label	See label	See label	See label	
	11 + M5	**Arius ADV** **Quadris Opti** (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl./crop for all QoI fungicides. Do not make more than one consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on label.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz/ year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	**Mural** (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2 lb	16 lb/year	5	2	Limit is 8 appl./crop. Some cantaloupes are sensitive. See label.
	22 + M5	**Zing** (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	
Downy mildew	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 53, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Grotto, Instill, Kalmor, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCu, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75 WG, Nu-Cop, Nu-Cop 3L, Nu-Cop 30HB, Nu-Cop 50 DF, Nu-Cop 50 WP, Nu-Cop HB, Previsto, Stretch	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
	M1 + M2	**Top Cop w Sulfur** (copper + sulfur)	1 qt	See label	-	1	Do not apply if air temperatures greater than 90°F are expected.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.
	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.
	M3 + 11	**Dexter Max** (mancozeb + azoxystrobin)	3.2 lb	12.8 lb/year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank mixing. Do not apply more than one application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions indicated in the label.
	M5 + 27	**Ariston Cymbol Advance** (chlorothalonil + cymoxanil)	3 pt	17.5 pt/ year	3	0.5	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/year	0	0.5	Check label for additional guidelines. Make no more than 2 sequential applications before rotating to a fungicide with different mode of action.
	P1	**Actigard 50WG** (acibenzolar-S-methyl)	1 oz	8 oz/year	0	0.5	Apply preventatively prior disease development. Suppression of disease.
	P4	**Vacciplant** (laminarin)	22 fl oz	See label	0	4 hr	Initiate as preventative application.
	3 + 33	**Viathon** (tebuconazole + potassium phosphite)	4 pt	12 pt	7	0.5	Watermelon only. See label.
	4 + M1	**Ridomil Gold Copper** (mefenoxam + copper hydroxide)	2 lb	8 lb	5	2	Limit is 4 appl./crop.
	4 + M3	**Ridomil Gold MZ WG** (mancozeb + mefenoxam)	2.5 lb	10 lb	5	2	Limit is 4 appl./crop. Rate is for downy mildew.
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	2.5 pt	See label	0	2	Limit is 4 appl./crop.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz/ year	0	0.5	See label
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	18.5 oz	74 oz/year	0	0.5	See label.
	11	(azoxystrobin) **Many brands available:** Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxyzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	Limit is 4 appl./crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	64 oz	0	0.5	See label for tank-mixing restrictions.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Evito 480 SC** **Tepera** (fluoxastrobin)	See label	See label	See label	See label	
	11	**Flint Extra** **Flint** (trifloxystrobin)	See label	See label	See label	0.5	(Disease suppression) Limit is 4 appl./crop and alternate chemistry.
	11	**Reason 500SC** (fenamidone)	5.5 fl oz	22 fl oz	14	0.5	See label.
	11 + M5	**Arius ADV** **Quadris Opti** (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl./crop for all QoI fungicides. Do not make more than one consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on label.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz/ year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	**Mural** (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	19	**Oso 5% SC** (polyoxin D zinc salt)	13.0 fl oz	See label	0	4 hr	
	21	**Ranman** **Ranman 400 SC** (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Limit is 6 appl./crop. Follow resistance management guidelines.
	22	**Elumin** (ethaboxam)	8 fl oz	16 fl oz/ year	1	0.5	Application interval should not be less than 14 days.
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2 lb	16 lb/year	5	2	Limit is 8 appl./crop. Some cantaloupes are sensitive. See label.
	22 + M5	**Zing** (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	
	27	**Curzate 60DF** **Cymbol** (cymoxanil)	See label	See label	3	0.5	Use only with a labeled rate of protectant fungicide.
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	See label	3	0.5	Limit is 4 appl./crop. Must tank-mix with a contact fungicide.
	28	**Previcur Flex** **Promess** (propamocarb hydrochloride)	1.2 pt	6 pt	2	0.5	See label for instructions.
	29	**Omega 500 F** **Lektivar 40 SC** **Omavo** **Orbus 4 F** (fluazinam)	24 fl oz	See label	7	0.5	See label for crop-specific guidelines.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	33	**Aliette 80WDG, Alude, Fosphite, Fungi-Phite, K-Phite 7 LP, Linebacker WDG, Prophyt, Reliant** (fosetyl-Al, phosphorous acid and salts)	See label	See label	See label	See label	See label for specific product guidelines.
	40	**Forum** (dimethomorph)	6 oz	30 oz	See label	0.5	Limit is 5 appl./crop. Apply with another fungicide that has a different mode of action and alternate.
	40	**Orondis Ultra B Revus** (mandipropamid)	8 fl oz	32 fl oz	0	4 hr	See label. For suppression only.
	43	**Presidio** (fluopicolide)	4 fl oz	8 fl oz/year	2	0.5	Tank-mix with another fungicide product with a different FRAC code.
	45 + 40	**Zampro** (ametoctradin + dimethomorph)	14 fl oz	42 fl oz/ year	0	0.5	No more than 2 sequential applications. Addition of a spreading/penetrating adjuvant is recommended.
	49	**Orondis Opti A Orondis Ultra A** (oxathiapiprolin)	4.8 fl oz	19.2 fl oz/ year	0	4 hr	Cucurbit vegetables, crop group 9. See label.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz/ year	0	4 hr	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Check label for additional details.
Fusarium wilt (watermelon)	3	**Proline 480 SC** (prothioconazole)	5.7 fl oz	17.1 fl oz/ year	7	0.5	Limit is 1 soil application and 2 foliar applications per year.
	7 + 3	**Propulse** (fluopyram + prothioconazole)	13.6 fl oz	34.2 fl oz/ year	7	0.5	Limit is 1 soil application and 2 foliar applications per year. See label for harvesting guidelines.
	7+12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz/ year	1	0.5	For suppression only. Follow specific guidelines in the label.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Gummy stem blight	M1	(copper compounds) **Many brands available:** AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Grotto, Kalmor, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCu, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75WG, Nu-Cop 3L, Nu-Cop 30 HB, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.
	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.
	M3 + 11	**Dexter Max** (mancozeb + azoxystrobin)	3.2 lb	12.8 lb/year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank mixing. Do not apply more than one application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions indicated in the label.
	M5 + 27	**Ariston** (chlorothalonil + cymoxanil)	3 pt	17.5 pt/ year	3	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/year	0	0.5	Check label for additional guidelines. Make no more than 2 sequential applications before rotating to a fungicide with different mode of action.
	1	(thiophanate-methyl) **Many brands available:** 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85WDG, Miramar, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP, Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label.
	3	**Mettle 125 ME** (tetraconazole)	8 fl oz	24 fl oz/ year	1	0.5	Make no more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3	**Proline** (prothioconazole)	5.7 fl oz	17.1 fl oz/ year	7	0.5	Limit is 1 soil application and 2 foliar applications per year.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz/ year	0	0.5	Do not apply more than 2 sequential applications before rotating with a different FRAC group fungicide.
	3	(tebuconazole) **Many brands available:** Buzz Ultra DF, Incognito 4.5F, Monsoon, Onset 3.6L, Orius 3.6F, Teb 3.6 SC, Tebu-Crop 3.6F, Tebu 3.6F, Tebuconazole 3.6 F, Tebustar 3.6L, Tebuzol 3.6F, Toledo, Vibe	See label	See label	7	1	Follow resistance management guidelines indicated on the label. Check label for additional guidelines.
	3	**Topguard** (flutriafol)	14 fl oz	56 fl oz/ year	0	0.5	Check label.
	3 + M5	**Muscle ADV** (tebuconazole + chlorothalonil)	2.1 pt	6.4 pt	7	0.5	Watermelon, squash, pumpkin, and melon
	3 + 9	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	80 fl oz/ year	7	0.5	Do not make more than two consecutive applications. See label for greenhouse use only for cucumber.
	3 + 33	**Viathon** (tebuconazole + potassium phosphite)	4 pt	12 pt	7	0.5	
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	2.5 pt	See label	0	2	Limit is 4 appl./crop.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7	**Endura** (boscalid)	6.5 oz	26 oz/year	0	0.5	Do not make more than one application before alternating to another labeled fungicide with a different mode of action for at least one application.
	7	**Fontelis** (penthiopyrad)	16 fl oz	67 fl oz/ year	1	0.5	Do not make more than 2 applications sequentially.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz/ year	0	0.5	See label for guidelines.
	7 + 3	**Luna Experience** (fluopyram + tebuconazole)	17 fl oz	34 fl oz/ year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.
	7 + 3	**Propulse** (fluopyram + prothioconazole)	13.6 fl oz	34.2 fl oz/ year	7	0.5	Limit is 1 soil application and 2 foliar applications per year. See label for harvesting guidelines.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz/ year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz/ year	0	0.5	Do not make more than one application before alternating to a non-FRAC 7, non-FRAC 11 group fungicide. In areas where gummy stem blight resistance to FRAC 7 or 11 fungicides have been reported, tank-mix with chlorothalonil at full rate.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	18.5 oz	74 oz/year	0	0.5	Limit is 4 appl./crop and alternate chemistry.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz/ year	1	0.5	Do not make more than two applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.
	9 + 12	**Alterity 62.5 Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz/year	1	0.5	Do not make more than two consecutive applications before switching to fungicide with a different mode of action.
	11	(azoxystrobin) **Many brands available:** Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxyzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	Limit is 4 appl./crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	**Evito 480 SC** **Tepera** (fluoxastrobin)	See label	See label	See label	See label	
	11	**Narvos 50 WDG** **Sovran** (kresoxim-methyl)	4.8 oz	19.2 oz	0	0.5	Follow resistance management guidelines on label.
	11 + M5	**Arius ADV** **Quadris Opti** (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl./crop for all QoI fungicides. Do not make more than one consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on label.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz/ year	1	0.5	Must be rotated with a non-QoI-containing fungicide.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	**Mural** (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	12	**Emblem** (fludioxonil)	7 fl oz	28 fl oz/ year	1	0.5	
	19	**Affirm WDG** **Oso 5% SC** **PH-D** (polyoxin D zinc salt)	See label	See label	0	4 hr	
	22 + M5	**Zing** (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	
	29	**Omavo** **Omega 500 F** (fluazinam)	24 fl oz	See label	7	0.5	See label for crop-specific guidelines.
Phytophthora blight/fruit and root rot	4	**Orondis Gold B** **Ridomil Gold SL** (mefonoxam)	2 pt	See label	5	2	See label for application-specific guidelines (soil-injected or soil-incorporated, soil-directed and other foliar). Suppression only.
	4 + M1	**Ridomil Gold Copper** (mefenoxam + copper hydroxide)	2 lb	8 lb	5	2	Limit is 4 appl./crop.
	21	**Ranman** **Ranman 400 SC** (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Limit is 6 appl./crop. Follow resistance management guidelines.
	22	**Elumin** (ethaboxam)	8 fl oz	16 fl oz/ year	2	0.5	Application interval should not be less than 14 days.
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2 lb	16 lb/year	5	2	Limit is 8 appl./crop. Some cantaloupes are sensitive. See label.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	27 + 11	**Tanos** (cymoxanil + famoxadone)	10 oz	See label	3	0.5	Limit is 4 appl./crop. Must tank-mix with a contact fungicide. Phytophthora blight foliar and fruit phase only (disease suppression).
	29	**Omavo** **Omega 500 F** (fluazinam)	24 fl oz	See label	7	0.5	See label for crop-specific guidelines.
	33	**Aliette 80WDG, Alude, Fosphite, K-Phite 7 LP, Linebacker WDG, ProPhyt, Reliant** (fosetyl-Al, phosphorous acid and salts)	See label	See label	See label	See label	See label for specific product guidelines.
	40	**Forum** (dimethomorph)	6 oz	30 oz	See label	0.5	Limit is 5 appl./crop. Apply with another fungicide that has a different mode of action and alternate.
	40	**Orondis Ultra B** **Revus** (mandipropamid)	8 fl oz	32 fl oz	0	4 hr	Phytophthora blight suppression only.
	43	**Presidio** (fluopicolide)	4 fl oz	8 fl oz/year	2	0.5	Tank-mix with another fungicide product with a different FRAC code.
	45 + 40	**Zampro** (ametoctradin + dimethomorph)	14 fl oz	42 fl oz/ year	0	0.5	No more than 2 sequential applications. Addition of a spreading/penetrating adjuvant is recommended.
	49	**Orondis Gold 200** **Orondis Opti A** **Orondis Ultra A** (oxathiapiprolin)	See label	See label	0	4 hr	Cucurbit vegetables, crop group 9. See label.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz/ year	0	4 hr	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Check label for additional details.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Powdery mildew	M1	(copper compounds) **Many brands available:** AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Camelot-O, Champ DP Dry Prill, Champ Formula 2 FL, ChampION++, Champ WG, Copper-Count-N, CS 2005, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, ET-F, Kentan DF, Kocide 2000, Kocide 2000-O, Kocide 3000, Kocide 3000-O, Kocide HCu, KOP-5, Kop-Hydroxide, MasterCop, Nordox 75WG, Nu-Cop 3L, Nu-Cop 30 HB, Nu-Cop 50DF, Nu-Cop 50 WP, Nu-Cop HB, Nu-Cop XLR, Previsto	See label	See label	1	Varies from 4 hr to 2 days	Check label for crop-specific guidelines.
	M1 + M2	**Top Cop w Sulfur** (copper + sulfur)	1 qt	See label	-	1	Do not apply if air temperatures greater than 90°F are expected.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.
	M2	(sulfur) **Many brands available:** Acoidal, Cosavet DF, Cosavet DF Edge, Crusade DF, Defend DF, Micro Sulf, Micronized Wettable Sulfur, Suffa, Sulfur 6L, Sulfur 90W, Thiolux	See label	See label	See label	1	See individual label. Do not use when temperatures are greater than 90°F or on sulfur-sensitive varieties. Check label for use.
	M2 + 3	**Unicorn** (sulfur + tebuconazole)	3.75 lb	15 lb	14	0.5	Suppression only. Only available for use on some cucurbits. See label.
	M3 + 11	**Dexter Max** (mancozeb + azoxystrobin)	3.2 lb	12.8 lb/year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank mixing. Do not apply more than one application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Praiz, Rialto 720F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions indicated in the label.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M5 + 27	**Ariston** (chlorothalonil + cymoxanil)	3 pt	17.5 pt/ year	3	0.5	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/year	0	0.5	Check label for additional guidelines. Make no more than 2 sequential applications before rotating to a fungicide with different mode of action.
	P1	**Actigard 50WG** (acibenzolar-S-methyl)	1 oz	8 oz	0	0.5	Apply preventatively prior disease development. Suppression of disease.
	P4	**Vacciplant** (laminarin)	22 fl oz	See label	0	4 h	
	U6	**Torino** (cyflufenamid)	3.4 oz	6.8 oz/year	0	4 hr	
	1	(thiophanate-methyl) **Many brands available:** 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85WDG, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP,Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label.
	3	**Mettle 125 ME** (tetraconazole)	8 fl oz	24 fl oz/ year	1	0.5	Make no more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3	**Procure 480SC** **Trionic 4 SC** (triflumizole)	8 fl oz	24 fl oz	0	0.5	Follow resistance management guidelines on label.
	3	**Proline** (prothioconazole)	5.7 fl oz	17.1 fl oz/ year	7	0.5	Limit is 1 soil application and 2 foliar applications per year.
	3	**Rally 40WSP** (myclobutanil)	5 oz	See label	0	1	
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz/ year	0	0.5	Do not apply more than 2 sequential applications before rotating with a different FRAC group fungicide.
	3	(tebuconazole) **Many brands available:** Buzz Ultra DF, Incognito 4.5F, Monsoon, Onset 3.6L, Orius 3.6F, Teb 3.6 SC, Tebu 3.6F, Tebuconazole 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6L, Tebuzol 3.6F, Toledo, Vibe	See label	See label	7	1	Follow resistance management guidelines indicated on the label. Check label for additional guidelines.
	3	**Topguard** (flutriafol)	14 fl oz	56 fl oz/ year	0	0.5	Check label.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3 + M5	**Muscle ADV** (tebuconazole + chlorothalonil)	2.1 pt	6.4 pt	7	0.5	Watermelon, squash, pumpkin, and melon
	3 + 9	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	80 fl oz/ year	7	0.5	Do not make more than two consecutive applications. See label for greenhouse use only for cucumber.
	3 + 33	**Viathon** (tebuconazole + potassium phosphite)	3 pt	12 pt	7	0.5	
	7	**Endura** (boscalid)	6.5 oz	26 oz/year	0	0.5	Do not make more than one application before alternating to another labeled fungicide with a different mode of action for at least one application.
	7	**Fontelis** (penthiopyrad)	16 fl oz	67 fl oz/ year	1	0.5	Maximum rate is for year. Do not make more than 2 applications sequentially.
	7	**Velum Prime** (fluopyram)	6.84 fl oz	13.7 fl oz/ year	0	0.5	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz/ year	0	0.5	See label for guidelines.
	7 + 3	**Luna Experience** (fluopyram + tebuconazole)	17 fl oz	34 fl oz/ year	7	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 3 fungicide.
	7 + 3	**Propulse** (fluopyram + prothioconazole)	13.6 fl oz	34.2 fl oz/ year	7	0.5	Limit is 1 soil application and 2 foliar applications per year. See label for harvesting guidelines.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz/ year	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC 7, non-FRAC 11 fungicide.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz/ year	0	0.5	Do not make more than one application before alternating to a non-FRAC 7, non-FRAC 11 group fungicide. In areas where gummy stem blight resistance to FRAC 7 or 11 fungicides have been reported, tank-mix with chlorothalonil at full rate.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	18.5 oz	74 oz/year	0	0.5	Limit is 4 appl./crop and alternate chemistry.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz/ year	1	0.5	Do not make more than two applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	9	**Vango** (cyprodinil)	7 oz	28 oz/year	1	0.5	Alternate to a different mode of action after 2 applications.
	9 + 12	**Alterity 62.5 Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz/year	1	0.5	Do not make more than two consecutive applications.
	11	(azoxystrobin) **Many brands available:** Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxyzone, AZteroid FC, AZteroid FC 3.3, Heritage, Heritage SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	Limit is 4 appl./crop and alternate chemistry. See label for tank-mixing restrictions. Heritage and Heritage SC fungicides are only for transplants production. See label for details.
	11	**Evito 480 SC Tepera** (fluoxastrobin)	See label	See label	See label	See label	
	11	**Flint Extra Flint** (trifloxystrobin)	See label	See label	See label	0.5	(Disease suppression) Limit is 4 appl./crop and alternate chemistry.
	11	**Narvos 50 WDG Sovran** (kresoxim-methyl)	4.8 oz	19.2 oz	0	0.5	Follow resistance management guidelines on label.
	11 + M5	**Arius ADV Quadris Opti** (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl./crop for all QoI fungicides. Do not make more than one consecutive application. Do not apply to mature watermelons under dry, hot, or other environmental conditions listed on label.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz/ year	1	0.5	Must be rotated with a non-QoI-containing fungicides.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	11 + 7	**Mural** (azoxystrobin + benzovindiflupyr)	See label	See label	0	0.5	Only for vegetable plants grown for resale to consumers.
	12	**Emblem** (fludioxonil)	7 fl oz	28 fl oz/ year	1	0.5	
	13	**Quintec** (quinoxyfen)	6 fl oz	See label	3	0.5	Do not make more than 4 applications. Do not make more than 2 consecutive applications. Not labeled for all cucurbits; labeled for various melons, cantaloupe, winter squash, gourds, pumpkins, and watermelon.
	19	**Affirm WDG Oso 5% SC PH-D** (polyoxin D zinc salt)	13 fl oz	See label	0	4 hr	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	39	**Torac** (tolfenpyrad)	21 fl. oz.	42 fl.oz	1	0.5	Minimum 14 days between application
	50	**Prolivo 300 SC** (pryriofenone)	5 fl oz	16 fl oz/ year	0		Do not make more than 2 sequential applications before rotating to another fungicide with a different mode of action.
	50	**Vivando** (metrafenone)	15.4 fl oz	46.2 fl oz/ year	0	0.5	See label for instructions.
***Pythium* spp.**	4	**Apron XL** **Orondis Gold B** **Ridomil Gold SL** **Ultra Flourish** (mefenoxam)	See label	See label	See label	See label	
	4	(metalaxyl) **Many brands available:** Acquire, Allegiance FL, Metalaxyl 265 ST, Metalaxyl 318 FS, Metalaxyl 4.0 ST, Metastar 2E, Metastar 4S, MetXL, Sebring 318 FS, Sebring 480 FS	See label	See label	See label	See label	
	4 + 11	**Uniform** (mefonoxam + azoxystrobin)	See label	See label	See label	0	Apply 0.34 fl oz/1000 ft of row as in-furrow spray in a minimum of 5 gallons of water per acre at planting. Make only one application per season.
	28	**Previcur Flex** **Promess** (propamocarb hydrochloride)	1.2 pt	6 pt	2	0.5	Use a tank-mix partner. See label for directions using a contact fungicide and Pythium suppression.
Scab	M1	**Cueva** **Camelot O** **Grotto** (copper octanoate)	See label	See label	0	4	See label for crops listed.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Some cantaloupe varieties are sensitive. Check label for details.
	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Protect DF, Roper DF Rainshield	See label	See label	5	1	Check label for crop-specific guidelines.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M3 + 11	**Dexter Max** (mancozeb + azoxystrobin)	3.2 lb	12.8 lb/year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank mixing. Do not apply more than one application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Oranil 6L, Orondis Opti B, Periapt, Praiz, Rialto 720 F	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions indicated in the label.
	M5 + 27	**Ariston Cymbol Advance** (chlorothalonil + cymoxanil)	3 pt	17.5 pt/ year	3	0.5	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/year	0	0.5	Check label for additional guidelines. Make no more than 2 sequential applications before rotating to a fungicide with different mode of action.
	P1	**Actigard 50WG** (acibenzolar-S-methyl)	1 oz	8 oz	0	0.5	Apply preventatively prior to disease development. Suppression of disease.
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	Limit is 4 appl./crop.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz/ year	0	0.5	See label for guidelines.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz/ year	1	0.5	Do not make more than two applications of Miravis Prime or other Group 7 and 12 before alternation with a fungicide that is not in Group 7 or 12.
	19	**Affirm WDG Oso 5% SC PH-D** (polyoxin D zinc salt)	See label	See label	0	4 hr	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Target spot	M3 + 11	**Dexter Max** (mancozeb + azoxystrobin)	3.2 lb	12.8 lb/year	5	1	See guidelines of adjuvants and pesticides to be avoided in tank mixing. Do not apply more than one application of Dexter Max or other group 11 fungicides before alternation with fungicides not in group 11.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B, Periapt, Praiz	See label	See label	0	1	Check label for crop-specific guidelines. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot, or other environmental conditions indicated in the label.
	M5 + 27	**Ariston Cymbol Advance** (chlorothalonil + cymoxanil)	3 pt	17.5 pt/ year	3	0.5	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/year	0	0.5	Check label for additional guidelines. Make no more than 2 sequential applications before rotating to a fungicide with different mode of action.
	1	(thiophanate-methyl) **Many brands available:** 3336 EG, 3336 F, 3336 WP, Cercobin, Incognito 4.5F, Incognito 85WDG, Talaris 70 WSB, Thiophanate methyl 85 WDG, TM 4.5 F, T-Methyl 4.5 AG, T-Methyl 4.5 F, T-Methyl 70 WP, Topsin 4.5 FL, Topsin M WSB	See label	See label	1	1	Follow resistance management guidelines on label.
	3	**Mettle 125 ME** (tetraconazole)	8 fl oz	24 fl oz/ year	1	0.5	Make no more than 2 sequential applications before rotating to another fungicide with alternate mode of action.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz/ year	0	0.5	Do not apply more than 2 sequential applications before rotating with a different FRAC group fungicide.
	3	**Topguard** (flutriafol)	14 fl oz	56 fl oz/ year	0	0.5	Check label.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz/ year	0	0.5	See label for guidelines.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz/ year	0	0.5	See label.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz/ year	1	0.5	Do not make more than two applications of Miravis Prime or other Group 7 and 12 fungicides before alternation with a fungicide that is not in Group 7 or 12.
	11	(azoxystrobin) **Many brands available:** Acadia 2SC, Aframe, A-Zox 25SC, Azoxy 2SC, Azoxy 2SC Prime, AzoxyStar, Azoxyzone, AZteroid FC, Azteroid FC 3.3, Equation, Equation SC, Mazolin, Quadris, Satori, Tetraban, Trevo	See label	See label	1	4 hr	Limit is 4 appl./crop and alternate chemistry. See label for tank-mixing restrictions.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	See label for tank-mixing restrictions.
	11	**Evito 480 SC** **Tepera** (fluoxastrobin)	See label	See label	See label	See label	
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	See label	1	0.5	See label for crop-specific use.
	19	**Affirm WDG** **Oso 5% SC** **PH-D** (polyoxin D zinc salt)	See label	See label	0	4 hr	
	22 + M5	**Zing** (zoxamide + chlorothalonil)	36 fl oz	See label	0	0.5	

[1] FRAC code (fungicide group): Number (1 through 50) and letter U is used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 7.12. Nonfumigant nematicides for cucurbit crops in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Mocap 15G (a.i. ethoprop) (only labeled on cucumber)	Apply 13 pounds per acre (7-foot row spacing) or 2.1 pounds per 1,000 linear feet of row in a band 12 to 15 inches wide on the row at planting. Prepare bed and knock off top to provide a level area for treatment. Mix with the top 2 to 4 inches of soil with mechanical equipment right after application. DO NOT use as a seed furrow treatment or allow granules to contact the seed. Only 1 application per season.
Vydate L (a.i. oxamyl)	Apply ½ to 1 gal/acre at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. Do not apply more than 2 gallons per acre per season. Minimum retreatment interval is 7 days unless a longer interval is stated. If an at-plant application of more than ½ gal/acre is made, do not make more than 2 additional applications.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints (56.0 to 80.0 fl oz) per acre, a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop and no more than 112 fl oz of product per acre per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/acre using only chemigation into root zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Observe minimum 5-day interval between soil applications. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Mocap and Vydate are insecticide/nematicides; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations as far as how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 7.13. Fumigant nematicides for cucurbit crops in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/ chisel-spaced 12" apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19 to 31.5 gal	57 to 90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and other flow-modifying directions.

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations with use of highly retentive mulch films.
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS726

doi.org/10.32473/edis-cv124-2022

Chapter 8. Eggplant Production[1]

Pamela D. Roberts, Craig Frey, Anna Meszaros, Nathan S. Boyd, Johan Desaeger, and Jawwad Qureshi[2]

Botany and Planting

Eggplant, Oriental, Thai, and Indian eggplant—*Solanum melongena*

Table 8.1. Planting information for eggplant.

Planting Dates	Eggplant	Japanese/Chinese/Indian Eggplant	Thai Eggplant
North Florida	Aug; Feb–Mar	Feb–Mar	Feb–Mar
Central Florida	Aug–Sept; Jan–Feb	Aug–Sept; Jan–Feb	Aug–Sept; Jan–Feb
South Florida	Aug–Feb	Aug–Feb	Aug–Feb
Planting Information			
Distance between rows (in)	36–72	36–72	36–72
Distance between plants (in)	18–40	18–40	36–60
Seeding depth (in)	0.5–0.75	0.5–0.75	0.5–0.75
Seed per acre to seed (lb)	1	0.25–0.5	0.25–0.5
Seed per acre to transplant (lb)	0.25–0.50		
Days to maturity from seed	90–115		
Days to maturity from transplant	70–90		
Plant population (acre)	9,680	9,680	9,680

1. This document is HS726, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Pamela D. Roberts, professor, Plant Pathology Department, UF/IFAS Southwest Florida Research and Education Center; Craig Frey, county Extension director and Extension agent II, UF/IFAS Extension Hendry County; Anna Meszaros, Extension agent II, UF/IFAS Extension Palm Beach County; Nathan S. Boyd, associate center director and professor, Horticultural Sciences Department, UF/IFAS Gulf Coast REC; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; and Jawwad Qureshi, associate professor, Entomology and Nematology Department, UF/IFAS Southwest Florida REC; UF/IFAS Extension, Gainesville, FL 32611.

Information on "Asian" solanums is included in this chapter. The Asian solanum group includes three types of eggplant and bird's eye pepper (Thai pepper). Pea eggplant, which was discussed in previous editions of this Handbook, is on the Federal Noxious Weed list, so it is not included in the current version. The harvestable product includes fruits that are eaten at the immature or mature stage. All can be grown on raised beds with or without plastic mulch, using either drip or subsurface irrigation. As with most eggplants, these types tend to be short-lived perennials, especially the Thai eggplant, which is a relatively compact, stocky plant. They can be severely pruned or ratooned and allowed to regrow if staking does not prohibit this operation. Fertilizer recommendations for eggplant should be used for the three types of eggplant, while those for peppers should be followed for bird's eye peppers. These crops can be started from seed or transplants. All the indeterminate types of eggplant need some type of staking support.

Cultivars

For more information on eggplant variety descriptions and disease resistance, see EDIS publication HS1243, *Conventional and Specialty Eggplant Varieties in Florida*, at https://edis.ifas.ufl.edu/publication/HS1243.

Disease Key: CM = cucumber mosaic, ToM = tomato mosaic, R = resistant, IR = intermediate resistance, T = tolerant.

Traditional Types

Classic. Erect, vigorous plant; glossy deep-purple-black elongated-oval, green-calyxed fruit; medium-tall upright plant; fancy fruit appearance. Heavy yields of high-quality fruit. Does not perform well in cooler weather. R to ToM.

Nadia. Oval, long, vigorous plant with good fruit set under cool conditions. Very firm, attractive, purple-black fruit with long harvest period, and sets well under cool conditions.

Night Shadow. Elongate oval, widely adapted with high-yield potential. Strong plants produce firm fruit that maintain rich, dark glossy black color right through harvest. R to ToM.

Specialty Types

Birgah. A Sicilian-style eggplant with a round, heavy, firm fruit, deep-purple color, sweet taste, and white flesh.

Ghostbuster. Hybrid variety that produces oval-shaped white fruit 6–7 inches long.

Italian Pink. Open-pollinated cultivar; oval fruit; cream/rose color; mature fruit color is rose pink, purple calyx.

Megal. Italian cylindrical fruit; purple-black color, very uniform; excellent shelf life and flavor; few spines; early maturity. R to CM, ToM.

Millionaire. Slender, oriental type; dark-purple fruit color; purple calyx; early maturing.

Vitoria. Very long cylindrical, deep-purple Imperial type; green calyx; mild flavor. R to ToM.

Zebra. Elongated oval; purple with white stripes; very attractive with good flavor.

Table 8.2. Ethnic eggplant cultivars.

Oriental (Japanese) Eggplant	
Black Shine	Money Maker 2
Hybrid Mangan	
Oriental (Chinese) Eggplant	
Bride Hybrid	Ma-Zu Purple
Hybrid Purple Charm	
Thai Eggplant	
White: Hybrid White Ball	Purple: Round Purple
Green: Green Beauty	Variegated: Hybrid Tiger
Purple: Hybrid Violet Prince	Variegated: Petch Slam
Indian Eggplant (Dark, Wine-Colored)	
Hybrid Bharata	Hybrid Chu-Chu

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture Extension agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 8.3. Herbicides approved for managing weeds in eggplant. Contact: Nathan S. Boyd, UF/IFAS Gulf Coast Research and Education Center.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		*****PRETRANSPLANT/PREEMERGENCE*****	
Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Annual broadleaves and grasses. Incorporate 2–4 inches with mechanical cultivation or irrigation.
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds up to 4 inches tall or rosettes less than 3 inches across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pretransplant interval.
Flumioxazin up to 0.128	(Chateau) SW up to 4 oz	14	Annual broadleaves. Apply to row middles of raised plastic-mulched beds that are at least 4 inches higher than the treated row middles and 24-inch bed width. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Tank-mix with a burndown herbicide to control emerged weeds.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses, and nutsedge. Apply preplant. Consult label for individual product directions.
Halosulfuron 0.024–0.05	(Sandea, Profine) 75 DF 0.5–1.0 oz	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. Do not exceed 2 oz/A per 12-month period. 30-day PHI.
Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaves. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to row middles only with shielded or hooded sprayers. Excessive injury occurs when product contacts green foliage or fruit. Drift of lactofen-treated soil particles onto plants can cause injury. Limit of 1 PRE and 1 POST application per growing season. 30-day PHI.
Napropamide 1.0–2.0	(Devrinol) DF-XT 2.0–4.0 lb (Devrinol) 2-XT 2–4 quarts	15	Annual broadleaves and grasses. Transplanted eggplant only. Use the lower rate on light soils (coarse-textured–sandy). Do not apply more than 4 lb/A per crop cycle.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Surfactant recommended. **Consult label for new restrictions.**
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with soil residual compounds.
Pendimethalin 0.48–0.72	(Prowl H20) 3.8 1.0–1.5 pt	3	Broadleaves and grasses. Apply to row middles or under the plastic. Do not exceed 3.0 pt/A per year. 70-day PHI.
Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaves less than 4 inches tall or rosettes less than 3 inches diameter. Apply as a preplant burndown treatment. Nonionic surfactant or crop oil concentrate recommended.
S-metolachlor 0.64–0.95	(Dual Magnum) 7.62 EC 0.67–1.0 pt	15	Annual broadleaves, grasses, and yellow/purple nutsedge suppression. Label is a Third Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to the finished bed immediately before laying the plastic or to row middles using a shielded applicator. Do not exceed 1.68 pt of Dual Magnum/A per crop cycle. 60-day PHI.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
Sulfentrazone 0.09	Willowood Sulfentrazone 3 fl oz	14	Broadleaves, grasses, and nutsedge species. Apply under the plastic mulch or in row middles. Do not use on soils with less than 1% organic matter.
Trifluralin 0.5	(Treflan, Triflurex) 4 EC 1 pt	3	Annual broadleaves and grasses. Do not apply in Dade County. Incorporate 4 inches or less within 8 hours of application. Results in Florida are erratic on soils with low organic matter and clay contents. Do not apply after transplanting. Not all trifluralin herbicides are labeled in eggplant, so consult labels before application.
			***** POSTTRANSPLANT *****
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaves. Apply as a hooded application to row middles only. Do not exceed 6.1 fl oz/A per cropping season. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. 0-day PHI.
Clethodim 0.09–0.13 0.07–0.25	(Select, Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grasses. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat applications 14 days apart. Use a crop oil concentrate at 1% v/v or a nonionic surfactant with Select Max. 20-day PHI.
DCPA 6.0–7.5	(Dacthal) 6 F 8–10 pt	3	Annual broadleaves and grasses. Apply to weed-free soil 6 to 8 weeks after crop is established and growing rapidly or to moist soil in row middles after crop establishment. Note label precautions against replanting nonregistered crops within 8 months.
Diquat 0.5	(Reglone Dessiccant) 1 qt	22	Broadleaves and grasses. Apply to row middles only. Maximum of 2 applications per season. Prevent drift to crop. Nonionic surfactant recommended. 30-day PHI.
Halosulfuron 0.024–0.05	(Sandea, Profine) 75 DF 0.5–1.0 oz	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. Include a nonionic surfactant. Do not exceed 2 oz/A per 12-month period. 30-day PHI.
Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaves. Apply to row middles only with shielded or hooded sprayers. Excessive injury can occur when lactofen contacts green foliage or fruit. Drift of lactofen-treated soil particles onto plants can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. Surfactant recommended. 30-day PHI.
Paraquat 0.5	(Gramoxone) 2 SL 2.0 pt (Firestorm) 3 SL 1.3 pt	22	Emerged broadleaves and grasses. Direct spray over emerged weeds 1 to 6 inches tall in row middles between mulched beds. Use low pressure and shields to control drift. Do not apply more than 3 times per season. Nonionic surfactant recommended. **Consult label for new restrictions.**
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
Pendimethalin 0.48–0.72	(Prowl H20) 3.8 1.0–1.5 pt	3	Broadleaves and grasses. May be applied posttransplant to row middles if previously untreated. Do not exceed 3.0 pt/A per year. 70-day PHI.
Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Actively growing grasses. A total of 4.5 pt/A applied in one season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. 20-day PHI.
S-metolachlor 0.95	(Dual Magnum) 7.62 EC 1.0 pt	15	Annual broadleaves and grasses. Yellow/purple nutsedge suppression. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Direct spray solution to row middles only. Do not exceed 1.68 pt of Dual Magnum/A per crop. 60-day PHI.
			***** POSTHARVEST *****
Diquat 0.5	(Reglone Dessiccant) 2.0 pt	22	Minimum of 35 gal/A. Thorough coverage is required. Nonionic surfactant recommended.

Table 8.4. Insecticides approved for management of arthropod pests of eggplant. Contact: Craig Frey, UF/IFAS Extension Hendry County.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Aphids (including green peach aphid, potato aphid, aphid-transmitted viruses)	1A	***Lannate LV; *SP** (methomyl)	**LV:** 0.75–3.0 pt **SP:** 0.25–1.0 lb	No more than 15 pints/A per crop. No more than 5 lb/A per crop.	5	48	No more than 10 applications per crop.
	1A	***Vydate L** (oxamyl)	**Foliar:** 2–4 pt	Do not apply more than 16 pt per acre per season.	1	48	
	1B	***Dibrom 8 EC** (naled)	1 pt	Do not apply more than 6 pints/A per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
	1B	**Malathion 8F** (malathion)	1.56 pt	Maximum application/A per crop is 6.24 pints.	3	12	Maximum number of applications is 4.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	5	24	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A	**Actara** (thiamethoxam)	2.0–5.5 oz	Maximum of 11 oz/ acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	Maximum 10.5 fl oz/A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/10,000 plants		21	12	**Planthouse:** 1 application. See label.
	4A	**Assail 30 SG** (acetamiprid)	1.5–4.0 oz	Do not exceed a total of 16.0 oz/A per growing season, including any pretransplant applications of acetamiprid.	7	12	Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	4A	**Belay 50 WDG** (clothianidin)	1.6–3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5.0–11.0 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 oz Platinum 75 SG/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Provado 1.6F** (imidacloprid)	3.8–6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply if imidacloprid or thiamethoxam have been used at planting.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	**Foliar:** 1 **Soil:** 21	12	Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6.0 oz	Do not apply more than 6 oz foliar or 12 oz soil per season.	**Foliar:** 1 **Soil:** 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	Do not exceed a total of 13 fl oz/A.	30	12	May be applied to soil by one of several methods—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Limited to 14 oz/acre per growing season.	1	12	
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	1	4	Minimum interval between applications: 7 days.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/acre per crop.	0	12	Apply before populations build to damaging levels. Minimum of 7 days between applications. Do not make more than two applications.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	Do not apply more than 4.8 fl oz (0.070 lb a.i.) per acre per crop cycle. Do not apply more than 9.6 fl oz (0.140 lb a.i.) per acre per year.	1	12	Do not apply by air. Do not make more than 2 applications per crop cycle. Do not make more than 4 applications per year.
	9C	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	Do not apply more than 8.4 oz/acre per season.	0	12	Begin applications before pests reach damaging levels.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	9D	**Sefina** (afidopyropen)	3.0 fl oz	Do not apply more than 28 fl oz of Sefina (0.09 lb afidopyropen a.i.) per acre per season.	0	12	Do not make more than 2 sequential applications of Sefina before using an effective insecticide with a different mode of action.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	Maximum of 10 fl oz per acre per season.	1	24	
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply more than 0.4 lb a.i./A per crop	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	Do not apply more than 0.4 lb a.i./A per crop	1	4	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.		0	4	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Compatible in tank mixes with some fungicides.
	-	**Molt-X** (azadirachtin)	10 fl oz		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		0	12	OMRI-listed.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.		0	4	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Compatible in tank mixes with some fungicides. OMRI-listed.
	-	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0–2.0 lb		0	4	Repeat applications at 3–10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI-listed.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt		0	4	Begin applications before pests reach damaging levels.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water.		0	4	OMRI-listed.
	-	**Ultra-Fine Oil JMS Stylet-Oil Saf-T-Side** (oil, insecticidal)	1–2 gal/100 gal water **JMS:** 3–6 qt/100 gal		0	4	Do not exceed four applications per season. Stylet-Oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Beetles (including blister beetle, Colorado potato beetle, cucumber beetle, flea beetle)	1A	**Carbaryl 4L** (carbaryl)	0.5–2 qt	Do not apply more than a total of 8 quarts/A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	1A	***Vydate L** (oxamyl)	**Foliar:** 2–4 pt	Do not apply more than 24 pt per acre per season.	1	48	
	1B	***Dibrom 8 EC** (naled)	1 pt	Do not apply more than 6 pints/A per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	Do not apply more than 2 lb a.i. per acre per season (128 oz).	3	12	
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	5.8–9.6 fl oz	Do not apply more than 0.35 lb a.i. per acre per season.	7	12	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	Do not apply more than 43.26 fl oz/A per season.	7	12	
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	Do not apply more than 0.3 lb a.i./acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	6.4–9.6 oz	Do not apply more than 0.6 lb a.i./acre per season.	3	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not exceed a total of 31 fl oz of Besiege per acre per year.	5	24	
	4A	**Actara** (thiamethoxam)	2.0–3.0 oz	Maximum of 11 oz/acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	Maximum 10.5 fl oz/A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	**Assail 30 SG** (acetamiprid)	1.5–4.0 oz	Do not exceed a total of 16.0 oz/A per growing season, including any pretransplant applications of acetamiprid.	7	12	Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	1.6–3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5.0–11.0 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 oz Platinum 75 SG/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Provado 1.6F** (imidacloprid)	3.8–6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply if imidacloprid or thiamethoxam have been used at planting.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	**Foliar:** 1 **Soil:** 21	12	Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6.0 oz	Do not apply more than 6 oz foliar or 12 oz soil per season.	**Foliar:** 1 **Soil:** 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	Do not exceed a total of 13 fl oz/A.	30	12	May be applied to soil by one of several methods—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Limited to 14 oz/acre per growing season.	1	12	

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	1	4	Minimum interval between applications: 7 days.
	5	**Entrust SC** (spinosad)	1.5–10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Agri-Mek SC** (abamectin)	1.7–3.5 fl oz	Do not apply more than 10.25 fl oz/A in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	28	**Coragen** (rynaxypyr)	3.5–7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray.
	28	**Exirel** (cyantraniliprole)	7.0–13.5 fl oz		1	12	For control of Colorado potato beetle. This product has pollinator protection warning information on the label.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	1	4	Colorado potato beetle and flea beetles
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water.		0	4	OMRI-listed.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
Caterpillars (including cabbage looper, imported cabbageworm, corn earworm, garden webworm, hornworms, tobacco budworm, tomato fruitworm, beet armyworm, fall armyworm, southern armyworm)	1A	**Carbaryl 4L** (carbaryl)	0.5–2 qt	Do not apply more than a total of 8 quarts/A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	***Lannate LV; *SP** (methomyl)	**LV:** 0.75–3.0 pt **SP:** 0.25–1.0 lb	**LV:** No more than 15 pints/A per crop. **SP:** No more than 5 lb/A per crop.	5	48	No more than 10 applications per crop.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	Do not apply more than 2 lb a.i. per acre per season (128 oz).	3	12	
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	5.8–9.6 fl oz	Do not apply more than 0.35 lb a.i. per acre per season.	7	12	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Do not exceed 42.67 fl oz total application/A per season.	3	24	Maximum of 4 applications (0.8 lb a.i./acre) per season.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	Do not apply more than 43.26 fl oz/A per season.	7	12	
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	Do not apply more than 0.3 lb a.i./acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	6.4–9.6 oz	Do not apply more than 0.6 lb a.i./acre per season.	3	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	5	24	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not exceed a total of 31 fl oz of Besiege per acre per year.	5	24	
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	Do not exceed a total of 13 fl oz/A.	30	12	May be applied to soil by one of several methods—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Limited to 14 oz/acre per growing season.	1	12	
	5	**Entrust SC** (spinosad)	1.5–10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	No more than 28.8 oz/acre per season.	7	12	
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	Do not apply more than 20 fl oz per acre per year.	7	24	This label contains pollinator warnings.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		0	4	Use high rate for armyworms. Treat when larvae are young. Not for organic production.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb		0	4	Use higher rates for armyworms. OMRI- listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. Can be used in greenhouses. OMRI-listed[2].
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.50 lb		0	4	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb		0	4	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	18	**Confirm 2F** (tebufenozide)	6–16 fl oz	Do not apply more than 64 oz product per season.	7	4	Do not apply more than 16 oz per application.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	18	**Intrepid 2F** (methoxyfenozide)	4–16 fl oz	Do not apply more than 64 oz product per season.	1	4	Do not apply more than 16 oz per application.
	28	**Coragen** (chlorantraniliprole/ rynaxypyr)	3.5–7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray.
	28	**Exirel** (cyantraniliprole)	7–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	5–13.5 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	1	4	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	-	**Checkmate TPW-F** (pheromone)	1.2–6.0 fl oz		0	0	For mating disruption of tomato pinworm. See label for details of use.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb		0	4	Can be used in organic production. OMRI-listed.
	-	**MBI-203 EP** (*Chromobacterium subtsugae*)	4.0–12.0 qt		0	4	OMRI-listed. Can be used in the greenhouse.
	-	**Molt-X** (azadirachtin)	10 fl oz		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
Fire ants	7A	**Extinguish** (S-methoprene)	1.0–1.5 lb		0	4	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb		1	12	Apply when ants are actively foraging.
Grasshoppers	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	Do not apply more than 43.26 fl oz/A per season.	7	12	
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	Do not apply more than 0.3 lb a.i./acre per season.	1	12	Do not make applications less than 7 days apart.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	5	24	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not exceed a total of 31 fl oz of Besiege per acre per year.	5	24	
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	**Foliar:** 1 **Soil:** 21	12	Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6.0 oz	Do not apply more than 6 oz foliar or 12 oz soil per season.	**Foliar:** 1 **Soil:** 21	12	Do not use both application methods. No more than 3 applications per season.
Lace bugs	1A	**Carbaryl 4L** (carbaryl)	0.5–2 qt	Do not apply more than a total of 8 quarts/A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	1B	**Malathion 8F** (malathion)	1.56 pt	Maximum application/A per crop is 6.24 pints.	3	12	Maximum number of applications is 4.
Leafhoppers	1A	**Carbaryl 4L** (carbaryl)	0.5–2 qt	Do not apply more than a total of 8 quarts/A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	Do not apply more than 43.26 fl oz/A per season.	7	12	

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	Do not apply more than 0.3 lb a.i./acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	5	24	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A	**Actara** (thiamethoxam)	2.0–5.5 oz	Maximum of 11 oz/acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	Maximum 10.5 fl oz/A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	**Belay 50 WDG** (clothianidin)	1.6–3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5.0–11.0 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 oz Platinum 75 SG/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	**Foliar:** 1 **Soil:** 21	12	Use only one application method.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	Do not exceed a total of 13 fl oz/A.	30	12	May be applied to soil by one of several methods—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Limited to 14 oz/acre per growing season.	1	12	

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	1	4	Minimum interval between applications: 7 days.
	9B	**PQZ** (pyrifluquinazon)	3.2 fl oz	Do not apply more than 4.8 fl oz (0.070 lb a.i.) per acre per crop cycle. Do not apply more than 9.6 fl oz (0.140 lb a.i.) per acre per year.	1	12	Do not apply by air. Do not make more than 2 applications per crop cycle. Do not make more than 4 applications per year.
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	1	12	Immature insects only. No more than 2 applications per crop cycle.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	-	**Molt-X** (azadirachtin)	10 fl oz		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		0	12	OMRI-listed.
	-	**SuffOil-X** (unsulfonated residue of petroleum oil)	1–2 gallons per 100 gallons of water.		0	4	OMRI-listed.
	-	**Ultra-Fine Oil** **JMS Stylet-Oil** **Saf-T-Side** (oil, insecticidal)	1–2 gal/100 gal water **JMS:** 3–6 qt/100 gal		0	4	Do not exceed four applications per season. Stylet-Oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
***Liriomyza* leafminers**	1A	***Vydate L** (oxamyl)	**Foliar:** 2–4 pt	Do not apply more than 16 pt per acre per season.	1	48	
	1B	***Dibrom 8 EC** (naled)	1 pt	Do not apply more than 6 pints/A per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	Do not apply more than 2 lb a.i. per acre per season (128 oz).	3	12	
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	Do not apply more than 43.26 fl oz/A per season.	7	12	
	3A	***Pounce 25 W** (permethrin)	6.4–9.6 oz	Do not apply more than 0.6 lb a.i./acre per season.	3	12	

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	4A	**Belay 50 WDG** (clothianidin)	1.6–3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	**Foliar:** 1 **Soil:** 21	12	Use only one application method.
	5	**Entrust SC** (spinosad)	1.5–10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Agri-Mek SC** (abamectin)	1.7–3.5 fl oz	Do not apply more than 10.25 fl oz/A in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	Do not apply more than 20 fl oz per acre per year.	7	24	This label contains pollinator warnings.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	
	28	**Coragen** (chlorantraniliprole/ rynaxypyr)	5.0–7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	1	4	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	-	**Molt-X** (azadirachtin)	10 fl oz		0	4	IGR and feeding repellant. OMRI-listed.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz		0	12	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0–2.0 lb		0	4	Repeat applications at 3–10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI-listed.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt		0	4	Begin applications before pests reach damaging levels.
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water.		0	4	OMRI-listed.
	-	**Ultra-Fine Oil** **JMS Stylet-Oil** **Saf-T-Side** (oil, insecticidal)	1–2 gal/100 gal water **JMS:** 3–6 qt/100 gal		0	4	Do not exceed four applications per season. Stylet-Oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Mealybug	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	1	12	Immature insects only. No more than 2 applications per crop cycle.
Mites (including banks grass mite, broad mite, carmine spider mite, tomato russett mite, two-spotted spider mite)	1A	***Vydate L** (oxamyl)	**Foliar:** 2–4 pt	Do not apply more than 16 pt per acre per season.	1	48	
	1B	***Dibrom 8 EC** (naled)	1 pt	Do not apply more than 6 pints/A per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
	1B	**Malathion 8F** (malathion)	1.56 pt	Maximum application/A per crop is 6.24 pints.	3	12	Maximum number of applications is 4.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Do not exceed 42.67 fl oz total application/A per season.	3	24	Maximum of 4 applications (0.8 lb a.i./acre) per season.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	Do not apply more than 43.26 fl oz/A per season.	7	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	5	24	
	6	***Agri-Mek SC** (abamectin)	1.7–3.5 fl oz	Do not apply more than 10.25 fl oz/A in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	Do not apply more than 20 fl oz per acre per year.	7	24	This label contains pollinator warnings.
	10B	**Zeal Miticide** (etoxazole)	2–3 oz	Do not apply more than 3 oz/A per season.	7	12	
	12B	***Vendex 50 WP** (fenbutatin-oxide)	2–3 lb	Apply no more than 9 lb/A per year.	3	48	Apply when mites first appear. No more than 3 applications per year.
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	Do not apply more than 62 fl oz/A per season.	1	12	Allow a minimum of 21 days between treatments. Do not make more than two applications per year. Do not use an adjuvant.
	20D	**Acramite 50WS** (bifenazate)	0.75–1.0 lb	One application per season.	3	12	
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	1	12	Do not make more than 2 applications per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**MET52 EC** (*Metarhizium anispoliae* strain F52)	**Drench:** 40–80 fl oz **Foliar:** 0.5 pint–2 qt		0	0	
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		0	12	OMRI-listed.
	-	**Oberon 23** (spiromesifen)	7.0–8.5 fl oz	Maximum amount per crop: 25.5 fl oz/acre.	7	12	No more than 3 applications.
	-	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0–2.0 lb		0	4	Repeat applications at 3–10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI-listed.
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water.		0	4	OMRI-listed.
	-	**Ultra-Fine Oil JMS Stylet-Oil Saf-T-Side** (oil, insecticidal)	1–2 gal/100 gal water **JMS:** 3–6 qt/100 gal		0	4	Do not exceed four applications per season. Stylet-oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
Plant bugs and Tarnished plant bug	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	Do not apply more than 0.3 lb a.i./acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	5	24	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not exceed a total of 31 fl oz of Besiege per acre per year.	5	24	
	4A	**Belay 50 WDG** (clothianidin)	1.6–3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	Do not apply more than 8.4 oz/acre per season.	0	12	
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		0	12	OMRI-listed.
Planthoppers	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	1	12	Immature insects only. No more than 2 applications per crop cycle.
Psyllids	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	**Foliar:** 1 **Soil:** 21	12	Use only one application method.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	1	4	Minimum interval between applications: 7 days.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	Maximum of 10 fl oz per acre per season.	1	24	

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
Soil insects (garden symphylans)	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
Stink bugs (including brown stink bug, green stink bug, southern green stink bug, squash bug)	1A	**Carbaryl 4L** (carbaryl)	0.5–2 qt	Do not apply more than a total of 8 quarts/A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Do not exceed 42.67 fl oz total application/A per season.	3	24	Maximum of 4 applications (0.8 lb a.i./acre) per season.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	Do not apply more than 43.26 fl oz/A per season.	7	12	
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	Do not apply more than 0.3 lb a.i./acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	5	24	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A	**Actara** (thiamethoxam)	2.0–5.5 oz	Maximum of 11 oz/acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	**Belay 50 WDG** (clothianidin)	1.6–3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	**Foliar:** 1 **Soil:** 21	12	Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6.0 oz	Do not apply more than 6 oz foliar or 12 oz soil per season.	**Foliar:** 1 **Soil:** 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Limited to 14 oz/acre per growing season.	1	12	
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Thrips (check label for species controlled) (eastern flower thrips, western flower thrips, Florida flower thrips, foliar feeding thrips, chilli thrips, melon thrips)	1A	**Carbaryl 4L** (carbaryl)	0.5–2 qt	Do not apply more than a total of 8 quarts/A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	Do not apply more than 43.26 fl oz/A per season.	7	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	Maximum 10.5 fl oz/A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Most effective if applied to soil at transplanting.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	4A	**Assail 30 SG** (acetamiprid)	1.5–4.0 oz	Do not exceed a total of 16.0 oz/A per growing season, including any pretransplant applications of acetamiprid.	7	12	Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5.0–11.0 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 oz Platinum 75 SG/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	**Foliar:** 1 **Soil:** 21	12	Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6.0 oz	Do not apply more than 6 oz foliar or 12 oz soil per season.	**Foliar:** 1 **Soil:** 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	Do not exceed a total of 13 fl oz/A.	30	12	May be applied to soil by one of several methods—see label.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	1	4	Minimum interval between applications: 7 days.
	5	**Entrust SC** (spinosad)	1.5–10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Agri-Mek SC** (abamectin)	1.7–3.5 fl oz	Do not apply more than 10.25 fl oz/A in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	Do not apply more than 20 fl oz per acre per year.	7	24	This label contains pollinator warnings.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	1	12	
	28	**Verimark** (cyantraniliprole)	**Tray drench/ transplant water:** 10.0–13.5 fl oz **Drip:** 10 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	1	4	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	-	**Azatin XL** (azadirachtin)	5–21 oz		0	4	
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.		0	4	Product contains live spores of a naturally occurring fungus. Some fungicides may interfere with efficacy. OMRI-listed. May be used in greenhouses. Contact dealer for recommendations if an adjuvant may be used. Compatible in tank mixes with some fungicides.
	-	**MET52 EC** (*Metarhizium anispoliae* strain F52)	**Drench:** 40–80 fl oz **Foliar:** 0.5 pt–2 qt		0	0	
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		0	12	OMRI-listed.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart		0	4	May be used in greenhouses. Contact dealer for recommendations if an adjuvant may be used. Compatible in tank mixes with some fungicides. OMRI-listed.
	-	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0–2.0 lb		0	4	
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt		0	4	Begin applications before pests reach damaging levels.
	-	**SuffOil-X** (mineral oil)	1%–2% v/v		0	4	OMRI-listed.
	-	**Ultra-Fine Oil JMS Stylet-Oil Saf-T-Side** (oil, insecticidal)	1–2 gal/100 gal water **JMS:** 3–6 qt/100 gal		0	4	Do not exceed four applications per season. Stylet-Oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
Weevils	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	Do not apply more than 0.3 lb a.i./acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	5	24	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
Whiteflies	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.5–11.2 oz	Do not apply more than 43.26 fl oz/A per season.	7	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	5	24	
	4A	**Platinum** (thiamethoxam)	5.0–11.0 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 oz Platinum 75 SG/A per growing season.	30	12	
	4A	**Actara** (thiamethoxam)	2.0–5.5 oz	Maximum of 11 oz/acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7–10.5 fl oz	Maximum 10.5 fl oz/A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/10,000 plants		21	12	**Planthouse:** 1 application. See label.
	4A	**Assail 30 SG** (acetamiprid)	1.5–4.0 oz	Do not exceed a total of 16.0 oz/A per growing season, including any pretransplant applications of acetamiprid.	7	12	Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	1.6–3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area. Do not apply if imidacloprid or thiamethoxam have been used at planting.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	**Foliar:** 1 **Soil:** 21	12	
	4A	**Venom Insecticide** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–6.0 oz	Do not apply more than 6 oz foliar or 12 oz soil per season.	**Foliar:** 1 **Soil:** 21	12	Do not use both application methods. No more than 3 applications per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	Do not exceed a total of 13 fl oz/A.	30	12	May be applied to soil by one of several methods—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Limited to 14 oz/acre per growing season.	1	12	
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	1	4	Minimum interval between applications: 7 days.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	Do not apply more than 20 fl oz per acre per year.	7	24	This label contains pollinator warnings.
	7C	**Knack IGR** (pyriproxyfen)	8–10 fl oz	Do not exceed 20 fl oz/A per season.	1	12	Apply before populations build to damaging levels. Minimum of 7 days between applications. Do not make more than two applications.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/acre per crop.	0	12	

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	Do not apply more than 4.8 fl oz (0.070 lb a.i.) per acre per crop cycle. Do not apply more than 9.6 fl oz (0.140 lb a.i.) per acre per year.	1	12	Do not apply by air. Do not make more than 2 applications per crop cycle. Do not make more than 4 applications per year.
	9D	**Sefina** (afidopyropen)	14 fl oz	Do not apply more than 28 fl oz of Sefina (0.09 lb afidopyropen a.i.) per acre per season.	0	12	Do not make more than 2 sequential applications of Sefina before using an effective insecticide with a different mode of action.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	1	12	Immature insects only. No more than 2 applications per crop cycle.
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	1	12	Do not make more than 2 applications per season.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	Maximum of 10 fl oz per acre per season.	1	24	
	23	**Oberon 2SC** (spiromesifen)	7.0–8.5 fl oz	Maximum amount per crop: 25.5 fl oz/acre.	7	12	No more than 3 applications.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	1	12	Foliar application.
	28	**Verimark** (cyantraniliprole)	**Tray drench/ transplant water:** 6.75–13.5 fl oz **Drip:** 6.75–10 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	1	4	Soil application.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	-	**Azatin XL** (azadirachtin)	5–21 oz		0	4	
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.		0	4	May be used in greenhouses. Contact dealer for recommendations if an adjuvant may be used. Compatible in tank mixes with some fungicides.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Rate per Season	Days to Harvest	REI (Hours)	Remarks
	-	**MET52 EC** (*Metarhizium anispoliae* strain F52)	**Drench:** 40–80 fl oz **Foliar:** 0.5 pt–2 qt		0	0	Product contains live spores of a naturally occurring fungus. Some fungicides may interfere with efficacy. OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		0	12	
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt		0	4	May be used in greenhouses. Contact dealer for recommendations if an adjuvant may be used. Compatible in tank mixes with some fungicides. OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz		0	12	
	-	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0–2.0 lb		0	4	OMRI-listed.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt		0	4	Begin applications before pests reach damaging levels.
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water		0	4	OMRI-listed.
	-	**Ultra-Fine Oil JMS Stylet-Oil Saf-T-Side** (oil, insecticidal)	1–2 gal/100 gal water **JMS:** 3–6 qt/100 gal		0	4	Do not exceed four applications per season. Stylet-Oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2 March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.
[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 8.5. Eggplant fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Pamela D. Roberts, UF/IFAS Southwest Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Alternaria blight/Early blight	M1	(copper compounds) **Many brands available:** AmeriCop 40DF, Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C-S WDG, COC DF, COC WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Master Cop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	3	**Tebuzol** **Toledo** (tebuconazole)	**SEE INDIVIDUAL LABELS**				
	7	**Endura** (boscalid)	3.5 oz	21 oz	0	0.5	
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	
	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
	7 + 12	**Miravis Prime** (fludioxonil + pydiflumetofen)	11.4 fl oz	22.8 fl oz/year	0	0.5	
	9	**Vango WG** (cyprodinil)	7 oz	28 oz	0	0.5	
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	
	9 + 12	**Alerity 62.5** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	
	9 + 12	**Switch** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Follow resistance management recommendations on label.
	11	**Aftershock** **Evito 480 EC** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Do not use in greenhouse production; see label for additional instructions.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Cabrio EG** (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11	**Flint Extra Gem** (trifloxystrobin)	3.0 oz	16 oz	3	0.5	
	11	**Reason 500 SC** (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	
	12	**Emblem** (fludioxonil)	7 fl oz	28 fl oz/A/year	0	0.5	
	19	**Ph-D WDG Oso 5SC** (polyoxin D zinc salt)	See label	See label	0	4 hr	
Anthracnose	M1	(copper compounds) **Many brands available:** AmeriCop 40DF, Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Master Cop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	M1 + M2	**Top Cop with Sulfur** (copper sulfate + sulfur)	2 qt			1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Chloronil 720, Echo 720, Equus 720 SST, Initiate	**SEE INDIVIDUAL LABELS**		See label	0.5	
	M5 + 27	**Ariston** (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt per 12 month	3	0.5	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	3	0.5	See label.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant 0.125% v/v is recommended.
	3	**Topguard** (flutriafol)	14 fl oz	56 fl oz	0	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3 + 7	**Aprovia Top** (difenoconazole + benzovindiflupyr)	13.5 fl oz	53.6 fl oz per 12 month	0	0.5	
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	See label	Disease suppression only.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	
	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	7	0.5	
	11	(azoxystrobin) **Many brands available:** Aframe, Azoxystar, Azoxystrobin, Azoxyzone, Equation, Heritage, Quadris, Satori, Trevo, Willowood Azoxy	15.5 fl oz	61.5 fl oz	0	4 hr	See individual labels.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11	**Flint Extra** **Gem** (trifloxystrobin)	3.0 oz	16 oz	3	0.5	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	
	11 + 3	**TopGuard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	
	19	**Ph-D** (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	Disease suppression only.
Botrytis gray mold	9	**Alerity 62.5WG** (cyprodinil)	7 oz	14 oz	0	0.5	
	9	**Vango WG** (cyprodinil)	7 oz	28 oz	0	0.5	
Crown rot (*Phythophthora capsici*)	4	**Metastar 2E AG** (metalaxyl)	8 pt	12 pt	7	2	See label for specific instructions.
	4	**Orondis Gold B** (mefenoxam)	1 pt	1.5 lb a.i./A	7	2	See label; suppression.
	4	**Ridomil Gold SL** **Ridomil Gold EC** **Ultra Flourish** (mefenoxam)	**SEE INDIVIDUAL LABELS**				

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	40 + 45	**Zampro** (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	4		See label.
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	9.6 fl oz	19.2 fl oz per year	0	4 hr	Apply at transplant; see label.
Damping off (Pythium, Rhizoctonia and other seed-borne and soilborne fungi)	M3	**Signet 480FS** **42-S Thiram** (thiram)	6.5 fl oz/100 lb seed			1	
	4	(mefenoxam) **Many brands available:** Apron XL, Ridomil Gold EC, Ridomil Gold SL, Ultra Flourish	**SEE INDIVIDUAL LABELS**			2	
	4	(metalaxyl) **Many brands available:** Acquire, Allegiance FL, Metastar 2E, Sebring 2.65 ST, Sebring 318 FS, Sebring 480 FS	**SEE INDIVIDUAL LABELS**				
	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
	11	(azoxystrobin) **Many brands available:** Aframe, Azoxystar, Azoxystrobin, Azoxyzone, Equation, Heritage, Quadris, Satori, Trevo, Willowood Azoxy	See label		0	4 hr	For Rhizoctonia seedling rot.
	11	**Dynasty** (azoxystrobin)	0.38 fl oz/100 lb seed			4 hr	
	12	**Maxim 4 FS** **Spirato 480 FS** **Dynashield** (fludioxonil)	0.16 fl oz/100 lb seed			0.5	See individual labels.
Gray leaf spot (*Stemphylium*)	3 + 4	**Aprovia Top** (difenoconazole + benzovindiflupyr)	13.5 fl oz	53.6 fl oz per 12 month	0	0.5	
	3 + 9	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	
	7 + 12	**Miravis Prime** (fludioxonil + pydiflumetofen)	11.4 fl oz/A	22.8 fl oz/year	0	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Flint Extra** **Gem** (trifloxystrobin)	3.0 oz	16 oz	3	0.5	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	55 fl oz/A				At planting. See label. For Pythium only.
Phomopsis blight	M1	(copper compounds) **Many brands available:** Americop 40DF, Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Master Cop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	M1 + M2	**Top Cop with Sulfur** (copper sulfate + sulfur)	2 qt			1	
Phytophthora blight and crown rot	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, C-O-C WDG, Cueva	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	Disease suppression only.
	11	**Aftershock** **Evito 480 EC** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	For disease suppression only. Do not use in greenhouse production.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11	**Flint** **Gem** (trifloxystrobin)	3.0 oz	16 oz	3	0.5	
	11	**Reason 500 SC** (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Disease suppression only.
	21	**Ranman** (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	
	22	**Elumin** (ethaboxam)	8 fl oz	16 fl oz	2	0.5	See label.
	29	**Omega 500F** (fluazinam)	1.5 pt	9 pt	12	30	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	33	(phosphites) **Many brands and formulations:** Confine Extra, Fosphite, Fungi-Phite, K-Phite, Rampart	**SEE INDIVIDUAL LABELS**				
	40	**Forum** (dimethomorph)	6 oz	30 oz	0	0.5	
	40	**Orondis Ultra B** (mandipropamid)	1 pt	1.5 lb a.i.	7	2	
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz per season	1	4 hr	Disease suppression only.
	40 + 45	**Zampro** (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	4		See label.
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz	2	0.5	
	49	**Orondis Ultra A** (oxathiapiprolin)	9.6 fl oz	19.2 fl oz	0	4 hr	Apply at transplant; see label.
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	55 fl oz/A				At planting. See label.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + manipropamid)	8 fl oz	32 fl oz/A/yr	1	4 hr	See label.
Powdery mildew	M2	(sulfur) **Many brands available:** Cosavet DF, Kumulus DF Fungicide-Acaricide, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Suffa, Sulfur 90 W/ Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Chloronil 720, Echo 720, Equus 720 SST, Initiate	**SEE INDIVIDUAL LABELS**			0.5	
	M5 + 27	**Ariston** (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt per 12 month	3	0.5	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt per year	3	0.5	See label.
	3	**Mettle 125ME** (tetraconazole)	8 fl oz		16 fl oz/A/year	7	0.5
	3	**Rally 40WSP** **Sonoma 40WSP** (myclobutanil)	**SEE INDIVIDUAL LABELS**		0	1	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	12	Use of silicone- or oil-based additives may result in negative crop response. In situations where an adjuvant is necessary, use of a nonionic surfactant 0.125% v/v is recommended.
	3	**Topguard** (flutriafol)	14 fl oz	56 fl oz	0	0.5	
	3 + 7	**Aprovia Top** (difenoconazole + benzovindiflupyr)	13.5 fl oz	53.6 fl oz per 12 month	0	0.5	
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	
	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
	7 + 12	**Miravis Prime** (fludioxonil + pydiflumetofen)	11.4 fl oz	22.8 fl oz/year	0	0.5	
	9	**Vango WG** (cyprodinil)	7 oz	28 oz	0	0.5	
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	
	9 + 12	**Switch** **Alerity 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Follow resistance management recommendations on label.
	11	(azoxystrobin) **Many brands available:** Aframe, Azoxystar, Azoxystrobin, Azoxyzone, Equation, Heritage, Quadris, Satori, Trevo, Willowood Azoxy					See individual labels.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	
	11 + 3	**TopGuard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	
	12	**Emblem** (fludioxonil)	7 fl oz	28 fl oz/A/ year	0	0.5	
	13	**Quintec** (quinoxyfen)	6 fl oz	24 fl oz	3	0.5	See label.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	19	**Ph-D WDG** (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	
	50	**Prolivo 300SC** (pyriofenone)	5 fl oz	16 fl oz/year	0	4	Follow resistance management on label.
	50	**Vivando** (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	Apply prior to symptoms of powdery mildew.
Sclerotinia	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
Septoria leaf spot	M1	**Cueva** (copper octanoate)	SEE LABEL				
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	
	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
	7 + 12	**Miravis Prime** (fludioxonil + pydiflumetofen)	11.4 fl oz	22.8 fl oz/year	0	0.5	
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	
	11	**Cabrio EG** (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11	**Flint Extra Gem** (trifloxystrobin)	3.0 oz	16 oz	3	0.5	Disease suppression only. See individual labels.
	11	**Reason 500 SC** (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Disease suppression only.
White mold	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	Disease suppression only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).
[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 8.6. Nonfumigant nematicides for eggplants in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Vydate L (a.i. oxamyl)	Apply ½ to 1 gal/acre at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. Do not apply more than 3 gal per acre per season. Minimum retreatment interval is 7 days unless a longer interval is stated. Do not make more than 8 applications per season.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints (56.0 to 80.0 fl oz) per acre, a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop and no more than 112 fl oz of product per acre per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/acre using only chemigation into root-zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Observe minimum 5-day interval between soil applications. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.

Vydate is an insecticide/nematicide; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations as far as how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.

Table 8.7. Fumigant nematicides for eggplants in Florida.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/chisel-spaced 12" apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone InLine[2,3]	13 to 20.5 gal	-	For drip fumigation, consult the product label for overall rate, drip concentration, and flow-modifying application directions.
Pic Clor 60[2,3]	19.5 to 31.5 gal	57 to 90	Consult product label for overall rate and chisel flow-modifying application directions.
Pic Clor 60 EC[2,3]	19.5 to 31.5 gal	-	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Vapam HL	75 gal	-	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See label details for additional use restrictions based on soil characteristics, buffer zones, requirements for personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and rate-modifying recommendations with use of highly retentive Totally Impermeable mulch films (TIF).
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS728

doi.org/10.32473/edis-cv293-2022

Chapter 9. Leafy Vegetable Production[1]

Germán Sandoya-Miranda, Ramdas Kanissery, Nicholas S. Dufault, Johan Desaeger, Anna Meszaros, Julien Beuzeli, and Katia Viana Xavier[2]

Lettuce, Endive, and Escarole

Botany and Planting

Lettuce—*Lactuca sativa,* Asteraceae (Compositae)

Endive—*Cichorium endivia*

Escarole—*Cichorium endivia*

Table 1. Planting information for lettuce, endive, and escarole.

Planting Dates	Crisphead	Butterhead	Romaine	Endive	Escarole
North Florida	Sept–Oct; Jan–Feb	Sept–Oct; Jan–Feb	Aug–Oct; Jan–Feb	Aug–Oct; Jan–Feb	Aug–Oct; Jan–Feb
Central Florida	Sept–Feb	Sept–Feb	Aug–Feb	Aug–Feb	Aug–Feb
South Florida	Sept–Feb	Sept–Feb	Sept–Mar	Sept–Mar	Sept–Mar
Planting Information					
Distance between rows (in)	18–30	18–30	18–30	18–30	18–30
Distance between plants (in)	8–12	9	12	14–16	14–16
Seeding depth (in)	0.25	0.25	0.25	0.25	0.25
Seed per acre (lb)	1–3	1–3	2–4	3–4	3–4
Days to maturity from seed	70–95	60–80	60–80	60–80	60–80
Plant populations (acre)	43,560	38,720	29,040	24,891	24,891

1. This document is HS728, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Germán Sandoya-Miranda, assistant professor, Horticultural Sciences Department, UF/IFAS Everglades Research and Education Center; Ramdas Kanissery, assistant professor, Horticultural Sciences Department, UF/IFAS Southwest Florida REC; Nicholas S. Dufault, associate professor, Plant Pathology Department; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; Anna Meszaros, Extension agent II, UF/IFAS Extension Palm Beach County; Julien Beuzelin, assistant professor, Entomology and Nematology Department, UF/IFAS Everglades REC; Katia Viana Xavier, UF/IFAS Everglades REC; UF/IFAS Extension, Gainesville, FL 32611.

Cultivars

Table 2. Lettuce, endive, and escarole cultivars.

Green Saladbowl	Romaine (Green)	Red Leaf	Crisphead	Endive	Escarole
Green Star	Concept	Galactic	Gator	Markant	Full Heart NR 65
Tropicana	Fusion	New Red Fire	Gulfstream	Salad King	Twinkle
Two Star	Kalura	Red Saladbowl	Raleigh		
	Medallion	Vulcan	Summer Crisp (red)		
	Snappy				
	Solid King				
	Terrapin				
Boston	**Romaine (Red)**	**Oakleaf (Green)**	**Bibb**		
Ermosa	Outredgeous	Ferrari	Cherokee		
Florida Butter Crisp	Rosalita	Royal Oak	Floribibb		
Margarita					

Table 3. Lettuce and escarole planted in south Florida.

Type	Cultivar	Planting
Iceberg	Belle Glade	Intermediate [1]
	Chosen	Early [2]
	Cooper	Intermediate/Late[3]
	Flagler	Throughout[4]
	Lantana	Early
Romaine	1505	Intermediate/Late
	Desert Gold	Intermediate
	Hialeah	Throughout
	Homestead	Intermediate
	Manatee	Throughout
	Okeechobee	Intermediate
	Sawgrass	Intermediate/Late
	Solid King	Intermediate
	Tammy	Intermediate
Leaf	3SX739	Intermediate
	Big Star	Intermediate
	Cherokee	Throughout
	RSX743	Throughout
Boston	Odyssey	Throughout
	Palmetto	Throughout
Escarole	38100	Throughout
	39019	Throughout
	Forbes	Throughout
	Olmos	Throughout
	Siena	Throughout

[1] Planting starts in December
[2] Planting starts in October
[3] Planting starts in January
[4] Planting all season (October to March)

Spinach

Botany and Planting

Spinach—*Spinacia oleracea*

Table 4. Planting information for spinach.

Planting Dates	
North and central Florida	Sept–Mar
South Florida	Oct–Feb
Planting Information	
Distance between rows (in)	12–36
Distance between plants (in)	2–6
Seeding depth (in)	0.5
Seed per acre (lb)	10–15
Days to maturity from seed	45–60
Plant population (acre)	261,136

Cultivars

Table 5. Spinach cultivars.

Smooth Leaf	
A+C #30 (H)	Space (H)
Semi-savoy Leaf	
Ashley (H)	Seaside
Chinook II (H)	Skookum (H)
Gladiator (H)	Tyee (H)
Melody (H)	
Savoy Leaf	
Ambassador (H)	Hybrid 612 (H)
H = hybrid	

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 6. Herbicides approved for managing weeds in lettuce. Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.				
***** PREEMERGENCE *****				
Benefin 1.2	(Balan) DF 2 lb	3	Lettuce	Annual broadleaf and grass weeds. Apply before seeding or transplanting. Incorporate with cultivation or irrigation into the top 2 to 3 in. of the final bed.
Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Leafy vegetables	Annual broadleaf and grass weeds. Incorporate with cultivation or irrigation. Do not use on spinach or Swiss chard.
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Leafy vegetables	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult label	9	Leafy vegetables	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
Imazethapyr 0.016–0.031	(Pursuit) 2 EC 1–2 fl oz	2	Lettuce, endive, escarole	Broadleaf weeds. Apply in fields with 40% organic matter or greater. Do not apply more than 2 applications per crop. A maximum of 4 oz of product per acre per crop season. Should be applied in 2 or more gallons of water per acre. Potential for rotational crop injury is highly variable. Label is a Third-Party Registration (TPR, Inc.). Use without having a signed authorization and waiver of liability agreement is a misuse of the product. PHI 30 days.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2–4 pt (Gramoxone) 3 SL 1.3–2.7 pt	22	Lettuce, endive, escarole	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Do not make more than 3 applications per year. Consult label for new restrictions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Leafy vegetables	Emerged broadleaf and grass weeds. Apply as a preplant burndown before planting.
Pronamide 1.0–2.0	(Kerb) 50 W 2.0–4.0 lb	3	Head lettuce, endive, escarole	Certain annual broadleaf and grass weeds. Overhead irrigate with 1 to 2 in. following applications. Observe rotational restrictions to other crops. Not recommended for soils with high organic matter. PHI 55 days.
Pyraflufen 0.001–0.003	(ET Herbicide/ Defoliant) 0.5–2.0 fl oz	14	Leafy vegetables	Emerged broadleaf weeds. Apply as a preplant burndown 1 day prior to planting. Include an NIS at 0.25% or COC at 1.0% to the spray solution.
Trifluralin 0.5	(Treflan, Trifluralin) 4 EC 1.0 pt (Trifluralin) 10 G 5 lb	3	Endive, escarole, radicchio	Annual broadleaf and grass weeds. Apply as preplant incorporate to mineral soils only.
****POSTEMERGENCE****				
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Leafy vegetables	Emerged broadleaf weeds. Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank mixed with other herbicides.
Clethodim 0.09–0.13 0.07–0.13	(Select, Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Leafy vegetables	Emerged annual and perennial grass weeds. For repeat application, minimum of 14 days between applications. PHI 14 days.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Crops	Weeds Controlled/Remarks
Imazethapyr 0.016–0.031	(Pursuit) 2 EC 1–2 fl oz	2	Lettuce, endive, escarole	Broadleaf weeds. Apply in fields with 40% organic matter or greater. Apply postemergence after 3–4 true leaf stage. Do not apply more than 2 applications per crop. A maximum of 4 oz per crop season. Potential for rotational crop damage is highly variable. Label is a Third-Party Registration (TPR, Inc.). Use without having a signed authorization and waiver for liability agreement is a misuse of the product. PHI 30 days.
Paraquat 0.3–0.5	(Gramoxone) 2 SL 1.2–2.0 pt (Gramoxone) 3 SL 0.8–1.3 pt	22	Lettuce	Emerged broadleaf and grass weeds. Row middles only. Consult individual labels for not all formulations are labeled for this use pattern. Include a NIS at 0.25% v/v. PHI 24 hrs. Consult label for new restrictions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Leafy vegetables	Emerged broadleaf and grass weeds. Apply as a directed or shielded spray to row middles.
Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Head/leaf lettuce, endive, radicchio	Emerged grass weeds. Do not exceed 3.0 pt/A per season. Include a crop oil concentrate. Head lettuce and radicchio PHI 30 days. Leaf lettuce and endive PHI 15 days.

Table 7. Herbicides approved for managing weeds in spinach. Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		***** PREPLANT/PREEMERGENCE *****	
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank mixed with soil residual compounds.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank mixed with soil residual compounds.
Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
		***** POSTEMERGENCE *****	
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank mixed with other herbicides. PHI 0 days.
Clethodim 0.09–0.13 0.07–0.25	(Arrow, Select) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grass weeds. Use higher rates under heavy grass pressure or larger grass weeds. Read the label for required surfactant. PHI 14 days.
Clopyralid 0.06–0.12	(Clopyr Ag) 3 EC 0.17–0.33 pt	4	Certain broadleaf weeds. Do not exceed a total of 0.5 pt/A per growing season. Apply in the 2- to 5-leaf stage of crop growth. PHI 21 days.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank mixed with several soil residual compounds.
Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Controls emerged grass weeds. A total of 3.0 pt/A applied in one season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 15 days.

Table 8. Insecticides labeled for management of arthropod pests of lettuce and other leafy vegetables (non-brassica, including escarole and endive). Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1A	***Lannate LV** ***Lannate SP** (methomyl)	**LV:** 1.5–3 pt **SP:** 0.5–1.0 lb	48	10, or 7 for lowest rates for lettuce only	**Head varieties:** Maximum of 24 pt (LV) or 8 lb (SP)/acre per crop. **Leaf varieties and endive (escarole), dandelions, Swiss chard:** Maximum of 12 pt (LV) or 4 lb (SP)/acre per crop.
	1B	***Diazinon AG500** ***Diazinon 50W** (diazinon)	**AG500:** 0.5–1 pt **50W:** 0.5–1 lb	72	14	Do not apply more than once. **Head and leaf lettuce only.**
	1B	**Dimethoate 4 EC** (dimethoate)	0.5 pt	48	14	**Leaf lettuce only; not for head lettuce. Also for endive (escarole) and Swiss chard.**
	1B	**Malathion 5EC** **Malathion 8F** (malathion)	**5EC:** Endive: 1.5–2.0 pt Lettuce: 2–3 pt **8F:** Endive: 1.25 pt Head and leaf lettuce: 1.88 pt	24	Endive: 7 Head and leaf lettuce: 14	Maximum of 2 applications per year.
	1B	**Orthene 97** (acephate)	0.5–1.0 lb	24	21	**Crisphead head lettuce only.** Maximum of 2.125 lb/acre per crop cycle. Other brands available with same active ingredient.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	**Head lettuce only.** Maximum of 32 fl oz/acre per season. Other brands available with same active ingredient.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	1	Maximum of 0.8 lb a.i./acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	24	1	**Head and leaf lettuce only.** Maximum of 19.2 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per growing season.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	4A	**Admire Pro** (imidacloprid)	**Foliar:** 1.3 fl oz **Soil:** 4.4–10.5 fl oz	12	**Foliar**: 7 **Soil:** 21	Maximum of 6.5 fl oz (foliar) or 10.5 fl oz (soil)/acre per year. Many other brands with same active ingredient are available.
	4A	**Assail 30SG** **Assail 70WP** (acetamiprid)	**30SG:** 2.0–4.0 oz **70WP:** 0.8–1.7 oz	12	7	**30SG:** Maximum of 20.0 oz/acre or 0.375 lb a.i. per year. **70WP:** Maximum of 8.5 oz/acre or 0.375 lb a.i. per year. Other brands available with same active ingredient.
	4A	**Belay** (clothianidin)	**Foliar:** 3–4 fl oz **Soil:** 9–12 fl oz	12	**Foliar**: 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar**: 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	12	30	May be applied using one of several soil application methods.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not exceed a total of 14 oz/ acre per season or 0.172 lb a.i. of thiamethoxam or 0.2 lb a.i. of chlorantraniliprole/acre per season.
	4C	**Closer SC** (sulfoxaflor)	1.5–2.0 fl oz	12	3	Maximum of 17 fl oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	4	1	Maximum of 28 fl oz/acre per crop season. Maximum crop seasons per year of 3.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	10 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products including all application types.
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Maximum of 5.5 oz/acre per season.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	12	1	Maximum of 4.8 fl oz/acre per crop cycle.
	9D	**Versys** (afidopyropen)	1.5 fl oz	12	0	Maximum of 14 fl oz/acre per season.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	12	1	Do not apply until at least 14 days after emergence. Maximum of 42 fl oz/acre per crop cycle.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	24	3	Do not apply more than 10 fl oz/acre per crop. See label for information about the use of adjuvants.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark) including all application types. For best performance, use an adjuvant.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	28	**Harvanta 50SL** (cyclaniliprole)	10.9–16.4 fl oz	4	1	Maximum of 49.2 fl oz/acre per year. For best performance, use an adjuvant.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	–	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	–	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.[2]
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–2 lb	4	0	OMRI-listed.[2]
	–	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	–	**M-Pede 49%** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	–	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.[2]
	–	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2.0–4.0 qt	4	0	
	–	**Suffoil-X** (mineral oil)	1–2 gal/100 gal	4	0	OMRI-listed.[2]
	–	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.[2]
Beetles (includes cucumber beetles, flea beetles) and **weevils**	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	0.5–1.0 qt	12	14	Maximum of 6 qt/acre per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	**Head lettuce only**. Maximum of 32 fl oz/acre per season. Other brands available with same active ingredient.
	3A	***Declare** (gamma-cyhalothrin)	1.02–1.54 fl oz	24	1	**Head and leaf lettuce only**. Maximum of 15.4 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	24	1	**Head and leaf lettuce only**. Maximum of 19.2 fl oz/acre per season. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	24	1	**Head and leaf lettuce only.** Maximum of 31 fl oz/acre per year.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per growing season. **Flea beetles only.**
	4A	**Admire Pro** (imidacloprid)	1.3 fl oz	12	7	Maximum of 6.5 fl oz/acre per year. **Flea beetles only.** Other brands available with same active ingredient.
	4A	**Belay** (clothianidin)	**Foliar:** 3–4 fl oz **Soil:** 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year. **Flea beetles only.**
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant. **Flea beetles only.**
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season. **Flea beetles only.**
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	12	30	May be applied using one of several soil application methods.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not exceed a total of 14 oz/acre per season or 0.172 lb a.i. of thiamethoxam or 0.2 lb a.i. of chlorantraniliprole/acre per season.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	12	1	Do not apply until at least 14 days after emergence. Maximum of 42 fl oz/acre per crop cycle. **Flea beetles only.**
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
Caterpillars (includes armyworms, corn earworm, green cloverworm, tobacco budworm, lesser cornstalk borer, loopers, cutworms)	1A	***Lannate LV** ***Lannate SP** (methomyl)	**LV:** 1.5–3 pt **SP:** 0.5–1.0 lb	48	10, or 7 for lowest rates for lettuce only	**Head varieties:** Maximum of 24 pt (LV) or 8 lb (SP)/acre per crop. **Leaf varieties and endive (escarole), dandelions, Swiss chard:** Maximum of 12 pt (LV) or 4 lb (SP)/acre per crop.
	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	1–2 qt	12	14	Maximum of 6 qt/acre per year.
	1B	***Diazinon AG500** ***Diazinon 50W** (diazinon)	**AG500:** 1–2 qt Endive (escarole): 1–4 qt **50W:** 2–4 lb Endive (escarole): 2–8 lb	Lettuce: 72 Endive (escarole): 96	preplant	**Head and leaf lettuce, endive (escarole) only.**
	1B	**Orthene 97** (acephate)	1.0 lb	24	21	**Crisphead head lettuce only**. Maximum of 2.125 lb/acre per crop cycle. Other brands available with same active ingredient.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	12	1	Maximum of 128 oz/acre per season.
	3A	***Asana XL** (esfenvalerate)	4.8–9.6 fl oz	12	7	**Head lettuce only**. Do not apply more than 0.35 lb a.i. per acre per season.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12	7	**Head lettuce only**. Maximum of 32 fl oz/acre per season. Other brands available with same active ingredient.
	3A	***Declare** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	1	**Head and leaf lettuce only**. Maximum of 15.4 fl oz/acre per season. Armyworms: 1st and 2nd instar larvae only.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season
	3A	***Pounce 25 WP** (permethrin)	3.2–12.8 oz	12	1	Maximum of 0.8 lb a.i./acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	1	**Head and leaf lettuce only**. Maximum of 19.2 fl oz/acre per season. 1st and 2nd instar larvae only. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 fl oz	24	1	**Head and leaf lettuce only.** Maximum of 31 fl oz/acre per year.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	12	30	May be applied using one of several soil application methods.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi per acre per season.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1 Turnip greens: 3	See label for resistance management recommendations. Do not apply more than 29 oz per acre per crop or more than twice in succession. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1 Turnip greens and other leaves of root, tuber, legume vegetables: 3	Maximum of 6 applications; no more than 2 consecutive applications before rotating to another MOA.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	7	Do not make more than 2 sequential applications without rotation to another product with a different mode of action.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10.0 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.
	11A	**Xentari DF** (*Bacilius thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Confirm 2F** (tebufenozide)	6–8 fl oz	4	7	Maximum of 40 fl oz/acre per season.
	18	**Intrepid 2F** (methoxyfenozide)	4–10 fl oz	4	1	Maximum of 64 fl oz/acre per year.
	22	**Avaunt** **Avaunt eVo** (indoxacarb)	2.5–6.0 oz	12	3	Maximum of 24 oz/acre per crop and 96 oz/acre per year (Avaunt) or 18 oz/acre per crop and 72 oz/acre per year (Avaunt eVo).
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	Can be applied by drip chemigation to soil at planting or used as a foliar spray.
	28	**Exirel** (cyantraniliprole)	7–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark) including all application types.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	28	**Harvanta 50SL** (cyclaniliprole)	10.9–16.4 fl oz	4	1	Maximum of 49.2 fl oz/acre per year.
	28	**Verimark** (cyantraniliprole)	5.0–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.
	32	**Spear-Lep** (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	4	0	Must be tank-mixed with a *Bacillus thurigiensis* (*Bt*) product. Maximum of 10 gallons/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–2 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.[2]
Fire ants	7	**Extinguish** (S-methoprene)	1–1.5 lb	0	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Grasshoppers, Mole crickets	1B	***Diazinon AG500** ***Diazinon 50W** (diazinon)	**AG500:** 1–2 qt Endive (escarole): 1–4 qt **50W:** 2–4 lb Endive (escarole): 2–8 lb	**AG500:** Lettuce: 72 **50W:** Endive (escarole): 96	preplant	See label. **Head and leaf lettuce, endive (escarole) only.**
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Declare** (gamma-cyhalothrin)	1.02–1.54 fl oz	24	1	**Head and leaf lettuce only**. Maximum of 15.4 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	1	**Head and leaf lettuce only**. Maximum of 19.2 fl oz/acre per season. Many other brands with same active ingredient are available.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
Leafhoppers	1A	***Lannate LV** ***Lannate SP** (methomyl)	**LV:** 1.5–3 pt **SP:** 0.5–1.0 lb	48	10, or 7 for lowest rates for lettuce only	**Head varieties:** Maximum of 24 pt (LV) or 8 lb (SP)/acre per crop. **Leaf varieties and endive (escarole), dandelions, Swiss chard:** Maximum of 12 pt (LV) or 4 lb (SP)/acre per crop.
	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	0.5–1.0 qt	12	14	Maximum of 6 qt/acre per year.
	1B	**Dimethoate 4 EC** (dimethoate)	0.5 pt	48	14	**Leaf lettuce only, not for head lettuce. Also for endive (escarole) and Swiss chard.**
	1B	**Malathion 5EC** **Malathion 8F** (malathion)	**5EC:** Lettuce: 2–3 pt **8F:** Endive: 1.25 pt Head and leaf lettuce: 1.88 pt	24	Head and leaf lettuce: 14	Do not apply more than twice per year.
	1B	**Orthene 97** (acephate)	0.5–1.0 lb	24	21	**Crisphead head lettuce only**. Maximum of 2.125 lb/acre per crop cycle. Other brands available with same active ingredient.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	12	1	Maximum of 128 oz/acre per season.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	**Head lettuce only**. Maximum of 32 fl oz/acre per season. Other brands available with same active ingredient.
	3A	***Declare** (gamma-cyhalothrin)	1.02–1.54 fl oz	24	1	Head and leaf lettuce only. Maximum of 15.4 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	1	**Head and leaf lettuce only.** Maximum of 19.2 fl oz/acre per season. Many other brands with same active ingredient are available.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per growing season.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	4A	**Admire Pro** (imidacloprid)	**Foliar:** 1.3 fl oz **Soil:** 4.4–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6.5 fl oz (foliar) or 10.5 fl oz (soil)/acre per year. Other brands available with same active ingredient.
	4A	**Belay** (clothianidin)	**Foliar:** 3–4 fl oz **Soil:** 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	12	30	May be applied using one of several soil application methods.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	4	1	Maximum of 28 fl oz/acre per crop season. Maximum crop seasons per year of 3.
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	12	7	Insect growth regulator. Do not make more than 2 applications per season per crop or 4 per year. Allow 7 days between applications.
	21A	**Torac** (tolfenpyrad)	14–21 fl oz	12	1	Do not apply until at least 14 days after emergence. Maximum of 42 fl oz/acre per crop cycle.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.
	-	**JMS Stylet-Oil, Saf-T-Side, Suffoil-X, Sun Spray 98.8%, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	4	0	Organic Stylet-Oil, Saf-T-Side, and Suffoil-X are OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**M-Pede 49%** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
Leafminers	1B	***Diazinon AG500 *Diazinon 50W** (diazinon)	**AG500:** 0.5–1 pt **50W:** 0.5–1 lb	72	14	Do not apply more than once. **Head and leaf lettuce only.**
	1B	**Dimethoate 4 EC** (dimethoate)	0.5 pt	48	14	Leaf lettuce only, not for head lettuce. Also for endive (escarole) and Swiss chard.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1 Turnip greens: 3	See label for resistance management recommendations. Do not apply more than 29 oz per acre per crop or more than twice in succession. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1 Turnip greens and other leaves of root, tuber, legume vegetables: 3	Maximum of 6 applications; no more than 2 consecutive applications before rotating to another MOA.
	6	***Agri-Mek SC** (abamectin)	1.75–3.50 fl oz	12	7	Maximum of 10.25 fl oz/acre per year. Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant. Many other brands with same active ingredient are available.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	7	Do not make more than 2 sequential applications without rotation to another product with a different mode of action.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10.0 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	Limited to six applications for head lettuce and five applications for other leafy vegetables.
	28	**Coragen** (chlorantraniliprole)	5.0–7.5 fl oz	4	1	May be applied by drip chemigation in addition to foliar and various soil application methods.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types. For best performance, use an adjuvant.
	28	**Harvanta 50SL** (cyclaniliprole)	10.9–16.4 fl oz	4	1	Maximum of 49.2 fl oz/acre per year.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.[2]
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2.0–4.0 qt	4	0	
	-	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed.[2]
Mites (includes carmine spider mite, two-spotted spider mite)	1B	**Malathion 5EC Malathion 8F** (malathion)	**5EC:** Endive: 1.5–2.0 pt Lettuce: 2.5–3.0 pt **8F:** Endive: 1.25 pt Head and leaf lettuce: 1.88 pt	24	Endive: 7 Head and leaf lettuce: 14	Do not apply more than twice per year.
	3A	***Brigade 2EC** (bifenthrin)	5.1–6.4 fl oz	12	7	**Head lettuce only**. Maximum of 32 fl oz/acre per season. Other brands available with same active ingredient.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	1	**Head and leaf lettuce only**. Maximum of 19.2 fl oz/acre per season. Many other brands with same active ingredient are available.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	6	***Agri-Mek SC** (abamectin)	1.75–3.50 fl oz	12	7	Maximum of 10.25 fl oz/acre per year. Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant. Many other brands with same active ingredient are available.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10.0 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**JMS Stylet-Oil, Saf-T-Side, Suffoil-X, Sun Spray 98.8%, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	4	0	Organic Stylet-Oil, Saf-T-Side, and Suffoil-X are OMRI-listed.[2]

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	-	**M-Pede 49%** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.[2]
Stink bugs, plant bugs, meadow spittlebug	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12	7	**Head lettuce only**. Maximum of 32 fl oz/acre per season. Other brands available with same active ingredient.
	3A	***Declare** (gamma-cyhalothrin)	1.02–1.54 fl oz	24	1	**Head and leaf lettuce only**. Maximum of 15.4 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	1	**Head and leaf lettuce only**. Maximum of 19.2 fl oz/acre per season. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–9 fl oz	24	1	Maximum of 31 fl oz/acre per year.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.
	-	**M-Pede 49%** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
Thrips (check labels for species control)	1A	***Lannate LV** ***Lannate SP** (methomyl)	**LV:** 1.5–3 pt **SP:** 0.5–1.0 lb	48	10, or 7 for lowest rates for lettuce only	**Head varieties:** Maximum of 24 pt (LV) or 8 lb (SP)/acre per crop. **Leaf varieties and endive (escarole), dandelions, Swiss chard:** Maximum of 12 pt (LV) or 4 lb (SP)/acre per crop.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1 Turnip greens: 3	See label for resistance management recommendations. Do not apply more than 29 oz per acre per crop, or more than twice in succession. OMRI-listed.[2]

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes[2]
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1 Turnip greens and other leaves of root, tuber, legume vegetables: 3	Includes turnip greens. Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
	21A	**Torac** (tolfenpyrad)	21 fl oz	12	1	Do not apply until at least 14 days after emergence. Maximum of 42 fl oz/acre per crop cycle.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.
	-	**BotaniGard ES BoteGHA ES Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**JMS Stylet-Oil, Saf-T- Side, Suffoil-X, Sun Spray 98.8%, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	4	0	Organic Stylet-Oil, Saf-T-Side, and Suffoil-X are OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**M-Pede 49%** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.[2]

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2 March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 9. Insecticides labeled for management of arthropod pests of spinach. Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (hours)	Days to Harvest	Notes[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1B	**Malathion 5EC** **Malathion 8F** (malathion)	**5EC:** 1.6 pt **8F:** 1.0 pt	12	7	Maximum of 2 applications per year.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	12	1	Do not apply more than 1.0 lb a.i./acre per season (5 applications at high rate).
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	1	Maximum of 0.6 lb a.i./acre per season (Maximum 3 applications at highest rate).
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.[2]
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per growing season.
	4A	**Admire Pro** (imidacloprid)	**Foliar:** 1.3 fl oz **Soil:** 4.4–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6.5 fl oz (foliar) or 10.5 fl oz (soil)/acre per year. Other brands available with same active ingredient.
	4A	**Assail 30SG** **Assail 70WP** (acetamiprid)	**30SG:** 2.0–4.0 oz **70WP:** 0.8–1.7 oz	12	7	**30SG:** Maximum of 20.0 oz/acre or 0.375 lb a.i. per year. **70WP:** Maximum of 8.5 oz/acre or 0.375 lb a.i. per year. Other brands available with same active ingredient.
	4A	**Belay** (clothianidin)	**Foliar:** 3–4 fl oz **Soil:** 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	12	30	May be applied using one of several soil application methods. One application per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi per acre per season. Do not use an adjuvant.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	4	1	Maximum of 28 fl oz/acre per year.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (hours)	Days to Harvest	Notes[2]
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Maximum of 5.5 oz/acre per season.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	12	1	Maximum of 4.8 fl oz/acre per crop cycle.
	9D	**Versys** (afidopyropen)	1.5 fl oz	12	0	Maximum of 14 fl oz/acre per season.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	24	3	Do not apply more than 10 fl oz/acre/crop. See label for information about the use of adjuvants.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types. Do not use an adjuvant.
	28	**Harvanta 50SL** (cyclaniliprole)	10.9–16.4 fl oz	4	1	Maximum of 49.2 fl oz/acre per year. For best performance, use an adjuvant.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	N/A: applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel) including all application types.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	0	Maximum of 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	-	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO is OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–2 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**M-Pede 49%** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	IGR and feeding repellant. OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.[2]
Beetles (includes cucumber beetle, flea beetles, darkling beetles) **and weevils**	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	0.5–1.0 qt	12	14	Maximum of 6 qt/acre per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Maximum of 25.6 fl oz/acre per season. Other brands available with same active ingredient.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (hours)	Days to Harvest	Notes[2]
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.[2]
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per growing season. **Flea beetles only.**
	4A	**Admire Pro** (imidacloprid)	1.3 fl oz	12	7	Maximum of 6.5 fl oz/acre per year. **Flea beetles only.** Other brands available with same active ingredient.
	4A	**Belay** (clothianidin)	**Foliar:** 3–4 fl oz **Soil:** 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./ acre per year. **Flea beetles only.**
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant. **Flea beetles only.**
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season. **Flea beetles only.**
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/ acre per season. **Flea beetles only.**
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	12	30	
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi per acre per season. Do not use an adjuvant.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
Caterpillars (including armyworms, corn earworm, green cloverworm, tobacco budworm, lesser cornstalk borer, loopers, cutworms)	1A	***Lannate LV** ***Lannate SP** (methomyl)	**LV:** 1.5–3 pt **SP:** 0.5–1.0 lb	48	7	Do not use more than 4 lb of SP or 12 pt of LV per acre/season. Do not apply to seedlings less than 3″ diameter.
	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	1–2 qt	12	14	Maximum of 6 qt/acre per year.
	1B	***Diazinon AG500** ***Diazinon 50W** (diazinon)	**AG500:** 2.0–4.0 qt **50W:** 4.0–8.0 lb	72	preplant	Do not make more than one soil application per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Maximum of 25.6 fl oz/acre per season. Other brands available with same active ingredient.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Pounce 25 WP** (permethrin)	3.2–12.8 oz	12	1	Maximum of 0.6 lb a.i./acre per season (maximum 3 applications at highest rate).

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (hours)	Days to Harvest	Notes[2]
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.[2]
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1	Use no more than 29 oz per acre per crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Maximum of 6 applications; no more than 2 consecutive applications before rotating to another MOA.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	7	Do not apply more than 28.8 oz/A per season.
	11A	**Biobit HP** (*Bacillus thuringiensis* ssp. *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.[2]
	11A	**Crymax WDG** (*Bacillus thuringiensis* ssp. *kurstaki*)	0.5–2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* ssp. *kurstaki*)	0.25–1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.[2]
	11A	**DiPel DF** (*Bacillus thuringiensis* ssp. *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. See label for rates for specific pests. For organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* ssp. *kurstaki*)	0.12–1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.[2]
	11A	**Xentari DF** (*Bacillus thuringiensis* ssp. *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Confirm 2F** (tebufenozide)	6–8 fl oz	4	7	Maximum of 40 fl oz/acre per season.
	18	**Intrepid 2F** (methoxyfenozide)	4–10 fl oz	4	1	Maximum of 64 fl oz/acre per year.
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	Can be applied by drip chemigation to soil at planting or used as a foliar spray.
	28	**Exirel** (cyantraniliprole)	7–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types. Do not use an adjuvant.
	28	**Harvanta 50SL** (cyclaniliprole)	10.9–16.4 fl oz	4	1	Maximum of 49.2 fl oz/acre per year.
	28	**Verimark** (cyantraniliprole)	5.0–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (hours)	Days to Harvest	Notes[2]
	32	**Spear-Lep** (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	4	0	Must be tank-mixed with a *Bacillus thurigiensis* (*Bt*) product. Maximum of 10 gallons/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	IGR and feeding repellant. OMRI-listed.[2]
Fire ants	7A	**Extinguish** (S-methoprene)	1–1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Grasshoppers, mole crickets	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/ acre per season.
Leafhopper	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	0.5–1.0 qt	12	14	Maximum of 6 qt/acre per year.
	1B	**Malathion 8F** (malathion)	1.6 pt	12	7	Maximum of 2 applications per year.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	12	1	Do not apply more than 1.0 lb a.i./acre per season (5 applications at high rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Pounce 25 W** (permethrin)	3.2–12.8 oz	12	1	Do not apply more than 0.6 lb a.i./acre per season (no more than 3 applications at highest rate).
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (hours)	Days to Harvest	Notes[2]
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per growing season.
	4A	**Admire Pro** (imidacloprid)	**Foliar:** 1.3 fl oz **Soil:** 4.4–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6.5 fl oz (foliar) or 10.5 fl oz (soil)/acre per year. Other brands available with same active ingredient.
	4A	**Belay** (clothianidin)	**Foliar:** 3–4 fl oz **Soil:** 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./ acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/ acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	12	30	May be applied using one of several soil application methods. One application per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi per acre per season. Do not use an adjuvant.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	4	1	Maximum of 28 fl oz/acre per year.
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	12	7	Insect growth regulator. Do not make more than 2 applications per season per crop or more than 4 per year. Allow 7 days between applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**M-Pede 49%** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.[2]
Leafminers	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1	Use no more than 29 oz per acre per crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Maximum of 6 applications; no more than 2 consecutive applications before rotating to another MOA.
	6	***Agri-Mek SC** (abamectin)	1.75–3.50 fl oz	12	7	Maximum of 10.25 fl oz/acre per year. Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant. Many other brands with same active ingredient are available.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	7	Do not apply more than 28.8 oz/A per season.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (hours)	Days to Harvest	Notes[2]
	17	**Trigard** (cyromazine)	2.66 oz	12	7	No more than 5 applications per crop.
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	May be applied by drip chemigation in addition to foliar and various soil application methods.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types. Do not use an adjuvant.
	28	**Harvanta 50SL** (cyclaniliprole)	10.9–16.4 fl oz	4	1	Maximum of 49.2 fl oz/acre per year.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	N/A; applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel) including all application types.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.[2]
Mites (includes carmine spider mite, two-spotted spider mite)	3A	***Brigade 2EC** (bifenthrin)	5.1–6.4 fl oz	12	7	Maximum of 25.6 fl oz/acre per season. Other brands available with same active ingredient.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	6	***Agri-Mek SC** (abamectin)	1.75–3.50 fl oz	12	7	Maximum of 10.25 fl oz/acre per year. Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant. Many other brands with same active ingredient are available.
Stink bugs, plant bugs, meadow spittlebug	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	1–2 qt	12	14	Maximum of 6 qt/acre per year.
	3A	***Brigade 2EC** (bifenthrin)	5.1–6.4 fl oz	12	7	Maximum of 25.6 fl oz/acre per season. Other brands available with same active ingredient.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.[2]
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.

Pest	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/Acre	REI (hours)	Days to Harvest	Notes[2]
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/ acre per season.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	0	Maximum of 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	-	**M-Pede 49%** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
Thrips (check label for species controlled)	3A, -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1	Use no more than 29 oz per acre per crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Maximum of 6 applications; no more than 2 consecutive applications before rotating to another MOA.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types. Do not use an adjuvant.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	OMRI-listed.[2]
	-	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO is OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**M-Pede 49%** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2 March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

***Restricted use insecticide.**

Table 10. Escarole and endive fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Alternaria leaf spot	3	**Procure 480SC** (triflumizole)	8 fl oz	18 fl oz	0	0.5	
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3	**Trionic 4SC** (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications per season.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	See label for restrictions.
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	11	**Quadris** (azoxystrobin)	15.4 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
Bacterial blight	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kop-hydroxide, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop D, Nu-Cop HB	**SEE INDIVIDUAL LABEL**		1	Varies by product from 4 hr to 2 days	
Basal rot Septoria Gray mold Sclerotinia	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	12	**Cannonball WG** (fludioxonil)	7 oz	28 oz	0	0.5	
	14	**Botran 5F** (dichloran)	5.33 lb	5.33 lb	14	0.5	
	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
Botrytis rot	7	**Endura** (boscalid)	9.0 oz	18 oz	14	0.5	See label for details.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	See label for details.
	14	**Botran 5F** (dichloran)	5.33 lb	5.33 lb	14	0.5	
	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
Cercospora leaf spot **Septoria leaf spot**	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	See label for restrictions.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	11	**Quadris** (azoxystrobin)	15.4 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
Damping off	M3	**Defiant 75 WP** (thiram)	5.3 oz/100 lb of seed			1	Seed treatment only.
Downy mildew	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kop-hydroxide, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB	**SEE INDIVIDUAL LABEL**		1	Varies by product from 4 hrs to 2 days	
	M2	(sulfur) Many brands available: Crusade DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W	SEE INDIVIDUAL LABEL		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	**Reason** (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate with fungicides with dissimilar modes of action.
	21	**Ranman** (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	24 oz	3	0.5	
	33	**Aliette WDG** **Legion 80WDG** **Linebacker WDG** (fosetyl-Al)	5 lb	**Aliette:** 35 lb **Legion, Linebacker:** 20 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.
	33	(mono- and dipotassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite 7LP, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart, Reveille	3 qt		0	4 hr	See label for details.
	40	**Forum** (dimethopmorph)	6.0 fl oz	30 fl oz	0	0.5	Do not apply sequentially.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	Do not exceed 2 sequential applications. See label for soil applications.
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with a fungicide of different mode of action. Do not exceed two sequential applications.
	45 + 40	**Zampro** (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	0	0.5	Do not exceed 2 sequential applications
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	19.2 fl oz	38.4 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if applied using soil applications. Be aware of plant-back restrictions.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz	1	0.5	Do not exceed 4 applications per crop. Do not make more than 2 sequential applications. Do not exceed more than 33% of total foliar applications.
Powdery mildew	M2	(sulfur) Many brands available: Microfine Sulfur, Micro Sulf, Microthiol Disperss, Suffa, Sulfur 90W	SEE INDIVIDUAL LABEL		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	**Procure 480SC** (triflumizole)	8 fl oz	18 fl oz	0	0.5	
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3	**Trionic 4SC** (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications per season.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	See label for restrictions.
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications. See label for details.
	11	(azoxystrobin) **Various brands available:** Equation, Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
Pythium damping off	4	**Sebring** (metalaxyl)	0.7 fl oz/100 lb of seed			2	Seed treatment only.
Pythium seedling blight	4	**Acquire** **Allegiance FL** (metalaxyl)	0.7 fl oz/100 lb of seed			1	Seed treatment only.
	4	**Apron XL** (mefenoxam)	0.64 fl oz/100 lb seed			2	
	4	**Metastar 2E** (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches.
Pythium seedling disease	4	**Ridomil Gold GR** **Ridomil Gold SL** **Ultra Flourish** (mefenoxam)	**GR:** 40 lb **SL:** 2 pt **Ultra Flourish:** 4 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Rhizoctonia bottom rot	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
Sclerotinia diseases	7	**Endura** (boscalid)	10.0 oz	18 oz	14	0.5	See label for details.
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	11	**Quadris** (azoxystrobin)	15.2 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
Various seedling diseases	4 + 11	**Uniform** (azoxystrobin + mefenoxam)	0.34 fl oz/1000 fl of row	1 appl.		0	Soil incorporated.
	12	**Maxim 4FSS** (fludioxonil)	0.16 fl oz/100 lb of seed			0.5	Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 11. Lettuce fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
***Alternaria* spp.**	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3	**Trionic** (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications per season.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	Do not make more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	**Quadris** (azoxystrobin)	15.4 fl oz	2.88 qt	0	4 hr	Alternate with fungicides with dissimilar modes of action.
Bacterial blight	M1	(copper compounds) **Many brands available:** Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Champ WG, Champ WP, C-O-C-S WDG, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kop-hydroxide, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Stretch, Tenn Cop, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
Basal rot	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	12	**Cannonball WG** (fludioxonil)	7 oz	28 oz	0	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Botrytis rot	7	**Endura** (boscalid)	11 oz	22 oz	14	0.5	
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	12	**Cannonball WG** (fludioxonil)	7 oz	28 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	14	**Botran 5F** (dichloran)	5.33 lb	5.33 lb	14	0.5	
Cercospora leaf spot	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	12	**Cannonball WG** (fludioxonil)	0.5 oz	1.5 lb	14	0.5	
Damping off	M3	**Defiant 75WP** (thiram)	5.3 oz/100 lb of seed			1	Seed treatment only.
Downy mildew	M1	(copper compounds) **Many brands available:** Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, C-O-C-S WDG, Cueva, Kocide 3000, Nordox 75 WG, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB, Stretch, Tenn Cop, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
	M2	(sulfur) **Many brands available:** Cosavet DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, That Flowable, Thiolux, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M3	(mancozeb) **Many brands available:** Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mankocide, Manzate Max, Manzate Pro-stick, Penncozeb 75 DF, Penncozeb 80 WP, Roper DF Rainshield	**SEE INDIVIDUAL LABELS**		10	1	
	4	**Ridomil Gold SL** (mefenoxam)	0.25 pt	1.0 pt	7	2	Must be applied in a tank mixture with full rate of another downy-mildew-registered product.
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Tetraban, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	11	**Reason** (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate with fungicides of dissimilar modes of action.
	21	**Actigard 50 WG** (acibenzolar)	1 oz	4 oz	7	0.5	Apply preventatively. See label for details.
	21	**Ranman** (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
(suppression only)	21A	**Toran** (tolfenpyrad)	21 fl oz	42 fl oz	14	0.5	Also an insecticide.
	27	**Curzate** (cymoxanil)	5 oz	30 oz	3	0.5	Must be applied as a tank mix with a fungicide of dissimilar mode of action.
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	24 oz	3	0.5	
	28	**Previcur Flex** (propamocarb)	2 pt	8 pt	2	0.5	
	28	**Promess** (propamocarb)	2 pt	8 pt	2	0.5	
	33	**Aliette WDG** (fosetyl-Al)	5 lb	35 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.
	33	**Legion 80WDG** (fosetyl-Al)	5 lb	20 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.
	33	**Linebacker WDG** (fosetyl-Al)	5 lb	20 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	33	(mono- and dipotassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosphite, Fungi-phite, K-Phite 7LP, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart	3 qt		0	4 hr	See label for details.
	40	**Forum** (dimethomorph)	6 fl oz	30 fl oz	0	0.5	Do not apply alone in sequential applications.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Do not exceed 2 sequential applications. See label for soil applications.
	43	**Presidio** (fluopicolide)	3–4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with a fungicide of different mode of action. Do not exceed two sequential applications. See label for soil applications.
	45 + 40	**Zampro** (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	0	4 hr	
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	4.8 fl oz	19.2 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if Orondis Gold was applied using soil applications. Do not make more than 2 sequential applications, and do not exceed more than 33% of all fungicide applications with Orondis.
Gray mold	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	Do not make more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	12	**Cannonball WG** (fludioxonil)	7 oz	28 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
Powdery mildew	M2	(sulfur) **Many brands available:** Cosavet DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, That Flowable, Thiolux, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M3	(mancozeb) **Many brands available:** Dithane F45 Rainshield, Dithane M-45, Fortuna 75WDG, Koverall, Mankocide, Manzate Flowable, Manzate Pro-stick, Penncozeb 75 DF, Penncozeb 80 WP, Roper DF Rainshield	**SEE INDIVIDUAL LABELS**		10	1	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	**Procure 480SC** (fludioxinil)	8 fl oz	18 fl oz	0	0.5	
	3	**Rally 40WSP** (myclobutanil)	5 oz	20 oz	3	1	Supplemental label.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3	**Sonoma 40WSP** (myclobutanil)	5 oz	20 oz	3	1	
	3	**Trionic** (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications per season.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	Do not make more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate. Alternate with fungicide with dissimilar modes of action after 2 applications.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	(azoxystrobin) **Various brands available:** Equation SC, Quadris, Satori, Tetraban, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides with dissimilar modes of action.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	13	**Quintec** (quinoxyfen)	6 fl oz	24 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
Pythium damping off	4	**Ridomil Gold SL** (mefenoxam)	2 pt	1 lb a.i.	7	2	
	4	**Sebring 318FS** **Sebring 480FS** (metalaxyl)	0.75 fl oz/100 lb of seed			1	Seed treatment only.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Pythium seedling blight	4	**Acquire** **Allegiance FL** (metalaxyl)	0.75 fl oz/100 lb of seed			1	Seed treatment only.
	4	**Apron XL** (mefenoxam)	0.64 fl oz/100 lb seed				
	4	**Metastar 2E** (metalaxyl)	8 pt				Apply as a broadcast soil application and incorporate into top 2 inches.
Pythium seedling diseases	4	**Ridomil Gold** **Ridomil Gold GR** **Ultra Flourish** (mefenoxam)	**Gold:** 2 pt **GR:** 40 lb **Ultra Flourish:** 4 pt		2		See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 + 11	**Uniform** (fludioxonil)	0.34 fl oz/1000 ft of row	1 appl.	0		Soil incorporated.
Rhizoctonia bottom rot	2	(iprodione) **Many brands available:** Enclosure 4F, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	2 pt	6 pt	14	1	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Apply at critical timing for disease suppression. See Extension guidelines for best application.
Rhizoctonia	7	**Endura** (boscalid)	11 oz	22 oz	14	0.5	
	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
Sclerotinia drop	2	(iprodione) **Many brands available:** Enclosure 4F, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	2 pt	6 pt	14	1	
	7	**Endura** (boscalid)	11 oz	22 oz	14	0.5	
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7	**Kenja 400 SC** (isofetamid)	12.3 fl oz	24.6 fl oz	14	0.5	Make first application after emergence and second at thinning.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemicals (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	Do not make more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	12	**Cannonball** (fludioxonil)	7 oz	28 oz	0	0.5	Apply after emergence and after thinning.
	14	**Botran 5F** (dichloran)	5.33 lb	5.33 lb	14	0.5	
	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
Septoria	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of actions.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	13.4 fl oz	14	0.5	Do not make more than 2 sequential applications without rotating to different mode of action. No more than 2 applications at max rate.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	11	(azoxystrobin) **Various brands available:** Equation SC, Quadris, Satori, Tetraban, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides with dissimilar modes of actions.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	16 oz	0	0.5	Alternate with fungicides with dissimilar modes of actions.
Various seedling diseases	4 + 11	**Uniform**	0.34 fl oz/1000 lb of seed	1 appl.		0	Soil incorporated.
	12	**Maxim 4FS** **Spirato 480 FS** (fludioxonil)	0.16 fl oz/100 lb of seed				Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 12. Spinach fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Alternaria	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without moving to dissimilar mode of action. May cause leaf cupping.
	9 + 12	**Switch** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	See label for details.
	11	**Quadris** (azoxystrobin)	6 fl oz	15.5 fl oz	0	4 hr	Alternate with fungicides of dissimilar modes of action.
Anthracnose	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Mastercop, Nordox, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Previsto, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**			Varies by product from 4 hr to 2 days	
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	11	**Quadris** (azoxystrobin)	6 fl oz	15.5 fl oz	0	4 hr	Alternate with fungicides of dissimilar modes of action.
Damping-off	M3	**Defiant 75WP** (thiram)	5.3 oz/100 lb of seed			1	Seed treatment only.
	4	**Ridomil Gold SL** (mefenoxam)	2 pt			2	Apply at seeding in a 7"–12" band on soil over seed furrow.
	4 + 11	**Uniform** (azoxystrobin + mefenoxam)	0.34 fl oz/1000 ft row			0	Make only 1 application per season at planting.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Downy mildew	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**			Varies by product from 4 hr to 2 days	
	M2	(sulfur) **Many brands available:** Microfine Sulfur, Micro Sulf, Microthiol Disperss, Suffa, Sulfur 90W, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	4	**Ridomil Gold SL** (mefenoxam)	0.25 pt	0.5 pt	21	2	Shank application. A total of two applications may be made.
	4 + M1	**Ridomil Gold/Copper** (mefenoxam + copper hydroxide)	2 lb	4 lb	21	2	Follow Ridomil Gold EC at planting. Apply no more than 2 foliar applications.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Apply only in water with no adjuvants or tank mixtures. Alternate with dissimilar modes of action.
	11	(azoxystrobin) **Various brands available:** Equation SC, Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	48 oz	0	0.5	Limit is 3 applications/crop + alternate chemistry.
	11	**Reason** (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	21	**Actigard 50WG** (acibenzolar)	0.75 oz	2.25 oz	7	0.5	See label for specific conditions.
(Suppression only)	21A	**Torac** (tolfenpyrad)	21 fl oz	42 fl oz	1	0.5	2 applications allowed per crop cycle. Insecticide also controls aphids, thrips, etc.
	27	**Curzate 60DF** (cymoxanil)	5 oz	30 oz	1	0.5	Use only in combination with a broad spectrum protectant such as copper fungicides.
	27 + 11	**Tanos 50DF** (cymoxanil + famoxadone)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with another FRAC group 11 fungicide.
	33	**Aliette 80WDG** **Legion 80WDG** **Linebacker 80WDG** (fosetyl-Al)	5 lb	35 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides or adjuvants.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	33	(mono- and dipotassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart, Reveille	3 qt		0	4 hr	See label for details.
	40	**Forum** (dimethomorph)	6 fl oz	18 fl oz	0	0.5	Must be tank mixed with another fungicide when used against downy mildew. Do not make more than 2 sequential applications.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	Do not exceed 2 sequential applications. See label for soil applications.
	40 + 45	**Zampro** (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	0	0.5	Do not exceed 2 sequential applications.
	43	**Presidio** (fluopicolide)	4 oz	1 pt	2	0.5	Must be tank-mixed with a fungicide of a different mode of action. See label for rotational restrictions.
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	19.2 fl oz	38.4 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if applied using soil applications. Be aware of plant-back restrictions.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	4.8 fl oz	19.2 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if Orondis Gold was applied using soil applications, and do not exceed more than 33% of all fungicide applications with Orondis.
Powdery mildew	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Do not make more than 2 sequential applications.
	9 + 12	**Switch 62.5WDG** (fludioxonil)	14 oz	56 oz	7	0.5	See label for details.
	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
	21A	**Torac** (tolfenpyrad)	21 fl oz	42 fl oz	1	0.5	2 applications allowed per crop cycle. Insecticide also controls aphids, thrips, etc.
Pythium seedling blight	4	**Acquire Allegiance FL** (metalaxyl)	0.75 fl oz/100 lb of seed			1	Seed treatment only.
	4	**Apron XL LS** (mefenoxam)	0.64 fl oz/100 lb seed			2	Seed treatment only.
	4	**Metastar** (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
	4	**Sebring 2.65ST** (metalaxyl)	0.75 fl oz/100 lb of seed			1	Seed treatment only.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Pythium seedling diseases	4	**Ridomil Gold GR** (mefenoxam)	40 lb			2	
	4	**Ridomil Gold SL** (mefenoxam)	2 pt			2	Apply at seeding in a 7"–12" band on soil over seed furrow.
	4	**Ultra Flourish** (mefenoxam)	4 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 + 11	**Uniform** (mefenoxam + azoxystrobin)	0.34 fl oz/1000 ft row			0	Make only 1 application per season at planting.
Stemphylium leaf spot	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without moving to dissimilar mode of action.
	11	(azoxystrobin) **Various brands available:** Equation SC, Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
Various leaf spots	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Nordox, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**			Varies by product from 4 hr to 2 days	
	M2	(sulfur) **Many brands available:** Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	No more than 4 applications per season.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	No more than 4 applications per season.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Do not make more than 2 sequential applications.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Apply only in water with no adjuvants or tank mixtures. Alternate with dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	14	0.5	No more than 2 sequential applications without moving to dissimilar mode of action.
	9 + 12	**Swithch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	(azoxystrobin) **Various brands available:** Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	11	**Quadris** (azoxystrobin)	6 fl oz	15.5 fl oz	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	**Reason** (fenamidone)	8.2 oz	24.6 fl oz	2	0.5	Alternate with fungicides of dissimilar modes of action.
	12	**Cannonball** (fludioxonil)	7 fl oz		7	0.5	Make no more than 2 sequential applications before rotating with dissimilar modes of action.
Various seedling diseases	12	**Maxim 4FS** (fludioxonil)	0.16 fl oz/100 lb of seed			0.5	Seed treatment only.
	21	**Actigard 50WG** (acibenzolar)	0.75 oz	2.25 oz	7	0.5	Do not apply to young seedlings.
White rust	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**			Varies by product from 4 hr to 2 days	
	4	**Ridomil Gold SL** (mefenoxam)	0.25 pt	0.5 pt	21	2	Shank application. A total of two applications may be made.
	4 + M1	**Ridomil Gold/Copper WP** (mefenoxam + copper hydroxide)	2 lb	4 lb	21	2	Follow Ridomil Gold EC at planting. Apply no more than 2 foliar applications.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Apply only in water with no adjuvants or tank mixtures. Alternate with dissimilar modes of action.
	11	(azoxystrobin) **Various brands available**: Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	**Quadris** (azoxystrobin)	6 fl oz	15.5 fl oz	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	**Reason** (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	21	**Ranman** (cyazofamid)	2.75 fl oz	13.75 fl oz	0	0.5	Do not make more than 3 sequential applications.
	33	**Aliette 80WDG** **Legion 80WDG** **Linebacker 80WDG** (fosetyl-Al)	5 lb	35 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides or adjuvants.
	P	**Actigard 50WG** (acibenzolar)	0.75 oz	2.25 oz	7	0.5	See label for specific conditions.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 13. Nonfumigant nematicides for leafy vegetables in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints, (56.0 to 80.0 fl oz) per acre, a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop and no more than 112 fl oz of product per acre per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.

Table 14. Fumigant nematicides for leafy vegetables in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/Chisel-Spaced 12″ Apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19 to 31.5 gal	57 to 90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and Personal Protective Equipment (PPE), mandatory Good Agricultural Practices (GAPs), product and applicator training certification, and other uses and rate recommendations.
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

CV294

doi.org/10.32473/edis-cv294-2022

Chapter 10. Minor Vegetable Crop Production[1]

Dakshina R. Seal, Qingren Wang, Ramdas Kanissery, Anna Meszaros, Crystal A. Snodgrass, Julien Beuzelin, Johan Desaeger, Nicholas S. Dufault, Katia Viana Xavier, and Shouan Zhang[2]

Celery, Okra, and Parsley Botany and Planting

Celery—*Apium graveolens*, Apiaceae (Umbelliferae)

Okra—*Abelmoschus esculentus*, Malvaceae

Parsley—*Petroselinum crispum*, Apiaceae (Umbelliferae)

Table 1. Planting information for celery, okra, and parsley.

Planting Dates	Celery	Okra	Parsley
North Florida	Aug–Feb	Mar–Jun	Sept–Mar
Central Florida	Sept–Mar	Feb–Aug	Sept–Mar
South Florida	Oct–Mar	Jan–Mar/Aug–Oct	All year
Planting Information			
Distance between rows (in)	18–40	36–60	6–12
Distance between plants (in)	6–12	4–10	drilled
Seeding depth (in)	on surface	0.5–1.0	0.25
Seed per acre (lb)	1–2	6–81	6–8
Days to maturity from seed	75–90	60–70	70–80
Plant population (acre)	58,080	43,560	1 million+

1. This document is CV294, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Dakshina R. Seal, scientist, pest management, UF/IFAS Tropical Research and Education Center; Qingren Wang, Extension agent III, UF/IFAS Extension Miami-Dade County; Ramdas Kanissery, assistant professor, UF/IFAS Southwest Florida REC; Anna Meszaros, Extension agent II, UF/IFAS Extension Palm Beach County; Crystal A. Snodgrass, county Extension director and Extension agent III, UF/IFAS Extension Manatee County; Julien Beuzelin, assistant professor, Entomology and Nematology Department, UF/IFAS Everglades REC; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; Nicholas S. Dufault, associate professor, Plant Pathology Department; Katia Viana Xavier, assistant professor, Plant Pathology Department, Everglades REC; and Shouan Zhang, professor, Plant Pathology Department, UF/IFAS Tropical REC; UF/IFAS Extension, Gainesville, FL 32611.

Cultivars

Table 2. Common cultivars of celery, okra, and parsley.

Celery	Okra	Parsley
Tall Utah 52-70R Improved*	Annie Oakley II (H[1])	Dark Green Italian (PL)
	Cajun Delight (H)	Forest Green (CL[1])
	Clemson Spineless	Improved Market Gardeners (CL)
	Clemson Spineless 80	Jade (CL, H)
	Millionaire (H)	
	North and South (H)	
	Spike (H)	

* Note the vast majority of celery production in FL uses proprietary varieties
[1] H=hybrid, CL=curly leaf, PL=plain leaf

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 3. Herbicides approved for managing weeds in celery. Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		***** PREPLANT/PREEMERGENCE *****	
Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Broadleaf and grass weeds. Incorporate mechanically 1–2 in. deep or with irrigation 2–4 in. deep.
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Scythe is a contact and postemergent/nonresidual herbicide and can be tank-mixed with residual/preemergence herbicides to lengthen control.
Prometryn 1.0–2.0	(Caparol) 4 L 2–4 pt	5	Most annual broadleaf and grass weeds. Do not exceed one application. Consult label for rotational crop restrictions.
Pyraflufen ethyl 0.0008–0.003	(ET Herbicide/Defoliant) 0.5–2.0 fl oz	14	Broadleaf and grass weeds. Burndown preplant application 1 day before planting. Include a nonionic surfactant or crop oil concentrate in the spray solution.
S-metolachlor 0.95–1.26	(Dual Magnum) 1.0–1.33 pt	15	Broadleaf, grass weeds, and nutsedge. Label is a Third-Party Registration (TPR, Inc.), and authorization and waiver agreements must be obtained prior to use. Rates are based on soil organic matter.
Trifluralin 0.5	(Treflan, Trifluralin) 4 EC 1 pt (Treflan, Trifluralin) 10 G 5 lb	3	Annual broadleaf and grass weeds. Do not apply to muck soils. For mineral soils with 2%–5% organic material, apply 0.75 lb a.i./A Incorporate 4 in. or less within 8 hr of application.
		***** POSTTRANSPLANT/POSTEMERGENCE *****	
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank-mixed with other herbicides. Do not exceed 6.1 fl oz per cropping season. PHI 0 days.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Weeds Controlled/Remarks
Clethodim 0.09–0.13 0.07–0.13	(Select, Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat applications 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Use a nonionic surfactant with Select Max. PHI 30 days.
Linuron 0.5–1.0	(Lorox DF) 50 DF 1–2 lb	7	Broadleaf and grass weeds. Apply after transplanting but before celery is 8 in. tall. Do not apply when temperatures exceed 85°F nor as a tank mix with surfactants, nitrogen, or fertilizer solution. PHI 45 days.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles with hooded or shielded sprayer. Product is a contact, nonselective herbicide with no residual control. May be tank-mixed with several soil residual compounds.
Prometryn 0.8–1.6	(Caparol) 4 L 1.6–3.2 pt	5	Broadleaf weeds. Apply one application during the 2-to-6-week period after transplanting. Weeds should not exceed 2 in.
Sethoxydim 0.28	(Poast) 1.5 EC 1.5 pt	1	Emerged grass weeds. A maximum of 3 pt/A per season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 30 days.
S-metolachlor 0.95–1.26	(Dual Magnum) 1.0–1.33 pt	15	Broadleaf, grass weeds, and nutsedge. Label is a Third Party Registration (TPR, Inc.), and authorization and waiver agreements must be obtained prior to use. Rates are based on soil organic matter.
***** CELERY SEEDBEDS *****			
Prometryn 0.6–0.8	(Caparol) 4 L 1.2–1.6 pt	5	Broadleaf weeds. Apply once per year to seedbeds. Apply after celery has 2–5 true leaves. Apply after seedbed covers have been removed for at least one week.

Table 4. Herbicides approved for managing weeds in okra. Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
***** PREEMERGENCE *****			
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Flumioxazin up to 0.128	(Chateau) 51 WDG up to 4 oz	14	Annual broadleaf weeds. Apply to row middles of raised plastic-mulched beds that are at least 4 in. higher than the treated row middle and 24 in. bed width. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization is a waiver of liability and is a misuse of the product. Tank-mix with a burndown herbicide to control emerged weeds. 0-day pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weed control. Apply as a preplant burndown for emerged weeds. Read label for individual product directions.
Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaf weeds. Apply to row middles only with a shielded or hooded sprayer. A minimum of 24 fl oz/A is required for residual control. Add a crop oil concentrate or nonionic surfactant for control of emerged weeds. Registration is through Third Party Registrations, Inc. (TPR, Inc.), and a copy of the label must be on-hand at time of application. PHI 30 days.
Mesotrione 0.19	(Callisto) 4 L 6 fl oz	28	Broadleaf and grass weeds. Apply to row middles only. Leave one-foot untreated area or 6" on either side of the plant row. Injury risk is greatest on coarse-textured soils (sand, sandy loam, or loamy sand). Apply as one preemergence application OR one postemergence application. Callisto will cause whitening of the okra leaves.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt	22	Emerged broadleaf and grass weed control. Apply one application before crop emergence. Do not exceed 8 pt/A per season. Consult label for new restrictions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Broadleaf and grass weeds. Scythe is a contact, nonselective herbicide with no residual activity. May be tank-mixed with trifluralin for soil residual activity. Consult label for rates and other information.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Weeds Controlled/Remarks
Prometryn 0.75–1.5	(Caparol) 4 L 1.5–3.0 pt	5	Apply after planting, but before crop emergence. Apply as one preemergence application at 3 pt OR 1 preemergence application at 1.5 pt followed by one POST directed application at 1.5 pt. Do not exceed 3 pt/A per crop cycle.
Sulfentrazone 0.07–0.09	(Willowood sulfentrazone) 4SC 2.25–3.0 fl oz	14	Broadleaf and grass weed control, nutsedge suppression. Do not apply on sands with less than 1% organic matter. Do not apply more than 12 fl oz/A within a 12-month period. Should be trialed on a small area to find suitable rate for the soil type in your area.
Trifluralin 0.5–0.75	(Treflan, Trifluralin) 4 EC 0.5–1.5 pt (Treflan, Trifluralin) 10 G 5.0–7.5 lb	3	Annual broadleaf and grass weeds. Incorporate 4 in. or less within 8 hr. Results in Florida are erratic on soils with low organic matter and clay contents. Note precautions against planting nonregistered crops within 5 months.
			***** POSTEMERGENCE *****
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply to row middles only with a hooded sprayer. Maximum rate of 0.096 lb a.i./A per season. Rates apply to mineral and muck soils. Use crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply to row middles only with a hooded sprayer. PHI 14 days.
Halosulfuron 0.024–0.05	(Sandea) 75 WG 0.5–1.0 oz	2	Broadleaf and purple/yellow nutsedge weeds. Apply to row middles of direct-seeded or transplanted okra. If plastic is used, prevent herbicide contact with the plastic. Do not apply more than 2 oz/A per 12-month period. PHI 30 days.
Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaf weeds. Apply to row middles only with a shielded or hooded sprayer. A minimum of 24 fl oz/A is required for residual control. Add a crop oil concentrate or nonionic surfactant for control of emerged weeds. One POST application may be made per growing season at 18 days after transplanting. Cobra contacting green foliage or fruit can cause excessive injury. Registration is through Third Party Registration, Inc., and a copy of the label must be on hand at time of application. PHI 30 days.
Mesotrione 0.09	(Callisto) 4 L 3 fl oz	28	Broadleaf and grass weeds. Direct spray with hooded sprayer to minimize contact with okra plants. Okra must be at least 3 in. tall. Use of a nonionic surfactant is required. Injury risk is greatest on coarse-textured soils. Apply as one preemergence or one postemergence application. PHI 28 days.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0 pt	22	Emerged broadleaf and grass weeds. Apply to row middles only and do not allow contact to okra plants. Limit of 2 applications after crop emergence. Do not exceed 8 pt/A per season. PHI 60 days. Consult label for new restrictions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Broadleaf and grass weeds. Apply to row middles only with a shielded sprayer.
Prometryn 0.75	(Caparol) 4 L 1.5 pt	5	Apply 1 postemergence application directed to the base of the crop. If a preemergence application was made, do not exceed 3 pt/A PHI 14 days.
Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Grass weeds. Efficacy will be decreased if grass weeds are under stress. Include a crop oil concentrate or methylated seed oil in the spray. PHI 14 days.

Table 5. Herbicides approved for managing weeds in parsley. Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Crops	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.				
***** PREEMERGENCE *****				
Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Parsley	Annual broadleaf and grass weeds. Incorporate or irrigate 1–2 in. deep within 36 hr of application. Consult label for rotation restrictions.
Carfentrazone up to 0.031	(Aim)2.0EC up to 2 fl oz	14	Parsley, cilantro	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Parsley, cilantro	Control emerged broadleaf and grass weeds. Consult individual labels for restrictions.
Linuron 0.5–1.5	(Lorox DF) 50 DF 1–3 lb	7	Parsley, cilantro	Mineral and muck soils. Apply after planting and before crop emergence. Use lower rates on coarse soils.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Parsley, cilantro	Controls emerged weeds. Apply before emergence of crop. Product is a contact, nonselective, foliar-applied herbicide. There is no residual activity.
Prometryn 1.0–1.6	(Caparol) 4 L 1.0 pt	5	Parsley, cilantro	A single preemergence application can be applied up to 14 days after planting. A second application can be made up to 30 days prior to harvest. Do not apply on sand or loamy sand. Read label for rotation restrictions.
Pyraflufen 0.001–0.003	(ET Herbicide/Defoliant) 0.5–2.0 fl oz	14	Parsley	Emerged broadleaf and grass weeds. Plant 1 day after application. Apply as a preplant burndown treatment.
***** POSTEMERGENCE *****				
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Parsley, cilantro	Emerged broadleaf control. Post-direct hooded application to row middles. Read the label for adjuvant requirements. PHI 0 days.
Clethodim 0.10–0.13 0.07–0.13	(Arrow, Select) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Parsley, cilantro	Annual and perennial grass control. Read the label for required adjuvants.
Linuron 0.5	(Lorox DF) 50 DF 1 lb	7	Parsley, cilantro	Apply after the crop has a minimum of 3 true leaves or crop injury may result. Apply when weeds are in the 1 to 3 true leaf stage. Do not exceed 3 lb of Lorox per acre per season. PHI 30 days.
Prometryn 0.5	(Caparol) 4 L 1.0 pt	5	Parsley, cilantro	An application can be made up to 30 days prior to harvest. Another application can be applied after harvest to the new regrowth. Do not use on sand or loamy sands. Read label for rotation restrictions.
Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Parsley, cilantro	Growing grass weeds. Decreased efficacy if weeds are under stress. Do not exceed 3.0 pt/A per season. Include a crop oil concentrate in the spray solution. PHI 15 days.

Table 6. Insecticides approved for management of arthropod pests of celery. Contact: Dakshina Seal, UF/IFAS Southwest Florida Research and Education Center.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 2.4 pt **8F:** 1–1.5 pt	24	7	Maximum of 2 applications per year.
	1B	**Orthene 97** (acephate)	0.5–1.0 lb	24	21	Do not use more than 2 lb a.i. per acre per season. All tops must be removed before shipment.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Maximum of 32 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	1	Maximum of 0.8 lb a.i./acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Breaks down rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 4.4–10.5 fl oz	12	45	Maximum of 10.5 fl oz/acre per year.
	4A	**Assail 30SG** **Assail 70WP** (acetamiprid)	**30SG:** 2.0–4.0 oz **70WP:** 0.8–1.7 oz	12	7	**30SG:** Maximum of 20.0 oz/acre or 0.375 lb a.i. per year. **70WP:** Maximum of 8.5 oz/acre or 0.375 lb a.i. per year.
	4A	**Belay** (clothianidin)	**Foliar:** 3–4 fl oz **Soil:** 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/ acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10.0–13.0 fl oz	12	30	Maximum of 13 fl oz/acre per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. An adjuvant may be used when applying to celery.
	4C	**Closer SC** (sulfoxaflor)	1.5–2.0 fl oz	12	3	Maximum of 17 fl oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	1	Maximum of 28 fl oz/acre per crop season. Maximum of 3 crop seasons per year.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	10 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Apply when aphids first appear, before populations build to damaging levels. Two applications (maximum allowed) may be needed to control persistent aphid populations.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	12	1	Maximum of 4.8 fl oz/acre per crop cycle.
	9D	**Versys** (afidopyropen)	1.5 fl oz	12	0	Maximum of 14 fl oz/acre per season.
	21A	**Torac** (tolfenpyrad)	14–21 fl oz	12	1	Do not apply until at least 14 days after emergence or after transplanting. Do not apply more than 42 fl oz per acre per crop cycle; apply no more than twice per crop or 4 times per year.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	24	3	Do not apply more than 10 fl oz/acre per crop.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types. For best performance, use an adjuvant.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt	4	0	OMRI-listed.
	-	**BotaniGard ES Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallons/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.
	-	**JMS Stylet-Oil, Saf-T- Side, Suffoil-X, Sun Spray 98.8%, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	4	0	Organic Stylet-Oil, Saf-T-Side, and Suffoil-X are OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2.0–4.0 qt	4	0	Apply before pests reach damaging levels.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.
Caterpillars (includes beet armyworm, cabbage looper, celery leaf-tier, corn earworm, cutworms, fall armyworm)	1A	***Lannate LV, *SP** (methomyl)	**LV:** 0.75–3 pt **SP:** 0.25–1.0 lb	48	7	Do not apply more than 21 pt of LV or 7 lb SP per acre per season.
	1A	**Sevin 4F, XLR Plus** (carbaryl)	1–2 qt	12	14	Maximum of 6 qt/acre per year.
	1B	**Orthene 97** (acephate)	1.0 lb	24	21	Do not use more than 2 lb a.i. per acre per season. All tops must be removed before shipment.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Maximum of 32 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Pounce 25 WP** (permethrin)	3.2–12.8 oz	12	1	Maximum of 0.8 lb a.i./acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Breaks down rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10.0–13.0 fl oz	12	30	Do not exceed more than 13 fl oz per acre per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. An adjuvant may be used when applying to celery.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1	Maximum of 29 oz/acre per year. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	7	Provides suppression of leafminers. Rotate with other products with different modes of action.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10.0 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Apply when larvae are small for best control. OMRI-listed.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. See label for rates for specific pests. For organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Confirm 2F** (tebufenozide)	6–8 fl oz	4	7	Maximum of 40 fl oz/acre per season.
	18	**Intrepid 2F** (methoxyfenozide)	4–10 fl oz	4	1	Maximum of 64 fl oz/acre per year.
	22	**Avaunt** **Avaunt eVo** (indoxacarb)	3.5 oz **eVo:** 3.5–6.0 oz	12	3	Maximum of 14 oz/acre per crop and 56 oz/acre per year (Avaunt) or 18 oz/acre per crop and 72 oz/acre per year (Avaunt eVo).
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	May be applied via drip chemigation in addition to foliar and various soil application methods.
	28	**Exirel** (cyantraniliprole)	7.0–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types.
	28	**Verimark** (cyantraniliprole)	5.0–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.
	32	**Spear-Lep** (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	4	0	Must be tank-mixed with a *Bacillus thurigiensis* (*Bt*) product. Maximum of 10 gallons/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt	4	0	OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
Fire ants	7A	**Extinguish** (S-methoprene)	1–1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Flea beetles	1A	**Sevin 4F, XLR Plus** (carbaryl)	0.5–1.0 qt	12	14	Maximum of 6 qt/acre per year.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	12	1	Do not apply more than 128 oz/acre per season.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Maximum of 32 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per season.
	4A	**Belay** (clothianidin)	**Foliar:** 3–4 fl oz **Soil:** 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/ acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10.0–13.0 fl oz	12	30	Do not exceed 13 fl oz per acre per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. An adjuvant may be used when applying to celery.
	21A	**Torac** (tolfenpyrad)	14–21 fl oz	12	1	Do not apply until at least 14 days after emergence or after transplanting. Do not apply more than 42 fl oz per acre per crop cycle and apply no more than twice per crop or 4 times per year.
Grasshoppers	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	4A	**Belay** (clothianidin)	**Soil:** 9–12 fl oz	12	21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/ acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
Leafhoppers	1A	**Sevin 4F, XLR Plus** (carbaryl)	0.5–1.0 qt	12	14	Maximum of 6 qt/acre per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Maximum of 32 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Breaks down rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	4.4–10.5 fl oz	12	45	Do not apply more than 0.38 lb a.i. (10.5 fl oz product) per acre per year.
	4A	**Belay** (clothianidin)	**Foliar:** 3–4 fl oz **Soil:** 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/ acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10.0–13.0 fl oz	12	30	Do not exceed more than 13 fl oz per acre per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. An adjuvant may be used when applying to celery.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	1	Maximum of 28 fl oz/acre per crop season. Maximum of 3 crop seasons per year.
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	12	7	Do not make more than 2 applications per crop cycle. IGR targets immatures.
	21A	**Torac** (tolfenpyrad)	14–21 fl oz	12	1	Do not apply until at least 14 days after emergence or after transplanting. Do not apply more than 42 fl oz per acre per crop cycle and apply no more than twice per crop or 4 times per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt	4	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**JMS Stylet-Oil, Saf-T- Side, Suffoil-X, Sun Spray 98.8%, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	4	0	Organic Stylet-Oil, Saf-T-Side, and Suffoil-X are OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Leafminers	1A	***Vydate L** (oxamyl)	2–4 pt	48	21	Do not apply more than 24 pt/acre per season.
	1B	**Dimethoate 4EC** (dimethoate)	1 pt	48	7	Do not apply more than 3 pt per acre per year.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	12	1	Do not apply more than 128 oz/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Breaks down rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Belay** (clothianidin)	**Soil:** 9–12 fl oz	12	21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz **Soil:** 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/ acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1	Maximum of 29 oz/acre per year. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Maximum of 6 applications; no more than 2 consecutive applications before rotating to another MOA.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	7	No more than 2 sequential applications. Must be used with an adjuvant (but not binder-sticker types). Not for use on leafy vegetables grown for transplant.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	7	Provides suppression of leafminers. Rotate with other products with different modes of action.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10.0 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	Do not make more than six applications per crop.
	28	**Coragen** (chlorantraniliprole)	5.0–7.5 fl oz	4	1	May be applied via drip chemigation in addition to foliar and various soil application methods.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types. For best performance, use an adjuvant.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2.0–4.0 qt	4	0	Apply before pests reach damaging levels.
	-	**SunSpray 98.8%, JMS Stylet-Oil, Saf-T-side, others** (oils, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	4	0	See label for cautions on tank mixes. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Plant bugs	1A	**Sevin 4F, XLR Plus** (carbaryl)	1–2 qt	12	14	Repeat as needed, up to 5 times, at least 7 days apart.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Maximum of 32 fl oz/acre per season.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
Planthoppers	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	12	7	Do not make more than 2 applications per crop cycle. IGR targets immatures.
Stink bugs	1A	**Sevin 4F, XLR Plus** (carbaryl)	1–2 qt	12	14	Repeat as needed, up to 5 times, at least 7 days apart.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2–5.25 fl oz **Soil:** 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar:** 1.0–3.0 oz **Soil:** 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
Two-spotted spider mite	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 2.4 pt **8F:** 1–1.5 pt	24	7	Maximum of 2 applications per year.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	7	Maximum of 32 fl oz/acre per season.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	7	No more than 2 sequential applications. Must be used with an adjuvant (but not binder-sticker types). Not for use on leafy vegetables grown for transplant.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10.0 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Suffoil-X** (mineral oil)	1–2 gal/100 gal	4	0	OMRI-listed.[2]

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2 March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.
[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 7. Insecticides approved for managing insect pests of okra crops. Contact: Dakshina Seal, UF/IFAS Tropical Research and Education Center.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
Aphids	1B	***Malathion 5EC** **Malathion 8F** (malathion)	**5EC:** 1.5 pt **8F:** 1.2 pt	**5EC:** 9.5 pt/yr **8F:** 6.0 pt/yr	12	1	
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	1	
	3A	**PyGanic 5.0** (pyrethrins)	4.5–15.6 fl oz	10 appl.	12	0	OMRI-listed.[2]
	4A	**Admire Pro** (imidacloprid)	**Soil**: 7–14 fl oz **Foliar**: 1.3–2.2 fl oz	**Soil:** 14 fl oz **Foliar**: 6.7 fl oz	12	**Soil:** 21 **Foliar:** 0	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	**Assail 30SG** (acetamiprid)	2.0–4.0 oz	16 oz	12	7	
	4D	**Sivanto Prime** (flupyradifurone)	**Foliar**: 7.0–14 fl oz **Soil**: 21–28 fl oz	28 fl oz/yr	4	**Foliar:** 1 **Soil:** 45	
	9D	**Sefina Inscalis** (afidopyropen)	3.0 fl oz	28 fl oz	12	0	
	23	**Movento** (spirotetramat)	4–5 fl oz	10.0 fl oz	24	1	
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.; see label	12	1	
	29	**Beleaf 50 SG** (flonicamid)	2.8–4.28 oz	8.4 oz	12	0	
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant insect growth regulator.
	-	**Azatin O** (azadirachtin)	5–16 fl oz	as needed	4	0	OMRI-listed.[2] Antifeedant, repellant insect growth regulator. Rate depends on pest. See label.
	-	**BotaniGard ES** **BotaniGard 22WP** (*Beauveria bassiana* strain GHA)	**ES:** 0.25–1.0 qt **22WP:** 0.50–2.0 qt	no limit	4	0	Compatible in tank mix with some fungicides.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	2–3 lb	none	4	0	OMRI-listed.[2]

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	2.0 gm a.i. per appl.	4	0	OMRI-listed.[2] Antifeedant, repellant insect growth regulator. May be used in greenhouses.
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100gal	no limit	4	0	OMRI-listed.[2] See label for tank-mix cautions.
	- + 3A	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	no limit	12	0	
Beetles (including cucumber beetles, flea beetles)	1B	***Malathion 5EC** **Malathion 8F** (malathion)	**5EC:** 1.9 pt **8F:** 1.2 pt	**5EC:** 9.5 pt/yr **8F:** 6.0 pt/yr	12	1	Do not graze or feed forage to livestock.
	3A	***Capture LFR** (bifenthrin)	3.4–6.8 fl oz	0.2 lb a.i.	12	at plant	
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	
	3A	**PyGanic 5.0** (pyrethrins)	4.5–15.6 fl oz	10 applications	12	0	OMRI-listed.[2]
	3A + 28	**Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	
	4A	**Admire Pro** (imidacloprid)	**Soil:** 7–14 fl oz **Foliar:** 1.3–2.2 fl oz	**Soil:** 14 fl oz **Foliar:** 6.7 fl oz	12	**Soil:** 21 **Foliar:** 0	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	**Assail 30SG** (acetamiprid)	1.5–2.5 oz	16 oz	12	7	
	15	**Rimon 0.83 EC** (novaluron)	9–12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant insect growth regulator.
Caterpillars (including armyworms, loopers, tomato fruitworm—also known as corn earworm, caterpillars, cutworms)	1A	**Sevin 4F, XLR Plus** (carbaryl)	**4F:** 1–1.5 qt **XLR:** 1–1.5 qt	6 qt/year	12	3	
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	38.4 fl oz	12	1	Do not feed or graze livestock on treated vines.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	1	
	3A	***Capture LFR** (bifenthrin)	3.4–6.8 fl oz	0.2 lb a.i.	12	at plant	
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	24 fl oz	12	1	
	3A	**PyGanic 5.0** (pyrethrins)	4.5–15.6 fl oz	10 appl.	12	0	OMRI-listed.[2]

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A + 28	**Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	
	5	**Entrust SC** (spinosad)	1.5–2.5 fl oz	9.0 fl oz	4	1	OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	5–10 fl oz	34 fl oz	4	1	
	6 + 28	**Minecto Pro** (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.; see label	12	Greenhouse tomato: 1 All other crops: 7	
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	no limit	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb	as needed	4	0	OMRI-listed.[2] Use higher rate for armyworms.
	11A	**DiPel** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	no limit	4	0	Can be used in organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.50 lb	no limit	4	0	OMRI-listed.[2] Treat when larvae are young. Thorough coverage is essential.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	no limit	4	0	OMRI-listed.[2]
	15	**Rimon 0.83 EC** (novaluron)	9–12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	18	**Intrepid** (methoxyfenozide)	4–16 fl oz	64 fl oz	4	1	
	22	**Avaunt** (indoxacarb)	2.5–3.5 oz	14 oz	12	3	
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	15.4 fl oz of chlorantraniliprole products	4	1	
	28	**Exirel** (cyantraniliprole)	7.0–13.5 fl oz	0.4 lb a.i. of cyantraniliprole or cyazapyr products	12	1	
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Azatin O** (azadirachtin)	5–16 fl oz	as needed	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator. Rate depends on pest. See label.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**BotaniGard 22WP** (*Beauveria bassiana* strain GHA)	0.50–2.0 qt	no limit			Contact dealer if an adjuvant must be used. Compatible in tank mix with some fungicides.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	no limit	4	0	May be used in greenhouses.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	no limit	4	0	OMRI-listed.[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	20 gm a.i.	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	- + 3	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	no limit			
Fire ants	7A	**Extinguish** (S-methoprene)	1–1.5 lb broadcast	as needed	4	0	Insect Growth Regulator. Colonies will get reduced after three weeks and eliminated after 8–10 weeks.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb	0.134 lb a.i.	12	1	Insect growth regulator. Apply at first sign of ant activity.
Leafminers	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	7	
	5	**Entrust SC** (spinosad)	2–3 fl oz	9 fl oz	4	1	OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	6–10 fl oz	34 oz/yr	4	1	Use adjuvant for leafminer.
	6 + 28	**Minecto Pro** (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.; see label	12	Greenhouse tomato: 1 All other crops: 7	
	15	**Rimon 0.83 EC** (novaluron)	12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i.; see label	12	1	
	28	**VeriMark** (cyantraniliprole)	6.75–13.5 fl oz	13.5 oz of cyantraniliprole or cyazapyr products	4	1	Apply at planting or in drip.
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Azatin O** (azadirachtin)	5–16 fl oz	as needed	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator. Rate depends on pest. See label.
	-	**Neemix 4.5** (azadirachtin)	4–7 oz	20 gm a.i.	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100gal	no limit	4	0	OMRI-listed.[2] See label for tank-mix cautions.
Mites	3A	**PyGanic 5.0** (pyrethrins)	4.5–15.6 fl oz	10 appl.	12	0	OMRI-listed.[2]
	6 + 28	**Minecto Pro** (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.; see label	12	Greenhouse tomato: 1 All other crops: 7	
	10B	**Zeal** (etoxazole)	2.0–3.0 oz	3.0 oz	12	7	
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	62 oz	12	1	
	20D	**Acramite-50WS** (bifenzate)	0.50–1.0 lb	1.0 lb	12	3	
	21A	**Portal** (fenpyroximate)	2.0 pt	4.0 pt	12	1	
	23	**Movento** (spirotetramat)	4–5 fl oz	10.0 fl oz	24	1	
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Insect growth regulator.
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100gal	no limit	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	as needed	4	0	OMRI-listed.[2]
Stink bugs	1A	**Sevin 4F, XLR Plus** (carbaryl)	**4F:** 1–1.5 qt **XLR:** 1–1.5 qt	6 qt/year	12	3	
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12.8 oz	7	1	
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	24 fl oz	12	1	
	3A	**PyGanic 5.0** (pyrethrins)	4.5–15.6 fl oz	10 appl.	12	0	OMRI-listed.[2]
	15	**Rimon 0.83 EC** (novaluron)	12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
Thrips	4A	**Admire Pro** (imidacloprid)	**Soil:** 7–14 fl oz	**Soil:** 10.5 fl oz	12	**Soil:** 21	Soil application only for thrips. Do not use other 4A insecticides if imidacloprid is used.
	5	**Entrust SC** (spinosad)	1.25–2.5 oz	9.0 oz	4	1	OMRI-listed.[2]
	6 + 28	**Minecto Pro** (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.	12	Greenhouse tomato: 1 All other crops: 7	
	15	**Rimon 0.83 EC** (novaluron)	12 fl oz	24.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard 22WP** (*Beauveria bassiana* strain GHA)	1.0–2.0 qt	as needed	4	0	Compatible in tank mix with some fungicides.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	1.0–2.0 qt	as needed	4	0	May be used in greenhouses.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	2–3 lb	none	4	0	OMRI-listed.[2]
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2.0–4.0 qt	10 appl.	4	0	
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100gal	no limit	4	0	OMRI-listed.[2]
	- + 3	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	as needed	12	0	
Whiteflies	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	12.8 fl oz	12	7	
	3A	**PyGanic 5.0** (pyrethrins)	4.5–15.6 fl oz	10 appl.	12	0	OMRI-listed.[2]
	4A	**Admire Pro** (imidacloprid)	**Soil:** 7–14 fl oz **Foliar:** 1.3–2.2 fl oz	**Soil:** 14 fl oz **Foliar:** 6.7 fl oz	12	**Soil:** 21 **Foliar:** 0	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	**Assail 30SG** (acetamiprid)	2.5–4.0 fl oz	16 oz	12	7	
	4D	**Sivanto Prime** (flupyradifurone)	**Foliar:** 10.5–14 fl oz **Soil:** 21–28 fl oz	28 fl oz/yr	4	**Foliar:** 1 **Soil:** 45	
	6 + 28	**Minecto Pro** (cyantraniliprole + abamectin)	5.5–10.0 oz	0.4 lb a.i.; see label	12	Greenhouse tomato: 1 All other crops: 7	
	7C	**Knack IGR** (pyriproxyfen)	8–10 fl oz	20 fl oz	12	1	Insect growth regulator
	9D	**Sefina Inscalis** (afidopyropen)	14 fl oz	28 fl oz	12	0	
	15	**Rimon 0.83 EC** (novaluron)	12.0 fl oz	24.0 oz	12	1	
	16	**Courier 40 SC** (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	1	
	23	**Movento** (spirotetramat)	4–5 fl oz	10.0 fl oz	24	1	
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	0.4 lb a.i; see label	12	1	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	13.5 fl oz of cyantraniliprole or cyazapyr products	4	1	
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Azatin O** (azadirachtin)	5–16 fl oz	as needed	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator. Rate depends on pest.
	-	**BotaniGard 22WP** (*Beauveria bassiana* strain GHA)	0.50–2.0 qt	no limit			
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	no limit	4	0	May be used in greenhouses.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	2–3 lb	no limit	4	0	OMRI-listed.[2] Can be used in organic production.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	20 gm a.i.	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2–4 qt	as needed	4	0	
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100gal	no limit	4	0	OMRI-listed.[2]
	- + 3	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA and pyrethrins)	0.25–2.0 qt	no limit	12	0	Compatible in tank mix with some fungicides.
Wireworm	3A	***Capture LFR** (bifenthrin)	3.4–6.8 fl oz	0.2 lb a.i.	12	at plant	Extremely toxic to bees, fish, and aquatic invertebrates.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2, March 2022. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. Un=unknown, or a mode of action that has not been classified yet.

[2] Information provided in the table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: listed by Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide**

Table 8. Insecticides labeled for management of arthropod pests of parsley. Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center; Dakshina Seal, UF/IFAS Tropical Research and Education Center.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Aphids	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5–2.4 pt **8F:** 1.5 pt	24	7	Maximum of 2 applications per year.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	1	Maximum of 0.8 lb a.i./acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Breaks down rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.**: 0.25–2.00 qt **Aerial appl.**: 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	**Foliar**: 1.3 fl oz **Soil**: 4.4–10.5 fl oz	12	**Foliar**: 7 **Soil**: 21	Maximum of 6.5 fl oz (foliar) or 10.5 fl oz (soil)/acre per year.
	4A	**Assail 30SG** **Assail 70WP** (acetamiprid)	**30SG:** 2.0–4.0 oz **70WP:** 0.8–1.7 oz	12	7	**30SG:** Maximum of 20.0 oz/acre or 0.375 lb a.i. per year. **70WP:** Maximum of 8.5 oz/acre or 0.375 lb a.i. per year.
	4A	**Belay** (clothianidin)	**Foliar**: 3–4 fl oz **Soil**: 9–12 fl oz	12	**Foliar**: 7 **Soil**: 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz **Soil**: 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar**: 2–5.25 fl oz **Soil**: 9–10.5 fl oz	12	**Foliar**: 7 **Soil**: 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar**: 1.0–3.0 oz **Soil**: 5.0–6.0 oz	12	**Foliar**: 7 **Soil**: 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10.0–13.0 fl oz	12	30	Maximum of 13 fl oz/acre per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. Do not use an adjuvant.
	4C	**Closer SC** (sulfoxaflor)	1.5–2.0 fl oz	12	3	Do not make more than 2 consecutive applications or more than 4 total applications per season.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	1	Maximum of 28 fl oz/acre per crop season. Maximum of 3 crop seasons per year.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Apply when aphids first appear, before populations build to damaging levels. Two applications (maximum allowed) may be needed to control persistent aphid populations.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	12	1	Maximum of 4.8 fl oz/acre per crop cycle.
	9D	**Versys** (afidopyropen)	1.5 fl oz	12	0	Maximum of 14 fl oz/acre per season.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	24	3	Do not apply more than 10 fl oz per acre per crop.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types. For best performance, use an adjuvant.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, to 3.5 pt if needed	4	0	OMRI-listed.
	-	**BotaniGard ES Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.
Caterpillars (includes beet armyworm, cabbage looper, celery leaf-tier, corn earworm, cutworms, fall armyworm)	1A	***Lannate LV, *SP** (methomyl)	**LV:** 1.5–3 pt **SP:** 0.5–1.0 lb	48	10	Do not apply more than 12 pt of LV or 4 lb SP per acre per season.
	1A	**Sevin 4F, XLR Plus** (carbaryl)	1–2 qt	12	14	Maximum of 6 qt/acre per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Pounce 25 WP** (permethrin)	3.2–12.8 oz	12	1	Maximum of 0.8 lb a.i./acre per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Breaks down rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.**: 0.25–2.00 qt **Aerial appl.**: 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	12	30	May be applied by one of several soil application methods. One application per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. Do not use an adjuvant.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1	Maximum of 29 oz/acre per crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Maximum of 6 applications, and no more than 2 consecutive applications before rotating to another MOA.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	7	Do not apply more than 28.8 oz/A per season.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10.0 fl oz Cabbage looper: 7.5–10.0 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Apply when larvae are small for best control. OMRI-listed.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. See label for rates for specific pests. Can be used for organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Confirm 2F** (tebufenozide)	6–8 fl oz	4	7	Maximum of 40 fl oz/acre per season.
	18	**Intrepid 2F** (methoxyfenozide)	4–10 fl oz	4	1	Maximum of 64 fl oz/acre per year.
	22	**Avaunt** **Avaunt eVo** (indoxacarb)	2.5–3.5 oz **eVo:** 2.5–6.0 oz	12	3	Maximum of 24 oz/acre per crop and 96 oz/acre per year (Avaunt) or 18 oz/acre per crop and 72 oz/acre per year (Avaunt eVo).

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	May be applied via drip chemigation in addition to foliar and various soil application methods.
	28	**Exirel** (cyantraniliprole)	7.0–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types.
	28	**Verimark** (cyantraniliprole)	5.0–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.
	32	**Spear-Lep** (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	4	0	Must be tank-mixed with a *Bacillus thurigiensis* (*Bt*) product. Maximum of 10 gallons/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–2 lb	4	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
Fire ants	7A	**Extinguish** (S-methoprene)	1.0–1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Flea beetles	1A	**Sevin 4F, XLR Plus** (carbaryl)	0.5–1.0 qt	12	14	Maximum of 6 qt/acre per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.**: 0.25–2.00 qt **Aerial appl.**: 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	1.3 fl oz	12	7	Maximum of 6.5 fl oz/acre per year.
	4A	**Belay** (clothianidin)	**Foliar**: 3–4 fl oz **Soil**: 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year. **Flea beetles only.**
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz **Soil**: 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant. **Flea beetles only.**
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar**: 2–5.25 fl oz **Soil**: 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/acre per season.
	4A	**Venom** (dinotefuran)	**Foliar**: 1.0–3.0 oz **Soil**: 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	12	30	May be applied by one of several soil application methods. One application per season.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. Do not use an adjuvant. Do not allow drift to weeds or nearby crops in bloom.
Grasshoppers	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	4A	**Belay** (clothianidin)	**Soil**: 9–12 fl oz	12	21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar**: 2–5.25 fl oz **Soil**: 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/ acre per season.
	4A	**Venom** (dinotefuran)	**Foliar**: 1.0–3.0 oz **Soil**: 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
Leafhoppers	1A	**Sevin 4F, XLR Plus** (carbaryl)	0.5–1.0 qt	12	14	Maximum of 6 qt/acre per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–3.2 fl oz	12	0	Maximum of 12.8 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	***Pounce 25 WP** (permethrin)	3.2–12.8 oz	12	1	Maximum of 0.8 lb a.i./acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Breaks down rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 11 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	**Foliar**: 1.3 fl oz **Soil**: 4.4–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6.5 fl oz (foliar) or 10.5 fl oz (soil)/acre per year.
	4A	**Belay** (clothianidin)	**Foliar**: 3–4 fl oz **Soil**: 9–12 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz **Soil**: 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar**: 2–5.25 fl oz **Soil**: 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/ acre per season.
	4A	**Venom** (dinotefuran)	**Foliar**: 1.0–3.0 oz **Soil**: 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 oz	12	30	May be applied by one of several soil application methods. One application per season.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	1	Maximum of 28 fl oz/acre per crop seasons. Maximum of 3 crop seasons per year.
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	12	7	Do not make more than 2 applications per crop cycle. IGR targets immatures.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, to 3.5 pt if needed	4	0	OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
Leafminers	3A	***Pounce 25 WP** (permethrin)	3.2–12.8 oz	12	1	Maximum of 0.8 lb a.i./acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Breaks down rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.**: 0.25–2.00 qt **Aerial appl.**: 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Belay** (clothianidin)	**Soil**: 9–12 fl oz	12	21	Maximum of 12 fl oz/acre or 0.2 lb a.i./acre per year.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz **Soil**: 4.8–6.4 oz	12	7	Maximum of 6.4 oz/acre per season. Do not use an adjuvant.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–3.67 oz	12	30	Maximum of 3.67 oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar**: 2–5.25 fl oz **Soil**: 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/ acre per season.
	4A	**Venom** (dinotefuran)	**Foliar**: 1.0–3.0 oz **Soil**: 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	5	**Entrust SC** (spinosad)	1.5–10.0 fl oz	4	1	Maximum of 29 oz/acre per crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Maximum of 6 applications, and no more than 2 consecutive applications before rotating to another MOA.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	7	No more than 2 sequential applications. Must be used with an adjuvant (but not binder-sticker types). Not for use on leafy vegetables grown for transplant.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	12	7	Do not apply more than 28.8 oz/A per season.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10.0 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	No more than 5 applications per crop.
	28	**Coragen** (chlorantraniliprole)	5.0–7.5 fl oz	4	1	May be applied by drip chemigation, in addition to foliar and various soil application methods.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Verimark), including all application types. For best performance, use an adjuvant.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	N/A—applied at planting	Maximum of 13.5 fl oz at planting or 0.4 lb a.i./acre per year of cyantraniliprole-containing products (such as Exirel), including all application types.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Aza-Direct** (azadirachtin)	1–2 pt, to 3.5 pt if needed	4	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2.0–4.0 qt	4	0	Apply before pests reach damaging levels.
Plant bugs	1A	**Sevin 4F, XLR Plus** (carbaryl)	1–2 qt	12	14	Maximum of 6 qt/acre per year.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.**: 0.25–2.00 qt **Aerial appl.**: 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
Planthoppers	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	12	7	Do not make more than 2 applications per crop cycle. IGR targets immatures.
Stink bugs	1A	**Sevin 4F, XLR Plus** (carbaryl)	1–2 qt	12	14	Maximum of 6 qt/acre per year.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar**: 2–5.25 fl oz **Soil**: 9–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 10.5 fl oz (foliar) or 21 fl oz (soil)/ acre per season.
	4A	**Venom** (dinotefuran)	**Foliar**: 1.0–3.0 oz **Soil**: 5.0–6.0 oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 6 oz (foliar) or 12 oz (soil)/acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, to 3.5 pt if needed	4	0	OMRI-listed.
Two-spotted spider mite	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.**: 0.25–2.00 qt **Aerial appl.**: 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	7	No more than 2 sequential applications. Must be used with an adjuvant (but not binder-sticker types). Not for use on leafy vegetables grown for transplant.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10.0 fl oz	12	7	Maximum of 20 fl oz/acre per year, or 0.4 lb a.i./acre per year of cyantraniliprole-containing products and 0.056 lb a.i./acre per year of abamectin-containing products, including all application types.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2 March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 9. Celery fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Katia Viana Xavier, Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
***Alternaria* spp.**	7	**Endura** (boscalid)	9 oz	18 oz	0	0.5	Alternate with non-FRAC code 7 fungicide.
	9 + 12	**Switch** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
	11	(azoxystrobin) **Many brands available:** Azoxyzone, Azteroid SC, Equation SC, Quadris SC, Satori, Willowood Azoxy	15.4 fl oz	96 fl oz	0	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Bacterial blight	M1	(copper compounds) **Many labels available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, Champion++, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox 75 WG, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB, Previs-to, Stretch, Tenn-Cop 5E, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days.	
	25	**Agri-mycin 17 AG Streptomycin Bac-Master Firewall 17 WP** (streptomycin)	200 ppm			0.5	See label for details. For transplant production.
Early blight (Cercospora)	M2	(sulfur) **Many labels available:** Cosavet, Dusting Sulfur – IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/Sulfur	SEE INDIVIDUAL LABELS		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M5	(chlorothalonil) **Many labels available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Praiz	SEE INDIVIDUAL LABELS		7	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M5 + 33	**Catamaran** (chlorothalonil + potassium phosphite)	4 pt	60 pt	7	0.5	
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Fitness, Propicure, Propimax EC, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total applications.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	Do not apply more than 4 applications per year.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	5.8 fl oz	23 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Merivon SC** (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	25 oz	50 oz	0	0.5	Do not make more than 1 application without rotating to a fungicide of dissimilar mode of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	See label for restrictions.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
	11	**Aftershock** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	(azoxystrobin) **Many brands available:** Azoxyzone, Azteroid SC, Equation SC, Quadris SC, Satori, Willowood Azoxy	15.4 fl oz or 0.8 fl oz/1000 row ft	96 fl oz	0	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Evito 480SC** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Flint Extra** (trifloxystrobin)	2.9 oz	11.6 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Gem 500SC** (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	3.7 pt	22.2 pt	7	0.5	Do not exceed 2 sequential and 6 total applications of Quadris Opti or rotate with non-Qol fungicides.
	11 + 3	**Quilt** **Quilt XCEL** (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with another FRAC group 11 fungicide.
Leaf Curl (Colletotrichum)	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	Do not apply more than 4 applications per year.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Merivon SC** (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	25 oz	50 oz	0	0.5	Do not make more than 1 application without rotating to a fungicide of dissimilar mode of action.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Do not exceed 1 sequential application of Qol fungicides. See label for soil application.
Late blight (Septoria)	M2	(sulfur) Many labels available: Cosavet, Dusting Sulfur – IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/Sulfur	SEE INDIVIDUAL LABELS		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M5	(chlorothalonil) Many labels available: Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Praiz	SEE INDIVIDUAL LABELS		7	0.5	
	M5 + 33	**Catamaran** (chlorothalonil + potassium phosphite)	4 pt	60 pt	7	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Fitness, Propicure, Propimax EC, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	14	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	Do not apply more than 4 applications per year.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	5.8 fl oz	23 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Merivon SC** (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	15 oz	50 oz	0	0.5	Do not make more than 1 application without rotating to a fungicide of dissimilar mode of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	See label for restrictions.
	9 + 12	**Switch** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
	11	**Aftershock** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	(azoxystrobin) **Many brands available:** Azoxyzone, Azteroid SC, Equation SC, Quadris SC, Satori, Willowood Azoxy	15.4 fl oz	96 fl oz	0	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Evito 480SC** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Flint Extra** (trifloxystrobin)	2.9 oz	11.6 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Gem 500SC** (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Reason** (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	3.7 pt	22.2 pt	7	0.5	Do not exceed 2 sequential and 6 total applications of Quadris Opti. or rotate with non-Qol fungicides.
	11 + 3	**Quilt** **Quilt XCEL** (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with another FRAC group 11 fungicide.
Botrytis	7	**Endura** (boscalid)	9 oz	18 oz	0	0.5	Alternate with non-FRAC code 7 fungicide.
	9 + 12	**Switch** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
Downy mildew	40	**Forum** (dimethomorph)	6 fl oz	18 fl oz	0	0.5	Rotate with fungicides of dissimilar mode of action.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	40 + 45	**Zampro** (dimethomorph + ametoctradin)	14 fl oz	52 fl oz	0	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	43	**Presidio** (fluopicoide)	4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with another fungicide active against the pathogen but of dissimilar mode of action.
Pink rot (Sclerotinia)	14	**Botran 75W** (dichloran)	2 lb	5.33 lb	7	0.5	Direct spray to base of plant.
Powdery mildew	M2	(sulfur) Many labels available: Cosavet, Dusting Sulfur – IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/Sulfur	SEE INDIVIDUAL LABELS		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	See label for restrictions.
	9 + 12	**Switch** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Rotate with fungicides of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Pythium	33	**Aliette WDG** **Legion 80WDG** **Linebacker WDG** (fosetyl-Al)	5 lb	20 lb		0.5	
Pythium seedling blight	4	**Apron XL** (mefenoxam)	0.64 fl oz/100 lb seed			2	Seed treatment only.
	4	**Metastar 2E** (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
Pythium seedling diseases	4	**Ridomil Gold GR** (mefenoxam)	40 lb			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4	**Ridomil Gold SL** (mefenoxam)	2 pt			2	Apply at seeding in a 7″–12″ band on soil over seed furrow.
	4	**Ultra Flourish** (mefenoxam)	4 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 + 11	**Uniform** (mefenoxam + azoxystrobin)	0.34 fl oz/1000 ft of row	1 appl.		2	Soil incorporated.
Sclerotinia	7	**Endura** (boscalid)	9 oz	18 oz	0	0.5	Alternate with non-FRAC code 7 fungicide.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with non-FRAC code 7 fungicide.
Stalk rot (Rhizoctonia)	M5	(chlorothalonil) **Many labels available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Praiz	**SEE INDIVIDUAL LABELS**		7	0.5	
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Propimax EC, Propi-Star EC, Shar-Shield PPZ, Tilt 3.6E	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total applications.
	7 + 11	**Merivon SC** (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredient)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Aftershock** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Evito 480SC** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Flint Extra** (trifloxystrobin)	2.9 oz	11.6oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Gem 500SC** (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	3.7 pt	22.2 pt	7	0.5	Do not exceed 2 sequential and 6 total applications of Quadris Opti or rotate with non-Qol fungicides.
Various	7 + 11	**Merivon SC** (pyraclostrobin + fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	11	(azoxystrobin) **Many brands available:** Azoxyzone, Azteroid SC, Equation SC, Quadris SC, Satori, Willowood Azoxy	15.4 fl oz or 0.8 fl oz/1000 row ft	96 fl oz	0	0.5	Do not exceed 1 sequential application of Qol fungicides. See label for soil application.
	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
	33	(mono- and dipotassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi- phite, K-Phite, Oxiphos, Phiticide, Phostrol, Prophyt, Rampart, Reveille	3 qt		0	4 hr	See label for details.
Various seedling diseases	4 + 11	**Uniform** (mefenoxam + azoxystrobin)	0.34 fl oz/1000 ft of row	1 appl.		0	Soil incorporated.
	12	**Maxim 4FS** (fludioxonil)	0.16 fl oz/100 lb seed			0.5	Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 10. Okra fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Shouan Zhang, UF/IFAS Tropical Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides including materials labeled for certified organic production.							
Anthracnose	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	2	0.5	Make no more than 2 consecutive applications.
	M1	**AmeriCop 40 DF** (copper hydroxide)	1.5 lb	13.1 lb	0	**Field:** 2 **GH:** 1	OMRI product.
	M1	**Champion++** (copper hydroxide)	1.75 lb	17.5 lb	0	2	
	M1	**Cueva** (copper octanoate)	2 gal	6.7 gal	0	4 hr	
	M1	**Cuproxat FL** (basic copper sulfate)	3.0 pt	26.25 pt	0	2	
	M1	**Kocide 2000** (copper hydroxide)	3 lb	15 lb	0	2	
	M1	**Kocide 3000** (copper hydroxide)	1.75 lb	17.5 lb	0	2	
	M1	**Kop-5** (copper sulfate pentahydrate)	32 fl oz	10.6 gal		**Field:** 2 **GH:** 1	
	M1	**MasterCop** (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	
	M1	**Nu-Cop 50 DF** (copper hydroxide)	2.1 lb	10.5 lb	1	2	
	M1	**Previsto** (copper hydroxide)	3 qt	69 qt		2	
	M1 + M1	**Badge SC** **Badge X2** (copper hydroxide + copper oxychloride)	1.8 pt	18.8 pt	0	**Field:** 2 **GH:** 1	OMRI product.
	M5	**Bravo Ultrex** (chlorothalonil)	1.4 lb	10.9 lb	3	0.5	
	M5	**Bravo Weather Stik** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Chlorothalonil 720** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Echo 720** (chlorothalonil)	1.5 pt	9.0 lb a.i. pt	3	0.5	
	M5	**Equus 720 SST** (chlorothalonil)	1.5 pt	12 pt	3	0.5	Do not apply at <7-day intervals.
	M5	**Initiate 720** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Oranil 6L** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Periapt** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Praiz (chlorothalonil)**	1.5 pt	12 pt	3	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
	M5	**Rialto** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5 + 22	**Zing!** (chlorothalonil + zoxamide)	34 fl oz	272 fl oz	3	0.5	
	M5 + 27	**Cymbol Advance** (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt	3	0.5	
	3	**Cevya** (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	
	3	**Mettle 125ME** (tetraconazole)	8 fl oz	16 fl oz	0	0.5	
	3	**Provysol** (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	
	3	**Rhyme Fungicide** (flutriafol)	7 fl oz	28 fl oz	7	0.5	
	3	**Topguard** (flutriafol)	14 fl oz	56 fl oz	0	0.5	
	3 + 11	**Acadia** (difenoconazole + azoxystrobin)	14 fl oz	55.3 fl oz	0	0.5	
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	
	3 + 9	**Inspire Super** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Do not apply more than 2 sequential applications.
	3 + 9	**Vango ESQ** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	0	0.5	
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	Only suppression; make no more than 2 sequential applications.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	Do not make more than 2 sequential applications.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	Do not make more than 2 sequential applications of Luna Sensation or any Group 7 or Group 11 containing fungicide before rotating with a fungicide of a different Group.
	11	**Aframe** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**Arius 250** (azoxystrobin)	15.5 fl oz	62 fl oz	0	4 hr	
	11	**A-Zox 25SC** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**Azoxystar** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
	11	**Azoxystrobin SC** (azoxystrobin)	15.3 fl oz	61.5 fl oz	0	4 hr	
	11	**Azoxyzone** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**AZteroid FC** (azoxystrobin)	19.5 fl oz	77.5 fl oz	0	4 hr	
	11	**GCS Azoxy 2SC** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**Quadris** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**Satori Fungicide** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	Do not apply more than 1 application.
	11	**Tetraban** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**Trevo** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11 + 3	**Quadris Top** (azoxystrobin; difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Make no more than 2 consecutive applications.
Bacterial leaf spot	BM01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	2	0.5	Make no more than 2 consecutive applications.
	M1	AmeriCop 40 DF (copper hydroxide)	1.5 lb	13.1 lb	0	Field: 2 GH: 1	OMRI product.
	M1	**Champion++** (copper hydroxide)	1.75 lb	17.5 lb	0	2	
	M1	**Cueva** (copper octanoate)	2 gal	6.7 gal	0	4 hr	
	M1	**Cuproxat FL** (basic copper sulfate)	3.0 pt	26.25 pt	0	2	
	M1	**Kocide 2000** (copper hydroxide)	3 lb	15 lb	0	2	
	M1	**Kocide 3000** (copper hydroxide)	1.75 lb	17.5 lb	0	2	
	M1	**KOP-5** (copper sulfate pentahydrate)	32 fl oz	10.6 gal		**Field:** 2 **GH:** 1	
	M1	**MasterCop** (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	
	M1	**Nu-Cop 30 HB** (copper hydroxide)	1.75 lb	17.5 lb	1	2	
	M1	**Nu-Cop 50 DF** (copper hydroxide)	2.1 lb	10.5 lb	1	2	
	M1	**Previsto** (copper hydroxide)	3 qt	69 qt		2	
	M1 + M1	**Badge SC** **Badge X2** (copper hydroxide + copper oxychloride)	1.8 pt	18.8 pt	0	**Field:** 2 **GH:** 1	OMRI product.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
Cercospora leaf spot	M2 + 3	**Unicorn DF** (sulfur + tebuconazole)	3.75 lb	15 lb	14	0.5	Do not mix with other DMI fungicides (Group 3).
	M5	**Bravo Ultrex** (chlorothalonil)	1.4 lb	10.9 lb	3	0.5	
	M5	**Bravo Weather Stik** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Chlorothalonil 720** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Echo 720** (chlorothalonil)	1.5 pt	9.0 lb a.i. pt	3	0.5	
	M5	**Equus 720 SST** (chlorothalonil)	1.5 pt	12 pt	3	0.5	Do not apply at <7-day intervals.
	M5	**Initiate 720** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Oranil 6L** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Periapt (chlorothalonil)**	1.5 pt	12 pt	3	0.5	
	M5	**Praiz (chlorothalonil)**	1.5 pt	12 pt	3	0.5	
	M5	**Rialto (chlorothalonil)**	1.5 pt	12 pt	3	0.5	
	M5 + 22	**Zing!** (chlorothalonil + zoxamide)	34 fl oz	272 fl oz	3	0.5	
	M5 + 27	**Cymbol Advance** (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt	3	0.5	
	3	**Monsoon** (tebuconazole)	6 fl oz	24 fl oz	3	2	Group 3 = DMI fungicide
	3	**Onset 3.6L** (tebuconazole)	6 fl oz	24 fl oz	7	0.5	
	3	**Orius 3.6F** (tebuconazole)	6 fl oz	24 fl oz	3	0.5	
	3	**Rhyme Fungicide** (flutriafol)	7 fl oz	28 fl oz	0	0.5	
	3	**TebuCon 3.6F** (tebuconazole)	6 fl oz	24 fl oz	3	0.5	
	3	**Tebu-Crop 3.6F** (tebuconazole)	6 fl oz	24 fl oz	3	0.5	
	3	**TebuStar 3.6L** (tebuconazole)	6 fl oz	24 fl oz	3	0.5	
	3	**TebuZol 3.6F** (tebuconazole)	6 fl oz	24 fl oz	3	0.5	
	3	**Toledo** (tebuconazole)	6 fl oz	24 fl oz	3	0.5	
	3	**Topguard** (flutriafol)	14 fl oz	56 fl oz	0	0.5	
	3	**Willowood Teb 3.6SC** (tebuconazole)	6 fl oz	24 fl oz	3	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
	3 + 11	**Acadia ESQ** (difenoconazole + azoxystrobin)	14 fl oz	55.3 fl oz	0	0.5	
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	Do not make more than 2 sequential applications.
	7 + 3	**Luna Experience** (fluopyram + tebuconazole)	12.8 fl oz	34 fl oz	3	0.5	Do not apply more than 2 sequential applications of Luna or any fungicide containing Group 7 or Group 3 before rotation with a fungicide of a different Group.
	7 + 3	**Luna Flex** (fluopyram + difenoconazole)	13.6 fl oz	27.2 fl oz	0	0.5	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Do not make 2 sequential applications.
Phytophthora	7 + 11	**Pageant Intrinsic** (pyraclostrobin + boscalid)	18 oz/100 gal			0.5	See label.
	11	**Reason 500 SC** (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Ground application only.
	21	**Ranman 400 SC** (cyazofamid)	2.75 fl oz	16.75 fl oz	7	0.5	Do not exceed 6 applications per season. Rotate with dissimilar modes of action.
	22	**Elumin** (ethaboxam)	8 fl oz	16 fl oz	2	0.5	Do not apply at intervals of less than 14 days.
	29	**Omavo (fluazinam)**	24 fl oz	144 fl oz	30	0.5	
	29	**Omega 500F (fluazinam)**	24 fl oz	144 fl oz	30	0.5	
	29	**Orbus 4F** (fluazinam)	24 fl oz	144 fl oz	30	0.5	
	40	**Micora** (mandipropamid)	8 fl oz	16 fl oz	1	4 hr	For suppression
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	For suppression
	43	**Presidio** (fluopicolide)	4 fl oz		2	0.5	Must be tank mixed with a labeled fungicide of different FRAC.
	46	**Timorex Act (tea tree oil)**	35 fl oz		2	4 hr	
	49	**Orondis Gold 200** (oxathiapiprolin)	9.6 fl oz	19.2 fl oz	0	4 hr	Soil application at planting. Do not make no more than two applications per year.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz	1	0.5	Do not exceed 2 sequential applications without alternating to a different MOA. Do not exceed 4 total applications. Do not exceed 33% of all applications with oxathiapiprolin.
Pod spot	M1	**AmeriCop 40 DF** (copper hydroxide)	1.5 lb	13.1 lb	0	**Field:** 2 **GH:** 1	Minimum retreatment interval is 5 days.
	M1	**Champion++** (copper hydroxide)	1.75 lb	17.5 lb	0	2	
	M1	**Cueva** (copper octanoate)	2 gal	6.7 gal	0	4 hr	
	M1	**Cuproxat FL** (basic copper sulfate)	3.0 pt	26.25 pt	0	2	
	M1	**Kocide 2000** (copper hydroxide)	3 lb	15 lb	0	2	
	M1	**Kocide 3000** (copper hydroxide)	1.75 lb	17.5 lb	0	2	
	M1	**KOP-5** (copper sulfate pentahydrate)	32 fl oz	10.6 gal		**Field:** 2 **GH:** 1	
	M1	**MasterCop** (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	
	M1	**Nu-Cop 30 HB** (copper hydroxide)	1.75 lb	1.75 lb	1	2	
	M1	**Nu-Cop 50 DF** (copper hydroxide)	2.1 lb	10.5 lb	1	2	OMRI product
	M1	**Previsto** (copper hydroxide)	3 qt	69 qt		2	
	M1 + M1	**Badge SC** **Badge X2** (copper hydroxide + copper oxychloride)	1.8 pt	18.8 pt	0	**Field:** 2 **GH:** 1	OMRI product
Powdery mildew	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	2	0.5	Make no more than 2 consecutive applications.
	M1	**AmeriCop 40 DF** (copper hydroxide)	1.5 lb	13.1 lb	0	**Field:** 2 **GH:** 1	OMRI product
	M1	**Champion++** (copper hydroxide)	1.75 lb	17.5 lb	0	2	
	M1	**Cueva** (copper octanoate)	2 gal	6.7 gal	0	4 hr	
	M1	**Cuproxat FL** (basic copper sulfate)	3.0 pt	26.25 pt	0	2	
	M1	**Kocide 2000** (copper hydroxide)	3 lb	15 lb	0	2	
	M1	**Kocide 3000** (copper hydroxide)	1.75 lb	17.5 lb	0	2	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
	M1	**KOP-5** (copper sulfate pentahydrate)	32 fl oz	10.6 gal		**Field:** 2 **GH:** 1	
	M1	**MasterCop** (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	
	M1	**Nu-Cop 30 HB** (copper hydroxide)	1.75 lb	17.5 lb	1	2	
	M1	**Nu-Cop 50 DF** (copper hydroxide)	2.1 lb	10.5 lb	1	2	
	M1	**Previsto** (copper hydroxide)	3 qt	69 qt		2	
	M1 + M1	**Badge SC** **Badge X2** (copper hydroxide + copper oxychloride)	1.8 pt	18.8 pt	0	**Field:** 2 **GH:** 1	OMRI product
	M2	**Auron DF** (sulfur)	10 lb	-	-	1	
	M2	**Microthiol-Disperss** (sulfur)	10 lb	-	-	1	
	M2	**Suffa** (sulfur)	0.5 gal	-	-	1	
	M2	**Sulfur 90W** (sulfur)	20 lb	-	-	1	
	M2	**Thiolux** (sulfur)	10 lb	-	-	1	
	M5	**Bravo Ultrex** (chlorothalonil)	1.4 lb	10.9 lb	3	0.5	
	M5	**Bravo Weather Stik** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Chlorothalonil 720** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Echo 720** (chlorothalonil)	1.5 pt	9.0 lb a.i.	3	0.5	
	M5	**Equus 720 SST** (chlorothalonil)	1.5 pt	12 pt	3	0.5	Do not apply at <7-day intervals.
	M5	**Initiate 720** (chlorothalonil)	1.5 lb	12 pt	3	0.5	
	M5	**Oranil 6L** (chlorothalonil)	1.5 pt	12 pt	3	0.5	
	M5	**Periapt (chlorothalonil)**	1.5 pt	12 pt	3	0.5	
	M5	**Praiz (chlorothalonil)**	1.5 pt	12 pt	3	0.5	
	M5	**Rialto (chlorothalonil)**	1.5 pt	12 pt	3	0.5	
	M5 + 27	**Cymbol Advance** (chlorothalonil + cymoxanil)	2.44 pt	17.5 pt	3	0.5	
	U6	**Torino** (cyflufenamid)	3.4 oz	10.2 oz	0	4 hr	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
	3	**Cevya** (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	
	3	**Mettle 125ME** (tetraconazole)	8 fl oz	16 fl oz	0	0.5	
	3	**Provysol** (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	
	3	**Rally 40WSP** (myclobutanil)	5 oz	1.25 lb	0	1	Do not exceed 4 applications per season.
	3	**Rhyme Fungicide** (flutriafol)	7 fl oz	28 fl oz	0	0.5	
	3	**Sonoma 40WSP (myclobutanil)**	5 oz	20 oz	0	1	
	3	**Topguard** (flutriafol)	14 fl oz	56 fl oz	0	0.5	
	3 + 9	**Inspire Super** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Do not apply more than 2 sequential applications.
	3 + 9	**Vango ESQ (difenoconazole + cyprodinil)**	20 fl oz	80 fl oz	0	0.5	
	3 + 11	**Acadia ESQ (difenoconazole + azoxystrobin)**	14 fl oz	55.3 fl oz	0	0.5	
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	
	7	**Velum (fluopyram)**	6.84 fl oz	13.7 fl oz	0	0.5	
	7	**Velum Prime** (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	Do not apply more than 2 sequential applications.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	
	7 + 3	**Luna Flex (fluopyram + difenoconazole)**	13.6 fl oz	27.2 fl oz	0	0.5	
	7 + 11	**Pageant Intrinsic** (pyraclostrobin + boscalid)	18 oz/100 gal			0.5	
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	Do not apply more than 2 sequential applications.
	9	**Vango WG** (cyprodinil)	7 oz	28 oz	0	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
	9 + 12	**Alterity 62.5 WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	After 2 application, alternate with another fungicide with a different mode of action for 2 applications.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	After 2 applications, alternate with another fungicide with a different mode of action for 2 applications.
	11	**Aframe** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**Arius 250** (azoxystrobin)	15.5 fl oz	62 fl oz	0	4 hr	
	11	**Atticus Acadia 2 SC** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**A-Zox 25SC** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**AzoxyStar** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	Do not apply more than 1 application of Azoxystar or other Group 11 fungicides before alternation with a non-Group 11 fungicide.
	11	**Azoxyzone** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**AZteroid FC 3.3** (azoxystrobin)	19.5 fl oz	77.5 fl oz	0	4 hr	
	11	**GCS Azoxy 2SC** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**Quadris** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**Satori Fungicide** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	Do not apply more than 1 application.
	11	**Tetraban** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	**Trevo** (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Do not make 2 consecutive applications.
	12	**Spirato GHN** (fludioxonil)	7 fl oz	28 fl oz	0	0.5	
	46	**Timorex Act (tea tree oil)**	35 fl oz		2	4 hr	
	50	**Prolivo 300SC** (pyriofenone)	5 fl oz	16 fl oz	0	4 hr	
	50	**Vivando** (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks2
			Appl.	Season	Harvest	Reentry	
Pythium damping-off	28	**Previcur Flex** (propamocarb hydrochloride)	1.2 pt	6 pt	5	0.5	Can be applied to the lower portions of the plants and surrounding soil, or via drip irrigation, transplant/setting water, or by sprinklers.
	46	**Timorex ACT** (tea tree oil)	1.2 fl oz/1000 sq ft 35 fl oz/A	120 fl oz	2	4 hr	
Rhizoctonia damping-off, seedling rot	11	**AFrame** (azoxystrobin)	0.8 fl oz/1000 row feet	61.5 fl oz	0	4 hr	
	11	**Arius 250** (azoxystrobin)	0.8 fl oz per 1000 row feet	62 fl oz	0	4 hr	In-furrow and banded applications
	11	**Atticus Acadia 2 SC (azoxystrobin)**	0.8 fl oz per 1000 row feet	61.5 fl oz	0	4 hr	In-furrow and banded applications over the row, either shortly after plant emergence or during herbicide applications or cultivation.
	11	**A-Zox 25SC** (azoxystrobin)	0.8 fl oz per 1000 row feet	61.5 fl oz	0	4 hr	In-furrow and banded applications
	11	**AzoxyStar** (azoxystrobin)	0.8 fl oz/1000 row feet	61.5 fl oz	0	4 hr	
	11	**Azoxystrobin SC (azoxystrobin)**	0.8 fl oz/1000 row feet	61.5 fl oz	0	0	
	11	**Azoxyzone (azoxystrobin)**	0.8 fl oz/1000 row feet	61.5 fl oz	0	4 hr	
	11 + P5	**AZterknot (azoxystrobin + extract of *Reynoutria sachalinensis*)**	0.9 fl oz/1000 row feet	73.6 fl oz	0	4 hr	Apply in-furrow as a spray or a banded spray targeting plant base and surrounding soil.
	11	**AZteroid FC 3.3** (azoxystrobin)	0.48 fl oz/1000 row feet	38.8 fl oz	0	4 hr	May be applied by ground, air or chemigation.
	11	**GCS Azoxy 2SC** (azoxystrobin)	0.8 fl oz per 1000 row feet	61.5 fl oz	0	4 hr	In-furrow and banded applications
	11	**Quadris Flowable** (azoxystrobin)	0.8 fl oz/1000 row feet	60 fl oz	0	4 hr	
	11	**Satori** (azoxystrobin)	0.8 fl oz/1000 row feet	60 fl oz	0	4 hr	
	11	**Tetraban** (azoxystrobin)	0.8 fl oz/1000 row feet	61.5 fl oz	0	4 hr	
	11	**Trevo** (azoxystrobin)	0.8 fl oz/1000 row feet	61.5 fl oz	0	4 hr	
	46	**Timorex ACT** (tea tree oil)	1.2 fl oz/1000 sq. ft. 35 fl oz/A	120 fl oz	2	4 hr	

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 11. Parsley fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Katia Viana Xavier, Everglades Research and Education Center.

Pertinent Diseases or Fungicides	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Alternaria leaf blight	3	**Procure 480SC** (triflumizole)	8 fl oz	18 fl oz	0	0.5	Repeat applications at 14-day intervals.
	3	(propiconazole) **Many brands available:** Bumper 41.8EC, Propi-star, Tilt, Topaz	4 fl oz	16 fl oz	14	0.5	Do not apply more than 2 sequential and 4 total applications.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	Do not apply more than 4 applications per year.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7	**Endura** (boscalid)	9 oz	18 oz	14	0.5	Do not make more than 2 applications without rotating to a fungicide of dissimilar mode of action.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	No more than 2 sequential applications without moving to dissimilar mode of action.
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
Bacterial blight	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Cuproxat, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Nordox 75 WG, NuCop 3L, NuCop 50WP, NuCop DF, NuCop HB, Stretch	**SEE INDIVIDUAL LABEL**		1	Varies by product from 4 hr to 2 days	
Basal rot & Botrytis	12	**Cannonball WP** (fludioxonil)	7 oz	28 oz	0	0.5	
***Cercospora* spp.**	3	**Bumper 41.8EC** (propiconazole)	4 fl oz	16 fl oz	14	0.5	Do not apply more than 2 sequential applications without alternating to different mode of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.

Pertinent Diseases or Fungicides	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Damping-off	33	**Aliette WDG** **Legion 80WDG** **Linebacker WDG** (fosetyl-Al)	5 lb	35 lb		0.5	
Downy mildew	11 + 27	**Tanos** (cymoxanil + famoxadone)	10 oz	48 oz	1	0.5	Must be tank-mixed with appropriate contact fungicide with different modes of action. Do not make more than 1 application without rotating to a fungicide of dissimilar mode of action.
	21	**Ranman** (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	33	(mono- and dipotassium salts of phosphorous acid) Many brands available: Alude, Fosphite, Fungi-phite, K-phite, Phiticide, Phostrol, Rampart, Reveille	SEE INDIVIDUAL LABELS		0	0.5	See label for details.
	40	**Forum** (dimethomorph)	6 fl oz	18 fl oz	0	0.5	See label for details.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	Do not exceed 2 sequential applications. See label for soil applications.
	40 + 45	**Zampro** (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	1	4 hr	Do not exceed 2 sequential applications.
	43	**Presidio** (fluopicolide)	3–4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with a fungicide of different mode of action. Do not exceed two sequential applications. See label for soil applications.
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	9.6 fl oz	19.2 fl oz	0	4 hr	Soil application only.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	4.8 fl oz	19.2 fl oz	0	4 hr	Do not make foliar applications with Orondis Ultra if Orondis Gold was applied using soil applications. Do not make more than 2 sequential applications, and do not exceed more than 33% of all fungicide applications with Orondis.
Powdery mildew	M2	(sulfur) Many brands available: Sulfur 90W, Super Six, Top Cop w/ Sulfur	SEE INDIVIDUAL LABEL		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	**Bumper 41.8EC** (propiconazole)	4 fl oz	16 fl oz	14	0.5	Do not apply more than 2 sequential applications without alternating to different mode of action.
	3	**Procure 480SC** (triflumizole)	8 fl oz	18 fl oz	0	0.5	Repeat applications at 14-day intervals.

Pertinent Diseases or Fungicides	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	Do not apply more than 4 applications per year.
	3	**Tilt** (propiconazole)	4 fl oz	16 fl oz	14	0.5	Do not exceed 2 sequential and 4 total applications.
	3	**Trionic** (triflumizole)	8 fl oz	16 fl oz	0	0.5	No more than 2 applications, spaced by at least 14 days.
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7	**Endura** (boscalid)	9 oz	18 oz	14	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	No more than 2 sequential applications without moving to dissimilar mode of action.
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
Pythium damping-off; Pythium seedling blight; Pythium seedling diseases	4	**Apron XL** (mefenoxam)	0.64 fl oz/100 lb seed			2	Seed treatment only.
	4	(metalaxyl) **Various brands available:** Acquire, Allegiance, Sebring 2.65ST	0.75 fl oz/100 lb seed			2	Seed treatment only.
	4	**Ridomil Gold EC** (mefenoxam)	2 pt			2	Apply at seeding in a 7″–12″ band on soil over seed furrow.
	4	**Ridomil Gold GR** (mefenoxam)	40 lb			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4	**Ultra-Flourish** (mefenoxam)	4 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Septoria	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	7	0.5	Do not apply more than 4 applications per year.
	3	**Tilt** (propiconazole)	4 fl oz	16 fl oz	14	0.5	Do not exceed 2 sequential and 4 total applications.

Pertinent Diseases or Fungicides	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3 + 11	**Topguard EQ** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	15.3 fl oz	0	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	5.5 fl oz	16.5 fl oz	7		Limit is 3 applications per season, and no more than 2 sequential applications without alternating to a different mode of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	36.5 fl oz	0	0.5	No more than 2 sequential applications without moving to dissimilar mode of action.
	11	(azoxystrobin) **Various brands available:** Azoxystrobin, Equation, Quadris, Satori, Willowood	15.4 fl oz or 0.8 fl oz/1000 row ft	92.3 fl oz	0	4 hr	Do not exceed 1 sequential and 4 total applications of QoI fungicides. See label for soil applications.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	64 oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides.
	11	**Reason** (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Various seedling diseases	4 + 11	**Uniform** (mefenoxam + azoxystrobin)	0.34 fl oz/1000 row ft	1 appl.		0	Soil incorporated.
	12	**Maxim 4FS** (fludioxonil)	0.16 fl oz/100 lb of seed			0.5	Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 12. Nonfumigant nematicides for celery crops in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints, (56.0 to 80.0 fl oz) per acre a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop, and no more than 112 fl oz of product per acre, per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (re-cropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.
Vydate L (a.i. oxamyl)	Apply ½ to 2 gal/acre at planting, preferably via drip application or soil spray. Make additional applications on a 10-to-14-day interval. Do not apply more than 3 gal per acre per season. Minimum retreatment interval is 5 days unless a longer interval is stated. Last application at least 21 days to harvest. Consult label for more details on application.

Table 13. Nonfumigant nematicides for okra in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Velum (a.i. fluopyram)	Apply 6.5-6.8 fl oz/acre by chemigation into root-zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Minimum 7-day interval between soil applications. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation or method of application (soil or foliar).
Vydate L (a.i. oxamyl)	Apply ½ to 1 gal/acre at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. Do not apply more than 2 gal per acre per season. Minimum retreatment interval is 7 days unless a longer interval is stated. If an at plant application of more than ½ gal/acre is made, do not make more than 2 additional applications.

Table 14. Fumigant nematicides for celery crops in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/ chisel-spaced 12" apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19 to 31.5 gal	57 to 90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and other flow-modifying directions.

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations with use of highly retentive mulch films.
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS727

doi.org/10.32473/edis-cv125-2022

Chapter 11. Legume Production[1]

Craig Frey, Peter J. Dittmar, Dakshina R. Seal, Shouan Zhang, Josh H. Freeman, Johan Desaeger, and Qingren Wang[2]

Botany and Planting

Cluster bean/Guar—*Cyamopsis tetragonolobus*

Edamame—*Gylcine max*

Fenugreek/Methi—*Trigonella foenum-gracum*

Hyacinth bean/Lablab bean—*Lablab purpureus*

Lima bean—*Phaseolus lunatus*

Pigeon pea—*Cajanus cajan*

Snapbean—*Phaseolus vulgaris*, Fabaceae (Leguminosae)

Snowpea—*Pisum sativum*

Southernpea/Yard-long bean—*Vigna unguiculata*

Winged bean—*Psophocarpus tetragonolobus*

1. This document is HS727, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Craig Frey, county Extension director and Extension agent II, UF/IFAS Extension Hendry County; Peter J. Dittmar, associate professor, Horticultural Sciences Department; Dakshina R. Seal, scientist, pest management, UF/IFAS Tropical Research and Education Center; Shouan Zhang, professor, Plant Pathology Department, UF/IFAS Tropical REC; Josh H. Freeman, associate professor, Horticultural Sciences Department, UF/IFAS North Florida Research and Education Center, Quincy; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; and Qingren Wang, Extension agent III, UF/IFAS Extension Miami-Dade County; UF/IFAS Extension, Gainesville, FL 32611.

Table 1. Planting information for legumes.

Planting Dates	Snapbean Bush	Snapbean Pole	Lima Bean Bush	Lima Bean Pole	Southern Pea	Snowpea
North Florida	Mar–Apr Aug–Sept	Mar–Apr Aug–Sept	Mar–Apr Aug	Mar–Apr Aug	Mar–July	Jan–Mar
Central Florida	Feb–Apr Aug–Sept	Feb–Apr Aug–Sept	Feb–Mar Aug–Sept	Feb–Mar Aug–Sept	Feb–Aug	Nov–Feb
South Florida	Sept–Apr	Sept–Apr	Sept–Apr	Sept–Apr	Sept–Apr	Nov–Feb
Planting Information						
Distance between rows (in)	18–40	36–48	18–36	36–48	20–42	36, 2-row beds
Number of rows/bed	1–2					
Distance between rows/bed	10–12					
Distance between plants (in)	2–4	3–5	3–6	8–12	2–6	2–6
Seeding depth (in)	1–1.5	1–1.5	1–1.5	1–1.5	1–1.5	1–1.5
Seed per acre (lb)	45–80	30–45	40–60	20–40	15–30	25–50
Days to maturity from seed	45–60	50–70	60–80	80–100	75–90	60–80
Plant populations	52,272–172,240	58,000	116,160	21,780	104,544	87,120

Cultivars

Table 2. Commercial legume cultivars.

Green Bush			Yellow Bush	Green Pole	Lima
Affirmed	Greencrop	PV 857	Carson	Dade	Bridgeton
BA 0958	Jackson	PV 959	Golden Rod	Macaslan	Fordhook 242
Caprice	LaSalle	Sybaris (BA 1007)	Gold Strike		Jackson Wonder
Coyote	Momentum	Valentino	SV 1003		Thorogreen
Desoto	PV 575				
Southern Pea			**Snowpea**		
CA Blackeye No.5	Pinkeye Purplehull	Top Pick Pinkeye	Oregon Sugarpod II		
Cream 8	Quickpick	White Acre			
Cream 12	Texas Cream 40	Zipper Cream			
Coronet Pinkeye	Top Pick Cream				
Knuckle Purplehull	Top Pick Crowder				

Asian Legumes

The Asian legume group includes fruits (usually known as pods), which are eaten at the immature stage with edible immature seeds (green shell), and some young leaves and stem tips. For instance, the winged bean has edible leaves and roots, though the latter are rarely cultivated commercially in the continental United States. Pole bean, long (or yard long) bean (both dark- and light-green colors), broad bean, and lablab beans are commercially grown in south Florida. All the pole or indeterminate types can be grown on raised beds with or without plastic mulch using drip, overhead, or subsurface irrigation. Fenugreek does not grow well in rocky soils, such as those found in Miami-Dade County. Pigeon peas are a semiperennial shrub in warmer areas. Many pigeon pea and winged bean varieties are short day and only flower during the fall. There are some day-neutral varieties available for both crops.

Edamame varieties, especially those from seed companies in the United States, are sensitive to daytime length, so care must be taken to select varieties for one's growing area. Japanese varieties are classified as "summer" or "fall" types, indicating when they flower. Fertilizer recommendations for pole, long, or broad beans are generally applicable to this group. All of these crops are started from seed, though winged beans require scarification prior to planting. All the indeterminate types need some kind of support, ranging from individual bamboo stakes to trellises. However, some bush-type broad beans (Indian type) do not need trellises. For pest control products, these crops are included in the legume crop chapter.

The following tables list registered pesticides that should be integrated with other pest management methods.

Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture Extension agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 3. Planting information for Asian legumes.

Planting Dates	Cluster Bean/Guar	Edamame	Fenugreek	Hyacinth Bean
North Florida	Mar–Apr; Aug	Mar–Apr; Aug	Mar–Apr; Aug	Mar–Apr; Aug
Central Florida	Feb–Mar; Aug–Sept	Feb–Mar; Aug–Sept	Feb–Mar; Aug–Sept	Feb–Mar; Aug–Sept
South Florida	Sept–Apr	Sept–Apr	Sept–Apr	Sept–Apr
Planting Information				
Distance between rows (in)	24	20–30	9	20
Distance between plants (in)	6	2–6	2–3	4–6
Seeding depth (in)	1–1.5	1–1.5	1–1.5	1–1.5
Days to maturity from seed	90–120	80–120	90–120	90–120
Plant populations	43,560	87,120	348,480	78,409
Planting Dates	**Pigeon Pea**	**Snowpea**	**Winged Bean**	**Yard-long Bean**
North Florida	Not recommended	Jan–Mar	Not recommended	Mar–July
Central Florida	Not recommended	Nov–Feb	Not recommended	Feb–Aug
South Florida	Nov–Feb	Nov–Feb	Mar–Apr	Sept–Apr
Planting Information				
Distance between rows (in)	24–36	36, 2-row beds	36	20–42
Distance between plants (in)	2–6	2–6	8	2–6
Seeding depth (in)	1–1.5	1–1.5	1–1.5	1–1.5
Days to maturity from seed	180 (early); 270–365 (late)	60–80	90 (day-neutral varieties)	75–90
Plant populations	10,890	87,120	21,780	104,544

Table 4. Cultivars for Asian legumes.

Crop	Life Cycle	Cultivars	Trellising
Broad bean	Annual		Yes
Bush-type broad bean	Annual	Indian type	No
Cluster bean, Guar	Annual		Yes
Edamame	Annual	Green Legend, Lucky Lion, Tohya, Triple Play	No
Fenugreek, Methi	Annual		No
Hyacinth bean, Lablab bean	Annual	Akahana Fugimame, Asia Purple, Asia White	No
Long bean (dark- and light-green color)	Annual		Yes
Pigeon pea (a short-lived perennial)	Short-lived perennial		No
Snow/snap (edible podded) pea	Annual	Oregon Sugarpod II	Yes
Winged bean, Goa bean	Annual	Winged Bean, Youdou	Yes
Yard-long bean	Annual	Bia-long, Orient Wonder, Stickless Wonder	Yes

Table 5. Herbicides approved for managing weeds in beans and peas. Contact: Peter J. Dittmar, UF/IFAS Horticultural Sciences Department.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Crops	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.				
			***** PREEMERGENCE *****	
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Bean (all), pea (all)	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
EPTC 2.0–4.0	(Eptam) 7E 2.25–4.5 pt	8	Bean (green, dry)	Broadleaf and nutsedge weeds. Incorporate in the same operation to reduce volatilization. Do not exceed 9 pt/A per crop.
Fomesafen 0.25–0.38	(Reflex) 2 EC 1.0–1.5 pt	14	Bean (dry, snap)	Annual broadleaf and grass weeds and nutsedge. Not for use in Miami-Dade County. Do not apply more than 1.5 pt/A per year.
Glyphosate	(various formulations) consult labels	9	Bean (all), pea (all)	Emerged broadleaf and grass weeds. Consult individual labels for restrictions.
Halosulfuron 0.02	(Sandea) 75 DF 0.5 oz	2	Bean (black-eyed, cowpea, southern pea)	Broadleaf weeds and nutsedge. Apply after planting but before crop emergence. May cause significant, temporary stunting and delayed maturity of peas, resulting in delayed harvest.
Imazethapyr 0.02	(Pursuit) 2 L 1.5 fl oz	2	Bean (snap)	Only one application a year. Preplant incorporate within 1 week of planting or preemergence application within 1 week of planting or preemergence application within 1 day after planting. PHI 3 days.
Imazethapyr 0.05	(Pursuit) 2 L 3.0 fl oz	2	Bean (dry, lima, southern pea, cowpea), pea (dry, English), chickpea	Only one application a year. Preplant incorporate within 1 week of planting or preemergence application within 1 day after planting. Can apply up to 4 oz/A to southern pea only. Consult label for preharvest interval.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2–4 pt (Firestorm) 3 SL 1.3–2.7 pt.	22	Bean (lima, snap), pea (all)	Emerged weeds. Apply prior, during, or after planting, but before crop emergence. Only three applications a season. Use a nonionic surfactant.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Bean (all), pea (all)	Emerged weeds. Apply before crop emergence. Product is a contact, nonselective, foliar-applied herbicide.
Pendimethalin 0.5–0.75	(Prowl) 3.3 EC 1.2–1.8 pt (Prowl H20) 3.8 1.0–1.5 pt	3	Bean (dry, lima, snap, garbanzo), Bean (southern pea, cowpea), chickpea	Annual broadleaf and grass weeds. Incorporate 1–2 in. deep within 7 days of application.
Pyraflufen 0.0008–0.003	(ET Herbicide/ Defoliant) 0.5–2.0 fl. oz	14	Bean (all), pea (all)	Emerged broadleaf and grass weeds. Plant 1 day after application. Apply as a preplant burndown treatment.
Saflufenacil 0.027	(Sharpen) 3.42 SL 1.0 fl oz	14	Bean (garbanzo), bean (dry, chickpea)	Broadleaf weeds. Apply as a preplant/preemergence burndown. Sequential application can be applied within 14 days between timings. Do not apply more than 2 fl oz/A per season.
S-metolachlor 0.95–1.27	(Brawl, Dual Magnum) 7.62 EC 1.0–1.33 pt	15	Bean (lima, mung, pinto, snap), bean (southern pea), pea (English)	Annual broadleaf and grass weeds and yellow nutsedge. Consult label for rate based on soil type and specific tank mix directions.
Sulfentrazone 0.07–0.09	(Willowwood sulfentrazone) 4 SC 2.25–3.0 fl oz	14	Bean and pea (dry shelled)	Broadleaf and grass weed control, nutsedge suppression. Do not apply on sands with less than 1% organic matter. Do not apply more than 8 fl oz/A within a 12-month period. Trial on a small area.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Crops	Weeds Controlled/Remarks
Sulfentrazone 0.07–0.12	(Willowwod sulfentrazone) 4 SC 2.25–3.75 fl oz	14	Succulent pea	Broadleaf and grass weed. Nutsedge suppression. Do not apply on sands with less than 1% organic matter. Do not apply more than 6 fl oz/A within a 12-month period. Trial on a small area.
Trifluralin 0.5–0.75	(Treflan, Trust) 4 EC 1.0–1.5 pt (Treflan, Trifluralin) 10 G 5.0–7.5 lb	3	Bean (lima, mung, guar, snap), bean (southern pea), pea (dry, English)	Annual broadleaf and grass weeds. Incorporate 4 in. or less within 8 hr. Results in Florida are erratic on soils with low organic matter and clay content. Consult label for rotation restrictions.
			*****POSTEMERGENCE*****	
Bentazon 0.5–1.0	(Basagran) 4 L 1.0–2.0 pt	6	Bean (dry, succulent), bean (southern pea), pea (garden, English)	Broadleaf weeds. Apply after the first trifoliate leaf is fully expanded in bean and three pairs of leaves in pea. Yellowing, bronzing, speckling, or leaf burning may occur under certain conditions. This injury is generally outgrown without delaying pod set or maturity. PHI 30 days.
Carfentrazone Up to 0.031	(Aim) 1.9 EW up to 2 fl oz (Aim) 2.0 EC up to 2 fl oz	14	Bean (all), pea (all)	Emerged broadleaf control. Direct application to row middles. Include crop oil concentrate or nonionic surfactant is recommended rates. PHI 0 days.
Clethodim 0.094–0.25 0.07–0.25	(Arrow) 2 EC 6–16 fl oz (Select Max) 1 EC 9–32 fl oz	1	Bean (succulent), pea (succulent)	Annual and perennial grass control. Consult label for bean types. PHI 21 days.
EPTC 3.1–4.0	(Eptam) 7 E 3.5–4.5 pt	8	Bean (green, dry)	Broadleaf and nutsedge weeds. Apply as layby treatment during the last cultivation of the season. Direct spray solution to the base of the crop. Do not exceed 9 pt/A per crop.
Fluazifop 0.19–0.38	(Fusilade DX) 2 EC 12–24 fl oz	1	Bean (dry)	Annual and perennial grass weeds. Do not apply to cowpea. Do not apply more than 48 fl oz/A per season. Include a COC or NIS in the spray solution. PHI 60 days.
Fomesafen 0.25–0.38	(Reflex) 2 EC 1.0–1.5 pt	14	Bean (dry, snap)	Annual broadleaf and grass weeds and nutsedge. Not for use in Miami-Dade County. Consult label for rate based on size of specific weed species. Do not apply more than 1.5 pt/A per year.
Halosulfuron 0.02–0.03	(Sandea) 75 DF 0.5–0.66 oz	2	Bean (dry)	Broadleaf weeds and nutsedge. Row middles only. Avoid contact with planted crop. Do not apply more than 1 oz/A per crop.
Halosulfuron 0.02–0.03	(Sandea) 75 DF 0.5–0.66 oz	2	Bean (snap, lima)	Broadleaf weeds and nutsedge. Directed sprays. Apply after the two to four trifoliate leaf stage, but before flowering.
Imazethapyr 0.14	(Pursuit) 2 L 3.0 oz	2	Bean (dry), bean (southern pea), pea (dry, English)	Do not apply before bean has at least one trifoliate leaf. Apply to peas at least 3 in. in height, but prior to the fifth node and before flowering. Consult label for preharvest intervals.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Bean (all), pea (all)	Emerged weeds, row middles only. Use a shielded sprayer directed to the row middles to reduce drift to the crop
Quizalofop 0.04–0.08	(Assure II) 6–12 fl oz	1	Bean (snap, dry), pea (succulent, dry)	Annual and perennial grass weeds. Allow 7 days between sequential applications to allow for regrowth. Include a COC or NIS in the spray solution. PHI 30 days for succulent pea and dry bean. PHI 60 days for dry pea.
Sethoxydim 0.19–0.47	(Poast) 1.5 EC 1.0–2.5 pt	1	Bean (dry, succulent), pea (dry, succulent)	Growing grass weeds. Do not exceed 4.0 pt/A per season. Include a COC in the spray solution. PHI 30 days for dry bean and dry pea. PHI days for succulent bean and succulent pea.

Table 6. Insecticides approved for managing insect pests of beans and peas. Contact: Anna Meszaros, UF/IFAS Extension Palm Beach County.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Aphids	1A	***Lannate LV; *SP** (methomyl)	**LV**: 1.50–3 pt **SP**: 0.25–1.0 lb	**LV:** 15 pt **SP:** 5.0 lb	48	See label; varies with rate and crop use.	
	1B	***Dibrom 8E** (naled)	1.0 pt	4.5 pt	48	1	Ground application only; not for cowpeas and fieldpeas intended for livestock feed.
	1B	**Dimethoate 4EC** (dimethoate)	0.5–1.0 pt	2.0 pt/year	48	**Mechanical harvesting:** 0	Do not use on field peas.
	1B	**Malathion 8F** (malathion)	1.0 pt	2.0 pt	12	3	Green and dried peas only. Do not graze or feed forage to livestock.
	1B	**Orthene 97** (acephate)	0.50–1.0 lb	2.0 lb a.i.	24	Dry succulent: 14 Lima beans succulent form: 1	Do not apply to succulent beans for fresh market or processing. Do not feed treated vines or seeds to livestock.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	38.4 fl oz	12	Snap: 3 Dry beans and peas: 21	Do not feed or graze livestock on treated vines.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	
	3A	**PyGanic 5.0** (pyrethrins)	4.5–17 fl oz	10 applications	12	0	OMRI-listed.[2] Treat when insects first appear.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 7–10.5 fl oz **Foliar:** 1.2 fl oz	**Soil:** 10.5 fl oz **Foliar:** 3.6 fl oz	12	**Soil:** 21 **Foliar:** 7	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	**Assail 30SG** (acetamidprid)	2.5–5.3 fl oz	16 fl oz	12	7	Edible podded legumes, succulent shelled peas and beans.
	4A	**Transform WG** (sulfoxaflor)	0.75–1.0 oz	8.5 oz	24	7	Succulent, edible podded, and dry beans.
	4A + 15	**Cormoran** (novaluron + acetamiprid)	9-12 fl oz	36 fl oz	12	7	
	4D	**Sivanto Prime** (flupyradifurone)	7.0–10.5 fl oz	28.0 fl oz/year	4	7	Minimum interval between applications: 10 days.
	23	**Movento** (spirotetramat)	4–5 fl oz	10 fl oz	24	Succulent: 1 Dry: 7	
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	None	4	0	OMRI-listed.[2] Succulent or dried.
	-	**M-Pede 49%** (soap, insecticidal)	0.25%–4.0% v/v	No limit 7-to-10-day interval	12	0	OMRI-listed.[2]
	-	**MycotrolESO** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	
	-	**Neemix 4.5** (azadirachtin)	4–16.0 fl oz	20 g a.i.	4	0	OMRI-listed.[2] Insect growth regulator and feeding repellant.
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	No limit	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	No limit	4	0	OMRI-listed.[2]
	- + 3A	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	No limit	12	0	
Armyworm, corn earworm, lesser cornstalk borer, loopers, cutworm, caterpillar, grubs, root maggots, wireworms	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.50–3 pt **SP:** 0.50–1.0 lb	**LV:** 15 pt **SP:** 5.0 lb	48	See label: varies with rate and crop use.	
	1A	**Sevin 4F** (carbaryl)	0.50–1.5 qt	6.0 qt/year	12	Fresh beans & peas: 3 Grazing or forage: 14 Dried beans seed or hay: 21	Use on succulent shelled peas and beans prohibited.
	1B	***Diazinon 50W AG 500** (diazinon)	**50W:** 4.8 lb **AG500:** 2–4 qt	1 application per year	72	Broadcast at planting	Succulent beans and peas only. Soil application only.
	1B	***Dibrom 8E** (naled)	1–1.5 pt	4.5 pt	48	1	Ground application only, not for cowpeas and fieldpeas intended for livestock forage.
	1B	**Orthene 97** (acephate)	0.75–1.0 lb	2.0 lb a.i.	24	Dry or succulent: 14 Lima beans, succulent form: 1	Do not apply to succulent beans for fresh market or processing. Do not feed treated vines or seeds to livestock.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	38.4 fl oz	12	Snap: 3 Dry beans and peas: 21	Do not feed or graze livestock on treated vines.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Baythroid XL** (beta-cyfluthrin)	Dry beans and peas: 0.8–3.2 fl oz Southern pea: 0.8–2.1 fl oz	Dry beans and peas: 6.4 fl oz Southern peas: 10.5 fl oz	12	Dry beans and peas: 7 Southern pea: 3	**Not for use on succulent beans or peas.** Do not feed treated vines or hay to livestock.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	
	3A	***Capture LFR** (bifenthrin)	3.4–6.8 fl oz	25.5 fl oz	12	At plant	Do not exceed allowed amounts including use of other products containing bifenthrin.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	1.54 fl oz	0.38 pt	24	Edible podded and succulent shelled: 7 Dry beans and peas: 21	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay.
	3A	***Mustang** ***Mustang Maxx** (zeta-cypermethrin)	3.0–4.3 oz **Maxx:** 1.28–4.0 oz	25.8 oz **Maxx:** 24 oz	12	Succulent: 1 Dried shelled peas or beans: 21	Can also be applied at planting for control of cutworms, white grubs, and wireworms. See label.
	3A	**PyGanic 5.0** (pyrethrins)	4.5–17 fl oz	10 applications	12	0	OMRI-listed.[2] Treat when insects first appear.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	Do not graze livestock in treated areas.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	
	5	**Entrust SC** (spinosad)	1.25–2.0 oz	Succulent: 9.0 fl oz Dry: 3.75 fl oz	4	Succulent: 3 Dry: 28	OMRI-listed.[2] Do not feed forage or hay to meat or dairy animals.
	5	**Radiant SC** (spinetoram)	4–8 fl oz	Succulent: 28.0 fl oz Dry: 12.0 fl oz	4	Succulent: 3 Dry: 28	
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	7.5–10 fl oz	20 fl oz	12	7	
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.50 lb	No limit	4	0	OMRI-listed.[2] Treat when larvae are young. Thorough coverage is essential.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	No limit	4	0	OMRI-listed.[2] Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse.
	15	**Rimon 0.83 EC** (novaluron)	6–12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	18	**Intrepid 2F** (methoxyfenozide)	4–16 fl oz	64 fl oz	12	7	
	22	**Avaunt** (indoxacarb)	3.5 oz	14 fl oz	12	7	Southern pea (dry) varieties only.
	28	**Coragen** (chlorantraniliprole/ rynaxypyr)	3.5–7.5 fl oz	15.4 fl oz of chlorantraniliprole products per acre per year.	4	1	Foliar application only.
	28	**Exirel** (cyantraniliprole/ cyazypyr)	10.5–20.5 oz	No more than 0.4 lb a.i. of Group 28 products	12	Succulent: 1 Dried: 7	Label contains pollinator warning language.
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	OMRI-listed.[2] May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	- + 3A	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	No limit	12	0	
Cucumber beetle, bean leaf beetle, Mexican bean beetle, cowpea curculio	1A	***Lannate LV; *SP** (methomyl)	**LV:** 0.75–3 pt **SP:** 0.25–1.0 lb	**LV:** 15 pt **SP:** 5.0 lb	48	See label; varies with rate & crop	
	1A	**Sevin 4F** (carbaryl)	0.50–1.5 qt	6.0 qt/year	12	Fresh beans and peas: 3 Grazing or forage: 14 Dried beans, peas, seed, or hay: 21	Use on succulent shelled peas and beans prohibited.
	1B	**Dimethoate 4EC** (dimethoate)	0.5–1.0 pt	2.0 pt/year	48	**Mechanical harvesting:** 0	Do not feed treated vines. Do not use on field peas.
	1B	**Orthene 97** (acephate)	0.50–1.0 lb	2.0 lb a.i.	24	Dry succulent: 14 Lima beans succulent form: 1	Do not apply to succulent beans for fresh market or processing.
	1B	***Thimet 20G EZ Load** (phorate)	4.9–9.4 oz/1000 ft row	1 application only at plant	48	60	**Poison**. Label pending in Florida. Do not graze livestock on treated forage. No direct contact with seed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Baythroid XL** (beta-cyfluthrin)	Dry beans and peas: 0.8–3.2 fl oz Southern pea: 0.8–2.1 fl oz	Dry beans and peas: 6.4 fl oz Southern pea: 10.5 fl oz	12	Dry beans and peas: 7 Southern pea: 3	**Not for use on succulent beans or peas.** Do not feed treated vines or hay to livestock.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	
	3A	***Declare Insecticide** (gamma-cyhalothrin)	1.02–1.54 fl oz	0.38 pt	24	Edible podded and succulent shelled: 7 Dry beans and peas: 21	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay.
	3A	***Mustang** ***Mustang Maxx** (zeta-cypermethrin)	3.0–4.3 oz **Maxx:** 2.72–4.0 oz	25.8 oz **Maxx:** 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	Can also be applied at planting for control of cutworms, white grubs, and wireworms. See label.
	3A	**PyGanic 5.0** (pyrethrins)	4.5–17 fl oz	10 applications	12	0	OMRI-listed.[2] Treat when insects first appear.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	
	4A	**Assail 30SG** (acetamidprid)	2.5–5.3 fl oz	16 fl oz	12	7	Edible podded legumes and succulent shelled peas and beans.
	4A + 15	**Cormoran** (novaluron + acetamiprid)	9-12 fl oz	36 fl oz	12	7	
	15	**Rimon 0.83 EC** (novaluron)	9–12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	20 g a.i.	12	0	OMRI-listed.[2] Insect growth regulator and feeding repellant.
Fire ants	7A	**Extinguish** (S-methoprene)	1–1.5 lb broadcast	No limit	4	0	Insect growth regulator. Colonies will get reduced after three weeks and eliminated after 8–10 weeks.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb	0.134 lb a.i.	12	1	Insect growth regulator. Apply at first sign of ant activity.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
Grasshoppers	1B	**Dimethoate 4EC** (dimethoate)	0.5–1.0 pt	2.0 pt/year	48	**Mechanical harvesting:** 0	Do not feed treated vines. Do not use on field peas.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	38.4 fl oz	12	Snap: 3 Dry beans and peas: 21	Do not feed or graze livestock on treated vines.
	3A	***Baythroid XL** (beta-cyfluthrin)	Beans and peas: 2.4–3.2 fl oz Southern pea: 1.6–2.1 fl oz	Beans and peas: 6.4 fl oz Southern pea: 10.5 fl oz	12	Dry beans and peas: 7 Southern pea: 3	**Not for use on succulent beans or peas.** Do not feed treated vines.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	
	3A	***Declare Insecticide** (gamma-cyhalothrin)	1.02–1.54 fl oz	0.38 pt	24	Edible podded and succulent shelled: 7 Dry: 21	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay.
	3A	***Mustang** ***Mustang Maxx** (zeta-cypermethrin)	3.0–4.3 oz **Maxx:** 3.2–4.0 oz	25.8 oz **Maxx:** 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	Can also be applied at planting for control of cutworms, white grubs, and wireworms. See label.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	Do not graze livestock in treated areas.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 qt	No limit	4	0	May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	No limit	4	0	OMRI-listed.[2] May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	- + 3A	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	No limit	12	0	
Leafhopper	1A	***Lannate LV; *SP** (methomyl)	**LV:** 0.75–3 pt **SP:** 0.25–1.0 lb	**LV:** 15 pt **SP:** 5.0 lb	48	See label; varies with rate & crop.	
	1B	***Dibrom 8E** (naled)	1.0 pt	4.5 pt	48	1	Ground application only; not for cowpeas and fieldpeas intended for livestock forage.
	1B	**Dimethoate 4EC** (dimethoate)	0.5–1.0 pt	2.0 pt/year	48	**Mechanical harvesting:** 0	Do not feed treated vines. Do not use on field peas.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	
	3A	***Mustang** ***Mustang Maxx** (zeta-cypermethrin)	3.0–4.3 oz **Maxx:** 2.72–4.0 oz	25.8 oz **Maxx:** 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	Can also be applied at planting for control of cutworms, white grubs, and wireworms. See label.
	3A	**PyGanic 5.0** (pyrethrins)	4.5–17 fl oz	10 applications	12	0	OMRI-listed.[2] Treat when insects first appear.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	Do not graze livestock in treated areas.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 7–10.5 fl oz **Foliar:** 1.2 fl oz	**Soil:** 10.5 fl oz **Foliar:** 3.6 fl oz	12	**Soil:** 21 **Foliar:** 7	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	**Assail 30SG** (acetamidprid)	2.5–5.3 fl oz	16 oz	12	7	Edible podded legumes and succulent shelled peas and beans.
	4A + 15	**Cormoran** (novaluron + acetamiprid)	9–12 fl oz	36 fl oz	12	7	
	4D	**Sivanto Prime** (flupyradifurone)	7.0–10.5 fl oz	28.0 fl oz/year	4	7	Minimum interval between applications: 10 days.
	16	**Courier 40 SC** (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	14	Insect growth regulator. For succulent beans only. Good coverage essential.
	28	**Exirel** (cyantraniliprole/ cyazapyr)	10.5–20.5 oz	no more than 0.4 lb a.i. of Group 28 products	12	Succulent: 1 Dried: 7	Label contains pollinator protection warnings.
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	-	**M-Pede 49%** (soap, insecticidal)	0.25%–4.0% v/v	No limit 7-to-10-day interval	12	0	OMRI-listed.[2]
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	OMRI-listed.[2] May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100gal	No limit	4	0	OMRI-listed.[2]

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	- + 3A	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	No limit	12	0	
***Liriomyza* leafminers**	5	**Entrust SC** (spinosad)	1.5–2.0 oz	Succulent: 9.0 fl oz Dry: 3.75 fl oz	4	Succulent: 3 Dry: 28	OMRI-listed.[2] Do not feed forage or hay to meat or dairy animals.
	5	**Radiant SC** (spinetoram)	5–8 fl oz	Succulent: 28 fl oz Dry: 12 fl oz	4	Succulent: 3 Dry: 28	Time applications to small larvae.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	10.5 fl oz	12	7	To avoid illegal residues, must be mixed with a nonionic activator-type wetting, spreading and/or penetrating spray adjuvant. Do not feed treated vines or hay to livestock.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	7.5–10 fl oz	20 fl oz	12	7	
	17	**Trigard** (cyromazine)	2.66 oz 1 packet	0.75 lb a.i./acre	12	7	Not for use on soybeans or peas.
	28	**Coragen** (chlorantraniliprole/ rynaxypyr)	7.5 fl oz	15.4 fl oz of chlorantraniliprole products per acre per year.	4	1	Foliar application only.
	28	**Exirel** (cyantraniliprole/ cyazapyr)	10.5–20.5 oz	No more than 0.4 lb a.i. of Group 28 products	12	Succulent: 1 Dry: 7	
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	20 g a.i.	12	0	OMRI-listed.[2] Insect growth regulator and feeding repellant.
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	No limit	4	0	OMRI-listed.[2]
Lygus bug, stink bug, kudzu bug	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.50–3 pt **SP:** 0.50–1.0 lb	**LV:** 15 pt **SP:** 5.0 lb	48	See label; varies with rate & crop.	
	1A	**Sevin 4F** (carbaryl)	1.0–1.5 qt	6.0 qt/year	12	Fresh beans and peas: 3 Grazing or forage: 14 Dried beans, peas, seed, or hay: 21	Use on succulent shelled peas and beans prohibited.
	1B	***Dibrom 8E** (naled)	1–1.5 pt	4.5 pt	48	1	Ground application only; not for cowpeas and fieldpeas intended for livestock feed.
	1B	**Dimethoate 4EC** (dimethoate)	0.5–1.0 pt	2.0 pt/year	48	**Mechanical harvesting:** 0	Do not feed treated vines. Do not use on field peas.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Baythroid XL** (beta-cyfluthrin)	Beans and peas: 2.4–3.2 fl oz Southern pea: 1.6–2.1 fl oz	Beans and peas: 6.4 fl oz Southern pea: 10.5 fl oz	12	Dry beans and peas: 7 Southern pea: 3	**Not for use on succulent beans or peas.** Do not feed treated vines or hay to livestock.
	3A	***Brigade 2 EC** (bifenthrin)	5.12–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	
	3A	***Declare Insecticide** (gamma-cyhalothrin)	1.02–1.54 fl oz	0.38 pt	24	Edible podded and succulent shelled: 7 Dry beans and peas: 21	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay.
	3A	***Mustang** ***Mustang Maxx** (zeta-cypermethrin)	3.4–4.3 oz **Maxx:** 3.2–4.0 oz	25.8 oz **Maxx:** 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	Can also be applied at planting for control of cutworms, white grubs, and wireworms. See label.
	3A	**PyGanic 5.0** (pyrethrins)	4.5–17 fl oz	10 applications	12	0	OMRI-listed.[2] Treat when insects first appear.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	7.68 fl oz	24	Edible podded and succulent shelled: 7 Dried, shelled: 21	
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	
	4A	**Transform WG** (sulfoxaflor)	2.25 oz	8.5 oz	24	7	Succulent, edible podded, and dry beans. Stink bug suppression.
	4A + 15	**Cormoran** (novaluron + acetamiprid)	12 fl oz	36 fl oz	12	7	
	15	**Rimon 0.83 EC** (novaluron)	12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	-	**M-Pede 49%** (soap, insecticidal)	0.25%–4.0% v/v	No limit 7-to-10-day interval	12	0	OMRI-listed.[2]
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	OMRI-listed.[2] May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	- + 3A	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	No limit	12	0	
Mites: two-spotted, southern, red	3A	***Brigade 2 EC** (bifenthrin)	5.12–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	
	3A	**PyGanic 5.0** (pyrethrins)	4.5–17 fl oz	10 applications	12	0	OMRI-listed.[2] Treat when insects first appear.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	10.5 fl oz	12	7	To avoid illegal residues, must be mixed with a nonionic activator-type wetting, spreading and/or penetrating spray adjuvant. Do not feed treated vines or hay to livestock.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	7.5–10 fl oz	20 fl oz	12	7	
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	62 fl oz	12	7	Succulent beans, including succulent soybean vegetable only.
	20D	**Acramite-50WS** (bifenzate)	1.0–1.5 lb	3.0 lb	12	3	Succulent beans, peas and soybean.
	21A	**Portal** (fenpyroximate)	2.0 pt	4.0 pt	12	1	Snap bean only. Allow 14 days between applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	No limit	4	0	OMRI-listed.[2] Succulent or dried.
	-	**M-Pede 49%** (soap, insecticidal)	0.25%–4.0% v/v	No limit 7-to-10-day interval	12	0	OMRI-listed.[2]
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100gal	No limit	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	No limit	4	0	OMRI-listed.[2]
Thrips	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.50–3 pt **SP:** 0.50–1.0 lb	**LV:** 15 pt **SP:** 5.0 lb	48	See label: varies with rate and crop use	
	3A	***Hero** (zeta-cypermethrin + bifenthrin)	10.3 oz	27.39 oz	12	Succulent: 3 Dry: 21	
	3A	**PyGanic 5.0** (pyrethrins)	4.5–17 fl oz	10 applications	12	0	OMRI-listed.[2]

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	31 fl oz	24	Edible podded succulent shelled: 7 Dry shelled: 21	Does not include Western Flower Thrips.
	4A	**Admire Pro** (imidacloprid)	7–10.5 fl oz	10.5 fl oz	12	21	Only soil applied is labeled and only for foliar feeding thrips.
	4A	**Assail 30SG** (acetamiprid)	4.5–5.3 fl oz	16 oz	12	7	Edible podded legumes and succulent shelled peas and beans.
	4A	**Transform WG** (sulfoxaflor)	2.25 oz	8.5 oz	24	7	Succulent, edible podded, and dry beans.
	4A + 15	**Cormoran** (novaluron + acetamiprid)	12 fl oz	36 fl oz (see remarks)	12	7	Do not apply more than two applications against thrips per season.
	5	**Entrust SC** (spinosad)	1.5–2.0 fl oz	Succulent: 9.0 fl oz Dry: 3.75 fl oz	4	Succulent: 3 Dry: 28	OMRI-listed.[2] Do not feed forage or hay to meat or dairy animals.
	5	**Radiant SC** (spinetoram)	5–8 fl oz	Succulent: 28 fl oz Dry: 12 fl oz	4	Succulent: 3 Dry: 28	
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	10 fl oz	20 fl oz	12	7	Suppression of foliage-feeding only.
	15	**Rimon 0.83 EC** (novaluron)	12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	23	**Movento** (spirotetramat)	4–5 fl oz	10.0 fl oz	24	Succulent: 1 Dry: 7	
	28	**Exirel** (cyantraniliprole/ cyazapyr)	10.5–20.5 oz	No more than 0.4 lb a.i. of Group 28 products	12	Succulent: 1 Dried: 7	Label contains pollinator protection warnings.
	-	**Aza-Direct** (azadirachtin)	1–2 pt	3.5 pt	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	No limit	4	0	OMRI-listed.[2] Succulent or dried.
	-	**M-Pede 49%** (soap, insecticidal)	0.25%–4.0% v/v	No limit 7-to-10-day interval	12	0	OMRI-listed.[2]
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	OMRI-listed.[2] May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	no limit	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	no limit	4	0	OMRI-listed.[2] Apply morning or evening to reduce potential for leaf burn.
	- + 3A	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	No limit	12	0	
Whiteflies	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 fl oz	Succulent: 12.8 fl oz Dry: 19.2 fl oz	12	Succulent: 3 Dry: 14	
	3A	***Mustang** ***Mustang Maxx** (zeta-cypermethrin)	3.4–4.3 oz **Maxx:** 3.2–4.0 oz	25.8 oz **Maxx:** 24.0 oz	12	Succulent: 1 Dried shelled peas or beans: 21	Can also be applied at planting for control of cutworms, white grubs, and wireworms. See label.
	3A	**PyGanic 5.0** (pyrethrins)	4.5–17 fl oz	10 applications	12	0	OMRI-listed.[2] Treat when insects first appear.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 7–10.5 fl oz **Foliar:** 1.2 fl oz	**Soil:** 10.5 fl oz **Foliar:** 3.6 fl oz	12	**Soil:** 21 **Foliar:** 7	Do not apply to both soil and foliage. Do not use other 4A insecticides if imidacloprid is used.
	4A	**Assail 30SG** (acetamiprid)	4.0–5.3 fl oz	16 oz	12	7	Edible podded legumes and succulent shelled peas and beans.
	4A + 15	**Cormoran** (novaluron + acetamiprid)	12 fl oz	36 fl oz (see remarks)	12	7	Do not apply more than two applications against whiteflies per season.
	4D	**Sivanto Prime** (flupyradifurone)	10.5–14 fl oz	28.0 fl oz/year	4	7	Minimum interval between applications: 10 days
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	10 fl oz	20 fl oz	12	7	
	7C	**Knack IGR** (pyriproxyfen)	8–10 fl oz	20 fl oz	12	7	
	15	**Rimon 0.83 EC** (novaluron)	12 fl oz	24 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects.
	16	**Courier 40 SC** (buprofezin)	9.0–13.6 fl oz	27.2 fl oz	12	14	For succulent beans only. Allow 14 days between applications.
	23	**Movento** (spirotetramat)	4–5 fl oz	10.0 fl oz	24	Succulent: 1 Dry: 7	
	28	**Exirel** (cyantraniliprole/ cyazapyr)	10.5–20.5 oz	No more than 0.4 lb a.i. of Group 28 products	12	Succulent: 1 Dried: 7	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	May be used in greenhouses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	No limit	4	0	OMRI-listed.[2] Succulent or dried. Do not apply if bees are visiting treatment area.
	-	**M-Pede 49%** (soap, insecticidal)	0.25%–4.0% v/v	No limit 7-to-10-day interval	12	0	OMRI-listed.[2] Use with a companion insecticide.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt	No limit	4	0	OMRI-listed.[2] May be used in houses. Contact dealer if adjuvant must be used. Compatible in tank mix with some fungicides.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	20 g a.i.	4	0	OMRI-listed.[2]
	-	**Sun Spray 98.8%, JMS Stylet Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal	No limit	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	No limit	4	0	OMRI-listed.[2] Apply morning or evening to reduce potential for leaf burn.
	- + 3A	**BotaniGard Maxx** (*Beauveria bassiana* strain GHA + pyrethrins)	0.25–2.0 qt	No limit	12	0	

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v.10.2, March 2022. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. Un—unknown, or a mode of action that has not been classified yet.

[2] Information provided in the table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by Organic Materials Review Institute for use in organic production.

***Restricted use insecticide**

Table 7. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Shouan Zhang, UF/IFAS Tropical Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Anthracnose	M1	(copper compounds) **Many brands available:** Cueva, Nordox, Nordox 75 WG	**SEE INDIVIDUAL LABEL**		Varies	Varies from 4 hr to 2 days	
	M1 + M1	**Badge SC** **Badge X2** (copper hydroxide + copper oxychloride)	2 pt	**SC:** 16.6 pt **X2:** 16.9 pt	0	**Greenhouse:** 1 **Field:** 2	
	M1 + M1	**C-O-C-S WDG** (basic copper sulfate + copper oxychloride)	1.5 lb	9.2 lb		2	
	1	(thiophanate-methyl) **Many brands available:** 3336 EG, 3336 F, 3336 WP, Helena-Methyl 4.5 AG, Incognito 4.5F, Incognito 85 WDG, Nufarm T-Methyl 4.5F, Topsin 4.5FL Fungicide, Topsin M WSB Fungicide	**SEE INDIVIDUAL LABEL**		14 to 28 (see label)	**3336 fungicides:** 0.5 Succulent beans: 1 Dry beans: 3	Apply once at 50%–70% bloom or twice (max=1.5 lb/appl.) with first at 10%–30% bloom and second at peak bloom.
	3	**Propiconazole 3.6EC** **Tilt** (propiconazole)	4 fl oz	12 fl oz	7	0.5	Supplemental label: For control of web blight caused by *Rhizoctonia solani*. Not labeled for cowpea used for livestock feed.
	3	**Rancona 3.8 FS** (ipconazole)	0.085 fl oz/100 lb seed			0.5	For suppressing seedborne anthracnose of dry bean.
	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before alternating to a non-FRAC 7 fungicide.
	7 + M3	**Vitaflo-280** (carboxin + thiram)	4.0 fl oz per 100 lb seed			1	
	7 + 11	**Priaxor Xemium** (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	0.5	Limit 2 appl./season. Crop cannot be used for livestock until 14 days after last application.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Aframe, Azoxystar, Azoxyzone, Quadris, Satori Fungicide, Tetraban, Trevo, Willowood Azoxy 2SSC** (azoxystrobin)	15.5 fl oz	92.3 fl oz	Dry: 14 Succulent: 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	**Azteroid FC** (azoxystrobin)	19.5 fl oz	116 fl oz	Dry: 14 Succulent: 0	4 hr	
	11	**Headline** **Headline SC** (pyraclostrobin)	9 fl oz	18 fl oz	7 or 21 **SC:** 7	4 hr **SC:** 0.5	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11 + 3	**Avaris 2XS, Cover XL, Quilt Fungicide, Quilt Xcel, Willowood Azoxyprop Xtra** (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	Supplemental label: Do not use on cowpea cultivars intended for livestock.
Ascochyta blight	3	**Propiconazole 3.6EC** **Tilt** (propiconazole)	4 fl oz	12 fl oz	7	0.5	Supplemental label: For control of web blight caused by *Rhizoctonia solani*. Not labeled for cowpea used for livestock feed.
	3	**Provysol** (mefentrifluconazole)	5 fl oz	15 fl oz	21	0.5	Only labeled for chickpea, lentils, and dry-edible peas and beans.
	7	**Endura** (boscalid)	11 oz	22 oz	Dry: 21 Succulent: 7	0.5	Limit 2 appl./crop, and alternate chemistry.
	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before alternating to a non-FRAC 7 fungicide.
	7 + 3 + 11	**Miravis Neo** (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	Dry: 14	0.5	
	7 + 11	**Priaxor Xemium** (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	0.5	Limit 2 appl./season. Crop cannot be used for livestock until 14 days after last application.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Aframe, Azoxystar, Azoxyzone, Mazolin, Quadris, Satori Fungicide, Tetraban, Trevo, Willowood Azoxy 2SC** (azoxystrobin)	15.5 fl oz	92.3 fl oz	Dry: 14 Succulent: 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	**Azteroid FC** (azoxystrobin)	19.5 fl oz	116 fl oz	Dry: 14 Succulent: 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	**Headline** **Headline SC** (pyraclostrobin)	9 fl oz	18 fl oz	7 or 21	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11 + 3	**Aframe Plus, Avaris 2XS, Cover XL, Quilt Fungicide, Quilt Xcel** (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	Supplemental label: Do not use on cowpea cultivars intended for livestock.
	M1	(copper compounds) **Many brands available:** Americop 40 DF, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 Flowable, Champion++, Champ WG, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide, MasterCop, Nordox, Nordox 75 WG, Nu-Cop 3 L, Nu-Cop 50 DF, Nu-Cop 50 WP, Nu-Cop HB, Previsto	**SEE INDIVIDUAL LABEL**		Varies	Varies from 4 hr to 2 days	
	M1 + M1	**Badge SC** **Badge X2** (copper hydroxide + copper oxychloride)	2 pt	**SC:** 16.6 pt **X2:** 16.9 pt	0	**Greenhouse:** 1 **Field:** 2	
	M1 + M1	**C-O-C-S WDG** (basic copper sulfate + copper oxychloride)	1.5 lb	9.2 lb		2	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Bacterial brown spot, Bacterial blight, Common blight, Halo blight	M2	(sulfur) **Many brands available:** Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, THAT Flowable Sulfur, Thiolux, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABEL**			1	Do not apply during periods of warm weather to avoid phytotoxicity.
	M2 + 3	**Unicorn DF** (sulfur + tebuconazole)	3.75 lb	Fresh: 15 lb Dry: 7.5 lb	14	0.5	Do not mix with other DMI fungicides.
Bean Rust (*Uromyces appendiculatus*)	3	**Propiconazole 3.6EC Tilt** (propiconazole)	4 fl oz	12 fl oz	7	0.5	
	3	**Rally 40WSP Fungicide** (myclobutanil)	5 oz	1.25 lb	0	1	30-day plantback interval
	7 + 3 + 11	**Miravis Neo** (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	Dry: 14	0.5	
	7 + 11	**Priaxor Xemium** (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	0.5	Limit 2 appl./season. Crop cannot be used for livestock until 14 days after last application.
	11	**Aframe, Azoxystar, Azoxyzone, Mazolin, Quadris, Satori Fungicide, Tetraban, Trevo** (azoxystrobin)	6 fl oz	92.3 fl oz	Dry beans: 14 Succulent: 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	**Azteroid FC** (azoxystrobin)	7.6 fl oz	116 fl oz	Dry: 14 Succulent): 0	4 hr	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11	**Headline** **Headline SC** (pyraclostrobin)	9 fl oz	18 fl oz	Succulent: 7 Dry: 21	0.5	No more than 2 sequential applications before alternating to a non-FRAC 11 fungicide.
	11 + 3	**Aframe Plus, Cover XL, Quilt Fungicide, Quilt Xcel** (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	Supplemental label: Do not use on cowpea cultivars intended for livestock.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Botrytis or Gray mold	1	**3336 EG, 3336 F, 3336 WP, Topsin 4.5 FL Fungicide, Topsin M WSB Fungicide** (thiophanate-methyl)	**SEE INDIVIDUAL LABEL**		14 to 28 (see label)	**3336 fungicides:** 0.5 Succulent: 1 Dry: 3	Apply once at 50%–70% bloom or twice (max=1.5 lb/appl.) with first at 10%–30% bloom and second at peak bloom.
	7	**Endura** (boscalid)	11 oz	22 oz	Succulent: 7	0.5	Limit 2 appl./crop, and alternate chemistry.
	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	
	7 + 11	**Priaxor Xemium** (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	0.5	Limit 2 appl./season. Crop cannot be used for livestock until 14 days after last application.
	M1	(copper compounds) **Many brands available:** Nordox, Nordox 75 WG	**SEE INDIVIDUAL LABEL**		Varies	Varies from 4 hr to 2 days	
	M1	**Cueva** (copper octanoate)	2 gal		0	4 hr	
	M1 + M1	**Badge SC** **Badge X2** (copper hydroxide + copper oxychloride)	2 pt	**SC:** 16.6 pt **X2:** 16.9 pt	0	**Greenhouse:** 1 **Field:** 2	
	M1 + M1	**C-O-C-S WDG** (basic copper sulfate + copper oxychloride)	1.5 lb	9.2 lb		2	
Cercospora leaf spot	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	
	7 + 3 + 11	**Miravis Neo** (pydiflumetofen + propiconazole + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	12	Limit 2 appl./crop. Minimum application interval 14 days.
	7 + 11	**Priaxor Xemium** (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	0.5	Limit 2 appl./season. Crop cannot be used for livestock until 14 days after last application.
	11	**Headline** **Headline SC** (pyraclostrobin)	9 fl oz	18 fl oz	Succulent: 7 Dry: 21	0.5	Limit 2 appl./crop, and alternate chemistry.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M1	(copper compounds) **Many brands available:** Basic Copper 53, Champ Formula 2 Flowable, Champion++, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000 Fungicide, Kocide 3000, Nordox, Nordox 75 WG, Nu-Cop 30 HB, Previsto	**SEE INDIVIDUAL LABEL**			4 hr to 2 days (see label)	
	M1 + M1	**Badge SC** **Badge X2** (copper hydroxide + copper oxychloride)	2 pt	**SC:** 16.6 pt **X2:** 16.9 pt	0	**Greenhouse:** 1 **Field:** 2	
	M1 + M1	**C-O-C-S WDG** (basic copper sulfate + copper oxychloride)	1.5 lb	9.2 lb		2	
Downy mildew	M1 + 4	**Ridomil Gold/Copper** (copper hydroxide + mefenoxam)	2 lb	8 lb	3	2	Limit 4 appl./crop.
	4	**Ridomil Gold SL** (mefenoxam)	0.2 pt	0.8 pt	3	2	Must be tank mixed with other effective fungicides.
	4	**Ultra Flourish** (mefenoxam)	0.4 pt	**Soil:** 2.0 pt **Foliar:** 1.6 pt	3	2	Must be tank mixed with other effective fungicides.
	7 + 11	**Priaxor Xemium** (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	0.5	Limit 2 appl./season. Crop cannot used for livestock until 14 days after last application.
	11	**Headline** **Headline SC** (pyraclostrobin)	9 fl oz	18 fl oz	7	0.5	Limit 2 appl./crop, and alternate chemistry.
	21	**Ranman 400SC Fungicide** (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Not labeled for cowpea used for livestock feed. Limit 6 appl./crop. No more than three sequential appl. before rotating chemistry.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	
	1	**Thiabendazole 4L ST** (thiabendazole)	1.72 fl oz/100 lb seed			0.5	
	1	**T-Methyl 4.5L ST** (thiophanate-methyl)	0.28 fl oz/100 lb seed			0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	**Rancona 3.8 FS** (ipconazole)	0.085 fl oz/100 lb seed			0.5	
Fusarium seeding blight, Fusarium root rot	4 + 11	**Trilex 2000** (metalaxyl + trifloxystrobin)	1.0 fl oz/100 lb seed			1	
	4 + 12	**Apron Maxx RFC** (mefenoxam + fludioxonil)	1.5 fl oz/100 lb seed			2	
	4 + 12	**Apron Maxx RTA** (mefenoxam + fludioxonil)	5.0 fl oz/100 lb seed			2	
	7	**Systiva XS Xemium** (fluxapyroxad)	0.47 fl oz/100 lb seed				
	7 + M3	**Vitaflo-280** (carboxin + thiram)	4.0 fl oz/100 lb seed			1	Seed treatment
	11	**Stamina** (pyraclostrobin)	1.5 fl oz/100 lb seed				
	11 + 12 + 4 + 4A (insecticide)	**Seed Shield Beans** (azoxystrobin + fludioxonil + mefenoxam + thiamethoxam)	3.0 fl oz/100 lb seed			2	
	12	**Dyna-Shield, Fludioxonil, Fludioxonil 4L ST, Maxim 4F S, Spirato 480 FS, STartUp FLUDI** (fludioxonil)	0.16 fl oz/100 lb seed			0.5	
	4	**Acquire, Allegiance FL, Dyna-Shield Metalaxyl 318 FS, Metalaxyl 4.0 ST** (metalaxyl)	0.75 fl oz/100 lb seed **Metalaxyl 4.0 ST:** 0.5 fl oz/100 lb seed			1	Seed treatment
	4	**Apron XL** (mefenoxam)	0.32 fl oz/100 lb of seed			2	Seed treatment only
	4 + 12	**Apron Maxx RTA** (mefenoxam + fludioxonil)	5 fl oz/100 lb seed			2	Seed treatment only

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Phytophthora	11 + 12 + 4 + 4A (insecticide)	**Seed Shield Beans** (azoxystrobin + fludioxonil + mefenoxam + thiamethoxam)	3.0 fl oz/100 lb seed			2	Seed treatment only
	21	**Ranman 400SC Fungicide** (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	
	43	**Presidio** (flupicolide)	4 fl oz		0	0.5	
	M1	**Cueva** (copper ocanoate)	2 gal		0	4 hr	OMRI-listed
	M2	(sulfur) **Many brands available:** Cosavet-DF Edge, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Suffa, Sulfur 6 L, Sulfur 90W, THAT Flowable Sulfur, Thiolux, TriTek, Wettable Sulfur	**SEE INDIVIDUAL LABEL**			1	Do not apply during periods of warm weather to avoid phytotoxicity.
Powdery mildew	3 + 11	**Veltyma** (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	
	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	
	7 + 3	**Luna Experience** (fluopyram + tebuconazole)	12.8 fl oz	25.6 fl oz	14	0.5	Do not make more than 2 sequential applications of Luna Experience or any Group 7– or Group 3–containing fungicide before rotating with a fungicide of a different group.
	7 + 3 +11	**Miravis Neo** (pydiflumetofen + propiconoze + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	
	7 + 11	**Priaxor Xemium** (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	Succulent: 7 Dry: 21	0.5	Do not make more than 2 applications per season.
	11	**Aproach** (picoxystrobin)	12 fl oz	24 fl oz	14	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Headline** **Headline SC** **Willowood Pyrac 2EC** (pyraclostrobin)	9 fl oz	18 fl oz	7	0.5	Limit 2 appl./crop, and alternate chemistry.
	4	**Acquire, Allegiance FL, Dyna-Shield Metalaxyl 318 FS, Metalaxyl 265 ST, Metalaxyl 4.0 ST** (metalaxyl)	0.75 fl oz/100 lb seed			1	Seed treatment
	4	**Apron XL** (mefenoxam)	0.64 fl oz/100 lb seed			2	Seed treatment only
Pythium damping-off & root rot	4	**MetaStar 2E** (metalaxyl)	4 pt			2	Preplant incorporated at planting or soil surface after planting. Do not use in greenhouse or field-grown bedding plants.
	4	**Ridomil Gold SL** (mefenoxam)	0.2 pt	0.8 pt	3	2	Must be tank mixed with other effective fungicides.
	4	**Ultra Flourish** (mefenoxam)	2 pt			2	Apply as a broadcast soil application at preplant or as a surface application at planting.
	4 + 11	**Trilex 2000** (metalaxyl + trifloxystrobin)	1.0 fl oz/100 lb seed			1	
	4 + 11	**Uniform** (mefenoxam + azoxystrobin)	0.34 fl oz/1000 ft row			0	
	4 + 12	**Apron Maxx RFC** (metalaxyl + fludioxonil)	1.5 fl oz/100 lb seed			2	
	4 + 12	**Apron Maxx RTA** (metalaxyl + fludioxonil)	5.0 fl oz/100 lb seed			2	
	7 + M3	**Vitaflo-280** (carboxin + thiram)	4 fl oz/100 lb seed			1	
	1	**St-Methyl 540 FS** **T-Methyl 4.5L ST** (thiophanate-methyl)	0.28 fl oz/100 lb seed			0.5	
	3	**Rancona 3.8 FS** (ipconazole)	0.085 fl oz/100 lb seed			0.5	Seed treatment for protection against *Rhizoctonia solani*.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Rhizoctonia diseases	3 + 7 +11	**Miravis Neo** (pydiflumetofen + propiconoze + azoxystrobin)	13.7 fl oz	27.4 fl oz	14	0.5	
	4 + 11	**Trilex 2000** (metalaxyl + trifloxystrobin)	1.0 fl oz/100 lb seed			1	
	4 + 11	**Uniform** (mefenoxam + azoxystrobin)	0.34 fl oz/1000 ft row			0	Make only one application per season
	4 + 12	**Apron Maxx RFC** (mefenoxam + fludioxonil)	1.5 fl oz/100 lb seed			2	Seed treatment only.
	4 + 12	**Apron Maxx RTA** (mefenoxam + fludioxonil)	5 fl oz/100 lb seed			2	Seed treatment only.
	7	**Systiva XS Xemium** (fluxapyroxad)	0.47 fl oz/100 lb seed			0	
	7	**Vibrance** (sedaxane)	0.16 fl oz/100 lb seed				
	7 + M3	**Vitaflo-280** (carboxin + thiram)	4 fl oz/100 lb seed			1	Seed treatment
	11	**Aframe** (azoxystrobin)	0.8 fl oz/1000 row ft			4 hr	
	11	**AzoxyStar** (azoxystrobin)	3.75 fl oz/100 lb seed			4 hr	Seed treatment
	11	**Azoxystrobin 100 ST** (azoxystrobin)	0.8 fl oz/1000 row ft			0	
	11	**Azoxyzone** (azoxystrobin)	1.0 fl oz/1000 row feet			4 hr	For Rhizoctonia root rot (*Rhizoctonia solani*)
	11	**Azteroid FC** (azoxystrobin)	19.5 fl oz	116 fl oz	Dry: 14 Succulent: 0	4 hr	For web blight (*Rhizoctonia solani*)
	11	**Dynasty** (azoxystrobin)	0.765 fl oz/100 lb seed			4 hr	Seed treatment
	11	**Quadris** (azoxystrobin)	15.5 fl oz	92.3 fl oz	Dry: 14 Succulent: 0	4 hr	For web blight (*Rhizoctonia solani*)
	11	**Satori Fungicide, Tetraban, Trevo, Willowood Azoxy 2SC** (azoxystrobin)	0.8 fl oz/1000 row ft				

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Stamina** (pyraclostrobin)	1.5 fl oz/100 lb seed			0.5	Seed treatment
	11 + 3	**Aframe Plus, Avaris 2XS, Cover XL, Quilt Xcel, Willowood AzoxyProp Xtra** (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	Dry: 14 Succulent: 7	0.5	For web blight (*Rhizoctonia solani*)
	12	**Dyna-Shield Fludioxonil, Fludioxonil 4L ST, Maxim 4FS, Spirato 480FS, STartUp FLUDI** (fludioxonil)	0.16 fl oz/100 lb seed			0.5	Seed treatment only.
	14	**Rizolex** (tolclofos-methyl)	0.3 fl oz/100 lb seed	200 lb		0.5	Only applied on the "true seed," not on other propagation parts.
	M1	**Cueva** (copper ocanoate)	2 gal		0	4 hr	OMRI-listed.
	1	(thiophanate-methyl) **Many brands available:** 3336 EG, 3336 F, 3336 WP, Incognito 4.5F, Topsin 4.5FL Fungicide, Topsin M WSB Fungicide	**SEE INDIVIDUAL LABEL**		14 to 28 (see label)	**3336 fungicides:** 0.5 Succulent: 1 Dry: 3	Apply once at 50%–70% bloom or twice (max=1.5 lb/appl.) with first at 10%–30% bloom and second at peak bloom.
	1 + 3 + 11	**Trevo Packed** (thiophanate-methyl + tebuconazole + azoxystrobin)	30 fl oz		Fresh: 14 Dry: 28	1	
White mold	2	**Meteor** **Nevado 4F** **Rovral 4 Flowable** (iprodione)	2 pt	4 pt	0	1	Limit 2 applications per season. Not for use as livestock feed.
	7	**Endura** (boscalid)	11 oz	22 oz	Succulent: 7	0.5	Limit 2 appl./crop, and alternate chemistry.
	7	**Fontelis** (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before alternating to a non-FRAC 7 fungicide.
	7 + 11	**Priaxor Xemium** (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	0.5	Limit 2 appl./season. Crop cannot be used for livestock until 14 days after last application.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	9 + 12	**Switch 62.5 WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	14	**Botran 5F** (DCNA dicloran)	1.6 qt	3.2 qt	2	0.5	Do not feed treated plants to livestock.
	29	**Omega 500F** (fluazinam)	0.85 pt	1.75 pt	Edible—podded and succulent beans: 14	2	

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2021; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).
[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 8. Nonfumigant nematicides for legume crops in Florida.

Product	Application Directions
Mocap 15G (a.i. ethoprop)	Apply 13 pounds per acre (36-inch row spacing) or 0.9 pounds per 1,000 linear feet of row in a band of 15 inches wide on the row at-planting. Mix with the top 2 to 4 inches of soil with mechanical equipment right after application. If broadcast, apply 34 lb/acre from 1 week before planting to at planting time and mix with 2–4 inches of soil. DO NOT use as a seed furrow treatment or allow granules to contact the seed. Only 1 application per season.
Velum (a.i. fluopyram)	Apply 4.0–5.0 fl oz/acre in seed furrow and cover with soil, or chemigation into root-zone through low-pressure drip or trickle irrigation. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation or method of application (soil or foliar). Do not apply within 14 days of harvest.

Table 9. Fumigant nematicides for legume crops in Florida.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/ chisel-spaced 12" apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19 to 31.5 gal	57 to 90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and other flow-modifying directions.

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations with use of highly retentive mulch films.
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS730

doi.org/10.32473/edis-cv299-2022

Chapter 12. Onion, Leek, and Chive Production in Florida[1]

Hugh A. Smith, Johan Desaeger, Peter J. Dittmar, Pamela Roberts, Xavier Martini, Shouan Zhang, and Lincoln Zotarelli[2]

Botany and Planting

Onion—*Allium cepa*, Alliaceae (Amaryillidaceae)

Leek—*Allium ampeloprasum*

Chive—*Allium schoenoprasum*

Bunching onion—*Allium fistulosum*

Table 1. Planting information for onion and alliums.

Planting Dates	Seeded	Transplanted
North Florida	mid-Sept–mid-Nov	Nov–Jan
Central Florida	Oct	Dec–Jan
South Florida	Oct	Dec–Jan
Planting Information		
Distance between rows (in.)	14–18	14–18
Distance between plants (in.)	3–4	4–6
Seeding depth (in.)	0.25–0.5	-
Seed per acre (lb)	3–4	1
Days to maturity	100–130	100–130
Plant populations (acre)	149,343	112,123

1. This document is HS730, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 2015. Revised annually. Most recent revision June 2022. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Hugh A. Smith, associate professor, Entomology and Nematology Department, UF/IFAS Gulf Coast Research and Education Center; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; Peter J. Dittmar, associate professor, Horticultural Sciences Department; Pamela D. Roberts, professor, Plant Pathology Department, UF/IFAS Southwest Florida REC; Xavier Martini, assistant professor, Entomology and Nematology Department, UF/IFAS North Florida REC, Quincy; Shouan Zhang, professor, Plant Pathology Department, UF/IFAS Tropical REC; and Lincoln Zotarelli, associate professor, Horticultural Sciences Department; UF/IFAS Extension, Gainesville, FL 32611.

Cultivars

Table 2. Onion and leek cultivars.

Onion		
Dawn (H)	Prowler (H)	Sweet Harvest (H)
Granex 33 (H)	Red Hunter	Sweet Success (H)
Pirate (H)	Savannah Sweet (H)	Vidurra (H)
Plethora (H)	Sweet Caroline (H)	
Bunching Onion		
Perfecto Blanco	Tokyo Long White	White Portugal
Leeks		
Chives	Lancelot	Tivi
Jolant	Megathon	Tornado
King Richard	Staro	Verina
H=hybrid		

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 3. Herbicides approved for managing weeds in onion, garlic, and shallot. Contact: Peter J. Dittmar, UF/IFAS Horticultural Sciences Department.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Crops	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.				
***** PREEMERGENCE *****				
Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Dry bulb vegetables: onion, garlic, shallot	Annual broadleaf and grass control. Incorporate or irrigate 1 to 2 in. deep within 36 hr of application. Consult label for rotational restrictions.
Bromoxynil 0.25–0.38	(Buctril) 2 EC 1.0–1.5 pt (Buctril) 4 EC 0.5–0.75 pt	6	Onion (dry bulb)	Broadleaf weeds. Preemergence is restricted to muck soils containing greater than 10% organic matter. Apply at least 3 to 4 days prior to emergence. Weeds should not exceed the 4-leaf stage, 2 in. in height or 1 in. in diameter.
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Onion, garlic, leek, chive, shallot	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Flumioxazin up to 0.06	(Chateau) 51 WDG up to 2 fl oz	14	Garlic, onion (dry bulb)	Broadleaf control. Apply to transplanted onions between the 2- and 6-leaf stage. Apply to direct seeded onions between the 3- and 6-leaf stage.
Glyphosate	(various formulations) consult label	9	Onion, garlic, leek, chive, shallot	Control of emerged broadleaf and grass weeds. Consult individual labels for restrictions.
Oxyfluorfen 2.0	(Goal 2XL) 2 EC 2.0 pt (GoalTender) 4 EC 1.0 pt	14	Onion (dry bulb), garlic (dry bulb)	Certain broadleaf weeds. Transplanted only. Apply within 2 days of transplanting. Necrotic lesions, twisting, or stunting of plants can occur if applications are made during cool, wet weather or prior to the full development of the true leaves.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2–4 pt	22	Onion (dry bulb)	Controls emerged weeds. Apply prior, during, or after planting, but before crop emergence. Only 2 applications a season. Use a nonionic surfactant.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Crops	Weeds Controlled/Remarks
Paraquat 0.63–1.0	(Gramoxone) 2 SL 2.5–4.0 pt (Firestorm) 3 SL 1.7–2.7 pt	22	Onion (seeded), garlic	Emerged broadleaf and grass weeds. Apply as a preplant burndown. A maximum of 1 lb a.i./A per season.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Onion, garlic, leek, chive, shallot	Emerged broadleaf and grass weeds. Apply before emergence of crop. Product is a contact, nonselective, foliar-applied herbicide. There is no residual activity.
Pendimethalin Mineral 0.5–0.75 Muck 1.0–2.0	(Prowl) 3.3 EC Mineral: 1.2–1.8 pt Muck: 2.4–4.8 pt (Prowl H20) 3.8 Mineral: 1.0–1.5 pt Muck: 2.0–4.0 pt	3	Onion (dry bulb), shallot (dry bulb), garlic	Mineral soils: Apply when crop has 2 to 9 true leaves. Muck soils: May be applied as sequential application: preemergence through loop stage, early postemergence (2 to 6 true leaf stage), late postemergence (6 to 9 true leaf stage). Do not exceed 5.9 lb a.i./A in a growing season. PHI 45 days.
Pyraflufen 0.001–0.003	(ET Herbicide/ Defoliant) 0.5–2.0 fl oz	14	Bulb vegetables	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment.
***** POSTEMERGENCE *****				
Bromoxynil 0.25–0.38	(Buctril) 2 EC 1.0–1.5 pt (Buctril) 4 EC 0.5–1.5 pt	6	Onion (dry bulb)	Broadleaf weeds. Soil and onion leaves should be dry before application. Waxy coating on leaves reduces chances for injury. Varieties vary in sensitivity, so use on a trial basis.
Bromoxynil 0.38–0.5	(Buctril) 2 EC 1.5–2.0 pt	6	Garlic	Broadleaf weeds. Apply after emergence but before 12 in. tall. Weeds are most susceptible up to the 4-leaf stage or 2 in. height or 1 in. wide. PHI 112 days.
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Onion (dry bulb), garlic, leek, chive, shallot	Emerged broadleaf control. Post-direct hooded application to row middles for burndown of emerged weeds. Use crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
Clethodim 0.09–0.25 0.07–0.25	(Arrow, Select) 2 EC 6–16 fl oz (Select Max) 1 EC 9–32 fl oz	1	Onion (dry bulb), garlic, shallot (dry bulb)	Annual and perennial grass control. Some labels include green onion. Consult label for use of a crop oil concentrate or nonionic surfactant. PHI 45 days.
Clethodim 0.09–0.13	(Arrow, Select) 2 EC 6–8 fl oz (Select Max) 1 EC 12–16 fl oz	1	Chive, leek	Emerged annual and perennial grasses. Consult labels rate of COC or NIS. Do not apply more than 0.5 lb a.i./A per season. Select Max is not registered in leek. PHI 14 days.
Dimethenamid-p up to 1.0	(Outlook) 6 EC up to 21 fl oz	15	Onion (dry bulb), garlic, leek, shallot (dry bulb, green)	Broadleaf and grass weeds. Apply after the 2-true-leaf stage. Apply as a single application or split application. Split application of 10–14 fl oz, followed by 7 to 10 fl oz/A with 14 days between applications. Do not exceed 21 fl oz/A per growing season. PHI 30 days.
Fluazifop 0.188	(Fusilade DX) 12 fl oz	1	Onion (dry bulb), garlic	Annual and perennial grass weeds. Do not apply more than 48 fl oz/A per season. Include a COC or NIS. PHI 45 days.
Oxyfluorfen 0.5	(Goal 2 XL) 2 EC 0.5 pt direct seeded (GoalTender) 4 EC 0.25 pt direct seeded	14	Onion (dry bulb), garlic (dry bulb)	Certain broadleaf weeds. Direct seeded only. Apply after the crop has 2 true leaves. Multiple treatments can be applied and do not exceed 0.5 lb a.i./A. Necrotic lesions, twisting, or stunting of plants can occur if applications are made during cool, wet weather or prior to development of true leaves. PHI 60 days.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Crops	Weeds Controlled/Remarks
Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Onion (dry bulb, green), garlic, leek, shallot	Grass weeds. Include a surfactant. Do not apply more than 4.5 pt/A per season. PHI 30 days.
Treflan 0.35–0.5	(Treflan) 4 EC 0.75–1.0 pt (Treflan TR-10) 3.75–5.0 lb	3	Onion (dry bulb)	Broadleaf and grass weeds. Apply at layby to the soil surface between onion rows. Remove weeds that are present. Do not apply in muck soils. PHI 60 days.

Table 4. Insecticides labeled for management of arthropod pests of garlic, leeks, and shallots. Contact: Xavier Martini, UF/IFAS North Florida Research and Education Center–Quincy.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–2.5 pt **8F**: 1–1.56 pt	24	3	**Leeks, shallots, garlic.** Three applications per year for garlic, two for all others.
	3A	**Karate** (lambda-cyhalothrin)	2.56–3.84 fl oz	24	14	Do not apply more than 30.72 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (garlic)**. Do not apply more than 15.36 fl oz per acre per season.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	12	30	Do not apply more than 38 oz per acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.	4	0	
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	**Leek, garlic, shallot.**
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Beet armyworm	1A	***Lannate LV; *SP** (methomyl)	**LV**: 1.5 pt **SP**: 0.5 lb	48	7	**Garlic only.**
	3A	**Karate** (lambda-cyhalothrin)	2.56–3.84 fl oz	24	14	Do not apply more than 30.72 fl oz per acre per season.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	2.56–3.84 fl oz	24	14	Do not apply more than 0.12 lb active ingredient (1.92 pints) per acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Remarks[2]
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	12	30	Do not apply more than 38 fl oz per acre per season.
	28	**Coragen** (chlorantraniliprole)	3.5–5.0 fl oz	4	1	No more than 4 foliar applications or 15.4 fl oz of product per acre per crop. For entire bulb vegetable group.
Caterpillars (includes cutworms and armyworms)	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Dry bulb and garlic only.** Maximum of 2 lb a.i./acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Garlic**. Maximum of 0.77 pt per acre per season.
	3A	**Karate** (lambda-cyhalothrin)	2.56–3.84 fl oz	24	14	Do not apply more than 30.72 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**
	3A	***Pounce 25 WP** (permethrin)	Garlic: 6.4–12.8 oz	12	1	**Garlic.**
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.20 fl oz	12	14	Do not apply more than 0.12 lb active ingredient (1.92 pints) per acre per season. **Onion and garlic.**
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (garlic)**. Do not apply more than 15.36 fl oz per acre per season.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	12	30	No more than 38 fl oz per season
	5	**Entrust SC** (spinosad)	3–8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For leeks, garlic, and shallots**. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Use with an adjuvant.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	1.0–2.0 lb	4	0	Apply when larvae are small for best control.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. For organic production.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Remarks[2]
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. OMRI-listed.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Intrepid 2F** (methoxyfenozide)	4–12 fl oz	4	1	Slow-acting growth regulator that only effects larvae.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	**Leek, garlic, and shallots.**
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
Fire ants	6	**Clinch** (abamectin)	**Broadcast application:** 1 lb **Per ant mound:** 5 to 7 tablespoons	4	0	Maximal annual rate: 4 lb/A/year. Only apply when ants are active and no rain is forecast for the next 6 hr.
	7A	**Extinguish** (S-methoprene)	1–1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb	12	1	**Dry bulb only.**
Flea beetles	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 3.5–7.0 fl oz **Soil**: 8.75–10.5 fl oz	12	**Foliar**: 1 **Soil**: N/A	**Garlic.** (Crop Groups 3-07A and 3-07B)
	5	**Entrust SC** (spinosad)	3–8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). For leeks, garlic, and shallots. OMRI-listed.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
***Liriomyza* Leafminers**	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Label is registered only for garlic.** Maximum of 2 lb a.i./acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Garlic**. Maximum of 0.77 pt per acre per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Remarks[2]
	3A	**Karate** (lambda-cyhalothrin)	2.56–3.84 fl oz	24	14	Do not apply more than 30.72 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, garlic.**
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 oz	12	30	No more than 38 fl oz per season.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 3.5–7.0 fl oz **Soil**: 8.75–10.5 fl oz	12	**Foliar**: 1 **Soil**: N/A	**Garlic.** (Crop Groups 3-07A and 3-07B)
	5	**Entrust SC** (spinosad)	3–8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For leeks, garlic, and shallots.** OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Use with an adjuvant.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	30	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant. Maximum of 10.25 fl oz per acre per season.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	7–10 fl oz	24	30	Maximum annual rate: 20.0 fl oz/A
	17	**Trigard** (cyromazine)	2.66 oz	12	7	Maximum of 6 applications per crop.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Do not apply more than 0.4 lb a.i. per acre of cyantraniliprole-containing products per season. Toxic to bees. Do not allow drift to blooming crops or weeds.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
Onion maggot (*Delia antiqua*)	1B	***Diazinon AG500** ***Diazinon 50W** (diazinon)	**AG500**: 2–4 qt **50W**: 4–8 lb	72	preplant	Do not make more than one soil application per year. **For leeks, garlic, and shallots.**
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–2.5 pt **8F**: 1–1.56 pt	Leeks, shallots, garlic: 24	3	**Leeks, shallots, and garlic**. Three applications per year for garlic, two for all others.
	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Label is registered only for garlic.** Maximum of 2 lb a.i./acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Garlic**. Maximum of 0.77 pt per acre per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Remarks[2]
	3A	**Karate** (lambda-cyhalothrin)	2.56–3.84 fl oz	24	14	Do not apply more than 30.72 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**
	3A	***Pounce 25 WP** (permethrin)	Onions: 6.4–19.2 oz Garlic: 6.4–12.8 oz	12	1	**Garlic**
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.20 fl oz	12	14	Do not apply more than 0.12 lb active ingredient (1.92 pints) per acre per season. **Onion and garlic.**
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (garlic).** Do not apply more than 15.36 fl oz per acre per season.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	12	30	No more than 38 fl oz per season.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
Plant bugs	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Garlic**. Maximum of 0.77 pt per acre per season.
	3A	**Karate** (lambda-cyhalothrin)	2.56–3.84 fl oz	24	14	Do not apply more than 30.72 fl oz per acre per season.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	2.56–3.84 fl oz	12	14	Do not apply more than 0.12 lb active ingredient (1.92 pints) per acre per season. **Onion and garlic.**
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (garlic).** Do not apply more than 15.36 fl oz per acre per season.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.
Stink bugs	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Garlic only. Label is registered only for garlic.** Maximum of 2 lb a.i./acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Garlic**. Maximum of 0.77 pt per acre per season.
	3A	**Karate** (lambda-cyhalothrin)	2.56–3.84 fl oz	24	14	Do not apply more than 30.72 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Pounce 25 WP** (permethrin)	Onions: 6.4–19.2 oz Garlic: 6.4–12.8 oz	12	1	**Garlic.**
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	2.56–3.84 fl oz	12	14	Do not apply more than 0.12 lb active ingredient (1.92 pints) per acre per season. **Onion and garlic.**
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.61 oz	12	0	OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (garlic).** Do not apply more than 15.36 fl oz per acre per season.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	12	30	Do not apply more than 38 fl oz per season.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 3.5–7.0 fl oz **Soil**: 8.75–10.5 fl oz	12	**Foliar**: 1 **Soil**: N/A	**Garlic.** (Crop Groups 3-07A and 3-07B)
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Thrips (check label for species controlled)	1A	***Lannate LV; *SP** (methomyl)	**LV**: 1.5–3.0 pt **SP**: 0.5–1.0 lb	48	7	
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–2.5 pt **8F**: 1–1.56 pt	Leeks, shallots, garlic: 24	3	**Leeks, shallots, and garlic**. Three applications per year for garlic, two for all others.
	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Garlic only. Label is registered only for garlic.** Maximum of 2 lb a.i./acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Garlic**. Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**
	3A	***Pounce 25 WP** (permethrin)	Onions: 6.4–19.2 oz Garlic: 6.4–12.8 oz	12	1	**Bulb onions and garlic.**
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	2.56–3.84 fl oz	12	14	Do not apply more than 0.12 lb active ingredient (1.92 pints) per acre per season. **Onion and garlic.**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (garlic).** Do not apply more than 15.36 fl oz per acre per season.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	12	30	No more than 38 fl oz per season.
	4A	**Admire Pro** (imidacloprid)	14.0 fl oz	12	21	Apply no more than 14 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	5.0–8.0 oz	12	7	No more than 4 applications or 32 oz of product per acre per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 3.5–7.0 fl oz **Soil**: 8.75–10.5 fl oz	12	**Foliar**: 1 **Soil**: N/A	**Garlic** (Crop Groups 3-07A and 3-07B)
	5	**Entrust SC** (spinosad)	3–8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For leeks, garlic, and shallots.** OMRI-listed.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Use with an adjuvant.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	30	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant. Maximum of 10.25 fl oz per acre per season.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	10 fl oz	12	30	Maximum annual rate: 20.0 fl oz/A
	7C	**Knack IGR** (pyriproxyfen)	8 fl oz	12	3	Maximum of 2 applications, at least 14 days apart. No activity against adult insects.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Label contains pollinator protection warnings.
	28	**Verimark** (cyantraniliprole)	**Drip:** 6.75–10 fl oz **In-furrow at planting**:10–13.5 fl oz	4	1	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.	4	0	
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	**Leek, garlic, and shallot.**
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	1.5–3.0 qt	4	0	Begin as soon as thrips are seen.
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/Acre	REI (Hours)	Days to Harvest	Remarks[2]
Wireworms	1B	***Diazinon AG500** ***Diazinon 50W** (diazinon)	**AG500**: 2–4 qt **50W**: 4–8 lb	72	preplant	Do not make more than one soil application per year. **For leeks, garlic, and shallots.**

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2, March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.
[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.
*** Restricted use insecticide.**

Table 5. Insecticides registered for managing arthropod pests of onions. Contact: Xavier Martini, UF/IFAS North Florida Research and Education Center–Quincy.

Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–2.5 pt **8F**: 1.5 pt	12	3	**Onions, bulb and green.** Two applications per year. Suppression only.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (onions and garlic), not green onions**. Do not apply more than 15.36 fl oz per acre per season. Suppression only.
	-	**Azaguard** (azadirachtin)	10–16 fl oz	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana*)	0.5–2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	Onion (bulb and green), and shallot.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	4	0	OMRI-listed.
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Caterpillars (includes cutworms and armyworms)	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Dry bulb and garlic only.** Maximum of 2 lb a.i./acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Pounce 25 WP** (permethrin)	6.4–19.2 oz	12	1	**Bulb onions**. Maximum 1 lb a.i./acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (onions), not green onions.** Do not apply more than 15.36 fl oz per acre per season.
	5	**Entrust SC** (spinosad)	3–6 fl oz	4	1	No more than 5 applications per year and no more than 29 fl oz product. **For onions, bulb and green.** OMRI-listed.

Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	5	**Radiant SC** (spinetoram)	5–10 fl oz	4	1	Use with an adjuvant. No more than 30 fl oz per acre per year.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	1.0–2.0 lb	4	0	Apply when larvae are small for best control.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. For organic production.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. OMRI-listed.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Intrepid 2F** (methoxyfenozide)	4–8 fl oz	4	1	**Green onion subgroup only**. Do not make more than 6 applications per year and do not apply more than 64 fl oz per acre per year.
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	**Beet armyworm only.** No more than 4 foliar applications or 15.4 fl oz of product per acre per crop.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	4	0	OMRI-listed.
Fire ants	7A	**Extinguish** (S-methoprene)	1–1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb	12	1	**Dry bulb only.**

Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Flea beetles	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 3.5–7.0 fl oz	12	**Foliar**: 1	**Bulb and green onions (Crop Groups 3-07A and 3-07B).** Do not apply more than 10.5 fl oz per acre per season.
	5	**Entrust SC** (spinosad)	3–6 fl oz	4	1	No more than 5 applications per year and no more than 29 fl oz product. **For onions, bulb and green.** OMRI-listed.
Leafminers	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Dry bulb only.** Maximum of 2 lb a.i./ acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Pounce 25 WP** (permethrin)	Onions: 6.4–19.2 oz	12	1	**Bulb onions.** Maximum 1 lb a.i./acre per season.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 5.25–7.0 fl oz **Soil**: 8.75–10.5 fl oz	12	**Foliar**: 1 **Soil**: N/A	**Bulb and green onions (Crop Groups 3-07A and 3-07B).** Do not apply more than 10.5 fl oz per acre per season.
	5	**Entrust SC** (spinosad)	3–6 fl oz	4	1	No more than 5 applications per year and no more than 29 fl oz product. **For onions, bulb and green.** OMRI-listed.
	5	**Radiant SC** (spinetoram)	6–10 fl oz	4	1	Use with an adjuvant. No more than 30 fl oz per acre per year.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	30	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant. Maximum of 10.25 fl oz per acre per season.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	Maximum of 6 applications per crop.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Do not apply more than 0.4 lb a.i. per acre of cyantraniliprole-containing products per season. Toxic to bees. Do not allow drift to blooming crops or weeds.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
Onion maggot	1B	***Diazinon AG500** ***Diazinon 50W** (diazinon)	**AG500**: 2–4 qt **50W**: 4–8 lb	72	preplant	Do not make more than one soil application per year. **For onions, bulb and green.**
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–2.5 pt **8F**: 1.5 pt	12	3	**Onions, bulb and green.** No more than two applications per year.
	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Dry bulb only.** Maximum of 2 lb a.i./ acre per season.

Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.28 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Pounce 25 WP** (permethrin)	6.4–19.2 oz	12	1	**Bulb onions.** Maximum 1 lb a.i./acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (onions and garlic), not green onions.** Do not apply more than 15.36 fl oz per acre per season.
	-	**Neemix 4.5 EC** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.
Plant bugs	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (onions and garlic), not green onions.** Do not apply more than 15.36 fl oz per acre per season.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.
Stink bugs	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Dry bulb only.** Maximum of 2 lb a.i./acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Pounce 25 WP** (permethrin)	6.4–19.2 oz	12	1	**Bulb onions.** Maximum 1 lb a.i./acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (onions), not green onions.** Do not apply more than 15.36 fl oz per acre per season.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 3.5–7.0 fl oz	12	1	**Bulb and green onions (Crop Groups 3-07A and 3-07B).** Do not apply more than 10.5 fl oz per acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Thrips (check label for species controlled)	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–2 pt **8F**: 1.56 pt	12	3	**Onions, bulb and green.** No more than two applications per year.
	3A	***Ambush 25W** (permethrin)	6.4–19.2 oz	12	1	**Dry bulb only.** Maximum of 2 lb a.i./acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77–1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.

Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Mustang** (zeta-cypermethrin)	3.2–4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Pounce 25 WP** (permethrin)	9.6–19.2 oz	12	1	**Bulb onions.** Maximum 1 lb a.i./acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	14	**For bulb crops only (onions and garlic), not green onions.** Do not apply more than 15.36 fl oz per acre per season.
	4A	**Admire Pro** (imidacloprid)	14.0 fl oz	12	21	Apply no more than 14 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	5.0–8.0 oz	12	7	No more than 4 applications or 32 oz of product per acre per season.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 5.25–7.0 fl oz **Soil**: 8.75–10.5 fl oz	12	**Foliar**: 1 **Soil**: N/A	**Bulb and green onions (Crop Groups 3-07A and 3-07B).** Do not apply more than 10.5 fl oz per acre per season.
	5	**Entrust SC** (spinosad)	3–8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For onions, bulb and green.** OMRI-listed.
	5	**Radiant SC** (spinetoram)	6–10 fl oz	4	1	Use with an adjuvant. No more than 30 fl oz per acre per year.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	30	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant. Maximum of 10.25 fl oz per acre per season.
	7C	**Knack IGR** (pyriproxyfen)	8 fl oz	12	3	Maximum of 2 applications, at least 14 days apart. No activity against adult insects. **Onion (dry bulb only).**
	23	**Movento** (spirotetramat)	5 fl oz	24	3	No more than 10 fl oz per season.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Do not apply more than 0.4 lb a.i. per acre of cyazypyr- or cyantraniliprole-containing products per season. Toxic to bees. Rotate with other effective modes of action. Begin making applications when populations are low. If populations are above threshold, use an effective knockdown product prior to applying Exirel.
	28	**Verimark** (cyantraniliprole)	**Drip chemigation**: 6.75–10 fl oz	4	1	Do not apply more than 2 drip chemigation applications. Begin drip applications when populations first appear. Rotate with other effective modes of action.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.

Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**BotaniGard ES** (*Beauveria bassiana*)	0.5–2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	1.5–3.0 qt	4	0	Begin as soon as thrips are seen.
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Wireworms	1B	***Diazinon AG500** ***Diazinon 50W** (diazinon)	**AG500**: 3–4 qt **50W**: 4–8 lb	72	preplant	Do not make more than one soil application per year. **For onions, bulb and green.**

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2, March 2022 Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 6. Onion fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Pamela Roberts, UF/IFAS Southwest Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Bacterial blight (*Xanthomonas axonopodis* pv. *allii*)	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Champ DP, Champ F2 FL, Champ WG, Cuprofix Ultra 40D, Cuproxat, Cueva, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-hydroxide, Master Cop, Nordox, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop HB	**SEE INDIVIDUAL LABEL**		0	Varies by product from 4 hr to 2 days	Frequent use of copper fungicides may cause foliar burn.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	2.25 lb	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
(Suppression only)	21	**Actigard 50WG** (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days of transplanting. Suppression only.
(Suppression only)	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	84 oz	3	0.5	See label.
Black mold (*Aspergillus niger*)	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application.
Botrytis leaf blight (*Botrytis squamosa*)	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	2.25 lb	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	**SEE INDIVIDUAL LABEL**		7	1	Do not apply to exposed bulbs.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN	**SEE INDIVIDUAL LABEL**		Dry bulb: 7 Green: 14	1	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	**SEE INDIVIDUAL LABEL**		7	1	
(Suppression only)	3	(propiconazole) **Many brands available:** Amtide Propiconazole 41.8% EC, Bumper 41.8 EC, Bumper ES, Fitness, Propicure, Propimax EC, Propistar EC, Shar-Shield PPZ, Tide Propiconazole EC, Tilt	**SEE INDIVIDUAL LABEL**		See label	0.5	
	3 + 7	**Luna Experience** (fluopyram + tebuconazole)	12.8 fl oz	25.6 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	See label		Dry bulb: 7 Green: 14/21	2	
	7	**Endura** (boscalid)	6.8 oz	41 oz	7	0.5	Alternate applications with a different fungicide group.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	See label.
	7 + 3	**Aprovia Top** (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. Do not exceed 4 applications per year.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 applications per year.
	7 + 11	**Merivon Xemium** (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	7	12	
	9	**Scala SC** (pyrimethanil)	18 fl oz	54 fl oz	7	0.5	Do not make more than 2 consecutive applications.
	9	**Vangard WG** (cyprodinil)	10 oz	28 oz	7	0.5	Do not make more than 2 consecutive applications.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	See label	Green: 14 Dry bulb: 7	0.5	Do not make more than 2 applications before alternating with a different fungicide group.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last applications.
(Suppression only)	11	**Cabrio EG** (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 applications/crop.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Quadris** (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank mix with COC, MSO, or silicon adjuvant.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non-Qol (Group 11) mode of action.
	11 + 3	**Quilt Xcel** (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb:14 Green: 0	0.5	Make only 1 application before alternating to a non-group 11 fungicide.
	11 + 7	**Pristine** (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 appl./crop.
	14	**Botran 5F** (DCNA dicloran)	2 to 3.2 lb	See label	14	See label	See label.
	22 + M5	**Zing!** (zoxamide + chlorothalonil)	30 fl oz	7.5 qt	7	0.5	Do not make more than 8 applications per year.
	29	**Omega 500F** (fluazinam)	1 pt	6 pt	7	2	
Botrytis neck rot (*Botrytis allii*)	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	**SEE INDIVIDUAL LABEL**		7	1	Do not apply to exposed bulbs.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN	**SEE INDIVIDUAL LABEL**		Dry bulb: 7 Green: 14	1	
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	**SEE INDIVIDUAL LABEL**		7	1	
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7 + 3	**Aprovia Top** (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. Do not exceed 4 applications per year.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl/oz	34.2 fl oz	7	12	
	9	**Scala SC** (pyrimethanil)	18 fl oz	54 fl oz	7	0.5	Do not make more than 2 consecutive applications.
(Suppression only)	9	**Vangard WG** (cyprodinil)	10 oz	28 oz	7	0.5	Do not make more than 2 consecutive applications.
(Suppression only)	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application.
(Suppression only)	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank mix with COC, MSO, or silicon adjuvant.
	11 + 7	**Pristine** (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 applications/crop.
	14	**Botran 5F** (DCNA dicloran)	3.5 lb	See label	14	See label	
	29	**Omega 500F** (fluazinam)	1 pt	6 pt	7	2	
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	7	0.5	Do not make more than 2 sequential applications, and do not exceed more than 33% of all fungicide applications with Orondis.
Cercospora leaf spot (*Cercospora duddiae*)	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.
Cladosporium leaf blotch (*Cladosporium allii*)	3 + 7 + 11	**Trivapro** (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	12 hours	Alternate applications with a different fungicide group not in 7 or 11.
	7 + 3	**Aprovia Top** (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. Do not exceed 4 applications per year.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl/oz	34.2 fl oz	7	12	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	See label	Green: 14 Dry bulb: 7	0.5	Do not make more than 2 applications before alternating with a different fungicide group.
	11	**Quadris** (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank-mix with COC, MSO, or silicon adjuvant.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.
	11 + 3	**Quilt Xcel** (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb: 14 Green: 0	0.5	Make only 1 application before alternating to a non-group 11 fungicide.
Damping-off	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABEL**		7	1	Do not apply to exposed bulbs.
	2	(iprodione) **Many brands available:** Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	**SEE INDIVIDUAL LABEL**		7	1	
	4	**Ridomil Gold** **Subdue Maxx** (mefenoxam)					See individual label.
	4 + 11	**Uniform** (mefenoxam, azoxystrobin)	0.34 fl oz/1000 ft of row				See label.
	12	**Cannonball WG** (fludioxonil)	7 oz	32 oz	7	0.5	
	12	**Maxim 4FS** (fludioxonil)	0.16 fl oz/100 lb seed				Seed treatment only.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Downy mildew (*Peronospora destructor*)	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABEL**		0	Varies from 4 hr to 2 days.	Frequent use of copper fungicides may cause foliar burn.
	M1 + M2	**Top Cop with sulfur** (basic copper sulfate + sulfur)	2–3 qt	See label	0	1	Do not use during hot weather or within 4 weeks of an oil application.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	2.25 lb	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABEL**		7	1	Do not apply to exposed bulbs.
(Suppression only)	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN	**SEE INDIVIDUAL LABEL**		Green: 14 Dry bulb: 7	1	
	4 + M1	**Ridomil Gold/Copper** (mefenoxam + copper hydroxide)	2 lb		Green: 7 Dry bulb: 10	2	Maximum 0.4 lb/A a.i. of metalaxyl or mefenoxam.
	4 + M3	**Ridomil Gold MZ WG** (mefenoxam + mancozeb)	2.5 lb		Dry bulb: 7	2	
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	See label		Dry bulb: 7 Green: 14/21	2	
	11	**Cabrio EG** (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 applications/crop.
	11	**Quadris** (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11	**Reason 500SC** (fenamidone)	5.5 fl oz	22 fl oz	7	0.5	Alternate applications with a different fungicide group.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with a different fungicide group. Make no more than 3 applications/crop. Do not tank-mix with COC, MSO, or silicon adjuvant.
	11 + 3	**Quilt Xcel** (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb: 14 Green: 0	0.5	Make only 1 application before alternating to a non-group 11 fungicide.
(Suppression only)	11 + 7	**Pristine** (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 appl./crop.
(Suppression only)	21	**Actigard 50WG** (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days transplanting.
	21	**Ranman** (cyazofamid)	3 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides of dissimilar modes of action. Do not make more than 3 sequential applications.
	22 + M5	**Zing!** (zoxamide + chlorothalonil)	30 fl oz	7.5 qt	7	0.5	Do not make more than 8 applications per year.
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	84 oz	3	0.5	
	29	**Omega 500F** (fluazinam)	1 pt	6 pt	7	2	
	33	**Aliette WDG** **Linebacker WDG** (fosetyl-Al)	3 lb	7 appl.	See label	See label	Do not tank mix with copper fungicides, adjuvants or foliar fertilizers.
	33	(mono- and dipotassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi-Phite, K-Phite 7LP, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart, Reveille	**SEE INDIVIDUAL LABEL**		0	4 hr	See label for details.
	40	**Forum** (dimethomorph)	6 oz	30 oz	0	0.5	Must be applied in a tank mix with another fungicide active against downy mildew. Do not make more than 2 sequential applications.
	40	**Revus** (mandipropamid)	8 fl oz	Dry: 32 fl oz Green: 24 fl oz	7	4 hr	Make no more than 2 consecutive applications before switching to a non-group 40 fungicide. A silicon-based adjuvant must be added at recommended rates.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	40 + 45	**Zampro** (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	0	0.5	See label.
	43	**Presidio** (fluopicolide)	4 fl oz		2	0.5	Do not make more than 4 applications of Presidio per season.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	7	0.5	Do not make more than 2 sequential applications and do not exceed more than 33% of all fungicide applications with Orondis.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8 fl oz	Dry: 32 fl oz Green: 24 fl oz	7	4 hr	Do not make more than 2 sequential applications and do not exceed more than 33% of all fungicide applications with Orondis.
Iris Yellow Spot (Iris yellow spot virus) (Suppression only)	21	**Actigard 50WG** (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days transplanting. Suppression only.
Powdery mildew	M2	(sulfur) **Many brands available:** Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABEL**		0	1	Do not use during hot weather or within 4 weeks of an oil application.
	3 + 7 + 11	**Trivapro** (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	12 hours	Alternate applications with a different fungicide group not in 7 or 11.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 + 3	**Aprovia Top** (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. Do not exceed 4 applications per year.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	See label	Green: 14 Dry bulb: 7	0.5	Do not make more than 2 applications before alternating with a different fungicide group.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 appl./crop.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Purple blotch (*Alternaria porri*)	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-hydroxide, Nordox, Nordox 75WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABEL**		0	Varies from 4 hr to 2 days.	Frequent use of copper fungicides may cause foliar burn.
	M1 + M2	**Top Cop with sulfur** (basic copper sulfate + sulfur)	3 qt	See label	0	1	Do not use during hot weather or within 4 weeks of an oil application.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	2.25 lb	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	**SEE INDIVIDUAL LABEL**		7	1	Do not apply to exposed bulbs.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate Zn	**SEE INDIVIDUAL LABEL**		Green: 14 Dry bulb: 7	1	
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	**SEE INDIVIDUAL LABEL**		7	1	
	3	(propiconazole) **Many brands available:** Amtide Propiconazole 41.8% EC, Bumper 41.8 EC, Bumper ES, Fitness, Propimax EC, Propistar EC, Shar-Shield PPZ, Tide Propionazole EC, Tilt	**SEE INDIVIDUAL LABEL**		See label	0.5	
	3	(tebuconazole) **Many brands available:** Monsoon, Onset 3.6L, Orius 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6 L, Tebuzol 3.6F, Toledo	**SEE INDIVIDUAL LABEL**		7	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3 + M5	**Muscle ADV** (tebuconazole + chlorothalonil)	1.6 pt	3.2 pt	7	0.5	Apply in a protective fungicide schedule.
	3 + 7	**Luna Experience** (fluopyram + tebuconazole)	12.8 fl oz	25.6 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	3 + 7 + 11	**Trivapro** (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	12 hours	Alternate applications with a different fungicide group not in 7 or 11.
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	See label		Dry bulb: 7 Green: 14/21	2	
	7	**Endura** (boscalid)	6.8 oz	41 oz	7	0.5	Alternate applications with a different fungicide group.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	See label.
	7 + 3	**Aprovia Top** (difenoconazole + benzovindiflupyr)	10.5 fl oz	54.0 fl oz	7	0.5	Adjuvant recommended. Do not exceed 4 applications per year.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 applications per year.
	7 + 11	**Merivon Xemium** (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl/oz	34.2 fl oz	7	12	
	9	**Scala SC** (pyrimethanil)	18 fl oz	54 fl oz	7	0.5	Do not make more than 2 consecutive applications.
	9	**Vangard WG** (cyprodinil)	10 oz	28 oz	7	0.5	Do not make more than 2 consecutive applications.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	See label	Green: 14 Dry bulb: 7	0.5	Do not make more than 2 applications before alternating with a different fungicide group.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 applications/crop.
	11	**Quadris** (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11	**Reason 500SC** (fenamidone)	5.5 fl oz	22 fl oz	7	0.5	Alternate applications with a different fungicide group.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank-mix with COC, MSO, or silicon adjuvant.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.
	11 + 3	**Quilt Xcel** (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb: 14 Green: 0	0.5	Make only 1 application before alternating to a non-group 11 fungicide.
	11 + 7	**Pristine** (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 appl./crop.
	22 + M5	**Zing!** (zoxamide + chlorothalonil)	30 fl oz	7.5 qt	7	0.5	Do not make more than 8 applications per year.
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	84 oz	3	0.5	
	29	**Omega 500F** (fluazinam)	1 pt	6 pt	7	2	
(Suppression only)	33	**Aliette WDG** **Linebacker WDG** (fosetyl-Al)	3 lb	7 appl.	See label	See label	Do not tank mix with copper fungicides, adjuvants, or foliar fertilizers.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	7	0.5	Do not make more than 2 sequential applications, and do not exceed more than 33% of all fungicide applications with Orondis.
Pythium damping-off	4	(mefenoxam) **Many brands available**: Apron XL, Ridomil Gold EC, Ridomil Gold SL, Ultra Flourish	**SEE INDIVIDUAL LABEL**		N/A	2	
	4	(metalaxyl) **Many brands available:** Allegiance, Aquire, MetaStar 2E, Sebring 2.65 ST, Sebring 318 FS, Sebring 480 FS					
	11 + 4	**Uniform** (azoxystrobin + mefenoxam)	See label				
Rhizoctonia damping off	11	**Dynasty** (azoxystrobin)	0.38 fl oz/100 lb seed	See label	See label	4 hr	Seed treatment only.
	11	**Quadris** (azoxystrobin)	0.8 fl oz/1000 row feet	See label	0	4 hr	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11 + 4	**Uniform** (azoxystrobin + mefenoxam)	See label				
Rust (*Puccinia allii*)	3	(tebuconazole) **Many brands available:** Monsoon, Onset 3.6L, Orius 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6 L, Tebuzol 3.6F, Toledo	**SEE INDIVIDUAL LABEL**		7	0.5	
	3 + M5	**Muscle ADV** (tebuconazole + chlorothalonil)	1.6 pt	3.2 pt	7	0.5	Apply in a protective fungicide schedule.
	3 + 7 + 11	**Trivapro** (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	12 hours	Alternate applications with a different fungicide group not in 7 or 11.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	See label	Green: 14 Dry bulb: 7	0.5	Do not make more than 2 applications before alternating with a different fungicide group.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 appl./crop.
	11	**Quadris** (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11 + 3	**Quilt Xcel** (azoxystrobin + propiconazole)	Dry bulb: 21 fl oz Green: 26 fl oz	56 fl oz	Dry bulb: 14 Green: 0	0.5	Make only 1 application before alternating to a non-group 11 fungicide.
Seedling blight	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	**SEE INDIVIDUAL LABEL**		7	1	Do not apply to exposed bulbs.
	11	**Dynasty** (azoxystrobin)	0.38 fl oz/100 lb seed	See label	See label	4 hr	
	12	**Maxim 4FS** **Spirato 480 FS** (fludioxonil)	0.16 fl oz/100 lb seed	-	-	0.5	
	14	**Botran 5F** (DCNA dicloran)	3.5 lb	See label	14	See label	
Stemphylium blight (*Stemphylium vesicarium*)	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	**SEE INDIVIDUAL LABEL**		7	1	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3 + 7 + 11	**Trivapro** (propiconazole + benzovindiflupyr + azoxystrobin)	27.7 fl oz	55.4 fl oz per year	Dry bulb: 7 Green: 14	12 hours	Alternate applications with a different fungicide group not in 7 or 11.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	See label	Green: 14 Dry bulb: 7	0.5	Do not make more than 2 applications before alternating with a different fungicide group.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non-QoI (Group 11) mode of action.
	11 + 7	**Pristine** (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 appl./crop.
	29	**Omega 500F** (fluazinam)	1 pt	6 pt	7	1	Begin sprays at first development and continue on 7–14 day schedule.
White rot (*Sclerotium cepivorum*)	1	(thiophanate-methyl) **Many brands available:** Incognito 4.5 F, NuFarm T-Methyl 4.5 F, NuFarm T-Methyl 70 WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin M 70 WDG, Topsin M 70 WP, Topsin M WSB	**SEE INDIVIDUAL LABEL**			3	
	3	(tebuconazole) **Many brands available:** Onset 3.6L, Orius 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6 L, Tebuzol 3.6F, Toledo	**SEE INDIVIDUAL LABEL**		7	0.5	
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	Spray into empty furrow at time of planting.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 appl./crop. Do not tank mix with COC, MSO, or silicon adjuvant.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	12	**Cannonball WG** (fludioxonil)	7 oz	32 oz	7	0.5	
	12	**Maxim 4FS** (fludioxonil)	0.16 fl oz/100 lb seed	-	-	0.5	
	14	**Botran 5F** (DCNA dicloran)	3.5 lb	See label	14	0.5	

[1] FRAC code (fungicide group): Number (1 through 45) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).
[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 7. Nonfumigant nematicides for onion and alliums.

Product	Application Directions
Velum (a.i. fluopyram)	Apply 6.5–6.8 fl oz/acre either (1) preplant banded or broadcast spray directed to the soil and incorporated into the planting bed or (2) via chemigation into root zone through low-pressure drip, trickle, microsprinkler, or equivalent irrigation. Minimum 14-day interval between applications. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation or method of application (soil or foliar). Do not apply within 30 days of harvest.

Table 8. Fumigant nematicides for onion and alliums.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/ chisel spaced 12" apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60[2,3]	19 to 31.5 gal	57 to 90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
KPam HL	60 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions.

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other use and rate-modifying recommendations and restrictions.
[3] Higher application rates are possible in the presence of cyst-forming nematodes.
Rates are believed to be correct for products named and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS732

doi.org/10.32473/edis-cv130-2022

Chapter 13. Pepper Production[1]

Craig Frey, Eugene J. McAvoy, Johan Desaeger, Gary E. Vallad, and Nathan S. Boyd[2]

Botany and Planting

Bell pepper—*Capsicum annuum*, Solanaceae

Habanero and Bird's-eye pepper—*Capsicum chinense*

Cultivars

Sweet Bell

Antebellum. Green, sweet pepper with earlier setting patterns and more concentrated fruit set, deep-green color, and blocky shape. R to Xcv 1–10, TMV: 0: IR TSWV.

Aristotle. Green-to-red blocky bell with great yield potential. Extra large, thick walled. Very vigorous plant that produces dark-green, anthocyaninless fruit. R to Xcv 1–3, PVY, Tobamo Po (R).

Autry. Uniformly blocky fruit that ripen red. Fruit set is concentrated, with high first-pick yields. R to Xcv 1–10, TMO and IR to TSWV.

Blitz. Early-maturing, extra-large, blocky, green-to-red bell with great yield potential at first harvest. Fruit are high quality with thick walls and a uniformly blocky shape. HR: TMV: 0 / Xcv: 0–5, 7–9 and IR: TEV.

Boca. Fruit is very dark green with thick firm walls. TSWV in addition to bacterial leaf spot resistance. R to Xcv 1–10.

Green Machine. Main-season hybrid bell pepper for the spring and fall season with robust plant that produces dark green, deep blocky, anthocyaninless fruits turning red at maturity. HR to TMV race 0 and IR to Xcv 1–10 and TSWV.

Nitro S10®. A mid-maturing hybrid suited for place pack. It is adapted to fall and spring in the Southeast. Fruit have good size uniformity, are smooth, firm, and glossy dark green, and mature to red color. R to TMV 0 and IR to Pc, TSWV, and Xcv 0–10.

Placepack. Main-season, high-quality, dark-green pepper with high percentage of 4-lobes. Plants provide good cover. R to Xcv 1–10, PVY 0–1, Tm 0 and IR to TEV.

Provider. Dark-green fruit with plant structure and fruit set making it ideal for extended harvest. R to Xcv 1–10, PVY 0–1, Tm 0 and IR to TEV.

PS 09979325. Main-season hybrid that develops a mid-sized plant that produces green, maturing-to-red fruit

1. This document is HS732. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Craig Frey, county Extension director and Extension agent II, UF/IFAS Extension Hendry County; Eugene J. McAvoy, Extension agent IV emeritus, UF/IFAS Southwest Florida REC; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; Gary E. Vallad, professor, Plant Pathology Department, UF/IFAS Gulf Coast REC; and Nathan S. Boyd, professor, Horticultural Sciences Department, UF/IFAS Gulf Coast REC; UF/IFAS Extension, Gainesville, FL 32611.

targeted to the southeastern United States. The plants produce a high, concentrated set of firm, dark-green, smooth, blocky fruit 74 days after transplant. The hybrid is resistant to Tobamo Po and bacterial leaf spot races 0 to 10 (X10R).

PS 9928302. High resistance to bacterial spot races 1–5 (X5R) and combines a large, robust plant with large, dark-green to firm-red fruits. In trials, 8302 has been very adaptable with good size, shape, uniformity, and color. It is anthocyaninless. Xcv 1–5, Tm Po (HR).

Regulator. Widely adapted. Strong plant with good cover. Produces a high percentage of uniform, four-lobed fruit. R to Xcv 1–10, Tm 0 and IR to TSWV 0.

Seedway 48. Medium plant size with large to jumbo, uniform, and dark-green fruit. R to Xcv 1–10.

Shogun S10®. Extra-large, dark-green fruit with high yield potential. Adapted to late fall, winter, and spring in the Southeast. R to TMV 0 and IR to TSWV, Xcv 1–10.

SV3255PB. Main season variety with blocky green-to-red fruit. IR: Xcv 0–10.

Standout. Uniformly shaped, extra-large to jumbo-sized dark, glossy fruit.

Vanguard. Medium plant with good foliage. Fruit are dark green, blocky, 4-lobed, and extra large with thick firm walls. Early maturity with concentrated harvest. R to Xcv 1–5, PepMo and ToM.

Sweet Peppers

Boris. Sweet banana type with light-yellow to red fruit. R to TSWV.

Lemon Delite, Orange Delite, Ruby Delite. Series is a large-fruited snack pepper variety with very early maturity and hot set potential. R to TMV 0 and Xcv 0–3, 7,8.

Natasha. Sweet banana with a vigorous plant. Light-yellow to red fruit. R to Xcv 1–3.

Sopron. Sweet banana type with light-yellow to red fruit. R to Xcv 1–3.

Cubanelle

Aruba. Early-maturing, erect plant, 3–4 lobed, elongated fruit, matures from a pale lime green to a bright red.

Bimini. Thick-walled, heavy fruit with good setting ability and excellent flavor. Performs well in both fall and spring seasons. T to Xcv 1–10.

Granada. Good canopy provides protection against sun scald, well-adapted to the Southeast. Heavy yields of sweet, thick-walled Cubanelle peppers. Peppers turn from light green to red at maturity. R to Xcv 0–3, 7, 8.

Key West. Long, lime-green fruit that matures to red. R to Xcv 1–3.

Hot Ancho Poblano

Hitman. Dark green and glossy open-field fruit with high percentage of two-lobed fruit. Medium-early maturity. R to Tm 0.

Massivo. Mostly two-lobed dark-green fruit. R to TMV.

Hot Cayenne

Arapaho. Cayenne type with early maturity on a medium-sized plant. Produces long (8–9 inch), medium-high pungent fruit with great flavor and aroma.

Iberia. Long hot type similar to Mesilla but longer and slightly hotter. R to TMV.

Mesilla. Long hot type produces very long (9–11 by 1.5 inches) fruit that can be used green or red. Pods grow pendant from a large plant, maturing at mid-season. R to Tobamo Po and PVY, and IR to TEV.

Hot Jalapeño

Baluarte. Large, thick-walled fruit, with low cracking. R to Xcv 1–3.

Compadre. Medium-to-late fruiting. Vigorous plant with good tolerance to extreme temperatures. Continuous picking. Uniform, smooth, large fruit. No purpling. R to PVY, TM and Xcv 2, 5.

Everman. Shiny and uniform fruit with excellent weight and shelf life and no cracking. Open plant with good regrowth and continuous set during the cycle. R to Xcv 1–3.

Jedi (Jaguar). Vigorous plant with jumbo fruit. R to Xcv 1–3.

Lexus. Concentrated early-season fruit set. Glossy dark-green fruit. HR to Xcv 1–3.

Mixteco. Early-maturing, heavy and thick-walled fruit with deep-green color. Strong plant with good regrowth that brings high yield potential. R to Tm 0 and IR to Xcv 1–3.

Orizaba. Large, strong fruit with excellent leaf cover. Spicy with little cracking. R to Xcv 1–3.

PS 11435807. Vigorous medium plant with concentrated fruit set. Smooth dark-green fruit. R to PVY, TE. Intermediate resistance to root-knot nematode.

PS 11435810. Vigorous tall plant with pungent, dark-green, smooth fruit. R to root-knot nematode, *Phytophthora capsici*, PVY, TE.

Other Hot Peppers

Altiplano. Vigorous serrano pepper with uniform and glossy green fruit.

Balada. Finger hot Asian-type pepper, fruit maturing from green to red, fruit slightly curved, tapers to point, highly pungent.

Camino Real. Serrano type, medium maturity, large green-fruit size. R to PVY and IR to TEV.

Canario Real. A main-season, hot banana pepper with large, heavy fruit and vigorous plant habit.

Charger. Anaheim type with smooth, flat, thick-walled fruit that is mildly hot. IR to TSWV.

Devil Serrano. Early, large, dark-green glossy fruit. Semi-indeterminate bush. HR to TMV, PVY. IR to TEV.

Don Picoso. Dark-green serrano type with thick wall fruit.

Flaming Flare. Widely adapted Fresno pepper with 4-inch-long, thin-walled fruit with a sweet and mildly hot flavor. R to TMV.

Fresno 3429. Vigorous medium-to-tall plant. 75 days to maturity. Thick, firm wall, good shipper. Deep red at maturity.

Habanero. Habanero type, ready for harvest 90–100 days from transplant, extremely pungent, both fresh and processing markets. The wrinkled fruit taper to a point and measure approximately 2 by 1 inches The thin flesh is light-green to orange-pink at full maturity.

Inferno. This Hungarian hot wax hybrid produces high yields of uniform fruit. The thick-walled pods mature from yellow to red and are pendant, large, smooth, tapered, and well-suited for fresh market and pickling.

Lone Ranger. Serrano pepper variety with excellent plant cover, good heat setting, large size that averages between 4 and 4.5 inches, and thick walls for great shelf life. R to Xcv 0-3, 7, 8.

Megalodon. Large, habanero-type pepper with compact growth habit. Fruit green to orange to red.

Pathfinder. Serrano pepper with excellent plant and foliar cover, with an average fruit length of 4.5 to 5 inches. Dark-green fruit with thick walls are suitable for the export market. R to Xcv 0-3, 7, 8.

Rio de Oro. Very large Santa Fe type with wide shoulders. Matures from golden yellow to red.

Rio Tesoro. Hybrid yellow Caribe pepper. 3.5”×2” fruit.

Super Habanero. Bright-red fruit with good shelf life. Medium-to-high plant vigor with good canopy coverage.

Bird's-Eye Pepper—Strain 3

Table 13.1. Planting information for pepper.

Planting Dates	Traditional	Bird's Eye
North Florida	July–Aug; Feb–Mar	Aug; Feb–Mar
Central Florida	Aug–Sept; Jan–Mar	Aug–Sept; Jan–Mar
South Florida	Aug–Feb	Aug–Feb
Planting Information		
Distance between rows (in)	36–48 60–72	36–48
Number of rows/bed	1–2	1
Distance between rows/bed	15–18	10–24
Distance between plants (in)	9–15	0.5–0.75
Seed per acre in transplant (lb)	0.25–0.5	0.25–0.5
Days to maturity from transplant	65–75	
Plant population (acre)	14,520–19,400	17,500

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension county offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 13.2. Herbicides approved for managing weeds in peppers. Contact: Nathan S. Boyd, UF/IFAS Gulf Coast Research and Education Center.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		*****PREPLANT/PREEMERGENCE *****	
Bensulide 5.0–6.0	(Prefar) 4 E 5–6 qt	8	Broadleaves and grasses. Incorporate mechanically 1–2 inches deep or with irrigation 2–4 inches deep.
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds up to 4 inches tall or rosettes less than 3 inches across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pretransplant interval.
Clomazone 0.25–1	(Command) 3ME 0.67 to 2.67 pt	15	Annual broadleaves and grasses. Do not use on banana peppers. Place the roots of transplanted peppers below the chemical barrier.
Flumioxazin up to 0.128	(Chateau) SW up to 4 oz	14	Annual broadleaves and grasses. Apply to row middles of raised plastic-mulched beds that are at least 4 inches higher than the treated row middles and with a 24-inch bed width. Do not apply after transplant. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Tank-mix with a burndown herbicide to control emerged weeds. 0-day pretransplant interval.
Fomesafen 0.25–0.38	(Reflex) 2 EC 1.0–1.5 pt	14	Broadleaves and yellow/purple nutsedge. Suppression of some annual and perennial grasses. Label is a 24(C) local indemnified label and a waiver of liability must be signed for use. Transplanted crop only. May be applied to bare-ground production 7 days before transplanting or to a formed bed but prior to laying plastic. Use shields or hooded sprayers if applying to row middles, and prevent contact with plastic mulch. 60-day PHI.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses, and nutsedge. Apply as a preplant burndown. Allow 3 days between application and planting. Consult label for individual product directions.
Halosulfuron 0.024–0.05	(Sandea, Profine) 75 DF 0.5–1.0 oz	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. Do not exceed 2 oz/A per 12-month period. 30-day PHI.
Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaves. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to the row middles only with a shielded or hooded sprayer. Product must not contact green foliage or fruit to avoid excessive injury. Drift of lactofen-treated soil particles onto plants can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. 30-day PHI.
Napropamide 1.0–2.0	(Devrinol) 2-XT 2–4 quarts (Devrinol DF XT) 50 DF 4–8 lb	15	Annual broadleaves. Apply to bed tops after forming beds but before plastic application. Rainfall or overhead irrigate to 1 inch within 24 hr of application. For row-middle treatments, do not apply between bloom and harvest, and do not exceed 2 lb a.i./A per crop cycle.
Oxyfluorfen 0.25–0.5	(Goal 2 XL) 2 EC 1–2 pt (GoalTender) 4 E 0.5–1.0 pt	14	Broadleaves. Apply as a preemergence broadcast or banded to preformed beds. 30-day pretransplant interval. Mulch may be applied any time during the 30-day interval.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Surfactant recommended. **Consult label for new restrictions.**
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with soil residual compounds.
Pendimethalin 0.48–0.72	(Prowl H20) 3.8 1.0–1.5 pt	3	Annual broadleaves and grasses. May be applied to row middles or under the plastic. Do not exceed 3.0 pt/A per year. 70-day PHI.
Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaves less than 4 inches tall or rosettes less than 3 inches diameter. Apply as a preplant burndown treatment. Nonionic surfactant or crop oil concentrate recommended.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
S-metolachlor 0.64–0.95	(Dual Magnum) 7.62 EC 0.67–1.0 pt	15	Annual broadleaves, grasses and suppression of yellow/purple nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to the finished bed immediately before laying the plastic. Do not exceed 1.68 pt of Dual Magnum/A per crop cycle. 60-day PHI.
Sulfentrazone 0.09	Willowood Sulfentrazone 3 fl oz	14	Broadleaves, grasses, and nutsedge species. Apply under the plastic mulch or in row middles. Do not use on soils with less than 1% organic matter.
Trifluralin 0.5–0.75	(Treflan, Trifluralin) 4 EC 1.0–1.5 pt (Treflan) 10 G 5.0–7.5 lb	3	Annual broadleaves and grasses. Incorporate 4 inches or less within 8 hr of application. Results in Florida are erratic on sandy soils with low organic matter. Note label precautions against planting noncrops within 5 months. Do not apply after transplanting. 60-day PHI.
*****POSTEMERGENCE/POSTTRANSPLANT *****			
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Emerged broadleaves. Apply as hooded application to row middles only. May be tank-mixed with other herbicides. Do not exceed 6.1 fl oz per cropping season. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. 0-day PHI.
Clethodim 0.09–0.13 0.07–0.13	(Arrow, Select) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grasses. Use higher rates under heavy grass pressure or larger weeds. Surfactant or crop oil concentrate recommended. Consult label. 20-day PHI.
Diquat 0.5	(Reglone Dessiccant) 1 qt	22	Broadleaves and grasses. Apply to row middles only. Maximum of 2 applications per season. Prevent drift to crop. Nonionic surfactant recommended. 30-day PHI.
Halosulfuron 0.024–0.05	(Sandea, Profine) 75 DF 0.5–1.0 oz	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. Do not exceed 2 oz/A per 12-month period. Nonionic surfactant recommended. 30-day PHI.
Imazosulfuron 0.19–0.30	(League) 75 DF 4.0–6.4 oz	2	Broadleaves and yellow/purple nutsedge suppression. Pepper must be well established and 10 inches tall. Direct sprays to base of stem, and avoid contact with leaves or fruit. Do not exceed 6.4 oz/A per crop season. Observe crop rotation restrictions. Nonionic surfactant recommended. 21-day PHI.
Paraquat 0.5	(Gramoxone) 2 SL 2 pt (Firestorm) 3 SL 1.3 pt	22	Emerged broadleaves and grasses. Direct spray over emerged weeds 1 to 6 inches tall in-the-row middles between mulched beds. Use low pressure and shields to control drift. Do not apply more than 3 times per season. Nonionic surfactant recommended. **Consult label for new restrictions.**
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
Pendimethalin 0.48–0.72	(Prowl H20) 3.8 1.0–1.5 pt	3	Broadleaves and grasses. May be applied posttransplant to row middles if previously untreated. Do not exceed 3.0 pt/A per year. 70-day PHI.
Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Actively growing grasses. A total of 4.5 pt/A applied in one season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. 20-day PHI.
S-metolachlor 0.95	(Dual Magnum) 7.62 EC 1.0 pt	15	Annual broadleaves, grasses, and yellow/purple nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Direct spray solution to row middles only with minimal contact to plants and plastic. Do not exceed 1.68 pt Dual Magnum/A per crop. 60-day PHI.
***** POSTHARVEST *****			
Diquat 0.5	(Reglone Dessiccant) 2.0 pt	22	Minimum of 35 gal/A. Thorough coverage is required. Nonionic surfactant recommended.

Table 13.3. Insecticides labeled for management of arthropod pests of peppers. Contact: Craig Frey, UF/IFAS Extension Hendry County.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Aphids (including aphid-transmitted viruses, green peach aphid, potato aphid)	1A	***Lannate LV, *SP** (methomyl)	**LV:** 1.5–3.0 pt **SP:** 0.5–1.0 lb	No more than 12 pt LV or 4 lb SP/acre crop.	48	3	No more than 8 applications per crop.
	1A	***Vydate L** (oxamyl)	**Foliar:** 2–4 pt **Drip chemigation & soil injection systems:** 2–4 pt/A of plant bed	Do not apply more than 24 pt per acre per season.	48	7	Do not make more than 8 applications per season.
	1B	**Acephate 90 WDG** (acephate)	0.55–1.11 lb	Do not apply more than 2.22 lb/A per crop cycle.	24	7	
	1B	***Dibrom 8EC** (naled)	1 pt	Do not apply more than 5 pints per acre per season.	48	1	Apply no more than 1 pt/acre in Florida. Do not apply when temperatures are over 90°F.
	1B	**Dimethoate LV, EC, 2.67** (dimethoate)	**LV & EC:** 0.5–0.66 pt **2.67:** 0.75–1.0 pt	Maximum total rate per year is 1.65 lb a.i./A.	48	0	Highly toxic to bees.
	1B	**Malathion 5EC** (malathion)	1.5–2.5 pt	No maximum.	12	3	Maximum of 2 applications per year.
	1B	**Orthene 97** (acephate)	Bell peppers: 0.5–1.0 lb Non-bell peppers: 0.5 lb	Do not apply more than 2 lb a.i. per acre per crop cycle or 1 lb a.i. per acre per season for non-bell peppers.	24	7	
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	Suppression only.
	3A	**Pyganic EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	Suppression only.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	No more than 19.0 fl oz/acre product or 0.36 lb a.i. of lambda-cyhalothrin products or 0.172 lb a.i. of thiamethoxam products per acre per season.	24	5	Toxic to bees.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	Do not apply more than 31.0 fl oz per acre per year.	24	5	Allow 5 days between applications. Suppression only.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Actara** (thiamethoxam)	2.0–3.0 oz	Maximum of 11 oz/acre or 0.172 lb a.i./acre of thiamethoxam-containing products per growing season.	12	0	Toxic to bees.
	4A	**Admire Pro** (imidacloprid)	7–14.0 fl oz	Maximum allowed on pepper is 14.0 fl oz/A (0.5 lb a.i./A).	12	**Soil:** 21	Most effective if applied to soil at transplanting.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/10,000 plants	0.44 fl oz/10,000 plants	12	**Soil:** 21	**Planthouse:** 1 application to transplants. See label.
	4A	**Assail 30SG** (acetamiprid)	2.0–4.0 oz	Do not exceed 16 oz of Assail 30SG per acre per season, including any acetamiprid pretransplant applications.	12	7	Do not apply more than 4 times per season or more often than every 7 days.
	4A	**Assail 70WP** (acetamiprid)	0.8–1.7 oz	Do not exceed 6.8 oz Assail 70WP per acre per season, including any acetamiprid pretransplant applications.	12	7	Do not apply more than 4 times per season or more often than every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting	Do not release irrigation water from the treated area. See label for instructions.
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	11 fl oz Platinum/A or 0.172 lb a.i. of thiamethoxam per acre per season.	12	30	Soil application. See label for rotational restrictions.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	3.8–6.2 oz maximum per crop per season	12	30	Soil application. See label for rotational restrictions.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:** 1 **Soil:** 21	Suppression only. Use only one application method (soil or foliar). Follow label restrictions to protect pollinators.
	4A	**Venom** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–7.5 oz	Maxium 6 oz (foliar) or 12 oz (soil) per acre per season.	12	**Foliar:** 1 **Soil:** 21	Suppression only. Use only one application method (soil or foliar). Max of 3 applications per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz acre/season product or 0.172 lb thiamethoxam or 0.2 lb chlorantraniliprole.	12	30	Make only one soil application per crop season. Several methods of soil application—see label.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz/acre per season (0.172 lb a.i. thiamethoxam) or 0.2 lb a.i. of chlorantraniliprole products per acre per season.	12	1	Not for greenhouses, transplants, or if seed was treated with thiamethoxam or other Group 4A insecticides. Do not use adjuvant on chili pepper or pimento. Highly toxic to bees.
	4C	**Transform WG** (sulfoxaflor)	0.75–1.0 oz	Do not apply more than 8.5 oz/ acre per year.	12	1	Do not apply more than 0.070 lb a.i./acre per season. Do not make more than 2 applications per crop cycle.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–12.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	4	1	Minimum interval between applications: 7 days.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/ acre per crop.	12	0	Do not make more than 2 applications.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	4.8 fl oz/A per crop cycle	12	1	Do not make more than 2 applications per crop cycle.
	9D	**Sefina** (afidopyropen)	3.0 fl oz	Do not apply more than 28 fl oz product per acre per season.	12	0	No more than 2 sequential applications per year before using a different mode of action.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	Maximum of 10 fl oz/acre per season.	24	1	Minimum interval between applications: 7 days
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Minimum spray interval is 5 days.
	28	**Verimark** (cyantraniliprole)	**Soil at-planting or transplant trays:** 6.75–13.5 fl oz **Drip chemigation or soil injection:** 6.75–10 fl oz	Do not apply more than 0.4 lb a.i./A per calendar year.	4	1	Suppression only.
	28 + 6	***Minecto Pro** (cyantraniliprole + abamectin)	10 fl oz	Do not apply more than 20 fl oz per calendar year.	12	7	
	29	**Beleaf 50 SG** (flonicamid)	2.8–4.28 oz	Do not apply more than 8.4 oz/ acre per season.	12	0	Begin applications before pests reach damaging levels.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	10–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt		4	0	OMRI-listed. Greenhouse approved. May be mixed with some fungicides.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Molt-X** (azadirachtin)	8 fl oz		4	0	OMRI-listed. Antifeedant, repellant, IGR.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	OMRI-listed.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt		4	0	OMRI-listed. Greenhouse approved. May be mixed with some fungicides.
	-	**Neemix 4.5** (azadirachtin)	5–7 fl oz		4	0	Suppression of nymphs and adult feeding deterrence. IGR and feeding repellant. OMRI-listed.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt		4	0	Begin before pests reach damaging levels.
	-	**Suffoil-X** (petroleum oil)	1–2 gal per 100 gal water		4	0	OMRI-listed. Greenhouse labeled.
	-	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal		4	0	Stylet Oil helps manage aphid-borne viruses but does not kill aphids. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Beetles (including beetle larvae, blister beetle, Colorado potato beetle, cucumber beetle, flea beetle)	1A	**Carbaryl 4L** (carbaryl)	0.5–2 quarts	Do not apply more than 8 quarts per crop per year.	12	3	**Bee Caution:** DO NOT apply to weeds or crops in bloom.
	1A	**Sevin XLR; 4F** (carbaryl)	**XLR, 4F:** 0.5–2.0 qt	Do not apply a total of more than 8 qt per acre per crop.	12	3	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	1B	***Dibrom 8EC** (naled)	1 pt	Do not apply more than 5 pints per acre per season.	48	1	Apply no more than 1 pt/acre in Florida. Do not apply when temperatures are over 90°F.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	Do not apply more than 1.6 lb a.i./acre per season.	12	3	Bell peppers only.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	Do not apply more than 0.35 lb a.i. per acre per season.	12	7	Repeat applications at 7-to-10-day intervals to achieve control.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	No more than 0.2 lb a.i. per acre per season.	12	7	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 27.39 oz product or 0.266 lb a.i. per acre per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	No more than 23.04 fl oz or 0.36 lb a.i./A per season.	24	5	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	Do not apply more than 0.8 lb a.i. per acre per season.	12	3	Labeled for bell peppers. Do not make applications less than 5 days apart.
	3A	**Pyganic EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	No more than 19.0 fl oz/A of Endigo ZC or 0.36 lb a.i. of lambda-cyhalothrin products or 0.172 lb a.i. of thiamethoxam products per acre per season.	24	5	Minimum interval between applications is 5 days. Toxic to bees.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	Do not apply more than 31.0 fl oz per acre per year.	24	5	Allow 5 days between applications.
	4A	**Actara** (thiamethoxam)	2.0–3.0 oz	Maximum of 11 oz/acre or 0.172 lb a.i./acre of thiamethoxam-containing products per growing season.	12	0	Toxic to bees.
	4A	**Admire Pro** (imidacloprid)	7–14.0 fl oz	Maximum allowed on pepper is 14.0 fl oz/A (0.5 lb a.i./A).	12	**Soil:** 21	Most effective if applied to soil at transplanting.
	4A	**Assail 70WP** (acetamiprid)	0.6–1.1 oz	No more than 6.8 oz Assail 70WP per acre per season, including any pretransplant applications of acetamiprid.	12	7	No more than 4 applications per season or reapplication within 7 days.
	4A	**Belay 50 WDG** (clothianidin)	1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting.	Do not release irrigation water from the treated area.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	11 fl oz Platinum/A or 0.172 lb a.i. of thiamethoxam per acre per season.	12	30	Soil application. See label for rotational restrictions.
	4A	**Provado 1.6F** (imidacloprid)	3.8–6.2 oz	Maximum per crop per season 19.2 fl oz/A.	12	0	Do not apply to crop treated with imidacloprid or thiamethoxam. Allow 5 days between apps.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:**1 **Soil:** 21	Application restrictions exist because of risk to bees and other insect pollinators. Follow directions for use to protect pollinators. Use only one application method.
	4A	**Venom** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5–7.5 oz	No more than 6 oz (foliar) or 12 oz (soil)/acre per season.	12	**Foliar:**1 **Soil:** 21	Use only one application method (soil or foliar). No more than 3 applications per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz per acre/season product or 0.172 lb thiamethoxam or 0.2 lb chlorantraniliprole.	12	30	Make only one soil application per crop season. Several methods of soil application—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz/acre per season (0.172 lb a.i. thiamethoxam) or 0.2 lb a.i. of chlorantraniliprole products per acre per season.	12	1	Not for greenhouses, transplants, or if seed was treated with thiamethoxam or other Group 4A insecticides. Do not use adjuvant on chili pepper or pimiento. Highly toxic to bees.
	4D	**Sivanto 200 SL** (flupyradifurone)	10.5–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	4	1	Minimum interval between applications: 7 days.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	34 fl oz product or 0.266 lb a.i. per acre per year.	4	1	Allow 4 days between applications. No more than 6 applications per year.
	6	**Abba Ultra** (abamectin)	4.0–8.0 fl oz	24 fl oz product or 0.056 lb a.i. foliarly applied per year.	12	7	No more than 2 sequential applications of product or same a.i. Wait 7 days before retreatment.
	28	**Coragen** (chlorantraniliprole)	**Foliar:** 3.5–7.5 fl oz	No more than 15.4 fl oz or 0.2 lb a.i. per acre per crop.	4	1	Can apply by drip chemigation, at planting to soil and foliar. No more than 4 applications per crop.
	28	**Exirel** (cyantraniliprole)	7.0–13.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Minimum spray interval is 5 days.
	28	**Verimark** (cyantraniliprole)	**Soil at-planting or transplant trays:** 6.75–13.5 fl oz **Drip chemigation or soil injection:** 6.75–10 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	
	28 + 6	***Minecto Pro** (cyantraniliprole + abamectin)	5.5–10 fl oz	Do not apply more than 20 fl oz per calendar year.	12	7	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–16 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz		4	0	IGR and feeding repellant. OMRI-listed.
	-	**Suffoil-X** (petroleum oil)	1–2 gal per 100 gal water		4	0	OMRI-listed.
	-	**Surround** (kaolin)	12.50–50 lb		4	0	12.5 lb/25 gallons preferred up to fruit set. Apply only up to 1/4 of desired fruit size unless washing capabilities are sufficient.
	-	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T- Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal		4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Caterpillars (including cabbage looper, corn earworm, garden webworm loopers, hornworms, salt marsh caterpillars, tobacco budworm, tomato fruitworm, tomato pinworm, beet armyworm, fall armyworm, southern armyworm)	1A	**Carbaryl 4L** (carbaryl)	1–2 quarts	Do not apply more than 8 quarts per crop per year.	12	3	Do not apply to target crop or weeds in bloom. Up to 7 applications allowed per year.
	1A	***Lannate LV, *SP** (methomyl)	**LV:** 0.75–3.0 pt **SP:** 0.25–1.0 lb	No more than 12 pt LV or 4 lb SP/acre crop.	48	3	No more than 8 applications per crop.
	1A	**Sevin XLR; 4F** (carbaryl)	**XLR, 4F:** 1–2 qt	Do not apply a total or more than 8 qt per acre per crop.	12	3	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	1B	**Acephate 90 WDG** (acephate)	0.55–1.11 lb	Do not apply more than 2.22 lb/A per crop cycle.	24	7	Bell-type peppers only.
	1B	**Lorsban 75WG** (chlorpyrifos) [24(c) label] SLN FL-040005	1.33 lb	10.64 lb per crop maximum.	24	7	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. Do not make more than 8 applications.
	1B	**Orthene 97** (acephate)	Bell peppers: 0.50–1.00 lb	Do not apply more than 2 lb a.i. per acre per season.	24	7	
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	Do not apply more than 1.6 lb a.i./acre per season.	12	3	Bell peppers only.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	Do not apply more than 0.35 lb a.i. per acre per season.	12	7	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz product or 0.132 lb a.i./A per season maximum.	12	7	Beet armyworm 1st and 2nd instars only. Do not apply more than 2.8 fl oz/A within 7 days.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	No more than 0.2 lb active ingredient per acre per season.	12	7	Do not make applications less than 7 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Maximum of 4 applications (0.8 lb a.i./acre) per season.	24	3	Do not mix with copper.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 27.39 oz or 0.266 lb a.i./A per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	0.96–1.92 fl oz	23.04 fl oz product or 0.36 lb a.i./A per season.	24	5	
	3A	***Pounce 25 W** (permethrin)	6.4–12.8 oz	Do not apply more than 0.8 lb a.i. per acre per season.	12	3	Labeled for bell peppers. Do not make applications less than 5 days apart.
	3A	**Pyganic EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	No more than 19.0 fl oz/acre product or 0.36 lb a.i. of lambda-cyhalothrin products or 0.172 lb a.i. of thiamethoxam products per acre per season.	24	5	Toxic to bees.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	**Cabbage looper, cutworms and hornworms:** 5.0–8.0 fl oz **All others:** 6.0–9.0 fl oz	Do not apply more than 31.0 fl oz per acre per year.	24	5	Allow 5 days between applications.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz acre/season product or 0.172 lb thiamethoxam or 0.2 lb chlorantraniliprole.	12	30	Make only one soil application per crop season. Several methods of soil application—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz/acre per season (0.172 lb a.i. thiamethoxam) or 0.2 lb a.i. of chlorantraniliprole products per acre per season.	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	5	**Entrust SC** (spinosad)	1.5–8.0 fl oz	Do not use more than 29 oz or 0.45 lb a.i. per acre per crop.	4	1	Maximum application is 6 per year. Do not apply to seedlings grown for transplant. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	5	**Radiant SC** (spinetoram)	5–10 fl oz	34 fl oz product or 0.266 lb a.i. per acre per year.	4	1	Allow 4 days between applications. No more than 6 applications per year.
	6	**Abba Ultra** (abamectin)	8.0 fl oz	No more than 24 fl oz product or 0.056 lb a.i. foliarly applied per year.	12	7	Tomato pinworm. No more than 2 sequential applications of product or same a.i. Wait 7 days before retreatment.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	No more than 28.8 oz/acre per season.	12	7	
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb		4	0	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed.[2]
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	Treat when larvae are young. Good coverage is essential. Greenhouse approved. OMRI-listed.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.50 lb		4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	Treat when larvae are young. Good coverage is essential. OMRI-listed.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.50 lb		4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb		4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	***Dimilin 25W, *2L** (diflubenzuron)	4–8 oz	Apply no more than 24 oz per acre per season.	12	7	Up to 5 applications per season. IGR effects not seen for 5–7 days.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Do not use with an adjuvant.
	18	**Confirm 2F** (tebufenozide)	6–16 fl oz	Do not apply more than 1.0 lb a.i. per acre per season.	4	7	
	18	**Intrepid 2F** (methoxyfenozide)	4–16 fl oz	Do not apply more than 64 fl oz per acre per season.	4	1	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	22A	**Avaunt eVo** (indoxacarb)	2.5–6.0 fl oz	Do not apply more than 24 fl oz per season.	12	3	Do not make more than 4 applications per season.
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	4	1	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray. Make no more than 4 applications per crop.
	28	**Exirel** (cyantraniliprole)	7–17 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Minimum spray interval is 5 days.
	28	**Verimark** (cyantraniliprole)	**Soil at-planting or transplant tray treatment:** 5–13.5 fl oz **Drip, soil injection or chemigation:** 5–10 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	
	28 + 6	***Minecto Pro** (cyantraniliprole + abamectin)	**Tomato pinworms:** 10 fl oz **Loopers:** 7.5–10 fl oz **All others:** 5.5–10 fl oz	Do not apply more than 20 fl oz per calendar year.	12	7	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb		4	0	Can be used in organic production. OMRI-listed.
	-	**MBI-203 EP** (*Chromobacterium subtsugae*)	4.0–8.0 quarts		4	0	OMRI listed. Can be used in the greenhouse.
	-	**Molt-X** (azadirachtin)	8 fl oz		4	0	OMRI-listed. Antifeedant, repellant, IGR.
	-	**Neemix 4.5** (azadirachtin)	4–10 fl oz		4	0	IGR and feeding repellant. OMRI-listed.
	-	**Suffoil-X** (petroleum oil)	1–2 gal per 100 gal water		4	0	OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
Fire ants	7A	**Extinguish** (S-methoprene)	1.0–1.5 lb		4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb		12	1	Apply when ants are actively foraging.
Grasshoppers	1B	**Acephate 90 WDG** (acephate)	0.28–1.11 lb	No more than 2.22 lb product or 2.0 lb a.i./A per crop cycle.	24	7	Bell-type peppers only.
	1B	**Orthene 97** (acephate)	Bell peppers: 0.25–0.5 lb—	Do not apply more than 2 lb a.i. per acre per season.	24	7	Bell-type peppers only.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 27.39 oz of product or 0.266 lb a.i./A per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	No more than 23.04 fl oz or 0.36 lb a.i./A per season.	24	5	
	3A	**Pyganic EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz or 0.36 lb lambda- cyhalothrin or 0.172 lb thiamethoxam/acre per season.	24	5	
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	Do not apply more than 31.0 fl oz per acre per year.	24	5	Allow 5 days between applications.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:**1 **Soil:** 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Venom** (dinotefuran)	**Foliar:**1–4 oz **Soil:** 5.0–7.5 oz	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	12	**Foliar:** 1 **Soil:** 21	Use only one application method (soil or foliar). No more than 3 applications per season. Toxic to bees.
	-	**Surround** (kaolin)	12.50–50 lb		4	0	12.5 lb is the preferred rate up to fruit set.
Lace bugs	1A	**Carbaryl 4L** (carbaryl)	1–2 quarts	Do not apply more than 8 quarts per crop per year.	12	3	Do not apply to crops in bloom. Up to 7 applications per year.
	1A	**Sevin XLR; 4F** (carbaryl)	**XLR, 4F:** 1.0–2.0 qt	Do not apply a total of more than 8 qt per acre per crop.	12	3	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
Leafhoppers	1A	**Carbaryl 4L** (carbaryl)	0.5–1 quart	Do not apply more than 8 quarts per crop per year.	12	3	Do not apply to crops or weeds in bloom. Toxic to bees.
	1A	**Sevin XLR; 4F** (carbaryl)	**XLR, 4F:** 0.5–1.0 qt	Do not apply a total of more than 8 qt per acre per crop.	12	3	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz product or 0.132 lb a.i./A per season maximum.	12	7	
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 27.39 oz of product or 0.266 lb a.i./A per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	No more than 23.04 fl oz of product or 0.36 lb a.i./A per season.	24	5	
	3A	**Pyganic EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz of product or 0.36 lb lambda-cyhalothrin or 0.172 lb thiamethoxam/acre per season.	24	5	
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	4A	**Admire Pro** (imidacloprid)	7–14.0 fl oz	Maximum allowed on pepper is 14.0 fl oz/A (0.5 lb a.i./A).	12	**Soil:** 21	Most effective if applied to soil at transplanting.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz	Do not apply more than 6.4 oz product or 0.2 lb a.i./acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz product or 0.2 lb a.i./acre per season.	12	Apply at planting	Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	11 fl oz Platinum/Acre or 0.172 lb a.i. of thiamethoxam per acre per season.	12	30	Soil application. See label for rotational restrictions.
	4A	**Provado 1.6F** (imidacloprid)	3.8–6.2 oz	Maximum per crop per season 19.2 fl oz/Acre	12	0	Do not apply to crop treated with imidacloprid or thiamethoxam. Allow 5 days between applications.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:** 1 **Soil:** 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz acre/season product or 0.172 lb thiamethoxam or 0.2 lb chlorantraniliprole.	12	30	Make only one soil application per crop season. Several methods of soil application—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz/acre per season (0.172 lb a.i. thiamethoxam) or 0.2 lb a.i. of chlorantraniliprole products per acre per season.	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0–10.5 fl oz	No more than 28.0 fl oz or 0.365 lb a.i./A per year.	4	1	Minimum interval between applications: 7 days.
	16	**Courier SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	12	1	Slow-acting IGR that will not kill nymphs immediately. 2 applications per season. Allow at least 5 days between applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	10–16 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**Molt-X** (azadirachtin)	10 fl oz		4	0	OMRI-listed. Antifeedant, repellant, IGR.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	OMRI-listed.
	-	**Suffoil-X** (petroleum oil)	1–2 gal per 100 gal water		4	0	OMRI-listed.
	-	**Surround** (kaolin)	12.50–50 lb		4	0	12.5 is the preferred rate up to fruit set.
	-	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal		4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
***Liriomyza* leafminers** (includes leafminer larvae)	1A	***Vydate L** (oxamyl)	**Foliar:** 2–4 pt	Do not apply more than 24 pt per acre per season.	48	7	Suppression only. May also be applied by drip chemigation or soil injection systems. See label for rate.
	1B	***Dibrom 8EC** (naled)	1 pt	Do not apply more than 6 pints per acre per season.	48	1	Apply no more than 1 pt/acre in Florida. Do not apply when temperatures are over 90°F.
	1B	**Dimethoate LV, EC, 2.67** (dimethoate)	**LV & EC:** 0.5–0.66 pt **2.67:** 0.75–1.0 pt	Maximum total rate per year is 1.65 lb a.i./A.	48	0	Highly toxic to bees.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	Do not apply more than 1.6 lb a.i./acre per season.	12	3	Bell peppers only. Suppression only.
	3A	***Baythroid XL** (beta-cyfluthrin)	2.8 fl oz	16.8 fl oz product or 0.132 lb a.i./A per season maximum.	12	7	Suppression only.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb a.i. per acre per season.	12	7	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 27.39 oz product or 0.266 lb a.i./A per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz product or 0.36 lb a.i./A per season.	24	5	Suppression only.
	3A	***Pounce 25 W** (permethrin)	6.4–12.8 oz	Do not apply more than 0.8 lb a.i. per acre per season.	12	3	Labeled for bell peppers. Do not make applications less than 5 days apart.
	3A	**Pyganic EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	Suppression only. For control: tank-mix with 2–2.5 oz/A of Actara.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A + 6	***Gladiator** (zeta-cypermethrin avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Suppression only. Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting	Suppression only. Do not release irrigation water from the treated area.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:** 1 **Soil:** 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz/acre per season (0.172 lb a.i. thiamethoxam) or 0.2 lb a.i. of chlorantraniliprole products per acre per season.	12	1	Suppression only. Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	5	**Entrust SC** (spinosad)	6–10 fl oz	Do not use more than 29 fl oz or 0.45 lb a.i./acre per crop.	4	1	No more than 6 applications per year. Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	6–10 fl oz	34 fl oz product or 0.266 lb a.i. per acre per year.	4	1	Allow 4 days between applications. No more than 6 applications per year.
	6	**Abba Ultra** (abamectin)	4.0–8.0 fl oz	24 fl oz product or 0.056 lb a.i. foliarly applied per year.	12	7	No more than 2 sequential applications of product or same a.i. Wait 7 days before retreatment.
	6	***Agri-Mek SC** (abamectin)	1.7–3.5 fl oz	No more than 10.25 fl oz/A (0.056 lb a.i./A) Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season.	12	7	No more than 2 sequential applications per year. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	15	**Rimon 0.83EC** (novaluron)	12 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Do not use with an adjuvant.
	17	**Trigard** (cyromazine)	2.66 oz (one packet)	Do not apply more than 15.96 oz/A per season.	12	0	No more than 6 applications per crop.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	28	**Coragen** (chlorantraniliprole)	5.0–7.5 fl oz	Do not apply more than 15.4 fl oz product or 0.2 lb a.i./acre per crop.	4	1	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. Make no more than 4 applications per crop.
	28	**Exirel** (cyantraniliprole)	13–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Minimum spray interval is 5 days.
	28	**Verimark** (cyantraniliprole)	**Soil at-planting or transplant tray treatment:** 6.75–13.5 fl oz **Drip, soil injection or chemigation:** 6.75–10 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	
	28 + 6	***Minecto Pro** (cyantraniliprole + abamectin)	5.5–10 fl oz	Do not apply more than 20 fl oz per calendar year.	12	7	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	10–16 fl oz		4	0	Antifeedant, repellant, insect growth regulator. Foliar application to larvae. Use with oil.
	-	**Molt-X** (azadirachtin)	10 fl oz		4	0	OMRI-listed. Antifeedant, repellant, IGR.
	-	**Neemix 4.5** (azadirachtin)	4–7 fl oz		12	0	IGR and feeding repellant. OMRI-listed. For larvae and nymphs.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	3–4 qt		4	0	Begin before pests reach damaging levels.
	-	**Suffoil-X** (petroleum oil)	1–2 gal per 100 gal water		4	0	OMRI-listed.
	-	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal		4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Mealybugs	1B	***Dibrom 8EC** (naled)	1 pt	Do not apply more than 6 pints per acre per season.	48	1	Apply no more than 1 pt/acre in Florida. Do not apply when temperatures are over 90°F.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
Mites (including broad mites, carmine spider mite, tomato russett mite, two-spotted spider mite)	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	12	7	Do not make applications less than 7 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Maximum of 4 applications (0.8 lb a.i./acre) per season.	24	3	Do not apply with copper.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	10.3 oz	Do not apply more than 27.39 oz or 0.266 lb a.i./A per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	No more than 23.04 fl oz or 0.36 lb a.i./A per season.	24	5	Suppression only (spider mite species).
	3A	**Pyganic EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	Suppression only (spider mite species).
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	Do not exceed a total of 19.0 fl oz product or 0.36 lb a.i. lambda-cyhalothrin or 0.172 lb a.i. thiamethoxam/acre per season.	24	5	Suppression only. For control: tank-mix with 2–2.5 oz/A of Actara.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	6	**Abba Ultra** (abamectin)	4.0–8.0 fl oz	24 fl oz product or 0.056 lb a.i. foliarly applied per year.	12	7	No more than 2 sequential applications of product or same a.i. Wait 7 days before retreatment.
	6	***Agri-Mek SC** (abamectin)	1.7–3.5 fl oz	No more than 10.25 fl oz/A (0.056 lb a.i./A) Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season.	12	7	No more than 2 sequential applications per year. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	10B	**Zeal WDG Miticide** (etoxazole)	2.0–3.0 oz	Do not make more than one application per season.	12	7	Do not use with an adjuvant or surfactant.
	20B	**Kanemite 15 SC** (acequinocyl)	31.0 fl oz	Do not apply more than 62 fl oz/A per season.	12	1	Minimum of 21 days between treatments. Two applications per year. Do not use an adjuvant.
	20D	**Acramite-50WS** (bifenazate)	0.75–1.0 lb	One application allowed per season.	12	3	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	12	1	Do not make more than two applications per season. Allow 14 days between applications.
	23	**Oberon 2SC** (spiromesifen)	7.0–8.5 fl oz	Maximum amount per crop: 25.5 fl oz/acre.	12	1	No more than 3 applications.
	28 + 6	***Minecto Pro** (cyantraniliprole + abamectin)	5.5–10 fl oz	Do not apply more than 20 fl oz per calendar year.	12	7	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**MET52 EC** (*Metarhizium anispoliae* strain F52)	**Drench:** 40–80 fl oz/100 gal **Foliar:** 0.5 pt–2 qt/A		4	0	
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		4	0	OMRI-listed.
	-	**Suffoil-X** (petroleum oil)	1–2 gal per 100 gal water		4	0	OMRI-listed.
	-	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal		4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Plant bugs (includes tarnished plant bug)	1A	**Sevin XLR; 4F** (carbaryl)	**XLR, 4F:** 1–2 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	12	3	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz product or 0.36 lb a.i./A per season.	24	5	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	Do not apply more than 31.0 fl oz per acre per year.	24	5	Allow 5 days between applications.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting	Do not release irrigation water from the treated area.
	4C	**Transform WG** (sulfoxaflor)	1.15–2.25 oz	Do not apply more than 8.5 oz/ acre per year.	12	1	Do not apply more than 0.070 lb a.i./acre per season. Do not make more than 2 applications per crop cycle.
	29	**Beleaf 50 SG** (flonicamid)	2.0–4.28 oz	Do not apply more than 8.4 oz/ acre per season.	12	0	Begin applications before pests reach damaging levels.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	OMRI-listed.
	-	**Suffoil-X** (petroleum oil)	1–2 gal per 100 gal water		4	0	OMRI-listed.
Planthoppers	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:** 1 **Soil:** 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method.
	16	**Courier SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	12	1	Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.
Psyllids	4D	**Sivanto 200 SL** (flupyradifurone)	10.5–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	4	1	Minimum interval between applications: 7 days.
	6	**Abba Ultra** (abamectin)	4.0–8.0 fl oz	24 fl oz product or 0.056 lb a.i. foliarly applied per year.	12	7	No more than 2 sequential applications of product or same a.i. Wait 7 days before retreatment.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	Maximum of 10 fl oz per acre per season.	24	1	Minimum interval between applications: 7 days
Stinkbugs (including brown stinkbug, green stinkbug, southern green stinkbug)	1A	**Carbaryl 4L** (carbaryl)	1–2 quarts	Do not apply more than 8 quarts per crop per year.	12	3	Suppression only.
	1A	**Sevin XLR; 4F** (carbaryl)	**XLR, 4F:** 0.5–2.0 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	12	3	Suppression. Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	16.8 fl oz product or 0.132 lb a.i./A per season maxiumum.	12	7	
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Maximum of 4 applications (0.8 lb a.i./acre) per season.	24	3	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 27.39 oz or 0.266 lb a.i./A per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz of product or 0.36 lb a.i./A per season.	24	5	
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	4A	**Actara** (thiamethoxam)	3.0–5.5 oz	Maximum of 11 oz/acre or 0.172 lb a.i./acre of thiamethoxam-containing products per growing season.	12	0	Toxic to bees.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:**1 **Soil:** 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method.
	4A	**Venom** (dinotefuran)	**Foliar (only):** 1–4 oz	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	12	**Foliar:** 1 **Soil:** 21	Use only one application method (soil or foliar). No more than 3 applications per season.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.4 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz/acre per season (0.172 lb a.i. thiamethoxam) or 0.2 lb a.i. of chlorantraniliprole products per acre per season.	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	15	**Rimon 0.83EC** (novaluron)	12 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Do not use with an adjuvant.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
Thrips: check label for species controlled (includes eastern flower thrips, foliar feeding thrips, chilli thrips, melon thrips, western flower thrips)	1A	**Carbaryl 4L** (carbaryl)	1–2 quarts	Do not apply more than 8 quarts per crop per year.	12	3	Suppression.
	1A	**Sevin XLR; 4F** (carbaryl)	**XLR, 4F:** 1.0–2.0 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	12	3	Suppression. Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	1A	***Vydate L** (oxamyl)	**Foliar:** 2–4 pt	Do not apply more than 24 pt per acre per season.	48	7	Does not control western flower thrips.
	1B	**Lorsban 75WG** (chlorpyrifos) [24(c) label] SLN FL-040005	1.33 lb	10.64 lb per crop maximum.	24	7	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. Do not make more than 8 applications. Application interval is 10 days.
	3A	***Baythroid XL** (beta-cyfluthrin)	2.1–2.8 fl oz	16.8 fl oz product or 0.132 lb a.i./A per season maximum.	12	7	Not effective on *Thrips palmi.*
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	12	7	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	10.3 oz	Do not apply more than 27.39 oz or 0.266 lb a.i./A per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.
	3A	**Pyganic EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	Will not control Western Flower Thrips.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	Will not control Western Flower Thrips.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	4A	**Admire Pro** (imidacloprid)	7–14.0 fl oz	Maximum allowed on pepper is 14.0 fl oz/A (0.5 lb a.i./A).	12	**Soil:** 21	Most effective if applied to soil at transplanting.
	4A	**Assail 30SG** (acetamiprid)	4.0 oz	Do not exceed a total of 16 oz of Assail 30SG per acre per growing season, including any pretransplant applications of acetamiprid.	12	7	Do not apply more than 4 times per season or apply more often than every 7 days.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Assail 70WP** (acetamiprid)	1.7 oz	Do not exceed a total of 6.8 oz Assail 70WP per acre per growing season, including any pretransplant applications of acetamiprid.	12	7	
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting	Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	11 fl oz Platinum/A or 0.172 lb a.i. of thiamethoxam per acre per season.	12	30	Soil application. See label for rotational restrictions.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	11 fl oz Platinum/A or 0.172 lb a.i. of thiamethoxam per acre per season.	12	30	Soil application. See label for rotational restrictions.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:** 1 **Soil:** 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method.
	4A	**Venom** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5.0–7.5 oz	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	12	**Foliar:** 1 **Soil:** 21	Use only one application method (soil or foliar). No more than 3 applications per season.
	4C	**Transform WG** (sulfoxaflor)	2.75 oz	Do not apply more than 8.5 oz/ acre per year.	12	1	Do not apply more than 0.070 lb a.i./acre per season. Do not make more than 2 applications per crop cycle.
	4D	**Sivanto Prime** (flupyradifurone)	12–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	4	1	Suppression—Chilli thrips. Minimum interval between applications: 7 days.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz acre/season product or 0.172 lb thiamethoxam or 0.2 lb chlorantraniliprole.	12	30	Make only one soil application per crop season. Several methods of soil application—see label.
	5	**Entrust SC** (spinosad)	4–8 fl oz	Do not use more than 29 fl oz or 0.45 lb a.i./acre per crop.	4	1	Maximum application is 6 per year. Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	6–10 fl oz	34 fl oz product or 0.266 lb a.i. per acre per year.	4	1	Allow 4 days between applications. No more than 6 applications per year.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	6	**Abba Ultra** (abamectin)	4.0–8.0 fl oz	No more than 24 fl oz product or 0.056 lb a.i. foliarly applied per year.	12	7	*Thrips palmi*. No more than 2 sequential applications of product or same a.i. Wait 7 days before retreatment.
	6	***Agri-Mek SC** (abamectin)	1.7–3.5 fl oz	No more than 10.25 fl oz/A (0.056 lb a.i./A) Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season.	12	7	*Thrips palmi*. No more than 2 sequential applications per year. Must be used with a nonionic activator-type wetting, spreading, or penetrating adjuvant.
	15	**Rimon 0.83EC** (novaluron)	12 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Do not use with an adjuvant. No more than 2 applications targeting thrips.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Minimum spray interval is 5 days.
	28	**Verimark** (cyantraniliprole)	**Soil at-planting or transplant tray treatment:** 10–13.5 fl oz **Drip, soil injection or chemigation:** 10 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	
	28 + 6	***Minecto Pro** (cyantraniliprole + abamectin)	5.5–10 fl oz **Foliage-feeding species:** 10 fl oz	Do not apply more than 20 fl oz per calendar year.	12	7	Suppression: foliage feeders
	29	**Beleaf 50 SG** (flonicamid)	**Greenhouse:** 4.2 oz	Do not apply more than 8.4 oz/acre per season. Allowed 2 applications per season.	12	0	Apply before pests reach damaging levels. Rotate MOA after 2 consecutive Beleaf applications. Allow a minimum of 7 days between applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	10–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt		4	0	OMRI-listed. Greenhouse approved. May be mixed with some fungicides. Contact dealer for recommendations when using an adjuvant.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	OMRI-listed.
	-	**MET52 EC** (*Metarhizium anispoliae* strain F52)	**Drench:** 40–80 fl oz/100 gal **Foliar:** 0.5 pt–2 qt/A		4	0	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Molt-X** (azadirachtin)	8 fl oz		4	0	OMRI-listed. Antifeedant, repellant, IGR.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt		4	0	OMRI-listed. Greenhouse approved. May be mixed with some fungicides. Contact dealer for recommendations if adjuvant being used.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt		4	0	Begin before pest reach damaging levels.
	-	**Suffoil-X** (petroleum oil)	1–2 gal per 100 gal water		4	0	OMRI-listed.
	-	**Surround** (kaolin)	12.50–50 lb		4	0	12.5 is the preferred rate up to fruit set.
	-	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal		4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Weevils (including pepper weevil, vegetable weevil)	1A	***Vydate L** (oxamyl)	**Foliar:** 2–4 pt	Do not apply more than 24 pt per acre per season.	48	7	
	1B	**Lorsban 75WG** (chlorpyrifos) [24(c) label] SLN FL-040005	1.33 lb	10.64 lb per crop maximum.	24	7	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. Do not make more than 8 applications. Application interval is 10 days.
	3A	***Ambush 25W** (permethrin)	6.4–12.8 oz	Do not apply more than 1.6 lb a.i./acre per season.	12	3	Bell peppers only.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8–9.6 fl oz	Do not apply more than 0.35 lb a.i. per acre per season or treat more than 7 times at high rate.	12	7	Aids in control.
	3A	***Baythroid XL** (beta-cyfluthrin)	2.8 fl oz	16.8 fl oz product or 0.132 lb a.i./A per season maximum.	12	7	Suppression.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	12	7	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 27.39 oz or 0.266 lb a.i./A per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz of product or 0.36 lb a.i./A per season.	24	5	Suppression.
	3A	***Mustang** (zeta-cypermethrin)	2.4–4.3 fl oz	Apply no more than 245.8 fl oz per acre per season	12	1	Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	6.4–12.8 oz	Do not apply more than 0.8 lb a.i. per acre per season.	12	3	Labeled for bell peppers. Do not make applications less than 5 days apart.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	Suppression.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	Suppression only. For control, tank-mix with 2–2.5 oz/A of Actara.
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	Do not apply more than 31.0 fl oz per acre per year.	24	5	Allow 5 days between applications.
	4A	**Assail 30SG** (acetamiprid)	2.5–4.0 oz	Do not exceed a total of 16 oz of Assail 30SG per acre per growing season, including any pretransplant application of acetamiprid.	12	7	Begin applications for whitefly when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Assail 70WP** (acetamiprid)	1.1–1.7 oz	Do not exceed a total of 6.8 oz Assail 70WP per acre per growing season, including any pretransplant applications of acetamiprid.	12	7	
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Provado 1.6F** (imidacloprid)	6.2 oz	19.2 fl oz/A maximum per crop per season	12	0	Do not apply to crop treated with imidacloprid or thiamethoxam. Allow 5 days between applications.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:** 1 **Soil:** 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	15	***Dimilin 25W, *2L** (diflubenzuron)	4–8 oz	Apply no more than 24 oz per acre per season.	12	7	Up to 5 applications per season. IGR effects not seen for 5–7 days. Will not control adults; however, eggs laid by adults will exhibit reduced hatching in fruits once adults have consumed or contacted residues on plant tissue.
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Do not use with an adjuvant. Apply at initial flowering stage.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Suppression only. Use as part of an effective control program. Rotate in other modes of action. Start applications when populations are low.
	28 + 6	***Minecto Pro** (cyantraniliprole + abamectin)	10 fl oz	Do not apply more than 20 fl oz per calendar year.	12	7	Suppression
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	10–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz		12	0	IGR and feeding repellant. OMRI-listed.
Whiteflies (adults, immatures)	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	12	7	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	10.3 oz	Do not apply more than 27.39 oz or 0.266 lb a.i./A per season.	12	7	Refer to label's maximum usage table when applying Hero and another product containing either of the same active ingredients.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	1.28–1.92 fl oz	23.04 fl oz of product or 0.36 lb a.i./A per season.	24	5	Suppression.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	Do not apply more than 10 times per season.	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	Do not apply more than 0.36 lb a.i./acre per season.	24	5	Suppression.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	Suppression only. For control, tank-mix with 2–2.5 oz/A of Actara.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	3A + 6	***Gladiator** (zeta-cypermethrin + avermectin B1)	19 fl oz	No more than 57 fl oz product or 0.036 lb avermectin or 0.078 lb z-cypermethrin/A per 12-month cropping year.	12	7	Do not reapply this product or others containing either of the same active ingredients within 7 days.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6.0–9.0 fl oz	Do not apply more than 31.0 fl oz per acre per year.	24	5	Allow 5 days between applications. Suppression only.
	4A	**Actara** (thiamethoxam)	3.0–5.5 oz	Maximum of 11 oz/acre or 0.172 lb a.i./acre of thiamethoxam-containing products per growing season.	12	0	Toxic to bees.
	4A	**Admire Pro** (imidacloprid)	7–14.0 fl oz	Maximum allowed on pepper is 14.0 fl oz/A (0.5 lb a.i./A).	12	**Soil:** 21	Most effective if applied to soil at transplanting.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/10,000 plants		12	**Soil:** 21	**Planthouse:** 1 application to transplants. See label.
	4A	**Assail 30SG** (acetamiprid)	2.5–4.0 oz	Do not exceed a total of 16 oz of Assail 30SG per acre per growing season, including any pretransplant applications of acetamiprid.	12	7	Begin applications for whitefly when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Assail 70WP** (acetamiprid)	1.1–1.7 oz	Do not exceed a total of 6.8 oz Assail 70WP per acre per growing season, including any pretransplant applications of acetamiprid.	12	7	
	4A	**Belay 50 WDG** (clothianidin)	**Foliar:** 1.6–3.2	Do not apply more than 6.4 oz per acre per season.	12	7	Suppression. Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil:** 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting	Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	11 fl oz Platinum/A or 0.172 lb a.i. of thiamethoxam per acre per season.	12	30	Soil application. See label for rotational restrictions.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	11 fl oz Platinum/A or 0.172 lb a.i. of thiamethoxam per acre per season.	12	30	Soil application. See label for rotational restrictions.
	4A	**Provado 1.6F** (imidacloprid)	3.8–6.2 oz	19.2 fl oz/A maximum per crop per season	12	0	Do not apply to crop treated with imidacloprid or thiamethoxam. Allow 5 days between applications.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2–7 fl oz **Soil:** 9–10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	12	**Foliar:** 1 **Soil:** 21	Risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method.
	4A	**Venom** (dinotefuran)	**Foliar:** 1–4 oz **Soil:** 5.0–7.5 oz	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	12	**Foliar:** 1 **Soil:** 21	Use only one application method (soil or foliar). No more than 3 applications per season.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	13.0 fl oz acre/season product or 0.172 lb thiamethoxam or 0.2 lb chlorantraniliprole.	12	30	Make only one soil application per crop season. Several methods of soil application—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4–7 oz	14 oz/acre per season (0.172 lb a.i. thiamethoxam) or 0.2 lb a.i. of chlorantraniliprole products per acre per season.	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4C	**Transform WG** (sulfoxaflor)	2.0–2.25 oz	Do not apply more than 8.5 oz/ acre per year.	12	1	Do not apply more than 0.070 lb a.i./acre per season. Do not make more than 2 applications per crop cycle.
	4D	**Sivanto Prime** (flupyradifurone)	10.5–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	4	1	Minimum interval between applications: 7 days.
	7C	**Knack IGR** Section 2(ee) #59639-95 FL (pyriproxyfen)	5 fl oz	Do not exceed 20 fl oz/A per season.	12	1	Immatures only. Apply when nymphs first appear. Alternate or mix application with a.i. of different mode of action.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/ acre per crop.	12	0	Suppression. Do not make more than two applications.
	9D	**Sefina** (afidopyropen)	14.0 fl oz	Do not apply more than 28 fl oz product per acre per season.	12	0	No more than 2 sequential applications per year before using a different mode of action.
	15	**Rimon 0.83EC** (novaluron)	12 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Do not use with an adjuvant. No more than 2 applications targeting whitefly.
	16	**Courier SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	12	1	Immatures only. Slow-acting IGR that will not kill nymphs immediately. Two applications per season. Allow at least 5 days between applications.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	12	1	Suppression. No more than two applications per season. Allow 14 days between applications.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	Maximum of 10 fl oz per acre per season.	24	1	Minimum interval between applications: 7 days.
	23	**Oberon 2SC** (spiromesifen)	7.0–8.5 fl oz	Maximum amount per crop: 25.5 fl oz/acre.	12	1	No more than 3 applications.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Minimum spray interval is 5 days.
	28	**Verimark** (cyantraniliprole)	**Soil at-planting or transplant tray treatment:** 6.75–13.5 fl oz **Drip, soil injection or chemigation:** 6.75–10 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	
	28 + 6	***Minecto Pro** (cyantraniliprole + abamectin)	10 fl oz	Do not apply more than 20 fl oz per calendar year.	12	7	
	28 + 16	**Vetica** (flubendiamide + buprofezin)	12.0–17.0 fl oz	Do not apply more than 38 fl oz/A per season.	12	1	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Use 14 to 17 fl oz per acre to control whiteflies.
	29	**Beleaf 50 SG** (flonicamid)	2.8–4.2 oz	8.4 oz per acre per season. 2 applications per season.	12	0	Apply before pests reach damaging levels. Rotate MOA after 2 consecutive Beleaf applications. Allow a minimum of 7 days between applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	10–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt		4	0	OMRI-listed. Greenhouse approved. May be mixed with some fungicides. Contact dealers for adjuvant recommendations.
	-	**MET52 EC** (*Metarhizium anispoliae* strain F52)	**Drench:** 40–80 fl oz/100 gal **Foliar:** 0.5 pt–2 qt/A		4	0	
	-	**Molt-X** (azadirachtin)	8 fl oz		4	0	OMRI-listed. Antifeedant, repellant, IGR.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1.0 qt		4	0	OMRI-listed. Greenhouse approved. May be mixed with some fungicides. Contact dealers for adjuvant recommendations.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz		4	0	IGR and feeding repellant. OMRI-listed.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–3 qt		4	0	Begin before pests reach damaging levels.
	-	**Suffoil-X** (petroleum oil)	1–2 gal per 100 gal water		4	0	OMRI-listed.
	-	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal **Others:** 1–2 gal/100 gal		4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2, March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

***Restricted use insecticide.**

Table 13.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Gary E. Vallad, UF/IFAS Gulf Coast Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Anthracnose	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	
	M3	(mancozeb) **Many brands available:** Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	**SEE INDIVIDUAL LABELS**		7	1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		3	1	
	3	**Cevya** (mefentrifluconzaole)	5 fl oz	15 fl oz	0	0.5	Limit is 3 applications per year. Supplemental label expires Oct. 30, 2023
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Limit is 4 applications per season.
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
(suppression)	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	For disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
(suppression)	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per year.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	11	(azoxystrobin) **Many brands available:** AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	**Cabrio 2.08 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicides/season.
(suppression)	11	**Flint 50 WGD** (trifloxystrobin)	4 oz	16 oz	3	0.5	Maximum of 4 appl./season & alternate with a fungicide from a different FRAC group.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Only 4 applications per season; no more than 2 sequential applications; use of a spreading- or penetrating-type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	11 + 27	**Tanos** (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank-mix with contact fungicides. Tank-mix or rotate with a fungicide from a different FRAC group.
(suppression)	19	**Ph-D WDG** (polyoxin D zinc salt)	6.2 oz	31.0 oz	0	4 hr	Limit is 5 applications in a 10-to-14-day interval. Alternate with a fungicide from a different FRAC group.
	27 + M5	**Ariston Cymbol Advance** (cymoxanil + chlorothalonil)	2.44 pt	17.5 pt	3	0.5	
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
Bacterial spot	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	For best possible chemical control of bacterial spot, tank-mix copper with a mancozeb fungicide.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	
	M3	(mancozeb) **Many brands available:** Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	**SEE INDIVIDUAL LABELS**		7	1	*Bacterial spot control only when tank-mixed with a copper fungicide. Use of 1 lb of mancozeb/A per application is sufficient.
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	Combine with a fixed-copper fungicide. Limit is a single application before alternating to a non-FRAC group 11 fungicide.
(suppression)	11 + 27	**Tanos** (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank-mix with contact fungicides. Tank-mix or rotate with a fungicide from a different FRAC group. Tank-mix with copper fungicides for suppression of Phytophthora blight, bacterial spot, and bacterial soft rot.
(suppression)	13	**Quintec** (quinoxyfen)	6 fl oz	24 fl oz	3	0.5	**Supplemental Section 2(ee) label:** Must be alternated with another product effective against bacterial spot. If multiple applications are made, at least one application must be a tank mix with another product effective against bacterial spot.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	21	***Actigard** (acibenzolar-S-methyl)	0.75 oz	6 oz	14	0.5	*Labelled for chili pepper only. Begin applications within one week of transplanting or emergence. Make up to 8 weekly, sequential applications.
	25	**Agri-mycin 50** **AG Streptomycin** **Harbour** (streptomycin sulfate)	200 ppm	-	-	0.5	For use on transplants only. Initiate when seedling is in 2-leaf stage. Apply at 4–5 day intervals until transplanting.
Bacterial soft rot (suppression)	11 + 27	**Tanos** (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank-mix with contact fungicides. Tank-mix or rotate with a fungicide from a different FRAC group.
Bacterial wilt (*Ralstonia solanacearum*)	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
Botrytis or Gray mold	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		3	1	
(suppression)	7	**Endura** (boscalid)	3.5 oz	21 oz	0	0.5	Limit is 6 applications per season at lower rate, with no more than 2 sequential applications before alternating with another effective fungicide from another FRAC group.
(suppression)	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	For disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
(suppression)	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9	**Vango** (cyprodinil)	7 oz	28 oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 9 for at least 2 sequential applications; no more than 4 applications per year. Can be applied via chemigation.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	9 + 12	**Alterity 62.5WG** **Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Limit is 56 oz per year; after 2 applications of Switch, alternate with another effective fungicide from a different FRAC group.
(suppression)	11	**Cabrio 2.08 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicides/season.
	11 + 7	**Pageant** (pyraclostrobin + fluxapyroxad)	23 oz	54 oz	0	0.5	**Greenhouse production only:** Limit is 2 applications per crop cycle. No sequential applications; must rotate to another fungicide with a different mode of action.
(suppression)	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	12	**Spirato GHN** (fludioxonil)	7 fl oz	28 fl oz	0	0.5	**For use in greenhouse and other enclosed structures only.** Limit to 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	17	**Decree 50 WDG** (fenhexamid)	1.5 lb	6 lb	0	0.5	**Transplant and greenhouse use only.** Do not make more than 2 consecutive applications.
	19	**Ph-D WDG** (polyoxin D zinc salt)	6.2 oz	31.0 oz	0	4 hr	Limit is 5 applications on 10-to-14-day interval. Alternate with a fungicide from a different FRAC group.
	27 + M5	**Ariston** **Cymbol Advance** (cymoxanil + chlorothalonil)	2.44 pt	17.5 pt	3	0.5	
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Frogeye leaf spot, Cercospora leaf spot (*Cercospora* spp.)	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	For best possible chemical control of bacterial spot, a copper fungicide should be tank-mixed with a mancozeb fungicide.
	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	M3	(mancozeb) **Many brands available:** Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	**SEE INDIVIDUAL LABELS**		7	1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		3	1	
	3	**Indar 2F** (fenbuconazole)	12 fl oz	48 fl oz	7	0.5	No more than 2 consecutive applications before alternating with a fungicide from another FRAC group. A 35-to-210-day plant-back interval exists for nonlabeled crops.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Limit is 4 applications per season.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Only 4 applications per season; no more than 2 sequential applications; use of a spreading- or penetrating-type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season.
	27 + M5	**Ariston** **Cymbol Advance** (cymoxanil + chlorothalonil)	2.44 pt	17.5 pt	3	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Gray leaf spot (*Stemphyllium* spp.)	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. Limit of 4 applications per a year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per year.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	11	**Flint 50 WGD** (trifloxystrobin)	4 oz	16 oz	3	0.5	Maximum of 4 appl./season, and alternate with a fungicide from a different FRAC group.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Only 4 applications per season; no more than 2 sequential applications; use of a spreading- or penetrating-type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1-year plant-back restriction for certain off-label crops.
Powdery mildew	M2	(sulfur) **Many brands available:** Cosavet DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 6L, Sulfur 90W, Super Six, That Flowable Sulfur, Thiolux Jet, Thiosperse 80%, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Follow label closely; sulfur may cause phytotoxicity.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		3	1	
	3	**Cevya** (mefentrifluconzaole)	5 fl oz	15 fl oz	0	0.5	Limit is 3 applications per year. Supplemental label expires Oct. 30, 2023.
	3	**Indar 2F** (fenbuconazole)	12 fl oz	48 fl oz	7	0.5	No more than 2 sequential applications before alternating with a fungicide from a different FRAC group. A 35-to-210-day plant-back interval exists for nonlabeled crops.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	3	**Rally** **Sonoma 40WSP** (myclobutanil)	5 oz	20 oz	0	1	No more than 4 applications per season on a 10-to-14-day treatment interval. Should be alternated or tank-mixed with a fungicide from a different FRAC group.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Limit is 4 applications per season.
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	For disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7	**Velum Prime** (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	For soil application only; the first foliar fungicide application following Velum Prime should be from a different FRAC group.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9	**Vango** (cyprodinil)	7 oz	28 oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 9 for at least 2 sequential applications; no more than 4 applications per year. Can be applied via chemigation.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction for off-label crops.
	9 + 12	**Alterity 62.5WG** **Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Limit is 56 oz per year; after 2 applications of Switch, alternate with another effective fungicide from a different FRAC group.
	11	(azoxystrobin) **Many brands available:** AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	**Flint 50 WGD** (trifloxystrobin)	4 oz	16 oz	3	0.5	Maximum of 4 appl./season, and alternate with a fungicide from a different FRAC group.
(suppression)	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Only 4 applications per season; no more than 2 sequential applications; use of a spreading- or penetrating-type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season.
	11 + 7	**Pageant** (pyraclostrobin + fluxapyroxad)	18 oz	54 oz	0	0.5	**Greenhouse production only:** Limit is 3 applications per crop cycle. No sequential applications; must rotate to another fungicide with a different mode of action.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	12	**Spirato GHN** (fludioxonil)	7 fl oz	28 fl oz	0	0.5	**For use in greenhouse and other enclosed structures only.** Limit to 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	13	**Quintec** (quinoxyfen)	6 fl oz	24 fl oz	3	0.5	Will not control latent or established infections. Must alternate or tank-mix with an effective fungicide from a different FRAC group.
	19	**Ph-D WDG** (polyoxin D zinc salt)	6.2 oz	31.0 oz	0	4 hr	Limit is 5 applications on 10-to-14-day intervals. Alternate with a fungicide from a different FRAC group.
	27 + M5	**Ariston Cymbol Advance** (cymoxanil + chlorothalonil)	2.44 pt	17.5 pt	3	0.5	
(suppression)	39	**Torac** (tolfenpyrad)	21 fl oz	42 fl oz	1	0.5	Primarily an insecticide. Limit 2 applications per season, 4 applications per year. 14-day minimum application interval.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	50	**Prolivo** (pyriofenone)	5 fl oz	16 fl	0	4 hr	No more than 2 sequential applications. Limit is 4 applications per year.
	50	**Vivando** (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	3 applications per season; no more than 2 sequential applications. Do not mix with horticultural oils.
	U6	**Torino** (cyflufenamid)	3.4 oz	10.2 oz	0	4 hr	3 applications per season with at least 14 days between applications.
Phytophthora blight, Phytophthora root rot, Phytophthora crown rot (*Phytophthora* spp.)	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
(suppression)	M1 + M3	**Mankocide** (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	
	M3	(mancozeb) **Many brands available:** Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	**SEE INDIVIDUAL LABELS**		7	1	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	4	**Metastar 2E** **ReCon 4F** **Xyler FC** (metalaxyl)	**Metastar:** 8 qt **ReCon:** 4 qt **Xyler:** 4 qt	**Metastar:** 12 qt **ReCon:** 6 qt **Xyler:** 4.3 qt	2	7	Must be soil applied. See labels.
	4	**Ridomil Gold SL** **Ultra Flourish** (mefenoxam)	**Ridomil:** 1 pt **Ultra:** 2 pt	**Ridomil:** 3 pt **Ultra:** 6 pt	7	2*	Do not apply more than 1.5 lb mefenoxam/A per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4 + M1	**Ridomil Gold Copper 64.8 W** (mefenoxam + copper hydroxide)	2.5 lb	10 lb	7	2	Use Ridomil Gold EC on soil preplant or at planting. Make up to 2 additional applications. Use 1 pt/A and apply at a 30-day interval.
(suppression)	11	**Reason 500 SC** (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Ground application only. Must alternate with a fungicide from a different FRAC group. See supplemental label for restrictions and details.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	3.4 lb	20.5 lb	7	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
(suppression)	11 + 27	**Tanos** (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank-mix with contact fungicides. Tank-mix or rotate with a fungicide from a different FRAC group.
	21	**Ranman** (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Limit is 6 applications per crop. Must be rotated with an effective fungicide from a different FRAC group. See label for application instructions, including the recommended use of specific surfactants.
	21	**Segway O** **Ranman** (cyazofamid)	3.2 fl oz/100 gal	13.5 fl oz/plant	0	-	**Greenhouse production only;** apply at transplant or up to first fruit set, followed by second application 42 days later. Soil drench only. Do not use any surfactant.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	22	**Elumin** (ethaboxam)	8 fl oz	16 fl oz	2	0.5	Limit is 2 applications per year, with at least 14 days between applications. Do not apply sequentially. Alternate with an effective fungicide from a different FRAC group. See label of additional instructions for foliar and soil applications.
	28	**Bruin** **Previcur Flex** **Promess** (propamocarb hydrochloride)	**SEE INDIVIDUAL LABELS**		5	0.5	**Greenhouse application:** 6 appl./ crop cycle. Do not mix with other products. Can cause phytotoxicity if applied in intense sunlight.
	28	**Bruin** **Previcur Flex** **Promess** (propamocarb hydrochloride)	1.2 pt	6 pt	5	0.5	**Field application:** Apply prior to infection when conditions are favorable for disease.
	29	**Lektivar** (fluazinam)	24 fl oz	144 fl oz	30	0.5	May be applied at transplanting. Begin foliar applications 7 days after transplant.
	29	**Omega** (fluazinam)	1.5 pt	9 pt	30	0.5	May be applied at transplanting. Begin foliar applications 7 days after transplant.
	33	**Aliette 80 WDG** (fosetyl-al)	5 lb	20 lb	14	0.5	See label for warnings concerning the use of copper compounds.
	40	**Forum** (dimethomorph)	6 oz	30 oz	0	0.5	Apply with another fungicide from a different FRAC group.
(suppression)	40	**Micora** (mandipropamid)	8 fl oz/5,000 sq ft	16 fl oz/5,000 sq ft	N/A	4 hr	Micora is only labeled for transplant and retail sale to consumers.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	No more than 2 sequential appl. Alternate with another effective fungicide. See label.
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz	2	0.5	4 applications per season; no more than 2 sequential applications. 10-day spray interval. Tank-mix with another labeled non-FRAC code 43 fungicide; 18-month rotation with off-label crops.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
	45 + 40	**Zampro** (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Addition of a spreading or penetrating adjuvant is recommended to improve performance. Limit of 3 applications per season.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	3	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	55 fl oz	55 fl oz	0	2	Soil applications cannot be combined or followed by foliar applications of Orondis Opti or Orondis Ultra. Not labeled for greenhouse use.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8.0 fl oz	32 fl oz	1	4 hr	Do not use Orondis Ultra following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Ultra should not exceed more than 33% of the total foliar fungicide applications or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
Pythium damping-off, Pythium root rot, or Pythium seedling blights (*Pythium* spp.)	4	**Allegiance-FL** **Acquire** (metalaxyl)	0.75 fl oz/100 lb seed	-	-	-	Seed treatment only
	4	**Apron XL** (mefanoxam)	0.64 fl oz/100 lb seed	-	-	-	Seed treatment only
	4	**Metastar 2E** **ReCon 4F** **Xyler FC** (metalaxyl)	**Metastar:** 8 qt **ReCon:** 4 qt **Xyler:** 4 qt	**Metastar:** 12 qt **ReCon:** 6 qt **Xyler:** 4.3 qt	2	7	Must be soil applied. See labels.
	4	**Ridomil Gold SL** **Ultra Flourish** (mefenoxam)	**Ridomil:** 1 pt **Ultra:** 2 pt	**Ridomil:** 3 pt **Ultra:** 6 pt	7	2*	Do not apply more than 1.5 lb mefenoxam/A per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4 + M1	**Ridomil Gold Copper 64.8 W** (mefenoxam + copper hydroxide)	2.5 lb	10 lb	7	2	Use Ridomil Gold EC on soil preplant or at planting. Make up to 2 additional application. Use 1 pt/A, and apply at a 30-day interval.
(suppression)	12	**Maxim 4 FS** (fludioxonil)	0.16 fl oz/100 lb seed	-	-	-	Seed treatment only
	21	**Ranman** **Segway O** (cyazofamid)	3.2 fl oz/100 gal	13.5 fl oz/plant	0	-	**Greenhouse production only;** apply at transplant or up to first fruit set, followed by second application 42 days later. Soil drench only. Do not use any surfactant.
	28	**Bruin** **Previcur Flex** **Promess** (propamocarb hydrochloride)	1.2 pt	6 pt	5	0.5	Apply prior to infection when conditions are favorable for disease. See label for greenhouse applications.
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	55 fl oz	55 fl oz	7	2	Soil applications cannot be combined or followed by foliar applications of Orondis Opti or Orondis Ultra. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
Rhizoctonia solani	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	11	(azoxystrobin) **Many brands available:** AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	**Cabrio 2.08 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicides/season.
	14	**Par-Flo 4F** (PCNB)	12 fl oz/100 gal	2 appl.	Soil drench	0.5	Limited to only container-grown plants in nurseries or greenhouse.
Southern blight (*Sclerotium rolfsii*)	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
(suppression)	7+ 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-to-10-day interval before rotating to a non-FRAC group 7 fungicide. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	11	**Aftershock** **Evito** **Tepera** (fluoxastrobin)	**Aftershock, Evito:** 5.7 fl oz **Tepera:** 12.6 fl oz	**Aftershock, Evito:** 22.8 fl oz **Tepera:** 12.6 fl oz	3	0.5	Limit is 4 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	**Cabrio 2.08 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicides/season.
	11 + IRAC 3	**Tepera Plus** (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	7	0.5	Contains bifenthrin insecticide. Limit is 4 appl./year. Minimum 7-day interval. No use in greenhouse.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Appl.	Season[2]	Harvest	Reentry	
(suppression)	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	14	**Blocker 4F** **Terraclor 75 WP** (PCNB)	**SEE INDIVIDUAL LABELS**		Soil treatment at planting	0.5	See label for application type and restrictions.
White mold (*Sclerotinia sclerotiorum*) (suppression)	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per a year.
	11	**Cabrio 2.08 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 applications of Cabrio or other group 11 fungicide/season.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants. White mold suppression only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per a season (or crop cycle) to a maximum rate per a year.

[3] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 13.5. Nonfumigant nematicides for peppers in Florida.

Product	Application Directions
Vydate L (a.i. oxamyl)	Apply ½ to 1 gal/acre at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. Do not apply more than 3 gallons per acre per season. Minimum retreatment interval is 7 days unless a longer interval is stated. Do not make more than 8 applications per season.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints (56.0 to 80.0 fl oz) per acre a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop and no more than 112 fl oz of product per acre per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/acre using only chemigation into root zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Observe minimum 5-day interval between soil applications. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Vydate is an insecticide/nematicide; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations for how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 13.6. Fumigant nematicides for peppers in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/ chisel-spaced 12" apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone InLine[2,3]	13 to 20.5 gal	-	For drip fumigation, consult the product label for overall rate, drip concentration, and flow-modifying application directions.
Pic Clor 60[2,3]	19.5 to 31.5 gal	57 to 90	Consult product label for overall rate and chisel flow-modifying application directions.
Pic Clor 60 EC[2,3]	19.5 to 31.5 gal	-	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Vapam HL	75 gal	-	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions.

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See label details for additional use restrictions based on soil characteristics, buffer zones, requirements for personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and rate-modifying recommendations with use of highly retentive Totally Impermeable mulch films (TIF).
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS733

doi.org/10.32473/edis-cv131-2022

Chapter 14. Potato Production[1]

Lincoln Zotarelli, Peter J. Dittmar, Pamela D. Roberts, Johan Desaeger, and Bonnie Wells[2]

Botany and Planting

Potato—*Solanum tuberosum*, Solanaceae

Table 1. Planting information for potato.

Planting Dates	
North Florida	Jan–Feb
Central Florida	Nov–Feb
South Florida	Oct–Jan
Planting Information	
Distance between rows (inch)	36–42
Distance between plants (inch)	7–10
Planting depth (inch)	3–4
Average seed piece size (oz)	2.5–3.0
Average seed per planted acre (lb)	2000–3000
Days from planting to tuber maturity	85–110

Cultivars

The University of Florida Potato Variety Evaluation Program screens new germplasm from public and private breeding programs and identifies the most promising cultivars for commercial potential, considering broad adaptability to Florida climate and conditions and market purpose: processing, fresh-market, and specialty-type varieties. The Florida Potato Variety Trial Report is available at https://hos.ifas.ufl.edu/extension/variety-trials/. A summary of the most popular potato clones for Florida is presented below. Key reference: total yield: high >300 cwt/A, medium-high 250–299 cwt/A; medium 200–249 cwt/A; low-medium 150–199 cwt/A. Tuber specific gravity (SG): high >1.075, medium-high 1.070–1.074, medium 1.065–1.069, low <1.064.

1. Chipping Types

Atlantic. Mid-season, high yield, high SG. Mostly round; shallow eye depth; tan skin color; cream flesh; good appearance; susceptible to internal heat necrosis and hollow heart. https://edis.ifas.ufl.edu/publication/HS1278

Elkton. Mid-season, high yield, medium-high SG. Mostly oblong; shallow eye depth; white skin color; white flesh; good appearance. https://edis.ifas.ufl.edu/publication/HS1237

Harley Blackwell. Mid–late season, high yield, high SG. Mostly round; shallow eye depth; tan skin color; white flesh; good appearance. https://edis.ifas.ufl.edu/publication/HS1298

1. This document is HS733. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Lincoln Zotarelli, associate professor, Horticultural Sciences Department; Peter J. Dittmar, associate professor, Horticultural Sciences Department; Pamela D. Roberts, professor, Plant Pathology Department, UF/IFAS Southwest Florida Research and Education Center; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; and Bonnie Wells, Extension agent II, UF/IFAS Extension Brevard County; UF/IFAS Extension, Gainesville FL 32611.

Lamoka. Mid–late season, medium-high yield, medium SG. Round to oblong; intermediate eye depth; tan skin color; cream flesh; fair to good appearance.

Pike. Late season; medium-high yield; medium-high SG. Round to oblong; shallow eye depth; buff skin color; white flesh; good appearance.

Snowden. Mid-season; high-yield, high SG. Round; intermediate eye depth; tan skin color; white flesh; fair to good appearance. https://edis.ifas.ufl.edu/publication/HS1286

Superior. Mid-season; medium-yield; medium SG. Round to oblong; intermediate eye depth; buff skin color; white flesh; fair to good appearance.

2. All-Purpose Types

LaChipper. Mid-season; high yield; medium SG. Round to oblong; intermediate eye depth; white skin and white flesh; good appearance. https://edis.ifas.ufl.edu/publication/HS1297

Marcy. Mid–late season; high yield; low SG. Round to oblong; shallow eye depth; buff skin color; white flesh; good appearance. https://edis.ifas.ufl.edu/publication/HS1277

Sebago. Early–mid season; high yield; medium SG. Mostly oblong; intermediate eye depth; buff skin color; white flesh; good appearance.

3. Fresh-Market/Table Types—Whites/Yellows

Almera. Early–mid season; high yield; low SG. Oblong to long; intermediate eye depth; buff skin color; light yellow flesh; good appearance.

Colomba. Mid-season; high yield; low SG. Mostly oblong; very shallow eye depth; cream skin color and light yellow flesh; excellent appearance.

Coronada. Mid-season; medium-high yield; low SG. Mostly oblong; very shallow eye depth; white skin color and light-yellow flesh; excellent appearance.

Electra. Mid-season; high yield; low SG. Round to oblong; shallow eye depth; white skin and white flesh; good appearance.

Fabula. Mid–late season. Medium-high yield; low SG. Mostly oblong; shallow eye depth; white-cream skin color; light yellow flesh; good appearance. https://edis.ifas.ufl.edu/publication/HS1294

Francisca. Mid–late season. Medium-high yield; low SG. Round to oblong; shallow eye depth; buff skin color; light yellow flesh; good appearance.

Jelly. Early–mid season; high yield; low SG. Round to oblong; shallow eye depth; cream skin color and dark-yellow flesh; good to excellent appearance.

Malou. Mid–late season; high yield; low SG. Round to oblong; intermediate eye depth; white skin color; medium-yellow flesh; good to excellent appearance.

Natasha. Mid-season; medium-high yield; low SG. Mostly oblong; shallow eye depth; cream skin color; light-yellow flesh; excellent appearance.

Satina. Mid-season; medium-high yield; low SG. Round to oblong; shallow eye depth; cream skin color; medium-yellow flesh; good to excellent appearance.

4. Fresh-Market/Table Types—Reds

Cerata. Early–mid season; high yield; low SG. Round to oblong; shallow eye depth; pink skin and white flesh; good to excellent appearance.

Chieftain. Mid–late season; high yield; low SG. Round to oblong; intermediate eye depth; red skin and white flesh; fair to good appearance

LaRouge. Early–mid season; high yield; medium SG. Round to oblong; intermediate eye depth; pink-red skin; white flesh; fair to good appearance.

Red Lasoda. Mid–late season; medium yield; low SG. Mostly oblong; intermediate to deep eye depth; red skin; white flesh; good appearance.

Strawberry Paw. Mid–late season; high yield; low SG. Round to oblong; shallow eye depth; red skin; cream flesh; good appearance.

5. Fresh-Market/Table Types—Purples

Adirondack Blue. Mid–late season; medium yield; medium SG. Oblong to long; intermediate eye depth; purple skin; purple flesh; fair to good appearance. https://edis.ifas.ufl.edu/publication/HS1293

All Blue. Mid–late season; medium yield; medium SG. Oblong to long; intermediate eye depth; purple skin; purple flesh; fair to good appearance.

Michigan Purple. Mid–late season; high yield; medium SG. Mostly oblong; intermediate eye depth; purple skin; white flesh; good appearance.

Peter Wilcox. Mid–late season; medium-high yield; medium SG. Round to oblong; intermediate eye depth; purple skin; medium-yellow flesh; good appearance. https://edis.ifas.ufl.edu/publication/HS1295

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 2. Herbicides approved for managing weeds in potato. Contact: Peter J. Dittmar, UF/IFAS Horticultural Sciences Department.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		***** PREPLANT/PREEMERGENCE *****	
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Dimethenamid-p 0.56–0.84	(Outlook) 6 L 12–18 fl oz	15	Apply after planting or drag-off. Consult label for exact rates based on soil texture. In cold, wet conditions, delayed crop emergence or stunting may occur. PHI 40 days.
EPTC 1	(Eptam) 20 G 15 lb	8	Broadleaf and grass weeds and nutsedge. Apply preplant or after drag-off. Incorporate mechanically or with irrigation 2–4 in. deep. Do not apply the emulsifiable formulation preemergence in winter and early spring potatoes.
Flumioxazin 0.05	(Chateau) 51 WDG 1.5 oz	14	Annual broadleaf weeds. Apply after hilling with a minimum of 2 in. of soil covering the vegetative portion of the potato plant. Should be tank-mixed with other herbicides, especially for grass control.
Fomesafen 0.25	(Reflex, Ringside) 2 EC 1.0 pt	14	Annual broadleaf and grass weeds. Effectiveness reduced if later cultural practices expose untreated soil. Can be applied after drag-off and before crop emergence. Variety tolerance may vary; test on a small sample before application to the entire field. PHI 7 days.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
Imazosulfuron 0.19–0.3	(League) 75 WG 4–6.4 oz	2	Broadleaf and grass weeds. Limit of 2 applications per year and no more than 6.4 oz/A per year.
Linuron 0.75–1.25	(Lorox DF) 50 DF 1.5–2.5 lb (Linex) 4 L 1–1.6 pt	7	Apply after final drag-off. If weeds are present, include a NIS. Best results are obtained in moist fields at application followed by rain or irrigation within 2 weeks.
Metribuzin 0.25–1.0	(Tricor DF) 75 DF 0.3–1.3 lb	5	Annual broadleaf weeds. Apply after drag-off but before crop emergence. Do not incorporate. Use lower rates on sandy soil.
Metribuzin + S-metolachlor	(Boundry) 6.5 EC 1.5–2.0 pt	5 + 15	Broadleaf and grass weeds. Apply before potato emergence. This includes drag-off. Do not incorporate.
Paraquat 0.25–0.5	(Gramoxone) 2 SL 1.0–2.0 pt (Firestorm) 3 SL 0.7–1.3 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Apply up to ground cracking before potatoes have emerged. Use a nonionic surfactant.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with soil residual compounds.
Pendimethalin 0.75	(Prowl H20) 3.8 1.5 pt	3	Annual broadleaf and grass weeds. Apply after planting but before potatoes and weeds emerge or after drag-off. Incorporate with rainfall or mechanically into the top 1–2 inches of soil within 7 days. Do not use on peat or muck soils.
Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
Pyroxasulfone 0.08–0.11	(Zidua Herbicide) 1.5–2.0 oz	15	Broadleaf and grass weeds. Apply after drag-off and before potato and weed emergence. No PHI between a preemergence application and harvest. Efficacy is decreased if the untreated soil is exposed.
Rimsulfuron 0.016–0.023	(Matrix) 25 DF 1.0–1.5 oz	2	Apply immediately after drag-off. Rainfall or sprinkler irrigation 0.3–1.0 inches required with 5 days after application. Do not exceed 2.0 oz/A per year.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
S-metolachlor 0.95–1.9	(Dual Magnum) 7.62 EC 1.0–2.0 pt	15	Annual broadleaf and grass weeds. Apply after drag-off before crop and weed emergence. If cool, wet soil conditions occur after application, a delay in maturity and/or reduced yield may occur. PHI 60 days.
Sulfentrazone 0.09–0.14	(Willowood sulfentrazone) 4SC 3.0–4.5 fl oz	14	Broadleaf and grass weed control. Nutsedge suppression. Do not apply on sands with less than 1% organic matter. Do not apply more than 8 fl oz/A within a 12-month period. Should be trialed on a small area to find suitable rate for the soil type in your area.
Trifluralin 0.5	(Trust, Treflan TR-10) 10 G 5 lb (Trifluralin, Treflan) 4 L 1 pt	3	Broadleaf and grass weeds. Apply after drag-off or prior to crop emergence. Incorporate the herbicide into the soil profile. If applied after plant emergence, do not allow soil contact with the emerged plants.
***** POSTEMERGENCE *****			
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl oz (Aim) 2.0 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use a COC or NIS at recommended rates. May be tank-mixed with other herbicides. Do not exceed 6.1 fl oz per cropping season. PHI 7 days.
Clethodim 0.09–0.25 0.07–0.25	(Arrow, Select) 2 EC 6–16 fl oz (Select Max) 1 EC 9–32 fl oz	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat application 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Nonionic surfactant with Select Max. PHI 30 days.
EPTC 3 3.1–7.9	(Eptam) 20 G 15 lb (Eptam) 7 E 3.5 to 9 pt	8	Annual broadleaf, grass weeds, and nutsedge. Apply at layby to a clean cultivated soil. Incorporate mechanically or with irrigation. Apply Eptam 7 E after true leaves have formed and apply as a layby treatment. Do not exceed 12.25 lb a.i. per season. PHI 45 days.
Imazosulfuron 0.19–0.3	(League) 75 WG 4–6.4 oz	2	Broadleaf and grass weeds. Limit of 2 applications per year and no more than 6.4 oz/A per year. PHI 45 days.
Metribuzin 0.23–0.5	(Tricor) 75 DF 0.3–0.6 lb	5	Broadleaf and grass weeds. Do not apply to early smooth-skinned, red-skinned, and other specified varieties on the label. Do not exceeded 1.3 lb of product /A. PHI 60 days.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
Rimsulfuron 0.016–0.023	(Matrix) 25 DF 1.0–1.5 oz	2	Apply immediately after drag-off. Rainfall or sprinkler irrigation 0.3–1.0 inches required within 5 days after application. Apply as a sequential treatment 14 to 28 days after the first application. Do not exceed 2.0 oz/A per year.
Sethoxydim 0.28–0.47	(Poast) 1.5 EC 1.5–2.5 pt	1	Control growing grass weeds. A total of 5.0 pt/A applied in one season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grass under stress. PHI 30 days.

Table 3. Insecticides approved for management of arthropod pests of potato. Contact: Bonnie Wells, UF/IFAS Extension Brevard County.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1A	***Lannate LV; *SP** (methomyl)	**LV**: 1.5–3.0 pt **SP**: 0.5–1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	1B	**Dimethoate 4EC** (dimethoate)	0.5–1.0 pt	48	**Mechanically harvested**: 0 **Otherwise**: 14	Highly toxic to bees. Do not apply more than 2 pt per acre per year.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–2.5 pt **8F**: 1–1.5 pt	12	0	Maximum of two applications per year.
	3A	***Ambush 25W** (permethrin)	3.2–12.8 oz	12	14	Do not apply more than 1.6 lb active ingredient per season (102.4 oz).
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9–9.6 fl oz	12	7	Do not apply more than 0.35 lb a.i./acre per season (7 applications at highest rate).
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 oz	12	1	A maximum of 24 fl oz/acre per season may be applied.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	14	Do not apply more than 0.8 lb a.i./ acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	14	Toxic to bees. Do not use following soil application of other Group 4A insecticides. Maximum 6 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 5.7–8.7 fl oz **Seed piece treatment:** 3.5–7.0 fl oz/100 lb seed **Foliar**: 1.3 fl oz	12	**At planting**: see label for options. **Foliar**: 7	Do not apply more than 0.31 lb a.i. per acre per season. Seed piece rate is based on seeding rate of 2000 lb/acre. **Foliar**: Maximum for foliar applications per year: 5.6 fl oz.
	4A	**Assail 30SG** (acetamiprid)	1.5–4.0 oz	12	7	Do not make more than 4 applications per season. Do not exceed a total of 0.3 lb a.i. (16 oz of product) per acre per season.
	4A	**Belay Insecticide** (clothianidin)	**In-furrow or sidedress application:** 9–12 fl oz **Foliar**: 2–3 fl oz	12	**Soil**: at planting, sidedress, or hilling **Foliar**: 14	See label for in-furrow, sidedress, and seed-piece applications. Do not apply during bloom or allow to drift to flowering plants. Toxic to bees for five days after application.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	4A	**Platinum 75SG** (thiamethoxam)	1.66–2.67 oz	12	Applied at planting or at plant emergence.	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 2–2.75 fl oz **Soil**: 11.5–13.25 fl oz	12	**Foliar**: 7 **Soil**: see label	Apply as foliar or soil application, but not both. Maximum per acre per season for foliar use: 8 fl oz. Maximum when applied to soil: 13.25 fl oz. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar**: 1–1.5 oz **Soil**: 6.5–7.5 oz	12	**Foliar**: 7 **Soil**: at planting	Do not apply more than 4.5 oz per acre per season to foliage. One soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A + 3A	**Leverage** (imidacloprid + cyfluthrin)	3–3.75 fl oz		7	Leverage should not be used in fields treated with Admire Pro or other 4A products. There have been reports of low levels of resistance to imidacloprid. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed-piece treatments. Utilize crop rotation and insecticide rotation to minimize Colorado potato beetle resistance.
	4C	**Transform WG** (sulfoxaflor)	0.75–1.0 oz	24	7	Bloom and tank-mix restrictions apply. Maximum amount 8.5 oz/acre per season.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Minimum interval between applications = 7 days.Maximum amount per year = 28 fl oz/acre.
	9B	**Fulfill** (pymetrozine)	2.75–5.5 oz	12	14	Apply when aphids first appear. Do not exceed 11.0 oz per acre per season.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	12	7	7 days before reapplication. Maximum of 9.6 fl oz rate per season.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	12	1	Do not apply until 14 days after emergence. Maximum of 42 fl oz/acre per season.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	28	**Exirel** (cyazypyr)	13.5–20.5 fl oz	12	1	Do not apply more than 0.4 lb a.i./acre of cyazypyr- or cyantraniliprole-containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	28	**Verimark** (cyazypyr)	**Soil:** 13.5 fl oz at planting	4	N/A—applied at planting	See label for diamondback moth resistance management.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	7	Begin applications before pest populations reach damaging levels. Do not apply more than 8.4 oz/acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Compatible as a tank mix with some fungicides.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–2 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Compatible as a tank mix with some fungicides.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Insect growth regulator and antifeedant. OMRI-listed.[2]
	-	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2–3 qt	4	0	Treat when threshold reached.
	-	**Suffoil-X** (mineral oil)	1%–2% v/v	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.[2]
Beetles: blister beetles, flea beetles, Colorado potato beetles, cucumber beetles, white-fringed beetles	1A	***Lannate LV; *SP** (methomyl)	**LV**: 1.5–3.0 pt **SP**: 0.5–1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	1A	**Sevin XLR, 4F; 80S** (carbaryl)	**XLR, 4F**: 0.5–2.0 qt **80S**: 0.63–2.5 lb	12	7	Do not apply more than a total of 6 qt (4F, XLR) or 7.5 lb (80S).
	1B	**Imidan 70 W** (phosment)	1.3 lb	5 days	7	Use only on potatoes to be harvested by machine. Do not apply where bees are foraging.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	1B	***Thimet 20 G** (phorate)	See label—varies with soil type and time of application.	48	90	One application per season
	3A	***Ambush 25W** (permethrin)	3.2–12.8 oz	12	14	Do not apply more than 1.6 lb active ingredient per season (102.4 oz).
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9–9.6 fl oz	12	7	Do not apply more than 0.35 lb a.i./acre per season (7 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.
	3A	***Brigade 2 EC** (bifenthrin)	**Soil**: 9.6–19.2 oz at plant and 3.2–9.6 oz at lay-by **Foliar**: 2.1–6.4 oz	12	21	No more than 2 foliar applications, at least 21 days apart. Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 oz	12	1	A maximum of 24 fl oz/acre per season may be applied. Consult label for use rate on specific species.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	14	Do not apply more than 0.8 lb a.i./ acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	24	14	Do not apply more than 27.0 fl oz of product per acre per season.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	14	Toxic to bees. Do not use following soil application of other Group 4A insecticides. Maximum 6 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	**Soil**: 5.7–8.7 fl oz **Seed piece**: 3.5–7.0 fl oz/100 lb seed **Foliar**: 1.3 fl oz	12	**At planting:** see label for options **Foliar**: 7	Do not apply more than 0.31 lb a.i. per acre per season. Seed piece rate is based on seeding rate of 2000 lb/acre. **Foliar**: Maximum for foliar applications per year: 5.6 fl oz.
	4A	**Assail 30SG** (acetamiprid)	1.5–4.0 oz	12	7	Do not make more than 4 applications per season. Do not exceed a total of 0.3 lb a.i. (16 oz of product) per acre per season.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	4A	**Belay Insecticide** (clothianidin)	**In-furrow or sidedress**: 9–12 fl oz **Foliar**: 2–3 fl oz	12	**Foliar**: 14 **At planting or sidedress or spray:** at ground crack over row at hilling	See label for in-furrow, sidedress, and seed-piece applications. Do not apply during bloom or allow to drift to flowering plants. Toxic to bees for five days after application.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–2.67 oz	12	applied at planting or at plant emergence	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 2–2.75 fl oz **Soil**: 11.5–13.25 fl oz	12	**Foliar**: 7 **Soil**: see label	Apply as foliar or soil application, but not both. Maximum per acre per season for foliar use: 8 fl oz. Maximum when applied to soil = 13.25 fl oz. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar**: 1–1.5 oz **Soil**: 6.5–7.5 oz	12	**Foliar**: 7 **Soil**: at planting	Do not apply more than 4.5 oz per acre per season to foliage. One soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4 oz	12	14	No more than two applications.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Minimum interval between applications = 7 days. Maximum amount per year = 28 fl oz/acre.
	5	**Entrust SC** (spinosad)	3–10 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more 21 fl oz per acre per season or more than 4 times/crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	4.5–8 fl oz	4	7	No more than 4 applications per year.
	15	**Rimon 0.83EC** (novaluron)	6–12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Does not affect adult insects.
	17	**Trigard** (cyromazine)	2.66–5.32 oz	12	7	Most effective for control of 1st and 2nd instar larvae. Does not control adult CPB. Use lower rate for leafminers. Maximum per acre per season: 1.0 lb.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	12	1	Do not apply until 14 days after emergence. Maximum of 42 fl oz/acre per season.
	22	**Avaunt eVo** (indoxacarb)	2.5–6.0 oz	12	7	Do not apply more than 24 oz/acre per crop.
	28	**Coragen** (rynaxypyr)	3.5–5.0 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	28	**Verimark** (cyazypyr)	6.75–13.5 fl oz	4	N/A—applied at planting	Do not apply more than 13.5 fl oz per acre at planting. pH of application solution must be between 4 and 6.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
		Kryocide (cryolite)	10–12 lb	12	0	Application to exposed tubers may result in excess residues.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Suffoil-X** (mineral oil)	1%–2% v/v	4	0	OMRI-listed.[2]
Caterpillars; armyworms, webworms, cutworms, loopers, corn earworms	1A	***Lannate LV; *SP** (methomyl)	**LV**: 1.5–3.0 pt **SP**: 0.5–1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	1A	**Sevin XLR, 4F; 80 S** (carbaryl)	**XLR, 4F**: 0.5–2.0 qt **80S**: 0.63–2.5 lb	12	7	Do not apply more than a total of 6 qt (4F, XLR) or 7.5 lb (80S).
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9–9.6 fl oz	12	7	Do not apply more than 0.35 lb a.i./acre per season (7 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 oz	12	1	A maximum of 24 fl oz/acre per season may be applied. Consult label for use rate on specific species.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	14	Do not apply more than 0.8 lb a.i./ acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.
	5	**Entrust SC** (spinosad)	3–10 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more 21 fl oz per acre per season or more than 4 times/crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	4.5–8 fl oz	4	7	No more than 4 applications per year.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. For organic production.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	6–12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Does not affect adult insects.
	22	**Avaunt eVo** (indoxacarb)	2.5–6.0 oz/A	12	3	No more than 4 applications per year.
	22	**Avaunt 30WG** (indoxacarb)	2.5–6.0 oz/A	12	7	Do not apply more than 24 oz/acre per crop.
	28	**Coragen** (rynaxypyr)	3.5–7.5 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.
	28	**Exirel** (cyazypyr)	10–17 fl oz/A	12	1	Do not apply more than 0.4 lb a.i./acre of cyazypyr- or cyantraniliprole-containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
	28 + 6	**Minecto Pro** (cyantraniliprole + abamectin)	5.5–10 fl oz/A	12	7	Must add an adjuvant. Check label for use requirements.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Insect growth regulator and antifeedant. OMRI-listed.[2]
European corn borer	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	4.5–8 fl oz	4	7	No more than 4 applications per year.
	22	**Avaunt eVo** (indoxacarb)	2.5–3.5 oz/A	12	3	No more than 4 applications per year.
	22	**Avaunt 30WG** (indoxacarb)	2.5–6.0 oz/A	12	7	Do not apply more than 24 oz/A per crop
	28	**Coragen** (rynaxypyr)	3.5–7.5 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.
	28	**Exirel** (cyazypyr)	5–20.5 fl oz/A **CPG:** 5–13.5 fl oz/A **Flea beetles:** 13.5–20.5 fl oz/A	12	1	Do not apply more than 0.4 b a.i./acre of cyazypyr- or cyantraniliprole-containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
Fire ants	6	**Clinch** (abamectin)	1 lb	12	0	Apply when ants are actively foraging. Apply after dew or rainfall has dried for maximum effectiveness. Do not apply if rainfall is anticipated within 4–6 hours. No more than 4 applications per year.
	7A	**Extinguish** (S-methoprene)	1.0–1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after 3 weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Leaf-footed bugs, plant bugs, stink bugs, mealybugs, false chinch bugs	1A	**Sevin XLR, 4F; 80S** (carbaryl)	**XLR, 4F**: 0.5–2.0 qt **80S**: 0.63–2.5 lb	12	7	Do not apply more than a total of 6 qt (4F, XLR) or 7.5 lb (80S).
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–2.5 pt **8F**: 1–1.5 pt	12	0	Maximum of two applications per year.
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9–9.6 fl oz	12	7	Do not apply more than 0.35 lb a.i./acre per season (7 applications at highest rate).
	3A	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.
	3A	***Mustang** (zeta-cypermethrin)		12	1	A maximum of 0.3 lb a.i./acre per season may be applied.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	14	Do not apply more than 0.8 lb a.i./acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	24	14	Do not apply more than 27.0 fl oz of product per acre per season.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	14	Toxic to bees. Do not use following soil application of other Group 4A insecticides. Maximum 6 oz/acre per season.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	7	Begin applications before pest populations reach damaging levels. Do not apply more than 8.4 oz/acre per season.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
Leafhoppers	1A	***Lannate LV; *SP** (methomyl)	**LV**: 1.5–3.0 pt **SP**: 0.5–1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	1A	**Sevin XLR, 4F; 80 S** (carbaryl)	**XLR, 4F**: 0.5–2.0 qt **80S**: 0.63–2.5 lb	12	7	Do not apply more than a total of 6 qt (4F, XLR) or 7.5 lb (80S).
	1B	**Dimethoate 4EC** (dimethoate)	0.5–1.0 pt	48	**Mechanically harvested:** 0 **Otherwise:** 14	Highly toxic to bees. Do not apply more than 2 pt per acre per year.
	1B	**Imidan 70 W** (phosment)	1.3 lb	5 days	7	Use only on potatoes to be harvested by machine. Do not apply where bees are foraging.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–2.5 pt **8F**: 1–1.5 pt	12	0	Maximum of two applications per year.
	1B	***Thimet 20 G** (phorate)	See label—varies with soil type and time of application.	48	90	One application per season.
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9–9.6 fl oz	12	7	Do not apply more than 0.35 lb a.i./acre per season (7 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 oz	12	1	A maximum of 24 fl/acre per season may be applied.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	14	Do not apply more than 0.8 lb a.i./ acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	24	14	Do not apply more than 27.0 fl oz of product per acre per season.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	4A	**Admire Pro** (imidacloprid)	**Soil**: 5.7–8.7 fl oz **Seed piece**: 3.5–7.0 fl oz/100 lb seed **Foliar**: 1.3 fl oz	12	**At planting:** see label for options. **Foliar**: 7	Do not apply more than, 0.31 lb a.i. per acre per season. Seed-piece rate is based on seeding rate of 2000 lb/acre. **Foliar**: Maximum for foliar applications per year: 5.6 fl oz.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–2.67 oz	12	Applied at planting or at plant emergence	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar**: 2–2.75 fl oz **Soil**: 11.5–13.25 fl oz	12	**Foliar**: 7 **Soil**: see label	Apply as foliar or soil application, but not both. Maximum per acre per season for foliar use: 8 fl oz. Maximum when applied to soil = 13.25 fl oz. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar**: 1–1.5 oz **Soil**: 6.5–7.5 oz	12	**Foliar**: 7 **Soil**: at planting	Do not apply more than 4.5 oz per acre per season to foliage. One soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4 oz	12	14	No more than two applications.
	4C	**Transform WG** (sulfoxaflor)	0.75–1.0 oz	24	7	Bloom and tank-mix restrictions apply. Maximum amount 8.5 oz/A per season.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Minimum interval between applications = 7 days. Maximum amount per year = 28 fl oz/acre.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	12	1	Do not apply until 14 days after emergence. Maximum of 42 fl oz/acre per season.
	28 + 6	**Minecto Pro** (cyantraniliprole + abamectin)	5.5–10 fl oz/A	12	7	Must add an adjuvant. Check label for use requirements.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal	4	0	See label for tank-mix cautions. Organic Stylet-Oil is OMRI-listed.[2]

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
Leafminer	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	5	**Entrust SC** (spinosad)	3–10 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more 21 fl oz per acre per season or more than 4 times/crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	4.5–8 fl oz	4	7	No more than 4 applications per year.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	14	No more than 2 sequential applications. Must be applied with nonionic activator-type wetting, spreading, or penetrating adjuvant. See label for resistance management.
	17	**Trigard** (cyromazine)	2.66–5.32 oz	12	7	Most effective for control of 1st and 2nd instar larvae. Does not control adult CPB. Use lower rate for leafminers. Maximum per acre per season: 1.0 lb.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	12	1	Do not apply until 14 days after emergence. Maximum of 42 fl oz/ acre per season.
	28	**Coragen** (rynaxypyr)	3.5–5.0 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.
	28 + 6	**Minecto Pro** (cyantraniliprole + abamectin)	5.5–10 fl oz/A	12	7	Must add an adjuvant. Check label for use requirements.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**Suffoil-X** (mineral oil)	1%–2% v/v	4	0	OMRI-listed.[2]
	-	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal	4	0	See label for tank-mix cautions. Organic Stylet-Oil is OMRI-listed.[2]
Mites	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	14	No more than 2 sequential applications. Must be applied with nonionic activator-type wetting, spreading, or penetrating adjuvant. See label for resistance management.
	23	**Oberon 2SC** (spiromesifen)	8–16 fl oz	12	7	Maximum amount per crop: 32.0 fl oz/acre. Maximum applications: 2.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal	4	0	See label for tank-mix cautions. Organic Stylet-Oil is OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.[2]
Potato tuberworm	1A	***Lannate LV; *SP** (methomyl)	**LV**: 1.5–3.0 pt **SP**: 0.5–1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	3A	***Ambush 25W** (permethrin)	3.2–12.8 oz	12	14	Do not apply more than 1.6 lb active ingredient per season (102.4 oz).
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9–9.6 fl oz	12	7	Do not apply more than 0.35 lb a.i./acre per season (7 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.
	3A	***Pounce 25 WP** (permethrin)	6.4–12.8 oz	12	14	Do not apply more than 0.8 lb a.i./ acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	24	14	Do not apply more than 27.0 fl oz of product per acre per season.
	15	**Rimon 0.83EC** (novaluron)	6–12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Does not affect adult insects.
	28	**Coragen** (rynaxypyr)	3.5–5.0 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.
Thrips	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed.[2]
	5	**Entrust SC** (spinosad)	3–10 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more 21 fl oz per acre per season or more than 4 times/crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	4.5–8 fl oz	4	7	No more than 4 applications per year.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	12	1	Do not apply until 14 days after emergence. Maximum of 42 fl oz/ acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Compatible as a tank mix with some fungicides.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Compatible as a tank mix with some fungicides.
	-	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal	4	0	See label for tank-mix cautions. Organic Stylet-Oil is OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.[2]
Whiteflies	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	14	Toxic to bees. Do not use following soil application of other Group 4A insecticides. Maximum 6 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	**Soil**: 5.7–8.7 fl oz **Seed piece**: 3.5–7.0 fl oz/100 lb seed **Foliar**: 1.3 fl oz	12	**At planting**: see label for options **Foliar**: 7	Do not apply more than 0.31 lb a.i. per acre per season. Seed piece rate is based on seeding rate of 2000 lb/acre. **Foliar**: Maximum for foliar applications per year: 5.6 fl oz.
	4A	**Assail 30SG** (acetamiprid)	1.5–4.0 oz	12	7	Do not make more than 4 applications per season. Do not exceed a total of 0.3 lb a.i. (16 oz of product) per acre per season.
	4A	**Belay Insecticide** (clothianidin)	**In-furrow or sidedress**: 9–12 fl oz **Foliar**: 2–3 fl oz	12	**Foliar**: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, sidedress and seed-piece applications. Do not apply during bloom or allow to drift to flowering plants. Toxic to bees for five days after application.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–2.67 oz	12	Applied at planting or at plant emergence	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year.
	4A	**Venom Insecticide** (dinotefuran)	**Foliar**: 1–1.5 oz **Soil**: 6.5–7.5 oz	12	**Foliar**: 7 **Soil**: at planting	Do not apply more than 4.5 oz per acre per season to foliage. One soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	4C	**Transform WG** (sulfoxaflor)	2.0–2.25 oz	24	7	Bloom and tank-mix restrictions apply. Maximum amount 8.5 oz/ acre per season.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Minimum interval between applications = 7 days. Maximum amount per year = 28 fl oz/acre.
	9B	**Fulfill** (pymetrozine)	2.75–5.5 oz	12	14	Apply when whiteflies first appear. Do not exceed 11.0 oz per acre per season.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	12	14	Maximum dosage per acre per year: 4.8 fl oz (0.070 lb a.i.). Maximum applications per year: 2
	15	**Rimon 0.83EC** (novaluron)	6–12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Does not affect adult insects.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	23	**Oberon 2SC** (spiromesifen)	8–16 fl oz	12	7	Maximum amount per crop: 32.0 fl oz/acre. Maximum applications: 2.
	28 + 6	**Minecto Pro** (cyantraniliprole + abamectin)	10 fl oz/A	12	7	Must add an adjuvant. Check label for use requirements.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Azatin XL** (azadirachtin)	5–21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Insect growth regulator and antifeedant. OMRI-listed.[2]
	-	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	**JMS:** 3–6 qt/100 gal	4	0	See label for tank-mix cautions. Organic Stylet-Oil is OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.[2]
Wireworms	1B	***Mocap 15 G, *EC** (ethoprop)	See labels.	48	Preplant or at planting	Use broadcast application for moderate to heavy infestations of wireworms.
	1B	***Thimet 20 G** (phorate)	See label—varies with soil type and time of application.	48	90	One application per season.
	2B	***Regent 4SC** (fipronil)	3.2 fl oz	0	90	Many plant-back restrictions. One in-furrow application at time of planting only. Must be incorporated and covered with soil.

Insects	MOA Code	Trade Name Active Ingredient	Rate Product/Acre	REI (Hours)	Days to Harvest	Notes
	3A	***Brigade 2 EC** (bifenthrin)	**Soil at plant:** 9.6–19.2 oz **Soil at lay-by:** 3.2–9.6 oz	12	21	Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.
	3A	**Capture LFR** (bifenthrin)	25.5 fl oz			In furrow at planting
	4A	**Admire Pro** (imidacloprid)	**Soil treatment**: 5.7–8.7 fl oz **Seed-piece treatment**: 3.5–7.0 fl oz/100 lb seed **Foliar**: 1.3 fl oz	12	**At planting**: see label for options **Foliar**: 7	Do not apply more than 0.31 lb a.i. per acre per season. Seed-piece rate is based on seeding rate of 2000 lb/acre. **Foliar**: Maximum for foliar applications per year: 5.6 fl oz.
	4A	**Belay Insecticide** (clothianidin)	**In-furrow or sidedress application:** 9–12 fl oz	12	**Foliar**: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, sidedress, and seed-piece applications.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–2.67 oz	12	Applied at planting or at plant emergence	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year. For wireworms: seed-piece only**.**

Table 4. Potato fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Pamela D. Roberts, UF/IFAS Southwest Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Botrytis gray mold	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 75DF, Roper DF Rainshield	**SEE INDIVIDUAL LABELS**		3	1	
(suppression)	M3 + M5	**Elixir** (mancozeb + chlorothalonil)	2 lb	18 lb	7	1	
	M5	(chlorothalonil) **Many brands available**: Bravo Ultrex, Bravo ZN, Bravo Weather Stik 6L, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus DF, Equus 500 ZN, Equus 720SST, Initiate 720, Initiate ZN, Orondis Opti B	**SEE INDIVIDUAL LABELS**		7	0.5	
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/A per year	7	0.5	See label.
	3	**Quash** (metconazole)	2.5 oz	7.5 oz	1	0.5	Follow resistance management recommendations on label.
	7	**Endura 70WP** (boscalid)	10 oz	20 oz	10	0.5	Do not make more than 4 applications at low rate or 2 applications at high rate.
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	Do not make more than 2 sequential applications.
(suppression)	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	43.6 fl oz	7	0.5	Do not make more than 2 sequential applications.
	7 + 11	**Priaxor** (fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Do not make more than 2 sequential applications.
	9	**Scala SC** (pyrimethanil)	7 fl oz	35 fl oz	7	0.5	Use only in a tank mix with labeled fungicide for early blight.
	9 + 12	**Alerity 62.5 WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	
(suppression)	11 + 4	**Quadris Ridomil Gold** (azoxystrobin + mefenoxam)	0.82 fl oz/1000 ft of row	See label		0	Apply at planting.
	12 + 7	**Miravis Prime** (fludioxonil + pydiflumetofen)	11.4 fl oz/A	34.2 fl oz/year	14	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
Early blight (*Alternaria solani*)	M1	(copper compounds) **Many brands available:** Americop, Badge SC, Badge X2, Basic Copper 53, COCS WDG, Champ DP Dry Prill, Champ 2 FL, Champion WP, Champ WG, Cueva, Cuprofix MZ Disperss, Cuprofix Ultra 40 Disperss, Kentan DF, Kocide 2000, Kocide 3000, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, Nu Cop 50WP, Nu-Cop HB	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	M1 + M3	**ManKocide 61.1DF** (copper hydroxide + mancozeb)	5 lb	74.66 lb	3	2	
	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	**SEE INDIVIDUAL LABELS**		3	1	Limit is 11.2 lb of active ingredient per a crop.
	M3	**Polyram 80DF** (metiram)	2 lb	14 lb	3	1	Limit is 7 applications/season.
	M3 + M5	**Elixir** (mancozeb + chlorothalonil)	2 lb	18 lb	7	1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik 6L, Bravo ZN, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	**SEE INDIVIDUAL LABELS**		7	0.5	Read label for application directions.
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/A per year	7	0.5	See label.
	2	**Nevado 4F** **Rovral 4F** (iprodione)	2 pt	8 pt	14	1	Limit is 4 applications/crop. See individual label for additional information.
	3	**Provysol** (mefentrifluconazole)	5 fl oz	15 fl oz	7	0.5	
	3	**Quash** (metconazole)	2.5 oz	7.5 oz	1	0.5	Follow resistance management recommendations on label.
	3 + 11	**Veltyma** (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
	4 + M3	**Ridomil Gold MZ** (mancozeb + mefenoxam)	2.5 lb	See label.	3	2	Also labeled for storage rots (Pink Rot and Leak).
	4 + M5	**Ridomil Gold Bravo SC** (chlorothalonil + mefenoxam)	2.5 pt	See label.	14	2	Limit is 4 applications/crop. Also labeled for storage rots (Pink Rot and Leak).
	7	**Endura 70WP** (boscalid)	10 oz	20 oz	10	0.5	Do not make more than 4 applications at low rate or 2 applications at high rate.
	7	**Velum Prime** (fluopyram)	See label for ground or aerial application rates.	See label for ground or aerial application rates.	7	0.5	Do not make more than 2 sequential applications.
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	Do not make more than 2 sequential applications.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	43.6 fl oz	7	0.5	Do not make more than 2 sequential applications.
	7 + 11	**Priaxor** (fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Do not make more than 2 sequential applications.
	9	**Scala SC** (pyrimethanil)	7 fl oz	35 fl oz	7	0.5	Use only in a tank mix with labeled fungicide for early blight.
	9	**Vango WG** (cyprodinil)	7 oz	28 oz	0	0.5	
	9 + 12	**Alerity 62.5 WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	
	11	**Aframe, Azoxystar, Azoxyzone, Equation, Satoria, Trevo, Quadris, Willowood Azoxy** (azoxystrobin)	See individual labels.				Alternate with non-group 11 chemistry. See label for soilborne disease applications.
	11	**Approach** (picoxystrobin)	12 fl oz	36 fl oz	3	0.5	Alternate with non-group 11 chemistry.
	11	**Evito 480SC Aftershock** (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	0.5	Limit is 6 applications per crop and alternate with non-group 11 chemistry.
	11	**Gem 500SC Flint Extra** (trifloxystrobin)	3.8 fl oz	23 fl oz	7	0.5	Limit is 6 applications per crop and alternate with non-group 11 chemistry.
	11	**Headline 2.09F** (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Alternate with non-group 11 chemistry.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
	11	**Reason 500SC** (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Alternate with non-group 11 chemistry.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	See label.	14	0.5	Alternate with non-group 11 chemistry.
	11 + 3	**Amistar Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	Do not make more than 2 consecutive applications before switching to another effective fungicide with a different mode of action.
	12 + 7	**Miravis Prime** (fludioxonil + pydiflumetofen)	11.4 fl oz	34.2 fl oz/year	14	0.5	
	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	
	19	**Ph-D** (polyoxin D zinc salt)	6.2 oz	31 oz	0	0	Limit is 5 applications/season. Use in alternation with fungicides that have different modes of action.
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2.0 lb	12 lb	3	2	This product contains 66.7% mancozeb, so do not exceed maximum allowed for mancozeb considering this and other mancozeb-containing products.
	22 + M5	**Zing!** (zoxamide + chlorothalonil)	34 fl oz/A	1.52 lb zoxamide and 8.8 lb chlorothalonil	7	0.5	Do not make more than 2 consecutive applications before switching to another effective fungicide with a different mode of action.
	27 + M5	**Ariston** (cymoxanil + chlorothalonil)	2 pt	17.5 pt cymoxanil and 11.25 lb a.i. chlorothalonil	14	0.5	
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	48 oz	14	0.5	Do not make consecutive applications. Rotate to material with different mode of action.
	28	**Previcur Flex** (propamocarb hydrochloride)	1.2 pt	6.0 pt	14	0.5	Use with a tank mix. See label for seed-piece treatment.
	30	**Agri Tin** (triphenyltin hydroxide)	3.75 oz	11.5 oz	7	2	
	30	**Super-Tin 4L** (triphenyltin hydroxide)	6 fl oz	18 fl oz	7	2	For use with closed tractor cabs only. Super Tin should be tank-mixed with another fungicide.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
	30	**Super-Tin 80WP** (triphenyltin hydroxide)	3.75 oz	11.25 oz	7	2	For use with closed tractor cabs only. Super Tin should be tank-mixed with another fungicide.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	14	0.5	Do not make more than 2 consecutive applications.
Fusarium tuber rot	M3	(mancozeb) **Many brands available:** Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	**SEE INDIVIDUAL LABELS**		3	1	See label for seed-piece treatment.
	1	**Mertect 340-F** (thiabendazole)	0.42 fl oz per 2,000 lb of tuber			0.5	See label
	7 + 3	**Emesto Silver** (penflufen + prothioconazole)	0.31 fl oz per 100 lb seed pieces				See label for seed-piece treatment.
	12	**Dyna-Shield Fludioxonil Maxim** (fludioxonil)	See label.				See label for equipment requirements.
	27 + M3 + 1	**Evolve** (cymoxanil + mancozeb + thiophanate-methyl)	0.75 lb/100 lb cut seed pieces			1	Potato seed-piece treatment.
Late blight (*Phytophthora infestans*)	M1	(copper compounds) **Many brands available:** Americop, Badge SC, Badge X2, Basic Copper 53, WDG, Champ 2 FL, Champ DP Dry Prill, Champion WP, Champ WG, Copper-Count-N, Copper sulfate crystals, Copper-Z 4/4, Cueva, Cuprofix MZ Disperss, Cuprofix Ultra 40 Disperss, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, Nu Cop 50WP, Nu-Cop HB, Quimag Copper Sulfate Crystal	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	M1 + M3	**ManKocide 61.1DF** (copper hydroxide + mancozeb)	5 lb	74.66 lb	3	2	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	**SEE INDIVIDUAL LABELS**		3	1	Limit is 11.2 lb of active ingredient per a crop.
	M3	**Polyram 80DF** (metiram)	2 lb	14 lb	3	1	Limit is 7 applications/season.
	M3 + M5	**Elixir** (mancozeb + chlorothalonil)	2 lb	18 lb	7	1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik 6L, Bravo ZN, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initate ZN, Orondis Opti B	**SEE INDIVIDUAL LABELS**		7	0.5	Read label for application directions.
	M5 + 49	**Orondis Opti** (chlorothalonil + oxathiapiprolin)	2.5 pt	10 pt/A per year	7	0.5	See label.
	3 + 11	**Veltyma** (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	
	4 + M1	**Ridomil Gold Copper 64.8W** (mefenoxam + copper hydroxide)	**SEE INDIVIDUAL LABELS**		14	2	Limit is 3 applications/crop of this product + other Ridomil products. Add protectant fungicide; see label. Also for storage rots (Pythium leak, Pink Rot)
	4 + M3	**Ridomil Gold MZ** (mancozeb + mefenoxam)	2.5 lb	See label.	3	2	Also labeled for storage rots (Pink Rot and Leak)
	4 + M5	**Ridomil Gold Bravo SC** (chlorothalonil + mefenoxam)	2.5 pt	See label.	14	2	Limit is 4 applications/crop. Also labeled for storage rots (Pink Rot and Leak)
	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	Do not make more than 2 sequential applications.
	11	**Aframe, Azoxystar, Azoxyzone, Quadris Satori** (azoxystrobin)	See individual labels				Alternate with non-group 11 chemistry between applications. See label for soilborne disease applications.
	11	**Evito 480SC** **Aftershock** (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	0.5	Limit is 6 applications per crop; alternate with non-group 11 chemistry.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
	11	**Gem 500SC** **Flint Extra** (trifloxystrobin)	3.8 fl oz	23 fl oz	7	0.5	Limit is 6 applications per crop; alternate with non-group 11 chemistry.
	11	**Headline** (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Alternate with non-group 11 chemistry between applications.
	11	**Reason 500SC** (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Alternate with non-group 11 chemistry between applications.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	See label	14	0.5	Alternate with non-group 11 chemistry between applications.
(suppression only)	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	
	21	**Ranman** (cyazofamid)	2.75 fl oz	27.5 fl oz	7	0.5	
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2.0 lb	12 lb	3	2	This product contains 66.7% mancozeb, so do not exceed maximum allowed for mancozeb considering this and other mancozeb-containing products.
	22 + M5	**Zing!** (zoxamide + chlorothalonil)	34 fl oz/A	1.52 lb zoxamide and 8.8 lb chlorothalonil	7	0.5	Do not make more than 2 consecutive applications before switching to another effective fungicide with a different mode of action.
	27	**Curzate 60DF** (cymoxanil)	3.2 oz	22.4 oz	14	0.5	Limit is 7 applications/year. Use in combination with a protectant fungicide. It is best to alternate Curzate with other fungicides, such as mancozeb or chlorothalonil. Also labeled for seed treatment.
	27 + 11	**Tanos** (cymoxanil + famoxadone)	8 oz	48 oz	14	0.5	Do not make consecutive applications. Rotate to material with different mode of action.
	28	**Previcur Flex** (propamocarb hydrochloride)	1.2 pt	6.0 pt	14	0.5	Use with a tank mix. See label for seed-piece treatment.
	29	**Omega 500F** (fluazinam)	5.5 fl oz	3.5 pt	14	2	Rate is higher for white mold.
	30	**Agri Tin** **Super-Tin** (triphenyltin hydroxide)	See individual label		7	2	
	30	**Super-Tin 80WP** (triphenyltin hydroxide)	6 fl oz	18 fl oz	7	2	For use with closed tractor cabs only. Super Tin should be tank-mixed with another fungicide.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
	33	**Alude, Confine Extra, K-Phite, Fosphite, Fungi-Phite, Phiticide, Phostrol, ProPhyt, Rampart,** (mono- and dipotassium salts of phosphorous acid)	See individual label				
	40	**Forum** (dimethomorph)	6 oz	30 oz	4	0.5	Tank-mix with another chemistry. Do not make more than two sequential applications before alternating to a non-group 40 fungicide.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	14	4 hr	Do not make more than 2 consecutive applications.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	14	0.5	Do not make more than 2 consecutive applications.
	45 + 40	**Zampro** (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Do not make more than 2 consecutive applications.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8 fl oz	32 fl oz/A per year	7		See label.
Pythium, Pink rot, and Phytophthora seed decays	4	**MetaStar 2E AG** (metalaxyl)	8 pt			2	See label for banding applications; for use at planting.
	4	**Ridomil Gold SL** **Orondis Gold B** **Ultra Flourish** (mefenoxam)	**SEE INDIVIDUAL LABELS**			2	At planting.
	4 + M1	**Ridomil Gold Copper 64.8W** (mefenoxam + copper hydroxide)	2 lb	6 lb	14	2	Limit is 3 applications/crop of this product + other Ridomil products. Add protectant fungicide; see label. Also for storage rots (Pythium leak, Pink Rot).
	4 + M3	**Ridomil Gold MZ** (mefenoxam + mancozeb)	2.5 lb	See label	3	2	Also labeled for storage rots (Pink Rot and Leak).
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	2.5 pt	See label	14	2	Limit is 4 applications/crop. Also labeled for storage rots (Pink Rot and Leak).
	21	**Ranman** (cyazofamid)	2.75 fl oz	27.5 fl oz	7	0.5	Alternate with non-group 11 chemistry between applications.
	22	**Elumin** (ethaboxam)	8 fl oz	16 fl oz	NA	0.5	At planting or side-dress between hilling and tuber initiation at least 25 days apart

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
	27	**Curzate 60DF** (cymoxanil)	3.2 oz	22.4 oz	14	0.5	Limit is 7 applications/year. Use in combination with a protectant fungicide. It is best to alternate Curzate with other fungicides such as mancozeb or chlorothalonil. Also labeled for seed treatment.
	33	**Alude, Confine Extra, Fosphite, Fungi-Phite, K-Phite, Phiticide, ProPhyt, Phostrol, Rampart, Reveille** (mono- and dipotassium salts of phosphorous acid)	See individual label				
	40 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	27.8				At planting. See label.
Rhizoctonia, black scurf & stem canker (*Rhizoctonia solani*)	M3	(mancozeb) **Many brands available:** Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	**SEE INDIVIDUAL LABELS**		3	1	See label for seed-piece treatment.
	7	**Moncut 70DF** (flutolanil)	1.1 lb			0.5	In-furrow use only.
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	Do not make more than 2 sequential applications.
	7 + M3	**Moncoat MZ** (flutolanil + mancozeb)	1.0 lb/100 lb seed			1	Seed treatment.
	7 + 3	**Emesto Silver** (penflufen + prothioconazole)	0.31 fl oz/100 lb seed pieces	0.93 fl oz		0.5	See label for seed treatment details.
	7 + 11	**Elatus** (azoxystrobin + benzovindiflupyr)	5 oz/1000 linear feet		14		In-furrow use only.
	11	**Azoxystrobin 100ST** **Azoyzone** **Dynasty** (azoxystrobin)	See label.			4 hr	Seed treatment.
	11	**Headline** (pyraclostrobin)	0.8 fl oz/1000 linear ft			0.5	In-furrow use only.
	12	**Dyna-Shield** **Maxim** **Spirato** (fludioxonil)	0.8 fl oz/100 lb seed			0.5	Seed treatment.
	12 + M3	**Maxim MZ** (fludioxonil + mancozeb)	0.5 lb/100 lb seed			1	Seed treatment.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
	14	**Blocker 10G** **Blocker 4F** (PCNB)	See label.				At planting
	27 + M3 + 1	**Evolve** (cymoxanil + mancozeb + thiophanate-methyl)	0.75 lb/100 lb cut seed pieces			1	Potato seed-piece treatment.
Soft rot	25	**Agri-Mycin 17** **Harbour** (streptomycin)	100 ppm			0.5	Seed treatment. Check individual labels for specific rates and instructions.
Soilborne pathogens (see specific pathogens)	M2	(mancozeb) **Many brands available:** Dithane M45, Fortuna 75WDG, Koverall, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	**SEE INDIVIDUAL LABELS**		3	1	See label for seed-piece treatment.
	11	**Dynasty** (azoxystrobin)	3.75 fl oz/100 lb seed			4 hr	For suppression of black scurf and stem canker and seed-borne black dot and for protection against silver scurf.
	12	**Maxim 4FS** **Spirato** (fludioxonil)	0.16 oz/100 lb seed			0.5	Seed treatment. Must be made using specific equipment.
	12	**Maxim Potato Seed Protectant** **Maxim PSP** (fludioxonil)	0.5 lb/100 lb seed			0.5	Seed treatment.
	12 + M3	**Maxim MZ** (fludioxonil + mancozeb)	0.5 lb/100 lb seed			1	Seed treatment.
White mold (*Sclerotinia sclerotiorum*)	1	**Incognito 4.5F, Topsin M WSB** (thiophanate-methyl)	**SEE INDIVIDUAL LABELS**		21	2	
	2	**Iprodione 4L, Meteor, Nevado 4F, Rovral 4F** (iprodione)	See label.	See label.	14	1	Limit is 4 applications/crop. See individual label for additional information.
	3	**Quash** (metconazole)	4.0 oz	7.5 oz	1	0.5	Follow resistance management recommendations on label.
(suppression)	7	**Endura 70WP** (boscalid)	10 oz	20 oz	10	0.5	Do not make more than 4 applications at low rate or 2 applications at high rate.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks
			Appl.	Season	Harvest	Reentry	
	7	**Velum Prime** (fluopyram)	See label for ground or aerial application rates.	See label for ground or aerial application rates.	7	0.5	Do not make more than 2 sequential applications.
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	Do not make more than 2 sequential applications.
(suppression)	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	43.6 fl oz	7	0.5	Do not make more than 2 sequential applications.
(suppression)	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	Do not make more than 2 sequential applications.
	11	**Aproach** (picoxystrobin)	12 fl oz	36 fl oz	3	0.5	Alternate with non-group 11 chemistry
	11	**Headline** (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Alternate with non-group 11 chemistry between applications.
	12 + 7	**Miravis Prime** (fludioxonil + pydiflumetofen)	11.4 fl oz/A	34.2 fl oz/year	14	0.5	
	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	
	29	**Omega 500F** (fluazinam)	5.5 fl oz	3.5 pt	14	2	

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

Table 5. Nonfumigant nematicides for potatoes in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Broadcast or overall rates		Row rates	
	Per acre	Per 1000 sq ft	Per acre, 36" row spacing	Per 1000 ft of row, any row spacing
Mocap 15G (a.i. ethoprop)	40 to 60 lb	0.9 to 1.4 lb	20 lb	1.4 lb
Mocap EC* (a.i. ethoprop)	1 to 1.5 gal	2.9 to 4.4 fl oz	2 qt	4.4 fl oz
Vydate C-LV** (a.i. oxamyl)	---	---	1 to 2 gal	9.8 to 19.5 oz
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints (56.0 to 80.0 fl oz) per acre, a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop and no more than 112 fl oz of product per acre per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.			
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/acre using overhead chemigation equipment. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year regardless of formulation (Velum or Luna) or method of application (soil or foliar). Do not apply within 7 days of harvest. For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.			
*Do not apply Mocap in furrow, because it can cause crop injury when in contact with the seed piece. Do not apply Mocap where sorghum will be grown during the same year, because its residual activity may cause serious injury to sorghum. Mix into the top 2 to 4 inches of soil. Do not exceed 9 lb a.i./A Mocap 15G and 12 lb a.i./A for Mocap EC. **Vydate C-LV has registration for nematode suppression in potatoes as an in-furrow and foliar treatment program only. Each application of Vydate C-LV should be applied in a minimum of 20 gals of water per acre, the spray solution water always buffered to a pH of 5.0 or lower. Do not apply more than 2.4 gallons (9 lb a.i.) per acre per season or make more than 8 applications of Vydate C-LV per crop; the last application should be made at least 7 days prior to harvest.				
Mocap and Vydate are insecticide-nematicides; Velum is a fungicide-nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations as for how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.				

Table 6. Fumigant nematicides for potatoes in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/ chisel-spaced 12" apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38.2 to 60.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19 to 31.5 gal	57 to 90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Chloropicrin 99%	150–350 lb	-	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.

[1] Gallons/acre and fl oz/1,000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All the fumigants mentioned are for retail sale and use only by state certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), applicator training certification, and other new rate modifying recommendations.
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS965

doi.org/10.32473/edis-cv300-2022

Chapter 15. Root Crop Production in Florida[1]

Julien Beuzelin, Peter J. Dittmar, Hugh A. Smith, Bonnie Wells, Johan Desaeger, Lincoln Zotarelli, Shouan Zhang, Qingren Wang, Craig Frey, and Anna Meszaros[2]

Beet, Carrot, Radish, and Sweetpotato Botany and Planting

Beet—*Beta vulgaris*, Chenopodiaceae

Carrot—*Daucus carota*, Apiaceae (Umbelliferae)

Radish—*Raphanus sativus*, Brassicaceae (Cruciferae)

Sweetpotato/Boniato—*Ipomoea batatas*, Convolvulaceae

Table 1. Planting information for beet, carrot, radish, and sweetpotato/boniato.

Planting Dates	***Beet***	***Carrot***	***Radish***	***Sweetpotato/Boniato***
North Florida	Aug–Feb	Aug–Mar	Sept–Mar	Mar–June
Central Florida	Sept–Feb	Aug–Mar	Sept–Mar	Feb–June
South Florida	Oct–Jan	Sept–Mar	Oct–Mar	Dec–Sept (orange flesh type) Year-round (boniato/batatas type)
Planting Information				
Distance between rows (in)	12–30	10–12	6	36–48
Distance between plants (in)	2–4	1–3	1	10–12
Seeding depth (in)	0.5–1.0	0.25	0.25	3–4
Seed per acre (lb)	10–15	2–4	10–20	9,000–15,000
Days to maturity from seed	50–70	70–120	20–30	85–130
Plant population (acre)	261,360	630,000	1 million+	9,000–15,000

1. This document is HS965, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 2015. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Julien Beuzelin, assistant professor, Entomology and Nematology Department, UF/IFAS Everglades Research and Education Center; Peter J. Dittmar, associate professor, Horticultural Sciences Department; Hugh A. Smith, associate professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; Bonnie Wells, Extension agent II, UF/IFAS Extension Brevard County; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; Lincoln Zotarelli, associate professor, Horticultural Sciences Department; Shouan Zhang, professor, Plant Pathology Department, UF/IFAS Tropical REC; Qingren Wang, Extension agent III, UF/IFAS Extension Miami-Dade County; Craig Frey, county Extension director and Extension agent II, UF/IFAS Extension Hendry County; and Anna Meszaros, Extension agent II, UF/IFAS Extension Palm Beach County; UF/IFAS Extension, Gainesville, FL 32611.

Cultivars

Table 2. Common cultivars of beet, carrot, and sweetpotato/boniato.

Beet	Carrot	Radish	Sweetpotato/Boniato
Bohan	Apache	Diego	Beauregard
Boro	Choctaw	Escala F[1]	Covington
Bulls Blood (tops)	Navajo	Fuego[1]	Evangeline
Golden Beets (yellow)	Top Notch	Red Castle	Hernandez
Green Top		Red Pearl	Picadito (Boniato)
Pacemaker III		Red Satin F[1]	
Red Ace		Red Silk2	
Red Cloud		Rudi	

[1] Resistant to yellows; tolerant to black root and rhizoctonia scurf.
[2] Resistant to pithing; intermediate resistance to black root, yellows, clubroots, rhizoctonia scurf.

Tropical Root Crops

Tropical root crops are planted primarily for their edible roots, tubers, corms, or cormels. In this regard, tropical root crops require a longer period of time to mature than many other vegetable crops. Some root crops take as long as 14 months to reach maturity. Some people also eat the edible leaves of sweetpotato/boniato, cassava, and taro. In the case of these crops, plants grown for edible leaves can be grown in cooler locations than would otherwise be possible. For pest control products, these crops are included in root and tuber vegetables.

Botany and Planting

Table 3. Planting information for cassava, taro, and malanga.

Planting Dates	Cassava	Taro	*Malanga*
Miami-Dade County	Year-round (mainly February to April)	Year-round	Year-round
Planting Information			
Distance between rows (in)	48	52	52
Distance between plants (ft)	2	1	1
Planting depth (in)	3–4	4–6	4–6
Propagules needed per acre	5,445	2,420–3,630	2,420–3,630
Minimum propagule size	10″–12″ stick or micropropagules	2 oz	2 oz
Bedded	No	Yes	Yes
Months to harvest from planting	8–12	6–10	9–14
Plant populations (acre)	5,445	10,052	10,052

Cultivars

Cassava—Known the world over by a variety of names, including manioc, yuca, mandioca, balinghoy, kamoteng, kahoy (Philippines), mogo (Africa), tapioca root (India), and manioc root in its native South America. Though the exact origins of cassava are unknown, it was likely domesticated between 7,000 and 9,000 years ago in the Amazon. This root crop is grown throughout the tropics and has become an important dietary staple in many parts of the world.

Varieties are often separated based of their cyanogenic glucoside (HCN) content into either low HCN, a.k.a. "sweet," or high HCN, a.k.a. "bitter," types. The term "bitter" comes from a bitter flavor that is commonly believed to accompany the HCN. Though no named varieties are currently known in southern Florida, 'Senorita' was locally popular in the 1980s, and attempts were made to introduce the CIAT variety 'Mantiqueira' at that time because it produced acceptable yields even with high levels of root-knot nematode infestation. The range of local genotypes covers a few unnamed clones that have been imported from various Caribbean basin countries. However, federal regulations prohibit further importation of cuttings or botanical seed.

Root development may occur as early as 28 days after planting, though it may take about six weeks before fibrous roots begin to thicken rapidly with starch granules. There does not appear to be any specific trigger to root thickening, but the number of roots that will eventually thicken is determined early in the life of the crop, with little change in the number of thickened roots after three months. A soil fertility analysis is conducted as a routine practice to ensure an adequate amount of potassium is maintained in the soil to improve root development for improved yield. The amount of nitrogen available to the crop is often limited because excessive nitrogen increases vegetative growth rather than the root development.

For people who are able to find cuttings, follow the technique developed by scientists at the International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria, where one makes 2-node cuttings, or ministakes, which can provide a 5-fold increase in the production of propagules from each parent cassava plant. According to IITA, "[t]hese ministakes are easily moved and protected in plastic sacks until they can be grown on and hardened in individual plastic bags or nursery beds before being planted in the field."

It takes 8–12 months for cassava roots to reach maturity. Plants are often cut back two weeks prior to harvest, resulting in increased tuber size and yields about 10% higher.

Preferences for specific varieties of cassava used for edible leaves may exist among consumers, though the ability to satisfy these requests is very limited, given the very small number of varieties currently grown in the United States.

Tannia is widely grown and used in the tropics. It has been grown since 1963 on a limited commercial scale in south Florida, where it is typically planted in the spring because the crop requires 9 to 10 months to reach maturity and can be injured by frosts. Tannia can be propagated by several methods: (1) plant the top (head), (2) plant the whole main tuber, (3) plant pieces of the main tuber, or (4) plant individual secondary tubers. Propagative materials should be set 3 to 5 inches below the surface. 'South Dade White' produces white-fleshed cormels; 'Malanga Amarilla' produces a yellow-fleshed edible corm. 'Vinola' produces purple-fleshed cormels.

Taro—'Malanga Isleña' produces one large white-fleshed central corm; a few unnamed Polynesian types are grown for the Asian market. The name "taro" is generally used to refer to *Colocasia esculenta*, one of several major root crops in the Araceae (Aroid) family.

There are several important crops throughout the tropical regions of the world related to taro and grown in certain Florida locations. These include the giant swamp taro, the giant taro, and cocoyam. Each of these Aroids has several other common names in different regions of the world.

Information about taro in Florida is limited due to a small acreage. However, taro can be cultivated under both wetland and dryland conditions, with the latter referred to as "dasheens" in Florida. Most will mature in 6 to 10 months, with corms being dug up with modified potato harvesters in commercial production. The corms are washed of soil, sorted by size, and packed. The recommended cold room temperature for prolonged storage is 45°F–50°F with a relative humidity of 85.

Tropical sweetpotato or boniato—'Picadito' is the main variety grown in Miami-Dade County. Sweetpotato usually has shallow-lobed leaves and wine-colored skin with orange flesh. However, boniato, which is predominantly grown in Miami-Dade County, has deeply lobed leaves and wine-colored skin with white flesh.

It is illegal to import sweetpotato/boniato into the United States due to soil pests, such as sweetpotato weevils, and there is no program to produce disease-free planting material of 'Picadito' in Florida. Other sweetpotato growing states have developed red-skinned, white-fleshed sweetpotatoes, which may grow well in Florida and which may be available from those plant breeders or through certified slip producers.

In regard to other tropical root crops, such as daikon radish or turmeric, readers may refer to Chapter 5, "Ethnic Vegetable Production."

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 4. Herbicides approved for managing weeds in beet. Contact: Peter J. Dittmar, UF/IFAS Horticultural Sciences Department.

Active Ingredient **lb a.i./A**	**Trade Name** ***Product/A***	***MOA*** ***Code***	***Weeds Controlled/Remarks***
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		****** PREEMERGENCE ******	
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult labels for individual product directions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Scythe is a contact and nonresidual herbicide and can be tank-mixed with residual preemergence herbicides to lengthen control.
Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds and grass weeds. Apply as a preplant burndown treatment.
		***** POSTEMERGENCE *****	
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as a hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank-mixed with other herbicides. Do not exceed 6.1 fl oz per cropping season. PHI 0 days.
Clethodim 0.09–0.13 0.07–0.25	(Select, Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat application 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Consult the label for necessary surfactant. PHI 30 days.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
Sethoxydim 0.28–0.47	(Poast) 1.5 EC 1.5–2.5 pt	1	Emerged grass weeds. A maximum of 5 pt/A applied in one season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 60 days.
S-metolachlor	(Dual Magnum) 7.62 EC	15	Grass and broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.

Table 5. Herbicides approved for managing weeds in carrot. Contact: Peter J. Dittmar, UF/IFAS Horticultural Sciences Department.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		***** PREEMERGENCE *****	
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
Linuron 0.5–1.0	(Lorox DF) 50 DF 1–2 lb	7	A single application after planting and before crop emergence. Plant seed at least 0.5 in. deep. Preemergence and postemergence application should not exceed 4 lb/A per season.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Apply before crop emergence. Use a nonionic surfactant.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Scythe is a contact and nonresidual herbicide and can be tank-mixed with a residual preemergence herbicide to lengthen time of control.
Pendimethalin 0.95	(Prowl H2O) 3.8 2.0 pt	3	Broadleaf and grass control. Apply within 2 days of planting before the emergence of the crop. PHI 60 days.
Prometryn 1.0–2.0	(Caparol) 4 L 2–4 pt	5	Most annual broadleaf and grass weeds. Do not exceed one application. Consult label for rotational crop restrictions.
Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment.
Trifluralin 0.5	(Treflan, Trifluralin) 4 EC 1 pt (Treflan TR-10) 5 lb	3	Annual broadleaf and grass weeds. Do not apply to muck soils. Mineral soils with 2%–5% organic material, apply 0.75 lb a.i./A. Incorporate 4 inches or less with 8 hr of application. PHI 60 days.
		*****POSTEMERGENCE*****	
Carfentrazone Up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rate. May be tank-mixed with other herbicides. Do not exceed 6.1 fl oz per cropping season. PHI 0 days.
Clethodim 0.09–0.13 0.07–0.13	(Select, Arrow) 2 EC 6–8 fl oz (Select max) 1 EC 9–16 fl oz	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat applications 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Nonionic surfactant with Select Max. PHI 30 days
Fluazifop 0.188	(Fusilade DX) 2 EC 12 fl oz	1	Actively growing grass weeds. Maximum is 48 fl oz/A per growing season. Withhold field flooding 45 to 60 days following application. In Palm Beach and Hendry Counties a 60-day interval must be observed for flooding. PHI 45 days.
Linuron 0.5–1.0	(Lorox DF) 50 DF 1–2 lb	7	Apply after carrots are 3 inches tall. Repeat applications may be made but do not exceed 4 lb/A. Can be applied following Stoddard Solvent provided that the applications are at least one day apart. Do not tank-mix with Stoddard Solvent.
Metribuzin 0.25	(Metribuzin, Metri, Tricor) 75 DF 0.3 lb (Metri, Tricor) 4 F 0.5 pt	5	Broadleaf and grass control. Total amount applied in a season should not exceed 0.5 lb a.i./A. Apply after carrots have 5–6 true leaves and weeds are less than 1 inch in height. If needed, a second application may be made after an interval of at least 3 weeks. PHI 60 days.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
Prometryn 1.0–2.0	(Caparol) 4 L 2–4 pt	5	Most annual broadleaf and grass weeds. Apply up to 6-leaf stage of carrot. One application of 4 pt/A or two applications of 2 pt/A. For POST control of weeds, include NIS or COC. Consult label for rotational crop restrictions. PHI 30 days.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Weeds Controlled/Remarks
Sethoxydim 0.28–0.38	(Poast) 1.5 EC 1.5–2.0 pt	1	Emerged grass weeds. A maximum of 5 pt/A applied in one season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 30 days.
S-metolachlor	(Dual Magnum) 7.62 EC	15	Grass and broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.

Table 6. Herbicides approved for managing weeds in radish. Contact: Peter J. Dittmar, UF/IFAS Horticultural Sciences Department.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		*****PREPLANT/PREEMERGENCE*****	
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Glyphosate	(various formulation) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown before planting.
Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
S-metolachlor	(Dual Magnum) 7.62 EC	15	Grass, broadleaf weeds, and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.
Trifluralin 0.5–0.75	(Treflan HFP, Trifluralin, Trilin) 4 EC 1.0–1.5 pt (Treflan) 4 L 1.0–1.5 pt	3	Annual broadleaf and grass weeds. Incorporate or irrigate 4 in. within 8 hr. Results in Florida are erratic on soils with low organic matter and clay contents.
		*****POSTEMERGENCE*****	
Clethodim 0.09–0.13 0.07–0.13	(Select, Arrow) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Emerged annual and perennial grass weeds. For repeat application, minimum of 14 days between applications. Do not exceed 0.25 lb a.i./A per season. PHI 15 days.
Sethoxydim 0.47	(Poast) 1.5 EC 2.5 pt	1	Emerged grass weeds. Do not exceed 3.0 pt/A per season. Include a crop oil concentrate. Head lettuce and radicchio PHI 30 days. Leaf lettuce and endive PHI 15 days.

Table 7. Herbicides approved for managing weeds in sweetpotato. Contact: Peter J. Dittmar, UF/IFAS Horticultural Sciences Department.

Active Ingredient lb a.i./A	Trade Name Product/A	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
			***** PRETRANSPLANT *****
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Clomazone 0.49–0.75	(Command) 3 ME 1.3–2.0 pt	13	Annual broadleaf and grass weeds. Use lower rates on coarse soils. Apply within 5 days of transplanting.
Flumioxazin 0.096	(Valor) 51 WDG 3 oz	14	Annual broadleaf weeds. Do not use transplants that were harvested 2 days before application. Severe injury occurs if applied after transplanting. Apply 2–5 days before transplanting, and minimize soil disturbance after application.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult labels for individual product directions.
Napropamide 1.0–2.0	(Devrinol DF XT) 50 DF 2.0–4.0 lb	15	Annual broadleaf and grass weeds. Apply immediately after transplanting, If rainfall does not occur within 24 hr after application, then incorporate or irrigate 2–4 in. deep.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Scythe is a contact and nonresidual herbicide and can be tank-mixed with residual preemergence herbicides to lengthen control.
Pyraflufen 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds and grass weeds. Apply as a preplant burndown treatment.
			***** POSTTRANSPLANT *****
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as a hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank-mixed with other herbicides. Do not exceed 6.1 fl oz per cropping season. PHI 0 days.
Clethodim 0.09–0.25 0.07–0.25	(Select, Arrow) 2 EC 6–16 fl oz (Select Max) 1 EC 9–16	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat application 14 days apart. Consult the label for the necessary surfactant. PHI 30 days.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
Sethoxydim 0.28–0.47	(Poast) 1.5 EC 1.5–2.5 pt	1	Emerged grass weeds. A maximum of 5 pt/A applied in one season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 60 days.
S-metolachlor	(Dual Magnum) 7.62 EC	15	Grass and broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.

Table 8. Insecticides labeled for management of arthropod pests of carrot and beet. Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1B	**Malathion 5EC** (malathion)	1.5–2.0 pt	Beets: 12 Carrots: 24	7	Maximum number of applications is 3 for beets and 2 for carrots.
	1B	**Malathion 8F** (malathion)	1.25 pt	12	7	**Beets only.** Maximum number of applications is 3.
	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	Carrots: 21 Beets: 1	Do not apply more than 0.5 lb a.i./acre per season for carrots or 0.4 lb a.i./acre per season for beets. Apply no more than once every seven days.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	4A	**Actara** (thiamethoxam)	1.5–4.0 oz	12	7	Do not exceed 8 oz product/acre/season.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 4.4–10.5 fl oz **Foliar:** 1.2 fl oz	12	**Soil:** 21 **Foliar:** 5	Limited to one soil application. If applied as a foliar spray, use no more than 3.7 fl oz per acre per season. Leaves may be used for food.
	4A	**Platinum 75SG** (thiamethoxam)	1.7–4.0 oz	12	At planting	Maximum of 4.0 oz/acre per season.
	4C	**Transform WG** (sulfoxaflor)	**Leaf production:** 0.75–1.0 oz **Root production:** 0.75–1.5 oz	24	7	Maximum of 8.5 oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Maximum allowed per year: 28 fl oz. Minimum interval between applications: 10 days. Foliar application only.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	3	Do not apply more than 3 times at high rate.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, max 3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**BotaniGard ES BoteGHA ES Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	**Greens and roots.** OMRI-listed.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Acts as IGR and feeding repellent. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.
Beetles (includes blister beetles, cucumber beetles, flea beetles)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	12	7	Repeat applications, as needed up to 6 times, at least 7 days apart.
	1B	**Malathion 8F** (malathion)	1.25 pt	12	7	**Beets only.** Maximum number of applications is 3.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	12	0	Do not exceed 14 fl oz/acre per season. **Carrots only.**
	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	Carrots: 21 Beets: 1	Do not apply more than 0.5 lb a.i./acre per season for carrots or 0.4 lb a.i./acre per season for beets. Apply no more than once every seven days.
	3A	***Fastac CS** (alpha-cypermethrin)	1.8–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	4A	**Actara** (thiamethoxam)	1.5–4.0 oz	12	7	Do not exceed 8 oz product/acre/season.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 4.4–10.5 fl oz **Foliar:** 1.2 fl oz	12	**Soil:** 21 **Foliar:** 5	Limited to one soil application. If applied as a foliar spray, use no more than 3.7 fl oz per acre per season. Leaves may be used for food.
	4A	**Platinum 75SG** (thiamethoxam)	1.7–4.0 oz	12	At planting	Maximum of 4.0 oz/acre per season.
	5	**Entrust SC** (spinosad)	**Roots:** 3–6 fl oz **Beet greens:** 1.5–10 fl oz	4	3	Do not apply more than a total of 21 fl oz/acre per crop (29 for beet greens) or apply more than 4 times. OMRI-listed.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, max 3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Caterpillars (includes beet armyworm, celery leaf-tier, corn earworm, cutworms, fall armyworm, loopers)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	12	7	Repeat applications as needed up to 6 times, at least 7 days apart.
	1B	***Diazinon AG500** ***Diazinon** (diazinon)	**AG500:** 1–4 qt **50W:** 2–8 lb	72	Preplant	Maximum one application per year.
	1B	**Malathion 8F** (malathion)	1.25 pt	12	7	Beets only. Maximum number of applications is 3.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	12	0	Do not exceed 14 fl oz/acre per season. Carrots only.
	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	Carrots: 21 Beets: 1	Do not apply more than 0.5 lb a.i./acre per season for carrots or 0.4 lb a.i./acre per season for beets. Apply no more than once every seven days.
	3A	***Fastac CS** (alpha-cypermethrin)	1.3–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.28–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	5	**Entrust SC** (spinosad)	**Roots:** 3–6 fl oz **Beet greens:** 1.5–10 fl oz	4	3	Do not apply more than a total of 21 fl oz/acre per crop (29 for beet greens) or apply more than 4 times. OMRI-listed.
	5	**Radiant SC** (spinetoram)	**Leaves:** 5–10 fl oz **Roots:** 6–8 fl oz	4	3	Maximum of 4 applications per year. If roots will be harvested, lower rate must be used.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Apply when larvae are small for best control. Leaves and roots. OMRI-listed.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used for organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.50 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Intrepid 2F** (methoxyfenozide)	**Leaves:** 4–16 fl oz **Roots:** 8–16 fl oz	4	**Leaves:** 1 **Roots:** 14	Do not apply more than 64 fl oz per acre per season.
	22	**Avaunt** (indoxacarb)	3.5–6.0 oz	12	7	Do not use adjuvants. Do not apply more than 24 oz per acre per crop. **Beets only.**
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	Maximum of 15.4 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per crop.
	28	**Exirel** (cyantraniliprole)	10–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole, including all application types.
	28	**Vantacor** (chlorantraniliprole)	1.2–2.5 fl oz	4	1	Maximum of 5.1 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per crop.
	28	**Verimark** (cyantraniliprole)	10–13.5 fl oz	4	At planting	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole, including all application types.
	32	**Spear-Lep** (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	4	0	Must be tank-mixed with a *Bacillus thurigiensis* (*Bt*) product. Maximum of 10 gallons/acre per year.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	**Greens and roots.** OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Acts as IGR and feeding repellent. OMRI-listed.
Fire ants	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	Carrots: 21 Beets: 1	Do not apply more than 0.5 lb a.i./acre per season for carrots or 0.4 lb a.i./acre per season for beets. Apply no more than once every seven days.
	7A	**Extinguish Fire Ant Bait** (S-methoprene)	1.0–1.5 lb	4	0	Slow-acting IGR (insect growth regulator).
Grasshoppers	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
Leafhoppers	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	12	7	Repeat applications as needed up to 6 times, at least 7 days apart.
	1B	**Malathion 5EC** (malathion)	1.5–2.0 pt	Beets: 12 Carrots: 24	7	Maximum number of applications is 3 for beets and 2 for carrots.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	7	Do not apply more than 0.5 lb a.i./acre per season. **Carrots only.**
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	12	0	Do not exceed 14 fl oz/acre per season. **Carrots only.**
	3A	***Fastac CS** (alpha-cypermethrin)	1.8–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	4A	**Actara** (thiamethoxam)	1.5–4.0 oz	12	7	Do not exceed 8 oz product/acre/season.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 4.4–10.5 fl oz **Foliar:** 1.2 fl oz	12	**Soil:** 21 **Foliar:** 5	Limited to one soil application. If applied as a foliar spray, use no more than 3.7 fl oz per acre per season. Leaves may be used for food.
	4A	**Platinum 75SG** (thiamethoxam)	1.7–4.0 oz	12	At planting	Maximum of 4.0 oz/acre per season.
	4C	**Transform WG** (sulfoxaflor)	1.5–2.75 oz	24	7	Maximum of 8.5 oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Maximum allowed per year: 28 fl oz. Minimum interval between applications: 10 days. Foliar application only.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, max 3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	**Greens and roots.** OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Leafminers	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	5	**Entrust SC** (spinosad)	**Roots:** 3–6 fl oz **Beet greens:** 1.5–10 fl oz	4	3	Do not apply more than a total of 21 fl oz/acre per crop (29 for beet greens) or apply more than 4 times. OMRI-listed.
	5	**Radiant SC** (spinetoram)	**Leaves:** 5–10 fl oz **Roots:** 6–8 fl oz	4	3	Maximum of 4 applications per year. If roots will be harvested, lower rate must be used.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, max 3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Acts as IGR and feeding repellant. OMRI-listed.
Mole crickets and wireworms	1B	***Diazinon AG500 *50W** (diazinon)	**AG500:** 1–4 qt **50W:** 2–8 lb	72	Preplant	Maximum of one application per year.
Plant bugs	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	3	Do not apply more than 3 times at high rate.
Stink bugs	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	12	7	Repeat applications as needed up to 6 times, at least 7 days apart.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, max 3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Tarnished plant bug	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63–2.5 lb **XLR, 4F:** 0.5–2 qt	12	7	Repeat applications as needed up to 6 times, at least 7 days apart.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
Weevils	3A	***Asana XL** (esfenvalerate)	9.6 fl oz	12	7	Do not apply more than 0.5 lb a.i./acre per season. **Carrots only.**
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	12	0	Do not exceed 14 fl oz/acre per season. **Carrots only.**
	3A	***Fastac CS** (alpha-cypermethrin)	1.8–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, max 3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2, March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

***Restricted use insecticide.**

Table 9. Insecticides labeled for management of arthropod pests of radish. Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5 pt **8F:** 1.0 pt	12	7	Maximum of 3 applications per year.
	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	21	Do not apply more than 0.5 lb a.i./acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 4 oz/acre per year.
	4A	**Admire Pro** (imidacloprid)	**Foliar:** 1.2 fl oz **Soil:** 4.4–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 1.2 fl oz (foliar) or 10.5 fl oz (soil)/acre per year.
	4A	**Platinum 75 SG** (thiamethoxam)	1.7–2.17 oz	12	At planting	Maximum of 2.17 oz/acre per crop.
	4C	**Transform WG** (sulfoxaflor)	**Leaf production:** 0.75–1.0 oz **Root production:** 0.75–1.5 oz	24	7	Maximum of 8.5 oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Maximum of 28 fl oz/acre per year.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole, including all application types. For best performance, use an adjuvant.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	3	Maximum of 8.4 oz/acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**BotaniGard ES BoteGHA ES Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.[2]

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**SuffOil-X** **Sun Spray 98.8% others** (oil, insecticidal)	1–2 gal/100 gal	4	0	SuffOil-X OMRI-listed.
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.
Beetles (includes cucumber beetle, flea beetles) **and weevils**	1A	**Sevin 4F, XLR Plus** (carbaryl)	0.5–1.0 qt	12	7	Maximum of 6 qt/acre per year.
	1B	**Malathion 8F** (malathion)	1.0 pt	12	7	Maximum of 3 applications per year. Flea beetles only.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	7	Do not apply more than 0.1 lb a.i. (19.2 oz of product) per acre per season.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	12	0	Do not consume tops. Maximum of 14.0 fl oz/acre per season.
	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	21	Do not apply more than 0.5 lb a.i./acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	1.8–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 4 oz/acre per year. **Flea beetles only.**
	4A	**Admire Pro** (imidacloprid)	1.2 fl oz	12	7	Maximum of 1.2 fl oz/acre per year.
	4A	**Platinum 75 SG** (thiamethoxam)	1.7–2.17 oz	12	At planting	Do not exceed 2.17 oz per acre per crop.
	5	**Entrust SC** (spinosad)	3–6 fl oz	4	3	3 applications per year. No more than 18 fl oz per acre per crop. OMRI-listed.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed.
Caterpillars (includes cutworms, armyworms, corn earworm, hornworm, loopers, webworms, saltmarsh caterpillar)	1A	***Lannate SP, *LV** (methomyl)	**SP:** 0.5 lb **LV:** 1.5 pt	48	3	SLN [24(c)] label for Florida.
	1A	**Sevin 4F, XLR Plus** (carbaryl)	1–2 qt	12	7	Maximum of 6 qt/acre per year.
	1B	***Diazinon AG-500** ***Diazinon 50W** (diazinon)	**AG500:** 2–4 qt **50W:** 4–8 lb	72	preplant	No more than one application per year.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	7	Do not apply more than 0.1 lb active ingredient (19.2 oz of product) per acre per season.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	12	0	Do not consume tops. Maximum of 14.0 fl oz/acre per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	21	Do not apply more than 0.5 lb a.i./acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.28–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	5	**Entrust SC** (spinosad)	3–6 fl oz	4	3	Three applications per year. No more than 18 fl oz per acre per crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	**Foliage harvest:** 5–10 fl oz **Root harvest:** 6–8 fl oz	4	3	Maximum of 34 fl oz (foliage harvest) or 24 fl oz (root harvest)/acre per year.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Apply when larvae are small for best control. OMRI-listed.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. Can be used in organic production.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young. Not for organic production.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Intrepid 2F** (methoxyfenozide)	**Leaves:** 4–16 fl oz **Roots:** 8–16 fl oz	4	**Leaves:** 1 **Roots:** 14	Do not apply more than 64 fl oz per acre/ season.
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	Maximum of 15.4 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per crop.
	28	**Exirel** (cyantraniliprole)	10.0–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole, including all application types. For best performance, use an adjuvant.
	28	**Vantacor** (chlorantraniliprole)	1.2–2.5floz	4	1	Maximum of 5.1 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per crop.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	28	**Verimark** (cyantraniliprole)	10–13.5 fl oz	4	At planting	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole, including all application types.
	32	**Spear-Lep** (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	4	0	Must be tank-mixed with a *Bacillus thurigiensis* (*Bt*) product. Maximum of 10 gallons/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed.
Fire ants	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	21	Do not apply more than 0.5 lb a.i./acre per season.
	7A	**Extinguish** (S-methoprene)	1–1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Grasshoppers, mole crickets	1B	***Diazinon AG-500** ***Diazinon 50W** (diazinon)	**AG500:** 1 qt **50W:** 2 lb	72	Preplant	No more than one application per year.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
Leafhoppers	1A	**Sevin 4F, XLR Plus** (carbaryl)	0.5–1.0 qt	12	7	Maximum of 6 qt/acre per year.
	1B	**Malathion 8F** (malathion)	1.0 pt	12	7	Maximum of 3 application per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	12	0	Do not consume tops. Maximum of 14.0 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	7	Maximum of 4 oz/acre per year.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	4A	**Admire Pro** (imidacloprid)	**Foliar:** 1.2 fl oz **Soil:** 4.4–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 1.2 fl oz (foliar) or 10.5 fl oz (soil)/acre per year.
	4A	**Platinum 75 SG** (thiamethoxam)	1.7–2.17 oz	12	At planting	Do not exceed 2.17 oz per acre per crop.
	4C	**Transform WG** (sulfoxaflor)	1.5–2.75 oz	24	7	Maximum of 8.5 oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Maximum of 28 fl oz/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.
	-	**SuffOil-X** **Sun Spray 98.8% others** (oil, insecticidal)	1–2 gal/100 gal	4	0	SuffOil-X OMRI-listed.
Leafminers	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	5	**Entrust SC** (spinosad)	3–6 fl oz	4	3	3 applications per year. No more than 18 fl oz per acre per crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	**Foliage harvest:** 6–10 fl oz **Root harvest:** 6–8 fl oz	4	3	Maximum of 34 fl oz (foliage harvest) or 24 fl oz (root harvest)/acre per year.
	-	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed.
	-	**Sun Spray 98.8%, others** (oil, insecticidal)	1–2 gal/100 gal	4	0	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Mites: carmine spider mite, two-spotted spider mite	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	21	Do not apply more than 0.5 lb a.i./acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.
	-	**SuffOil-X Sun Spray 98.8% others** (oil, insecticidal)	1–2 gal/100 gal	4	0	SuffOil-X OMRI-listed.
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.
Stink bugs, plant bugs, meadow spittlebug	1A	**Sevin 4F, XLR Plus** (carbaryl)	1–2 qt	12	7	Maximum of 6 qt/acre per year.
	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Thrips (check label for species controlled)	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight. OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Admire Pro** (imidacloprid)	4.4–10.5 fl oz	12	**Soil:** 21	Maximum of 10.5 fl oz (soil)/acre per year.
	5	**Entrust SC** (spinosad)	3–6 fl oz	4	3	3 applications per year. No more than 18 fl oz per acre per crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	**Foliage harvest:** 6–10 fl oz **Root harvest:** 6–8 fl oz	4	3	Maximum of 34 fl oz (foliage harvest) or 24 fl oz (root harvest) /acre per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.
	-	**SuffOil-X** **Sun Spray 98.8% others** (oil, insecticidal)	1–2 gal/100 gal	4	0	SuffOil-X OMRI-listed.
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.
Whiteflies	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	21	Do not apply more than 0.5 lb a.i./acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Pyrethrins degrade rapidly in sunlight OMRI-listed.
	3A + -	**BotaniGard Maxx** (pyrethrins + *Beauveria bassiana* strain GHA)	**Ground appl.:** 0.25–2.00 qt **Aerial appl.:** 0.25–1.00 qt	12	0	Apply in sufficient water to cover foliage. Compatible in tank mix with some fungicides. May not be compatible with adjuvants.
	4A	**Actara** (thiamethoxam)	3.0–4.0 oz	12	7	Maximum of 4 oz/acre per year.
	4A	**Admire Pro** (imidacloprid)	**Foliar:** 1.2 fl oz **Soil:** 4.4–10.5 fl oz	12	**Foliar:** 7 **Soil:** 21	Maximum of 1.2 fl oz (foliar) or 10.5 fl oz (soil)/acre per year.
	4A	**Platinum 75 SG** (thiamethoxam)	1.7–2.17 oz	12	At planting	Do not exceed 2.17 oz per acre per crop.
	4C	**Transform WG** (sulfoxaflor)	2–2.75 oz	24	7	Maximum of 8.5 oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	10.5–14.0 fl oz	4	7	Maximum of 28 fl oz/acre per year.
	29	**Beleaf 50 SG** (flonicamid)	2.8 oz	12	3	Maximum of 8.4 oz/acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed.
	-	**SuffOil-X** **Sun Spray 98.8% others** (oil, insecticidal)	1–2 gal/100 gal	4	0	SuffOil-X OMRI-listed.
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.
Wireworms	1B	***Diazinon AG-500** ***Diazninon 50 W** (diazinon)	**AG500:** 2–4 qt **50W:** 4–8 lb	72	preplant	Maximum of one application per year.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2, March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.
[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: listed by the Organic Materials Review Institute for use in organic production.
***Restricted use insecticide.**

Table 10. Insecticides labeled for management of arthropod pests of sweetpotato. Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	24	7	Maximum of 7.68 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	24	14	Donotapplymorethan27.0flozofproductperacreperseason.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	14	Do not use after Platinum.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 4.4–10.5 fl oz **Foliar:** 1.2 fl oz	12	**Soil:** 125 **Foliar:** 7	One application to soil per season. If using as a foliar spray, no more than 3.7 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	12	7	Whiteflies not on label for sweetpotatoes but are for other crops on label. No more than 4 applications per season.
	4A	**Belay** (clothianidin)	**In-furrow or side-dress:** 9–12 fl oz **Foliar:** 2–3 fl oz	12	**Foliar:** 14	In-furrow or side-dress application, including chemigation up to 50% ground cover. Do not apply more than 12 fl oz per acre per year.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	4A	**Platinum 75SG** (thiamethoxam)	1.66–2.67 oz	12	Applied at planting	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum.
	4C	**Transform WG** (sulfoxaflor)	**Leaf production:** 0.75–1.0 oz **Root production:** 0.75–1.5 oz	24	7	Maximum of 8.5 oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Minimum interval between applications = 7 days. Maximum allowed per acre per year = 28 fl oz.
	9B	**Fulfill** (pymetrozine)	2.75–5.5 oz	12	14	Allow a minimum of 7 days between applications. Do not exceed 11 oz/acre per season.
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	12	7	7 days before reapplication. Maximum of 9.6 fl oz rate per season.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	At planting	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole, including all application types.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	7	Do not apply more than 8.4 oz per acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**M-Pede** (potassium salts of fatty acids)	1%–2% v/v	12	0	OMRI-listed.[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed.[2]
	-	**SuffOil-X** (oil, insecticidal)	1%–2% v/v	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.[2]

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
Beetles (including cucumber beetle, Japanese beetle, tortoise beetle, flea beetle, whitefringed beetle)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 1.25–2.5 lb **XLR, 4F:** 1–2 qt	12	7	Do not apply more than 10 lb (80S) per acre per crop or 8 qt (4F, XLR). See label for preplant dip treatment.
	1B	**Imidan 70 W** (phosmet)	1.3 lb	**Seedbed treatment:** 4 days **Foliar:** 5 days	7	No more than 5 applications per season. Do not apply through irrigation system. Crop must be mechanically harvested.
	1B	***Mocap 15 G, *EC** (ethoprop)	See labels	48	Preplant	Two to three weeks before planting.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	No more than 16.8 fl oz/acre per season.
	3A	***Brigade 2 EC** (bifenthrin)	**Soil:At plant:** 9.6–19.2 oz**At lay-by:** 3.2–9.6 oz **Foliar:** 2.1–6.4 oz	12	21	No more than 2 foliar applications, at least 21 days apart. Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.
	3A	***Fastac CS** (alpha-cypermethrin)	1.8–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	7	Maximum of 7.68 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	24	14	Do not apply more than 27.0 fl oz of product per acre per season. Supplemental label.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	14	Do not use after Platinum.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 4.4–10.5 fl oz **Foliar:** 1.2 fl oz	12	**Soil:** 125 **Foliar:** 7	One application to soil per season. If using as a foliar spray, no more than 3.7 fl oz per acre per season. Flea beetles only.
	4A	**Assail 30SG** (acetamiprid)	1.5–4.0 oz	12	7	Whiteflies not on label for sweetpotatoes but are for other crops on label. No more than 4 applications per season.
	4A	**Belay Insecticide** (clothianidin)	**In-furrow or side-dress:** 9–12 fl oz **Foliar:** 2–3 fl oz	12	**Foliar:** 14	In-furrow or side-dress application, including chemigation up to 50% ground cover. Do not apply more than 12 fl oz per acre per year. Flea beetles only.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–2.67 oz	12	Applied at planting	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. Flea beetles only.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2.0–2.75 fl oz **Soil:** 11.5–13.25 fl oz	12	**Foliar:** 7 **Soil:** apply preplant, preemergence or at ground crack	Do not apply more than 8 fl oz per acre per season as foliar sprays or more than 13.25 fl oz as a soil application. Flea beetles only.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4 oz	12	14	Do not exceed a total of 8 oz of product per acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	OMRI-listed.[2]
Caterpillars (including armyworms, loopers, corn earworms, hornworms, webworms, saltmarsh caterpillars)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 1.25–2.5 lb **XLR, 4F:** 1–2 qt	12	7	Do not apply more than 10 lb (80S) per acre per crop or 8 qt (4F, XLR). See label for preplant dip treatment.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	No more than 16.8 fl oz/acre per season.
	3A	***Brigade 2 EC** (bifenthrin)	**Soil:At plant:** 9.6–19.2 oz**At lay-by:** 3.2–9.6 oz **Foliar:** 2.1–6.4 oz	12	21	No more than 2 foliar applications, at least 21 days apart. Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.
	3A	***Fastac CS** (alpha-cypermethrin)	1.8–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	7	Maximum of 7.68 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	24	14	Do not apply more than 27.0 fl oz of product per acre per season. Supplemental label.
	5	**Entrust SC** (spinosad)	4.5–10 fl oz	4	7	Do not make applications less than 7 days apart or apply more than 4 times per crop. Do not apply more than 21 fl oz/acre per crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	6–8 fl oz	4	7	Do not make more than 4 applications per year.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in organic production.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Caterpillars only. Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	15	**Rimon 0.83 EC** (novaluron)	6–12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Limited to two applications for whiteflies (12 oz rate).
	18	**Intrepid 2F** (methoxyfenozide)	6–10 fl oz	4	7	Do not apply more than 64 fl oz of product per acre per year or apply more often than every 14 days.
	22	**Avaunt** (indoxacarb)	2.5–6.0 oz	12	7	Do not apply more than 24 oz/ acre per crop.
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	Maximum of 15.4 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per crop.
	28	**Exirel** (cyantraniliprole)	10–20.5 fl oz	12	1	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole, including all application types.
	28	**Vantacor** (chlorantraniliprole)	1.2–2.5 fl oz	4	1	Maximum of 5.1 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per crop.
	28	**Verimark** (cyantraniliprole)	6.75–13.5 fl oz	4	At planting	Maximum of 0.4 lb a.i./acre per year of cyantraniliprole, including all application types.
	32	**Spear-Lep** (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	4	0	Must be tank-mixed with a *Bacillus thurigiensis* (*Bt*) product. Maximum of 10 gallons/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed.[2]
Fire ants	7A	**Extinguish** (S-methoprene)	1.0–1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks.
	7D	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb	12	1	Do not exceed a total of 0.109 lb pyriproxyfen per acre (all formulations, e.g., Knack IGR). Ant Bait contains 0.5% a.i., or 0.10 lb at 2-lb rate.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
Leafhoppers	1B	**Malathion 5 EC** (malathion)	**5EC:** 1.5–2.5 pt **8F:** 1–1.5 pt	12	**5EC:** 0 **8F:** 3	Maximum of two applications per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	No more than 16.8 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	1.8–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	1.76–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	7	Do not apply more than 7.68 fl oz of product per acre per season.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	24	14	Do not apply more than 27.0 fl oz of product per acre per season. Supplemental label.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 4.4–10.5 fl oz **Foliar:** 1.2 fl oz	12	**Soil:** 125 **Foliar:** 7	One application to soil per season. If using as a foliar spray, no more than 3.7 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	1.5–4.0 oz	12	7	Whiteflies not on label for sweetpotatoes but are for other crops on label. No more than 4 applications per season.
	4A	**Platinum 75SG** (thiamethoxam)	1.66–2.67 oz	12	Applied at planting	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum.
	4A	**Scorpion 35 SL** (dinotefuran)	**Foliar:** 2.0–2.75 fl oz **Soil:** 11.5–13.25 fl oz	12	**Foliar:** 7 **Soil:** apply preplant, preemergence, or at ground crack	Do not apply more than 8 fl oz per acre per season as foliar sprays, or more than 13.25 fl oz as a soil application.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4 oz	12	14	Do not exceed a total of 8 oz of product per acre per season.
	4C	**Transform WG** (sulfoxaflor)	1.5–2.75 oz	24	7	Maximum of 8.5 oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Minimum interval between applications = 7 days. Maximum allowed per acre per year = 28 fl oz.
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed.[2]
	-	**SuffOil-X** (oil, insecticidal)	1%–2% v/v	4	0	OMRI-listed.[2]
Leafminers	1B	**Malathion 5 EC** (malathion)	**5EC:** 1.5–2.5pt **8F:** 1–1.5 pt	12	**5EC:** 0 **8F:** 3	Maximum of two applications per year.
	4A	**Actara** (thiamethoxam)	1.5–3.0 oz	12	14	Do not use after Platinum.
	5	**Entrust SC** (spinosad)	4.5–10 fl oz	4	7	Do not make applications less than 7 days apart or apply more than 4 times per crop. Do not apply more than 21 fl oz/acre per crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	6–8 fl oz	4	7	Do not make more than 4 applications per year.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	14	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant.
	15	**Rimon 0.83 EC** (novaluron)	6–12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Limited to two applications for whiteflies (12 oz rate).
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed[2]. Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed[2].
	-	**Oil, insecticidal**	1–2 gal/100 gal	12	0	No residual. Good coverage needed.
Mites	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	12	14	Must be used with a nonionic activator-type wetting, spreading, and/or penetrating adjuvant, not a binder-sticker-type adjuvant.
	23	**Oberon 2SC** (spiromesifen)	8–16 fl oz	12	7	Maximum amount per crop: 32 oz/acre. No more than 2 applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Oil, insecticidal**	1–2 gal/100 gal	12	0	No residual. Good coverage needed.
	-	**SuffOil-X** (oil, insecticidal)	1%–2% v/v	4	0	OMRI-listed.[2]

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.[2]
Stink bugs, plant bugs	3A	***Fastac CS** (alpha-cypermethrin)	3.2–3.8 fl oz	12	1	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 fl oz	12	1	Maximum of 24 fl oz/acre per season. Leaves cannot be used for food or feed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	24	7	Maximum of 7.68 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5–9 oz	24	14	Do not apply more than 27.0 fl oz of product per acre per season. Supplemental label.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	12	7	Do not apply more than 8.4 oz per acre per season.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
Sweetpotato weevil	1B	**Imidan 70 W** (phosmet)	1.3 lb	**Seedbed treatment:** 4 days **Foliar:** 5 days	7	No more than 5 applications per season. Do not apply through irrigation system. Crop must be mechanically harvested.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	No more than 16.8 fl oz/acre per season. Adults only.
	4A	**Belay Insecticide** (clothianidin)	9–12 fl oz			In furrow or side dressing.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed.[2]
Thrips (check label for species controlled)	5	**Entrust SC** (spinosad)	4.5–10 fl oz	4	7	Do not make applications less than 7 days apart or apply more than 4 times per crop. Do not apply more than 21 fl oz/acre per crop. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	6–8 fl oz	4	7	Do not make more than 4 applications per year.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	-	**SuffOil-X** (oil, insecticidal)	1%–2% v/v	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.[2]
Whitefly	1B	**Malathion 5 EC** (malathion)	**5EC:** 1.5–2.5 pt **8F:** 1–1.5 pt	12	**5EC:** 0 **8F:** 3	Maximum of two applications per year. Tank mix with pyrethroid for best control.
	3A	***Brigade 2 EC** (bifenthrin)	2.1–6.4 oz	12	21	Foliar only. No more than 2 foliar applications, at least 21 days apart. Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications. Tank-mix with Malathion for best control.
	3A	***Warrior II** (lambda-cyhalothrin)	2.1–6.4 oz	24	7	Do not apply more than 7.68 fl oz of product per acre per season. Tank-mix with Malathion for best control.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	3.5–4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	4A	**Admire Pro** (imidacloprid)	**Soil:** 4.4–10.5 fl oz **Foliar:** 1.2 fl oz	12	**Soil:** 125 **Foliar:** 7	One application to soil per season. If using as a foliar spray, no more than 3.7 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	1.5–4.0 oz	12	7	Whiteflies not on label for sweetpotatoes but are for other crops on label. No more than 4 applications per season.
	4C	**Transform WG** (sulfoxaflor)	2–2.75 oz	24	7	Maximum of 8.5 oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7–14 fl oz	4	7	Minimum interval between applications = 7 days. Maximum allowed per acre per year = 28 fl oz.
	15	**Rimon 0.83 EC** (novaluron)	6–12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Limited to two applications for whiteflies (12 oz rate).
	23	**Movento** (spirotetramat)	4.0–5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	23	**Oberon 2SC** (spiromesifen)	8–16 fl oz	12	7	Maximum amount per crop: 32 oz/acre. No more than 2 applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Notes[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2] Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed.[2]
	-	**Oil, insecticidal**	1–2 gal/100 gal	12	0	No residual. Good coverage needed.
	-	**SuffOil-X** (oil, insecticidal)	1%–2% v/v	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	0.5%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn. OMRI-listed.[2]
Wireworms	1B	***Mocap 15 G, *EC** (ethoprop)	See labels	48	Preplant	Two to three weeks before planting.
	3A	***Brigade 2 EC** (bifenthrin)	**Soil:** **At plant:** 9.6–19.2 oz **At lay-by:** 3.2–9.6 oz	12	21	Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2, March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or a similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.

[2]Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

***Restricted use insecticide.**

Table 11. Beet fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Mathews Paret, UF/IFAS North Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Alternaria Powdery mildew	7	**Fontelis SC** (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Apply no more than 2 sequential applications without alternating to dissimilar chemistry.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Apply no more than 2 sequential applications without alternating to dissimilar chemistry.
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	19	**OSO 5% SC** (polyoxin D zinc salts)	13 fl oz	84 fl oz	0	4 hr	See label for details.
Cercospora	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, Champ WP, COC DF, C-O-C-S WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox 75 WG, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
	M2	(sulfur) **Many brands available:** Kumulus DF, Micro Sulf, Microthiol Disperss, Sulfur 90W, Top Cop w/ Sulfur, Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	(propiconazole) **Many brands available:** Bumper 41.8EC, Propiconazole 3.6 EC, Propicure 3.6 F, Propi-Star EC, Tilt	**SEE INDIVIDUAL LABELS**		7	0.5	Do not apply more than 4 appl./season.
	3	(tebuconazole) **Many brands available:** Folicur 3.6F, Monsoon, Onset 3.6L, Orius 3,6F, Tebusha 3.6L, Tebustar 3.6L Tebuzol 3.6F, Toledo	7.2 fl oz	28.8 fl oz	7	0.5	Do not apply more than 4 appl./season.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7	**Fontelis** (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Apply no more than 2 sequential applications without alternating to dissimilar chemistry.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Apply no more than 2 sequential applications without alternating to dissimilar chemistry.
	11	**Cabrio EG** (pyraclostrobin)	16 oz	48 oz	0	0.5	Limit is 3 appl./crop + alternate chemistry.
	11	**Flint Extra** (trifloxystrobin)	3 oz	12 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Gem 500SC** (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Quadris** (azoxystrobin)	15.4 fl oz	3.75 qt	0	4 hr	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Reason** (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Damping-off	M3	**Defiant 75WP** (thiram)	5.3 oz/100 lb of seed			1	Seed treatment only.
	M3	**Signet** (thiram)	5.0 oz/100 lb of seed			1	Seed treatment only.
Downy mildew	33	(mono- and dipotassium salts of phosphorous acids) **Many brands available:** Confine Xtra, Fosphite, Fungi-phite, K-Phite 7LP, Oxiphos, Rampart	3 qt		0	4 hr	See label for details.
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz	7	0.5	Do not exceed more than 2 sequential applications.
Pythium seedling blight	4	**Apron XL LS** (mefenoxam)	0.64 fl oz/100 lb seed			2	Seed treatment only.
	4	(metalaxyl) **Various brands available:** Acquire, Allegiance FL, Dynashield, Metalaxyl 318 FS	0.75 fl oz/100 lb seed			0.5	Seed treatment only.
	4	**Metastar 2E** (metalaxyl)	8 pt			1	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
	4	**Sebring** (metalaxyl)	0.7 fl oz/100 lb seed			1	Seed treatment only.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Pythium seedling diseases	4	**Ridomil Gold EC** (mefenoxam)	2 pt			2	Apply at seeding in a 7"–12" band on soil over seed furrow.
	4	**Ridomil Gold GR** (mefenoxam)	40 lb			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4	**Ultra Flourish** (mefenoxam)	4 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Various seedling diseases	4 + 11	**Uniform SC** (mefenoxam + azoxystrobin)	0.34 fl oz/1000' of row	1 appl.		0	Soil incorporated.
	12	**Maxim 4FS** (fludioxonil)	0.16 fl oz/100 lb of seed			0.5	Seed treatment only.
	12	**Spirato 480 FS** (fludioxonil)	0.16 fl oz/100 lb of seed			0.5	Seed treatment only.
Various diseases	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.

[1] FRAC code (fungicide group): Number (1 through 45) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 12. Carrot fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Mathews Paret, UF/IFAS North Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Alternaria blight	M1	(copper compounds) **Many labels available:** Badge SC, Badge X2, Basic Copper 53, Champ, Champ DP, Champ Formula 2, Champ WG, COC DF, COCS WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Cuproxat, Kentan DF, Kocide, Kocide 2000, Kocide 3000, Kop-hydroxide, Mastercop, Nordox 75 WG, Nu-Cop, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop HB, Previsto, Stretch, Tenn-Cop 5E, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
	M5	(chlorothalonil) **Many labels available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN, Praiz	**SEE INDIVIDUAL LABELS**		7	0.5	
	M5 + 33	**Catamaran** (chlorothalonil + phosphite)	4 pt	50 pt	0	0.5	
	2	(iprodione) **Many labels available:** Enclosure 4F, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	2 pt	8 pt	0	1	
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Fitness, Propicure, Propimax, Propi-Star EC, Shar-Shield PPZ, Tide Propiconazole, Tilt, Topaz, Willowood Azoxy	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total applications.
	3 + 9	**Inspire Super** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	4 + M5	**Ridomil Gold Bravo** (mefenoxam + chlorothalonil)	2 lb		7	2	
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	2.5 pt		7	2	
	7	**Endura** (boscalid)	7.8 oz	22.5 oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7	**Fontelis** (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11	**Cabrio EG** (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total applications of Amistar or other QoI fungicides. See label for soil application.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	2.4 pt	14.4 pt	0	0.5	Do not exceed 2 sequential and 6 total applications of Quadris Opti, and rotate with non-QoI fungicides.
	11 + 3	**Quilt** (azoxystrobin + propiconazole)	14 fl oz	55 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	**Quilt XCEL** (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Botrytis rot Sclerotinia white mold	7	**Endura** (boscalid)	7.8 oz	22.4 oz	0	0.5	See label for additional instructions.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz		7	0.5	See label for additional instructions.
	29	**Omega** (fluazinam)	1 pt		7	0.5	White mold only.
Cavity spot	M5	(chlorothalonil) **Many labels available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN	**SEE INDIVIDUAL LABELS**		7	0.5	
	4	**Metastar 2E** (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
	4	**Ridomil Gold Ultra Flourish** (mefenoxam)	2 pt		7	2	Apply at seeding in a 7"–12" band on soil over seed furrow.
	4	**Ridomil Gold SL** (mefenoxam)	2 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 + M1	**Ridomil Gold Copper** (mefenoxam + copper hydroxide)	2 lb	8 lb	7	2	
	4 + M5	**Ridomil Gold Bravo** (mefenoxam + chlorothalonil)	2 lb		7	2	
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	2.5 pt		7	2	
	11	**Reason** (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	21	**Ranman** (cyazofamid)	6 fl oz	30 fl oz	14	0.5	Alternate with fungicides of dissimilar chemistry.
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz	7	0.5	Must be applied with a fungicide of different mode of action.
Cercospora leaf spot	M1	(copper compounds) **Many labels available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champ WG, COC DF, COCS WDG, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kocide DF, Kop-hydroxide, Mastercop, Nordox 75 WG, Nu-Cop 3L, Nu-Cop 50WP, Nu-Cop DF, Nu-Cop HB, Nu-Cop XLR, Stretch, Tenn-Cop 5E, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Fitness, Propimax, Propi-Star EC, Shar-Shield PPZ, Tide Propiconazole, Tilt, Topaz	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total applications.
	3 + 9	**Inspire Super** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	4 + M5	**Ridomil Gold Bravo** (mefenoxam + chlorothalonil)	2 lb		7	2	
	4 + M5	**Ridomil Gold Bravo SC** (mefenoxam + chlorothalonil)	2.5 pt		7	2	
	7	**Fontelis** (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	230 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Merivon** (pyraclostrobin + fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total applications of Amistar or other QoI fungicides. See label for soil application.
Damping-off	M3	**Defiant 75WP** (thiram)	5.3 oz/100 lb seed			1	Seed treatment only.
Powdery mildew	M2	(sulfur compounds) **Many brands available:** Dusting Sulfur – Crusade, IAP, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/Sulfur, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Fitness, Propimax, Propi-Star EC, Shar-Shield PPZ, Tilt	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total applications.
	3 + 9	**Inspire Super** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	7	**Fontelis** (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	**Merivon SC** (pyraclostrobin + fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	2.4 pt	14.4 pt	0	0.5	Do not exceed 2 sequential and 6 total applications of Quadris Opti, and rotate with non-QoI fungicides.
	11 + 3	**Avaris** **Quilt** **Willowood Azoxy** (azoxystrobin + propiconazole)	14 fl oz	55 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	**Quilt XCEL** (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	33 + M2	**Sanction** (potassium phosphate + sulfur)	6 pt			2	
Pythium	21	**Ranman** (cyazofamid)	6 fl oz	30 fl oz	14	0.5	Alternate with fungicides of dissimilar chemistry.
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz	7	0.5	Must be applied with a fungicide of different mode of action.
Pythium damping-off	4	**Acquire, Sebring 318FS, Sebring 480FS, Metalaxyl 4.0 ST** (metalaxyl)	0.7 fl oz/100 lb of seed			1	Seed treatment only.
Pythium seedling blight	4	**Apron XL** (mefenoxam)	0.64 fl oz/100 lb seed			2	Seed treatment only.
	4	**Metastar 2E** (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
	4	**Ridomil Gold** (mefenoxam)	2 pt			2	Apply at seeding in a 7"–12" band on soil over seed furrow.
	4	**Ridomil Gold SL** **Ultra Flourish** (mefenoxam)	2 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Various (see label)	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	23 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	10.5 oz	63 oz	0	0.5	Limit is 6 appl./crop and alternate chemistry.
	11	(azoxystrobin) **Many labels available:** Azoxystar, Azoxyzone, Equation SC, Quadris, Satori, Trevo, Willowood Azoxy	15.4 fl oz or 0.8 fl oz/1000 ft	3.75 qt	0	4 hr	Do not exceed 1 sequential and 4 total applications of QoI fungicides. See label for soil application.
	11	**Flint** (trifloxystrobin)	3 oz	12 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Gem 500SC** (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	**Heritage** (azoxystrobin)	10.5 oz	4 lb	0	4 hr	Do not apply more than 3 sequential applications without alternating to a fungicide of dissimilar mode of action.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	2.4 pt	14.4 pt	0	0.5	Do not exceed 2 sequential and 6 total applications of Quadris Opti, and rotate with non-QoI fungicides.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	7	0.5	Do not exceed 1 sequential and 4 total applications of Quadris Top.
	11 + 3	**Quilt** (azoxystrobin + propiconazole)	14 fl oz	55 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	**Quilt XCEL** (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	19	**OSO 5%SC** (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
	29	**Omega** (fluazinam)	1 pt	4 pt	7 day	0.5	For southern blight, apply 45 days prior to harvest.
	33	(mono- and dipotassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosphite, Fungi-phite, K-Phite 7LP, Oxiphos, Phiticide, Prophyt, Phostrol, Rampart	3 qt		0	4 hr	See label for details.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Various seedling diseases	12	**Maxim 4FS** **Spirato 480 FS** (fludioxonil)	0.16 fl oz/100 lb of seed			0.5	Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 45) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).
[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 13. Radish fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Mathews Paret, UF/IFAS North Florida Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Alternaria leaf spot	7	**Fontelis** (pentiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides.
Cercospora leaf spot	3	**Tilt** (propiconazole)	4 fl oz	16 fl oz	14	0.5	
	3 + 11	**Quilt** (propiconazole + azoxystrobin)	14 fl oz	56 fl oz	14	0.5	Alternate with fungicides of dissimilar modes of action.
	7	**Fontelis** (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	5.8 fl oz	23 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides.
	11	**Flint Extra** (trifloxystrobin)	3 oz	12 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
Damping-off	M3	**Defiant 75WP** (thiram)	5.3 oz/100 lb of seed			1	Seed treatment only.
Downy mildew	4 + M1	**Ridomil Gold Copper** (mefenoxam + copper hydroxide)	2 lb	8 lb	7	2	
	33	(mono- and dipotassium salts of phosphorous acid) **Many brands available:** Confine Extra, Fosphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Rampart	3 qt		0	4 hr	See label for details.
	43	**Presidio** (fluopicolide)	4 fl oz	16 fl oz	7	0.5	Alternate with fungicides of dissimilar chemistry.
Powdery mildew	M2	(sulfur compounds) **Many brands available:** Micro Sulf, Microthiol Disperss, Sulfur 90W, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	7	**Fontelis** (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 + 12	**Switch 62.5WDG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides. See label for soil application.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides. See label for soil application.
Pythium	21	**Presidio** (fluopicolide)	4 fl oz	16 fl oz	7	0.5	Alternate with fungicides of dissimilar chemistry.
Pythium damping-off	4	**Acquire** **Sebring 318FS** **Sebring 480FS** (metalaxyl)	0.7 fl oz/100 lb of seed			1	Seed treatment only.
Pythium seedling blight	4	**Apron XL** (mefenoxam)	0.64 fl oz/100 lb seed			2	Seed treatment only.
	4	**Metastar 2E** (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
	4	**Ridomil Gold** (mefenoxam)	2 pt			2	Apply at seeding in a 7″–12″ band on soil over seed furrow.
	4	**Ridomil Gold SL** (mefenoxam)	2 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
White rust	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides. See label for soil application.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides. See label for soil application.
Various (see label)	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 sequential applications without rotating to a fungicide of dissimilar mode of action.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	11	(azoxystrobin) **Various brands available**: Quadris, Satori, Willowood Azoxy	15.4 fl oz or 0.8 fl oz/1000 row ft	62 fl oz	0	0.5	Do not exceed 1 sequential and 4 total applications of QoI fungicides. See label for soil application.
	33	(mono- and dipotassium salts of phosphorous acid) **Many brands available:** Confine Extra, Fosiphite, Fungi-phite, K-Phite 7LP, Oxiphos, Rampart	3 qt		0	4 hr	See label for details.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Various seedling diseases	12	(fludioxonil) **Various brands available:** Dynashield, Maxim 4FS, Spirato 480 FS	0.16 fl oz/100 lb of seed			0.5	Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 45) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).
[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 14. Sweetpotato fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Shouan Zhang, UF/IFAS Tropical Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Alternaria leaf blight	BM01 + 3	**Regev** (tea tree oil, difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	
	3	**Provysol** (mefentrifluconazole)	5 fl oz	15 fl oz	7	0.5	
	3	**Quash (metconazole)**	4 oz	16 oz	1	0.5	
	3 + 11	**Veltyma** (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	
	3 + 29	**Orbus ESQ** (difenoconazole + fluazinam)	14.5 fl oz	64 fl oz	14	2	
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	32.4 fl oz	14	0.5	
	9	**Vango WG** (cyprodinil)	7 oz	28 oz	14	0.5	
	9 + 12	**Alterity 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	14	0.5	Alternate with another labeled non-Group 9 or 12 fungicide for 2 applications after 2 applications of Switch WG.
	11	**Aframe** (azoxystrobin)	15.5 fl oz	123 fl oz	0	4 hr	Do not make more than 1 sequential application, including other Group 11 fungicides.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Atticus Acadia 2 SC, Arius 250, A-Zox 25SC AzoxyStar, Azoxyzone, GCS Azoxy 2SC, Tetraban (azoxystrobin)**	20 fl oz	123 fl oz	14	4 hr	
	11	**AZteroid FC 3.3** (azoxystrobin)	12.8 fl oz	77.6 fl oz	14	4	
	11	**Cabrio EG** (pyraclostrobin)	12 oz	48 oz	0	0.5	Make no more than 1 consecutive application.
	11	**Headline Headline SC** (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Do not make more than 2 sequential applications, including other Group 11 fungicides.
	11	**Quadris** (azoxystrobin)	15.5 fl oz	120 fl oz	14	4 hr	Make no more than 1 consecutive application.
	11	**Satori** (azoxystrobin)	20 fl oz	120 fl oz	14	4 hr	Do not make more than 1 sequential application, including other Group 11 fungicides.
	11	**Trevo** (azoxystrobin)	20 fl oz	123 fl oz	14	4 hr	Make no more than 2 sequential applications, including other Group 11 fungicides, before alternating with another group
Ascochyta leaf spot	3 + 7 X	**Miravis Top** (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	An adjuvant may be added at recommended rates; minimum application interval is 7 days.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 sequential applications of Luna Tranquility or any Group 7 or Group 9 containing fungicides.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl	34.2 fl oz	14	0.5	An adjuvant may be added at recommended rates.
	11	**Aframe Quadris** (azoxystrobin)	15.5 fl oz	120 fl oz	14	4 hr	Do not make more than 1 sequential application, including other Group 11 fungicides.
	11	**Atticus Acadia 2 SC, Arius 250, A-Zox 25SC, AzoxyStar, Azoxyzone, GCS Azoxy 2SC, Satori, Tetraban, Trevo (azoxystrobin)**	20 fl oz	123 fl oz	14	4 hr	Do not make more than 1 sequential application, including other Group 11 fungicides.
	11	**Azteroid FC 3.3** (azoxystrobin)	12.8 fl oz	77.6 fl oz	14	4 hr	Do not make more than 1 sequential application, including other Group 11 fungicides.
	11 + 3	**Acadia ESQ Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	Make no more than 2 consecutive applications; addition of a spreading/penetrating adjuvant (nonionic surfactant or crop oil concentrate) is recommended.
Black dot	3	**Provysol** (mefentrifluconazole)	5 fl oz	15 fl oz	7	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	**Quash** (metconazole)	4 oz	16 oz	1	0.5	
	3 + 11	**Veltyma** (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	
	3 + 29	**Orbus ESQ (difenoconazole + fluazinam)**	14.5 fl oz	64 fl oz	14	2	
	7	**Velum Prime** (fluopyram)	6.84 fl oz	13.7 fl oz	7	0.5	
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 sequential applications of Luna Tranquility or any Group 7 or Group 9 containing fungicides.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	14	0.5	An adjuvant may be added at recommended rates.
	11	**Aftershock Evito 480 SC** (fluoxastrobin)	0.24 fl oz/1000 row ft	22.8 fl oz	7	0.5	Make no more than 1 application of seed treatment or in-furrow or banded application in conjunction with foliar application.
	11	**Reason 500 SC** (fenamidone)	8.2 fl oz	16.4 fl oz	14	0.5	Make no more than 1 consecutive application.
	11	**Tepera** (fluoxastrobin)	9.2 fl oz	50.4 fl oz	7	0.5	Do not apply more than 6 applications per year.
	11 + 3	**Acadia ESQ Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	Make no more than 2 consecutive applications; addition of a spreading/penetrating adjuvant (nonionic surfactant or crop oil concentrate) is recommended.
	11 + 3	**Tepera Plus** (fluoxastrobin + bifenthrin)	18.5 fl oz	37 fl oz	21	0.5	Do not make more than 1 in-furrow or banded application in conjunction with foliar application. Do not make more than 2 applications per year.
	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	
Botrytis	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl	34 fl oz	14	0.5	
	3	**Quash** (metconazole)	4.0 oz	16 oz	1	0.5	
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 sequential applications of Luna Tranquility or any Group 7 or Group 9 fungicides.
	7 + 12	**Miravis Prime (pydiflumetofen + fludioxonil)**	11.4 fl oz	34.2 fl oz	14	0.5	
	9	**Scala SC** (pyrimethanil)	7 fl oz	35 fl oz	7	0.5	See label.
Cercospora leaf spot	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	14	0.5	Do not make more than two consecutive applications of Miravis Prime or other Group 7 fungicide before alternation with a fungicide that is not in Group 7.
	11	**Aframe, Arius 250, Atticus Acadia™ 2 SC,A-Zox 25SC, AzoxyStar, Azoxystrobin SC, Azoxyzone, GCS Azoxy 2SC, Satori, Tetraban, Trevo** (azoxystrobin)	15.5 fl oz	123 fl oz	14	4 hr	Do not make more than 1 sequential application, including other Group 11 fungicides.
	11	**Azteroid FC 3.3** (azoxystrobin)	9.7 fl oz	77.6 fl oz	14	4 hr	Do not make more than 1 sequential application, including other Group 11 fungicides.
	11	**Cabrio EG** (pyraclostrobin)	12 oz	48 oz	0	0.5	
	11	**Headline Headline SC** (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	
	11	**Quadris** (azoxystrobin)	15.5 fl oz	120 fl oz	0	4 hr	
Early blight	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	Do not make more than 1 postharvest application to the tubers.
	3	**Provysol** (mefentrifluconazole)	5 fl oz	15 fl oz	7	0.5	
	3	**Quash** (metconazole)	4 oz	16 oz	1	0.5	
	3 + 7	**Miravis Top** (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	An adjuvant may be added at recommended rates. Minimum application interval is 7 days.
	3 + 11	**Veltyma** (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	
	3 + 29	**Orbus ESQ** (difenoconazole + fluazinam)	14.5 fl oz	64 fl oz	14	2	
	7	**Endura** (boscalid)	10 oz	20 oz	10	0.5	

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7	**Velum Prime** (fluopyram)	6.84 fl oz	13.7 fl oz	7	0.5	Do not make more than 2 sequential applications or with Group 7 fungicides. Postplanting drench or hill drench.
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	Apply on a 14-day interval. Do not apply more than 2 consecutive applications. Addition of a spreading/penetrating-type adjuvant is recommended.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 sequential applications or with Group 7 or 9 fungicides.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	6.8 fl oz	20.4 fl oz	7	0.5	An adjuvant may be added at recommended rates.
	9	**Scala SC** (pyrimethanil)	7 fl oz	35 fl oz	7	0.5	See label.
	9	**Vango WG** (cyprodinil)	7 oz	28 oz	14	0.5	
	9 + 12	**Alterity 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	14	0.5	
	11	**Aftershock** **Evito 480 SC** (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	0.5	See label.
	11	**Aproach** (picoxystrobin)	12 fl oz	36 fl oz	3	0.5	
	11	**Flint Extra** (trifloxystrobin)	3.8 fl oz	23 fl oz	7	0.5	
	11	**Reason 500 SC** (fenamidone)	8.2 fl oz	16.4 fl oz	14	0.5	
	11	**Tepera** (fluoxastrobin)	8.4 fl oz	50.4 fl oz	7	0.5	Do not apply more than 6 applications of product per acre per year, with a minimum retreatment interval of 7 days between applications.
	11 + 3	**Acadia ESQ** **Quadris TOP** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	Addition of nonionic surfactant or crop oil concentrate or blend is recommended.
	11 + 3	**Tepera Plus** (fluoxastrobin + bifenthrin)	18.5 fl oz		21	0.5	Do not make more than 1 in-furrow or banded application in conjunction with foliar application; do not make more than 2 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	28	**Previcur Flex** (propamocarb hydrochloride)	1.2 pt	6 pt	14	0.5	Tank-mix with chlorothalonil, maneb, or mancozeb for better control
Fusarium dry rot	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	
	11	**Atticus Acadia 2SC** **A-Zox 25SC** **AzoxyStar** **Azoxystrobin SC** **GCS Azoxy 2SC** **Satori** **Tetraban** (azoxystrobin)	0.6 fl oz/ton tubers			4 hr	In-line aqueous spray. Do not make more than one postharvest application to tubers.
	11 + 12 + 3	**Stadium** (azoxystrobin + fludioxonil + difenoconazole)	0.5 fl oz/1000 lb tubers				
Phytophthora	BM 01	**Timorex ACT** (tea tree oil)	35 fl oz	120 fl oz	2	4 hr	
	4	**MetaStar 2E** (metalaxyl)	See label.		1	2	See label.
	4	**Orondis Gold B** (mefenoxam)	2 pt	1.5 lb a.i.		2	Do not apply more than 3 applications per crop.
	4	**Ridomil Gold SL** (mefenoxam)	2 pt	1.5 lb a.i.		2	Preplant incorporated broadcast or band application, soil spray.
	4	**Ultra Flourish** (mefenoxam)	4 pt	1.5 lb a.i.		2	Preplant incorporated broadcast or band application, surface application.
	4	**Xyler FC** (metalaxyl)	2.9 qt	2.9 qt			Preplant incorporated broadcast or band application, surface application.
	11	**Aframe** (azoxystrobin)	15.5 fl oz	123 fl oz	14	4 hr	Do not make more than one sequential application, including other Group 11 fungicides.
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz	7	0.5	
Pink rot	BM 01	**Timorex ACT** (tea tree oil)	35 fl oz	120 fl oz	2	4 hr	
	11	**Acadia 2SC** **Azoxystar** (azoxystrobin)	0.6 fl oz/ton tubers			4 hr	Do not make more than 1 postharvest application to the tubers.
	11	**Satori** **Tetraban** (azoxystrobin)	0.6 fl oz/ton tubers				

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	21	**Ranman 400SC** (cyazofamid)	**At planting:** 0.42 fl oz/1000 linear ft **Lay-by/Hilling:** 2.75 fl oz/A	27.5 fl oz	7	0.5	
	22	**Elumin** (ethaboxam)	8 fl oz	16 fl oz		0.5	
	49	**Orondis Gold** (oxathiapiprolin)	9.6 fl oz	9.6 fl oz	5	4 hr	Apply as an in-furrow application at planting.
	49 + 4	**Orondis Gold (Premix)** (oxathiapiprolin + mefenoxam)	**Soil applied:** 27.8 fl oz **Foliar:** 12 fl oz	27.8 fl oz	14	2	
Powdery mildew	BM 01	**Timorex ACT** (tea tree oil)	35 fl oz	120 fl oz	2	4 hr	
	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	
	M2	**Acoidal** (sulfur)	5 lb			1	OMRI-listed. repeat every 14 days or as needed.
	M2	**Auron DF** (sulfur)	5 lb			1	OMRI-listed.
	M2	**Cosavet DF Edge** (sulfur)	10 lb				OMRI-listed. Apply every 14 days or as needed.
	M2	**Micro Sulf** (sulfur)	5 lb			1	Do not apply within 14 days of an oil spray.
	M2	**Microthiol Disperss** (sulfur)	10 lb			1	
	M2	**Suffa** (sulfur)	0.6 gal.	2.8 gal.	0	1	Apply at 14-day intervals or as needed.
	M2	**Sulfur 80 WDG** (sulfur)	10 lb			1	OMRI-listed. Apply at early leaf stage; repeat every 14 days or as needed.
	M2	**Sulfur 90W** (sulfur)	20 lb			1	For greenhouse use.
	3	**Quash** (metconazole)	4 oz	16 oz	1	0.5	Do not make more than 2 sequential applications.
	3 + 7	**Miravis Top** (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	An adjuvant may be added at recommended rates; minimum application interval is 7 days.
	3 + 11	**Veltyma** (mefentrifluconazole + pyraclostrobin)	10 fl oz	30 fl oz	7	0.5	
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	May be used with adjuvants; other crops cannot be planted until 120 days after the last application of Vertisan.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	Apply on a 14-day interval. Do not apply more than 2 consecutive applications. Addition of a spreading/penetrating-type adjuvant is recommended.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	14	0.5	An adjuvant may be added at recommended rates.
	9	**Vango WG** (cyprodinil)	7 oz	28 oz	14	0.5	
	9 + 12	**Alterity 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	Leaves of root & tuber subgroup: 7 Tuberous and corm subgroup: 14	0.5	
	9 + 12	**Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Alternate with another labeled fungicide for 2 applications after 2 applications of Switch WG.
	11	**Aframe, Arius 250, A-Zox 25SC, AzoxyStar, Azoxyzone, GCS Azoxy 2SC, Quadris, Satori, Tetraban, Trevo** (azoxystrobin)	15.5 fl oz	123 fl oz	0	4 hr	
	11	**Acadia 2SC** (azoxystrobin)	20 fl oz	123 fl oz	0	4 hr	Do not make more than one sequential application or with other Group 11 fungicides.
	11	**Azteroid FC 3.3** (azoxystrobin)	9.7 fl oz	77.6 fl oz	Leaves of root & tuber subgroup: 0 Tuberous and corm subgroup: 14	4 hr	
	11	**Cabrio EG** (pyraclostrobin)	12 oz	48 oz	0	0.5	
	11	**Headline Headline SC** (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Do not make more than 2 sequential applications or with other Group 11 fungicides.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	Make no more than 2 sequential applications or with other Group 11 fungicides. Adding adjuvant may enhance the efficacy.
Pythium damping-off	4	**MetaStar 2E** (metalaxyl)	8 pt			2	Preplant incorporated application or surface application.
	4	**Orondis Gold B** (mefenoxam)	2 pt	1.5 lb a.i.		2	Preplant incorporated application or soil spray.
	4	**ReCon 4 F** (metalaxyl)	4 pt			2	
	4	**Ridomil Gold SL** (mefenoxam)	2 pt			2	
	4	**Thrive 4M (mefenoxam)**	31.4 fl oz			2	
	4	**Ultra Fluorish** (mefenoxam)	4 pt			2	Preplant incorporated broadcast or band application, surface application.
	4	**Xyler FC** (metalaxyl)	2.9 qt			2	
	11	**Aframe Satori (azoxystrobin)**	0.8 fl oz/1000 row feet	120 fl oz	14	4 hr	
	11	**Atticus Acadia 2 SC** **Arius 250** **A-Zox 25SC** **AzoxyStar** **Azoxyzone** **GCS Azoxy 2SC** (azoxystrobin)	0.8 fl oz/1000 row feet	123 fl oz	0	4 hr	In-furrow and banded applications over the row shortly after plant or during herbicide applications or cultivation.
	11	**AZteroid FC 3.3** (azoxystrobin)	0.48 fl oz/1000 row feet	77.6 fl oz	14	4 hr	
	11	**Quadris** (azoxystrobin)	0.8 fl oz/1000 row feet	120 fl oz	14	4 hr	
	11	**Tetraban** **Trevo** (azoxystrobin)	0.8 fl oz/1000 row feet	123 fl oz	14	4 hr	
	11 + 4	**Uniform** (azoxystrobin + mefenoxam)	0.34 fl oz/1000 ft row			0	Make only 1 application per crop season as an in-furrow spray.
	21	**Ranman 400SC** (cyazofamid)	0.42 fl oz/1000 linear ft	27.5 fl oz	7	0.5	To avoid development of resistant strains, do not apply at reduced rate; rotate with other fungicides of a different group.
	22	**Elumin** (ethaboxam)	8 fl oz	16 fl oz		0.5	Make applications at least 25 days apart.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz	7	0.5	Must be tank-mixed with another fungicide of different group; apply no more than 2 sequential applications.
	49 + 9	**Orondis Gold (Premix)** (oxathiapiprolin + mefenoxam)	**In furrow:** 27.8 fl oz **Foliar:** 12 fl oz	27.8 fl oz	14	2	
Rhizopus rot	12	**Scholar SC** (fludioxonil)	**Postharvest dip:** 32 fl oz/100 gal water **Spray:** 16 fl oz/200,000 lb sweet potatoes				Do not make more than one postharvest application.
	14	**Botran 5F** (DCNA dicloran)	0.6 qt in 100 gal water for postharvest or for root dip 5–10 seconds			0.5	See label.
Rust/white rust	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	Apply on a 14-day interval. Do not apply more than 2 consecutive applications. Addition of a spreading/penetrating-type adjuvant is recommended.
	11	**Aframe** **Satori** (azoxystrobin)	15.5 fl oz	120 fl oz	14	4 hr	Do not make more than one sequential application, including other Group 11 fungicides.
	11	**Arius 250** **Atticus Acadia 2 SC** **A-Zox 25SC** **AzoxyStar** **Azoxyzone** **GCS Azoxy 2SC** **Tetraban** **Trevo** (azoxystrobin)	20 fl oz	123 fl oz	14	4 hr	
	11	**AZteroid FC 3.3** (azoxystrobin)	12.8 fl oz	77.6 fl oz	14	4 hr	
	11	**Cabrio EG** (pyraclostrobin)	16 oz	48 oz	0	0.5	Alternate with other labeled fungicides after each application.
	11	**Headline** **Headline SC** (pyraclostrobin)	12 fl oz	48 fl oz	3	0.5	Alternate with other labeled fungicides after each application.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Quadris Flowable** (azoxystrobin)	15.5 fl oz	120 fl oz	14	4 hr	Do not make more than 1 application before alternating with a different mode of action.
	11	**Reason 500SC** (fenamidone)	8.2 fl oz	16.4 fl oz	14	0.5	
	11 + 3	**Acadia ESQ** **Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	Make no more than 2 consecutive applications; adding adjuvant may enhance the efficacy.
Sclerotinia white mold	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	
	3	**Quash** (metconazole)	4 oz	16 oz	1	0.5	Do not make more than 2 sequential applications.
	3 + 7	**Miravis Top** (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	Apply at early flowering, followed by a second application 14 days later; minimum application interval is 7 days.
	3 + 29	**Orbus ESQ (difenoconazole + fluazinam)**	12.5 fl oz	64 fl oz	14	2	
	7	**Endura** (boscalid)	10 oz	20 oz	10	0.5	Do not make more than 2 sequential applications or with other Group 7 fungicides.
	7	**Velum Prime** (fluopyram)	6.84 fl oz	13.7 fl oz	7	0.5	
	7	**Vertisan** (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	7	0.5	Do not make more than 2 sequential applications of Luna Tranquility or any Group 7 or Group 9 fungicides.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	32.4 fl oz	14	0.5	Apply at or before row closure, followed by a second application 14 days later; an adjuvant may be added at recommended rates.
	11	**Aproach** (picoxystrobin)	12 fl oz	36 fl oz	3	0.5	
	29	**Omega 500F** **Orbus 4F** (fluazinam)	8 fl oz	3.5 pt	14	0.5	
Scurf	BM 01 + 3	**Regev** (tea tree oil + difenoconazole)	8.5 fl oz	34 fl oz	14	0.5	
	7	**Vertisan** (penthiopyrad)	1.6 fl oz/1000 row ft	24 fl oz	7	0.5	Make no more than 2 sequential applications.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Acadia 2SC** **AzoxyStar** **A-Zox 25SC** **Azoxystrobin SC** **GCS Azoxy 2SC** **Satori** **(azoxystrobin)**	0.6 fl oz/ton tubers			4 hr	Do not make more than 1 postharvest application to tubers.
	11	**Aftershock** **Evito 480 SC**	0.24 fl oz/1000 row ft 9.2 fl oz	22.8 fl oz	7	0.5	Make no more than 1 application of seed treatment or in-furrow or banded application in conjunction with foliar application.
		Tepera (fluoxastrobin)	9.2 fl oz	0.72 lb a.i.	7	0.5	
	11 + 3	**Tepera Plus** (fluoxastrobin + bifenthrin)	18.5 fl oz		21	0.5	Do not make more than 1 in-furrow or banded application in conjunction with foliar application; do not make more than 2 applications per year.
	11 + 12 + 3	**Stadium** (azoxystrobin + fludioxonil + difenoconazole)	0.5 fl oz/1000 lb tubers				
	12	**Pilato SC** **(fludioxonil)**	0.6 fl oz/ton tubers				
	14	**Botran 5F** (DCNA dicloran)	**Seed dip:** 0.6 qt/7.5 gal water; **Plant bed spray:** 5.73 oz/1000 linear ft bed (42 in)	3.2 qt		0.5	Do not plant tomatoes as a follow-up crop.
Seed decay, damping-off, seedling blight caused by soil pathogens	12	**Maxim 4FS** **Maxim 480FS** (fludioxonil)	**4FS:** 0.16 fl oz/100 lb seed **480FS:** 0.80 fl oz/100 lb seed		0	0.5	Not effective against *Pythium*; tank-mix with others for *Pythium* control.
Septoria leaf spot	M2	**Sulfur 80 WDG** (sulfur)	5 lb/treated acre 10 lb		0	1	Do not use within 2 weeks of an oil spray treatment. OMRI-listed. Apply at early leaf stage; repeat every 14 days or as needed.
	3 + 7	**Miravis Top** (difenoconazole + pydiflumetofen)	13.7 fl oz	56 fl oz	14	0.5	An adjuvant may be added at recommended rates; minimum application interval is 7 days.
	3 + 29	**Orbus ESQ** **(difenoconazole + fluazinam)**	14.5 fl oz	64 fl oz	14	2	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	27 fl oz	14	0.5	Apply on a 14-day interval. Do not apply more than 2 consecutive applications. Addition of a spreading/penetrating-type adjuvant is recommended.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	34.2 fl oz	14	0.5	An adjuvant may be added at recommended rates.
	9	**Vango WG** (cyprodonil)	7 oz	28 oz	14	0.5	
	9 + 12	**Alterity 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11 + 3	**Acadia ESQ** **Quadris Top** (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	0.5	Make no more than 2 consecutive applications; adding adjuvant may enhance the efficacy.
Southern blight (*Sclerotium rolfsii*)	11	**Aframe** **Satori** **(azoxystrobin)**	0.80 fl oz/1000 row ft	120 fl oz	14	4 hr	
	11	**Atticus Acadia 2 SC** **Arius 250,** **A-Zox 25SC,** **AzoxyStar,** **Azoxyzone,** **GCS Azoxy 2SC,** **Tetraban,** **Trevo** (azoxystrobin) (azoxystrobin)	0.80 fl oz/1000 row feet	123 fl oz	Tuberous and corm subgroup: 14	4 hr	
	11	**AZteroid FC3.3** (azoxystrobin)	0.48 fl oz/1000 row feet	77.6 fl oz		4 hr	
	11	**Quadris Flowable** (azoxystrobin)	0.80 fl oz/1000 row feet	120 fl oz		4 hr	
Various soilborne diseases	11	**Many brands** (azoxystrobin)	Various; see label	See label	4 hr	See label.	

[1] FRAC code (fungicide group): Number (1 through 45) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or a similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/(FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 15. Nonfumigant nematicides for carrot, beet, and radish in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Vydate L (a.i. oxamyl) (carrot only)	Apply within one week before planting or before emergence if postplant, either broadcast (2 gal/A, incorporate 2″ at least), in the seed furrow (1–2 gal/A), or via chemigation (1 gal/A). Do not apply more than 4 gal/A per season. Minimum retreatment interval is 14 days. No more than 8 applications per season. Last application at least 14 days to harvest.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints (56.0 to 80.0 fl oz) per acre a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop, and no more than 112 fl oz of product per acre, per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.
Vydate is an insecticide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations for how best to apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 16. Nonfumigant nematicides for sweetpotato in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	When to Apply	Application Pattern	Incorporation Depth	Rate
Mocap 15G (a.i. ethoprop)	2 to 3 weeks preplant	Row, 12″ to 15″ band	2″ to 4″ with rotary hoe, tiller, etc. or by bedding over the band	20 to 26 lb/A or 1.6 to 2.1 per 1000 ft of row (min. row spacing 42″)
Mocap EC (a.i. ethoprop)	2 to 3 weeks preplant	Row, 12″ to 15″ band	2″ to 4″ deep	5.1 to 6.9 fl oz/1000 ft row
Vydate L* (a.i. oxamyl)	Within one week before planting	Broadcast, band, or in-furrow transplant drench	4″ to 6″ deep	2 gal/A broadcast or 1 to 2 gal/A in-furrow (Consult table for specific instructions and other uses.)
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints (56.0 to 80.0 fl oz) per acre a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop, and no more than 112 fl oz of product per acre, per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.			
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/acre as an in-furrow spray during planting directed on or below seed, by using overhead chemigation equipment, or for transplanted crops, as a postplanting drench or hill drench. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). Do not apply Velum within 7 days of harvest. For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group. The grazing of livestock in treated areas within 7 days of application is prohibited.			
Mocap and Vydate are insecticide/nematicides; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations for how best to apply them (see specific label recommendations). When nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants. *Vydate L has registration for nematode control on sweet potatoes only as a broadcast or in-furrow treatment. Foliar applications are registered for insect control only. For broadcast or in-furrow treatments, Vydate L should be applied in a minimum of 20 gallons of water. As a broadcast treatment thoroughly incorporate to a soil depth of 4″–6″.				

Table 17. Fumigant nematicides for carrot and sweetpotato in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/ chisel-spaced 12" apart	
Telone II[2,3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2,3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19 to 31.5 gal	57 to 90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions.

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Fumigant Management Plans (FMP) and Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other use and rate-modifying recommendations.
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS736

doi.org/10.32473/edis-cv134-2022

Chapter 16. Strawberry Production[1]

Vance M. Whitaker, Nathan S. Boyd, Natalia Peres, Johan Desaeger, Sriyanka Lahiri, and Shinsuke Agehara[2]

Botany and Planting

Strawberry—*Fragaria ×ananassa*, Rosaceae.

Table 1. Planting information for strawberries.

Planting Dates	
North Florida	Sept 15–Oct 15
Central Florida	Sept 25–Oct 25
South Florida	Oct 1–Nov 1
Planting Information (2-Row Beds)	
Number of plant rows per bed	2
Distance between beds (in)	48–60
Distance between plants within a row (in)	12–16
Distance between plant rows (in)	12–14
Days to first ripe fruit	25–50
Plant populations (acre)	16,000–22,000

1. This document is HS736. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Vance M. Whitaker, associate professor, Horticultural Sciences Department, UF/IFAS Gulf Coast Research and Education Center; Nathan S. Boyd, associate center director and professor, Horticultural Sciences Department, UF/IFAS Gulf Coast REC; Natalia Peres, professor, Plant Pathology Department, UF/IFAS Gulf Coast REC; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; Sriyanka Lahiri, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; and Shinsuke Agehara, assistant professor, Horticultural Sciences Department, UF/IFAS Gulf Coast REC; UF/IFAS Extension, Gainesville, FL 32611.

Cultivars

Main Cultivars

Florida Brilliance. Released in 2017. Highest early yield of all varieties; large fruit size; uniform conic to broad-conic shape; very firm with excellent shelf life; externally very glossy red; light red internally; moderately resistant to rain damage; balanced flavor. The plant is robust but not overly vigorous; is upright with long stems, allowing ease of harvest; and does not require high N applications as Florida Medallion™ 'FL 16.30-128' does. Fruit can develop weak skin during hot periods in mid-late season, and both N rates and irrigation volumes should be reduced to counteract this possible problem. Recommended planting dates in central Florida are Oct. 5–15. Resistant to anthracnose fruit rot; moderately resistant to powdery mildew and charcoal rot; moderately susceptible to Botrytis fruit rot, angular leaf spot, and Colletotrichum crown rot; susceptible to Phytophthora root rot.

Sweet Sensation® Florida127. Released in 2013. Large fruit size; moderately uniform conic to broad-conic fruit; bright-red with lighter color than other cultivars. During cool weather a longer interval between harvests compared to other cultivars is usually necessary to allow optimum color development. Exceptional flavor throughout season; 1.0 to 1.5 degree Brix higher and slightly lower acidity than 'Florida Brilliance'; susceptible to rain damage. The plant is vigorous, which may be an advantage in north Florida but in central Florida will require reduced nutrient applications early in the season and/or later planting dates to maintain a small plant size. Recommended planting dates in central Florida are Oct. 15–25. Resistant to anthracnose fruit rot and Colletotrichum crown rot; moderately resistant to charcoal rot (caused by *Macrophomina phaseolina*); moderately susceptible to angular leaf spot; susceptible to Botrytis fruit rot and powdery mildew (caused by *Podosphaera aphanis*); highly susceptible to Phytophthora root rot. Ridomil and phosphite applications are highly recommended.

Florida Medallion™ 'FL 16.30-128'. Released in 2020. Medium size; extremely uniform, conic fruit with glossy appearance; glossy-red external color and medium-red internal color; moderately acidic and high brix like or even more so than Sweet Sensation® 'Florida127'; moderately firm with good shipping quality. Low to medium plant vigor with upright canopy; N rates higher than for 'Florida Brilliance' will be required for optimum plant growth. Recommended planting dates in central Florida are Oct. 1–10 due to a compact plant and low runner production. Moderately susceptible to Colletotrichum crown rot and angular leaf spot; susceptible to Botrytis fruit rot and powdery mildew; highly susceptible to Phytophthora root rot and charcoal rot.

Minor Cultivars

Florida Pearl® '109' and '66'. Released in 2020, the '109' was the first white-fruited strawberry or "pineberry" released by UF/IFAS. It is the result of hybridization between descendants of Japanese white strawberries, the source of its unique color, and red Florida strawberries, the source of its yield, disease resistance, and other commercial production qualities. It has a pure white internal color and a white external base color with red seeds and a pink blush when ripe. It has a distinctive low-acid flavor and often has aromatic notes similar to those of pineapple or apricot. Fruit have moderate gloss and are uniform, conic, and less firm than red varieties. Fertilization rates should be similar to those of 'Florida Brilliance'. Recommended planting dates in central Florida are Oct. 10–20. It has moderate resistance to most diseases. The '66' was released in 2022 with improved early yield and firmness over the '109'. It otherwise has similar management needs. It also has a good disease resistance profile with few weaknesses and is tolerant to diseases caused by *Neopestalotiopsis* sp.

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 2. Herbicides approved for managing weeds in strawberry. Contact: Nathan S. Boyd, UF/IFAS Gulf Coast Research and Education Center.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		*****PRETRANSPLANT*****	
Acifluorfen up to 0.375	(Ultra Blazer) 1.5 pt	14	Broadleaves. May be applied under the plastic mulch or with a shielded or hooded spray directed to row middles. 60-day PHI.
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Broadleaves. Apply as a preplant burndown for emerged broadleaves up to 4 inches tall or rosettes less than 3 inches across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pretransplant interval.
DCPA 9	Dacthal W-75 12 lb	3	Broadleaves and some grasses. Apply to formed beds prior to laying the plastic mulch or to row middles. Preplant incorporation is recommended.
Flumioxazin 0.1	(Chateau) SW 3 oz	14	Broadleaves. May be applied under the plastic mulch or with a shielded or hooded spray directed to row middles before weed emergence. 30-day pretransplant interval if applied under the plastic mulch. Do not apply after fruit set.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves and grasses. Apply as a preplant burndown. Consult label for individual product directions.
Napropamide 4	(Devrinol) 2-XT 1–2 gallons (Devrinol DF XT) 4–8 lb	15	Annual broadleaves and grasses. Apply under the plastic and in the row middles. Mechanically incorporate in the row middle to a 1–2 in. depth within 24 hours of application. When applied under plastic, incorporate mechanically or with irrigation. Do not apply between bloom and harvest.
Oxyfluorfen 0.25–0.5	(Galigan H2O, GoalTender) 4 EC 0.5–1.0 pt (Collide, Goal 2XL) 2 EC 1–2 pt	14	Broadleaves. Apply pretransplant just prior to installation of plastic mulch. 30-day pretransplant interval. Mulch may be applied any time during the 30-day interval.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment or post-transplant with shielded or hooded sprayers. Product is a contact, nonselective, foliar-applied herbicide with no residual control.
Pendimethalin 0.72	(Prowl H20) 3.8 1.5 pt	3	Broadleaves and grasses, in the row middles. Do not apply under the plastic. In systems that use irrigation at planting, delay application until after irrigation regime. 35-day PHI.
S-metolachlor 0.64–1.27	Dual Magnum 0.67–1.33 pt	15	Broadleaves, grasses and nutsedge suppression. Apply to row middles using a shielded applicator pre- and posttransplant. Label is a 24(C) local indemnified label and a waiver of liability must be signed for use. 30-day PHI.
Sulfentrazone 0.125	(Spartan FL) 4F 4 oz	14	Broadleaves, grasses, and nutsedge species. Apply under the plastic mulch or in row middles. Do not use on soils with less than 1% organic matter.
Terbacil 0.2	(Sinbar WDG) 80 WDG 4 oz	3	Broadleaves, grasses, and some sedges. One application per crop of 4 oz/A after bedding but prior to transplanting. Rainfall or irrigation required. Do not apply to soils with less than 0.5% organic matter. 110-day PHI.
		*****POSTTRANSPLANT*****	
Acifluorfen up to 0.375	(Ultra Blazer) 1.5 pt	14	Broadleaves. Apply directed to the row middles with a shielded or hooded sprayer. Do not allow to contact strawberry plants. 60-day PHI.
Carfentrazone up to 0.031	(Aim) 2.0 EC up to 2 fl oz	14	Broadleaves. Apply with hooded applicator directed to the row middles for control of emerged broadleaves up to 4 inches tall or rosettes less than 3 inches across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. 0-day PHI.
Clethodim 0.09–0.13 0.07–0.13	(Arrow, Select) 2 EC 6–8 fl oz (Select Max) 1 EC 9–16 fl oz	1	Perennial and annual grasses. Use higher rates under heavy grass pressure or larger weeds. Surfactant or crop oil concentrate recommended. Consult label. 4-day PHI.
Clopyralid 0.125–0.25	(Stinger) 3 EC 0.33–0.66 pt	4	Broadleaves. Do not exceed 2/3 pt/A per year. Do not include a surfactant. 7-day PHI.

DCPA 9	Dacthal W-75 12 lb	3	Broadleaves and some grasses. Apply to row middles with shielded applicator. Do not apply after first bloom.
Fluazifop-P-butyl 0.25	Fusilade DX 16 fl oz	1	Supplemental label. Emerged annual and perennial grasses. Most effective on young, actively growing grasses. Do not apply more than 1 application per year. 14-day PHI.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses, and nutsedge. Apply directed to the row middles. Injury has been observed from translocation from daughter plants in the row middle to the mother plants. 14-day PHI. Spot treatment has 7-day PHI.
Paraquat 0.5	(Gramoxone) 2 SL 2 pt (Firestorm) 3 SL 1.3 pt	22	Emerged broadleaves and grasses. Apply as a directed spray to row middles only. Do not allow spray to contact plants. Do not apply more than 3 times per season. Nonionic surfactant recommended. 21-day PHI. **Consult label for new restrictions.**
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment or posttransplant with shielded or hooded sprayers. Product is a contact, nonselective, foliar-applied herbicide with no residual control.
Sethoxydim 0.28–0.47	(Poast) 1.5 EC 1.5–2.5 pt	1	Emerged grasses. A maximum of 2.5 pt/A applied in one season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. 7-day PHI.
S-metolachlor 0.64–1.27	Dual Magnum 0.67–1.33 pt	15	Broadleaves, grasses and nutsedge suppression. Apply to row middles using a shielded applicator posttransplant. Label is a 24(C) local indemnified label and a waiver of liability must be signed for use. 30-day PHI.
*****POSTHARVEST*****			
Paraquat 0.49	(Gramoxone) 2 SL 1.95 pt	22	Broadcast spray over the top of the plants after the last harvest. Thorough coverage is required to ensure maximum herbicide burndown. Do not use treated crop for human or animal consumption. Nonionic surfactant recommended. **Consult label for new restrictions.**

Table 3. Selected insecticides approved for managing insect pests of strawberry. Contact: Sriyanka Lahiri, UF/IFAS Gulf Coast Research and Education Center.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Ants	7A	**Extinguish Professional Fire Ant Bait** (S-methoprene)	See label		4	0	
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb		12	1	
Aphids	1B	**Diazinon 50W, AG600 WBC** (diazinon)	**50W**: 1 lb **AG600 WBC**: 12.75 fl oz	Make a maximum of one foliar application per crop and one soil application per crop.	3 days	5	Highly toxic to bees.
	1B	**Dibrom 8-E*** (naled)	1 pint	Do not apply more than 5 pints per season.	48	1	Do not make more than 5 applications per season. Allow minimum of 7 days between applications.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–3.2 pints **8F**: 1.5–2.0 pints	**8F**: Do not apply more than 8 pints/A per year	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	3A	***Brigade WSB** (bifenthrin)	6.4–32.0 oz	Do not apply more than 80 oz/A per season.	12	0	
	3A	**Evergreen EC 60-6** (pyrethrins + piperonyl butoxide)	2.0–16.0 fl oz		12	0	Do not make applications less than 7 days apart. Do not make more than 10 applications in a season.
	3A	**PyGanic EC 5.0** (pyrethrins)	See label		12	0	OMRI approved.
	3A + 4A	***Brigadier** (bifenthrin + imidacloprid)	5.1–6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	Do not make applications less than 5 days apart.
	3A + 6	**Athena** (bifenthrin + avermectin B1)	7.0–17.0 fl oz	Do not apply more 68 fl oz in a growing season after transplanting.	12	3	Make 2 applications 7–10 days apart. If further applications are needed, wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A + -	**Azera Insecticide** (azadirachtin + pyrethrins)	3.5 pints/A	Do not apply more than 10 times per season.	4	0	OMRI approved. Repeat applications as required but not more than 5–7 days apart.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	4A	**Actara** (thiamethoxam)	1.5–4.0 oz	Do not exceed a total of 12 oz/A (0.188 lb a.i./A) of Actara or 0.188 lb a.i. of thiamethoxam-containing products per acre per growing season.	12	3	Minimum interval between applications is 10 days. Do not use Actara in nurseries, greenhouses, plant propagation houses, or on any plants grown for use as transplants. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Admire Pro** (imidacloprid)	**Soil**: 10.5–14 fl oz **Foliar**: 1.3 fl oz	Do not apply more than 14.0 fl oz/A for soil and 3.9 fl oz/A for foliar applications per season.	12	**Soil**: 14 **Foliar**: 5	Soil applications may be made as chemigation, as a plant hole treatment, or as a band spray over the row followed by overhead irrigation. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG**: 1.9–6.9 oz **70 WP**: 0.8–3.0 oz	**30 SG**: Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season. **70 WP**: Do not exceed a total of 6.0 oz Assail 70 WP/A per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	4A	**Platinum 75 SG** (thiamethoxam)	1.7–4.01 oz	Do not exceed 4.01 oz/A per growing season.	12	50	
	4A + 15	**Cormoran** (acetamiprid + novaluron)	9.0–12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp. 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	2.0–5.0 oz	Do not exceed 15.0 oz/A per growing season.	12	3	Application restrictions exist for this product because of the risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–10.5 fl oz	Maximum allowed per year is 28.0 fl oz/A.	4	0	10-day minimum interval between applications.
	6	**Timectin 0.15 EC Ag** (abamectin)	16.0 fl oz	Do not apply more than 16 fl oz/A per application and more than 64 fl oz/A per season.	12	3	Highly toxic to fish, mammals, and aquatic organisms. Allow a minimum of 7–10 days between applications.
	29	**Beleaf 50 SG** (flonicamid)	2.8 oz	Do not apply more than 8.4 oz/A Beleaf 50 SG per year.	12	0	Do not apply more than 3 applications per year. Allow a minimum of 7 days between applications.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	-	**Aza-Direct** (azadirachtin)	See label; 1–2 pints for most pests and crop conditions. Add 3.5 pints/A under severe pest pressure.		4	0	OMRI approved. Agitation is necessary, and mixture should be applied within 8 hr. Check pH of water to be within 5.5-–6.5.
	-	**Botanigard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
	-	**Grandevo** (Heat-killed *Chromobacterium subtsugae* strain PRAA4-1 and spent fermentation media)	2–3 lb		4	0	OMRI approved. Broad spectrum, repels, reduces fecundity. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
	-	**M-Pede** (potassium salts of fatty acids)	See label.		12	0	OMRI approved.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	OMRI approved. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
	-	**Neemix 4.5% EC** (azadirachtin)	4.0–16.0 fl oz		12	0	OMRI approved.
	-	**PFR-97 20%WDG** (*Cordyceps javanica* Apopka strain 97)	1–2 lb		4	0	OMRI approved.
	-	**SuffOil-X** (unsulfonated residue of petroleum oil)	1–2 gallons		4	0	OMRI approved.
	-	**Trilogy** (neem oil)	0.5%–2%		4	0	OMRI approved. Avoid tank mixes with captan, sulfur, or other chemically similar products.
	-	**Venerate** (Heat-killed *Burkholderia rinojensis* strain A396)	2–4 quarts		4	0	OMRI approved. Broad spectrum, degrades exoskeleton, interferes with molting. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
Armyworms (see also caterpillars)	1A	**Carbaryl 4 L** (carbaryl)	1–2 quarts	Do not apply more than a total of 10 quarts/A per crop per year.	12	7	Bee restriction: do not apply to target crops in bloom.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	1A	**Sevin 4F, 80 Solupak** (carbaryl)	**4F**: 1–2 quarts **80 Solupak**: 1.25–2.5 lb	**4F**: Do not apply more than a total of 10 quarts/A per crop per year. **80 Solupak**: Do not apply more than a total of 12.5 quarts/A per crop per year.	12	7	
	3A	***Brigade WSB** (bifenthrin)	6.4–32.0 oz	Do not apply more than 80 oz/A per season.	12	0	
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	Do not apply more than twice a year to the same planting. May be tank-mixed with Dipel DF for armyworm control.
	3A	**Evergreen EC 60-6** (pyrethrins + piperonyl butoxide)	2.0–16.0 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label.		12	0	OMRI approved.
	3A + 4A	***Brigadier** (bifenthrin + imidacloprid)	5.1–6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	Do not make applications less than 5 days apart.
	3A + 6	**Athena** (bifenthrin + avermectin B1)	7.0–17.0 fl oz	Do not apply more than 68 fl oz in a growing season after transplanting.	12	3	Make 2 applications 7–10 days apart. If further applications are needed, wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A + -	**Azera Insecticide** (pyrethrins + azadirachtin)	3.5 pints/A	Do not apply more than 10 times per season	4	0	OMRI approved. Repeat applications as required but no more than 5-7 days apart.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG**: 1.9–6.9 oz **70 WP**: 0.8–3.0 oz	**30 SG**: Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season. **70 WP**: Do not exceed a total of 6.0 oz Assail 70 WP/A per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp. 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	2.0–5.0 oz	Do not exceed 15.0 oz/A per growing season.	12	3	Application restrictions exist for this product because of the risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators.
	5	**Entrust SC Naturalyte Insect Control** (spinosad)	4.0–6.0 fl oz	Do not apply more than 18 fl oz/A/year.	4	1	OMRI approved. Do not make more than 3 applications in a year.
	5	**Radiant SC** (spinetoram)	6.0–10.0 fl oz	Do not apply more than a total of 39 fl oz/A per year.	4	1	
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai* strain GC-91)	0.5–2.0 lb		4	0	OMRI approved.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	OMRI approved.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb		4	0	OMRI approved.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	For armyworm and cutworm control, use the higher rate. OMRI approved.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb		4	0	OMRI approved
	11A	**Xentari** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb		4	0	For organic production.
	15	**Rimon 0.83EC** (novaluron)	9.0–12.0 fl oz	Do not apply more than 36 oz/A per season.	12	1	7-day minimum interval between applications.
	18	**Intrepid 2F** (methoxyfenozide)	6.0–12.0 fl oz	Do not apply more than 64 fl oz/A per year.	4	3	

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	Do not apply more than 15.4 fl oz/A per crop.	4	1	Make no more than 4 applications/A per crop. Minimum interval between treatments is 7 days.
	28	**Harvanta 50SL** (cyclaniliprole)	10.9–16.4 fl oz	Do not apply more than 49.2 fl oz/A/year	4	1	Do not make more than 3 applications per year. Minimum interval between treatments is 5 days.
	-	**Aza-Direct** (azadirachtin)	See label; 1–2 pints for most pests and crop conditions. Apply 3.5 pints/A under severe pest pressure.		4	0	OMRI approved. Agitation is necessary, and mixture should be applied within 8 hr. Check pH of water to be 5.5 – 6.5.
	-	**Grandevo** (Heat-killed *Chromobacterium subtsugae* strain PRAA4-1 and spent fermentation media)	1–3 lb		4	0	OMRI approved. Broad spectrum, repels, reduces fecundity. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
	-	**Neemix 4.5% EC** (azadirachtin)	4.0–16.0 fl oz		12	0	
	-	**Venerate** (Heat-killed *Burkholderia rinojensis* strain A396)	1–4 quarts		4	0	OMRI approved. Broad spectrum, degrades exoskeleton, interferes with molting. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
Beetles and weevils (including sap beetles) (see also grubs)	1B	***Govern 4E** (chlorpyrifos)	See label.	Do not apply more than 2 quarts preplant/A per year or 2 quarts foliar/A per year.	24	21	Do not make more than 1 preplant or 2 foliar applications per year. Do not apply after berries form or when berries are present.
	1B	**Lorsban 75WG** (chlorpyrifos)	1.33–2.67 lb	Do not apply more than 2.67 lb/A per year.	24	21	Do not make more than 1 preplant or 2 foliar applications per year.
	3A	***Brigade WSB** (bifenthrin)	6.4–32.0 oz	Do not apply more than 80 oz/A per season.	12	0	
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	Do not apply more than twice a year to the same planting. May be tank-mixed with Dipel DF for armyworm control.
	3A + 4A	***Brigadier** (bifenthrin + imidacloprid)	5.1–6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	Do not make applications less than 5 days apart.
	3A + 6	**Athena** (bifenthrin + avermectin B1)	7.0–17.0 fl oz	Do not apply more than 68 fl oz in a growing season after transplanting.	12	3	Make 2 applications 7–10 days apart. If further applications are needed, wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	3A + -	**Azera Insecticide** (pyrethrins + azadirachtin)	3.5 pints/A	Do not apply more than 10 times per season	4	0	OMRI approved. Repeat applications as required but no more than every 5-7 days.
	4A	**Admire Pro** (imidacloprid)	**Soil**: 10.5–14 fl oz **Foliar**: 1.3 fl oz	Do not apply more than 14.0 fl oz/A for soil and 3.9 fl oz/A for foliar applications per season.	12	**Soil**: 14 **Foliar**: 5	Soil applications may be made as chemigation, as a plant-hole treatment, or as a band spray over the row followed by overhead irrigation. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG**: 1.9–6.9 oz **70 WP**: 0.8–3.0 oz	**30 SG**: Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season. **70 WP**: Do not exceed a total of 6.0 oz Assail 70 WP/A per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications.
	15	**Rimon 0.83EC** (novaluron)	9.0–12.0 fl oz	Do not apply more than 36 oz/A per season.	12	1	7-day minimum interval between applications.
	28	**Harvanta 50SL** (cyclaniliprole)	10.9–16.4 fl oz	Do not apply more than 49.2 fl oz/A/year	4	1	Do not make more than 3 applications per year. Minimum interval between treatments is 5 days.
	-	**MET52 EC** (*Metarhizium anisopliae* strain F52)	**Drench**: 40–80 fl oz/100 gal **Foliar**: 0.5 pint–2 quarts		4	0	
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	OMRI approved. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
Caterpillars (including budworms, earworms, leafrollers, leaftiers, borers, and loopers) (see also armyworms)	1A	**Carbaryl 4 L** (carbaryl)	1–2 quarts	Do not apply more than a total of 10 quarts/A per crop per year.	12	7	Bee restriction: do not apply to target crops in bloom.
	1A	**Sevin 4F, 80 Solupak** (carbaryl)	**4F**: 1–2 quarts **80 Solupak**: 1.25–2.5 lb	**4F**: Do not apply more than a total of 10 quarts/A per crop per year. **80 Solupak**: Do not apply more than a total of 12.5 quarts/A per crop per year.	12	7	
	1B	**Diazinon 50W, AG600 WBC** (diazinon)	**50W**: 1–2 lb **AG600 WBC**: 12.75–25.5 fl oz	Make a maximum of one foliar application per crop and one soil application per crop.	3 days	5	
	1B	**Dibrom 8-E*** (naled)	1 pint	Do not apply more than 5 pints per season.	48	1	
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–3.2 pints **8F**: 1.5–2.0 pints	**8F**: Do not apply more than 8 pints/A per year.	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	3A + -	**Azera Insecticide** (pyrethrins + azadirachtin)	3.5 pints/A	Do not apply more than 10 times per season	4	0	OMRI approved. Repeat applications as required but no more than every 5-7 days.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG**: 1.9–6.9 oz **70 WP**: 0.8–3.0 oz	**30 SG**: Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season. **70 WP**: Do not exceed a total of 6.0 oz Assail 70 WP/A per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp. 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications
	5	**Entrust SC Naturalyte Insect Control** (spinosad)	4.0–6.0 fl oz	Do not apply more than 18 fl oz/A/year.	4	1	OMRI approved. Do not make more than 3 applications per year.
	5	**Radiant SC** (spinetoram)	6.0–10.0 fl oz	Do not apply more than a total of 39 fl oz/A per year.	4	1	

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb		4	0	
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	For armyworm and cutworm control, use the higher rate.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb		4	0	
	11A	**Xentari** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb		4	0	
	28	**Harvanta 50SL** (cyclaniliprole)	10.9–16.4 fl oz	Do not apply more than 49.2 fl oz/A/year	4	1	Do not make more than 3 applications per year. Minimum interval between treatments is 5 days.
	-	**Botanigard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
	-	**Grandevo** (Heat-killed *Chromobacterium subtsugae* strain PRAA4-1 and spent fermentation)	1–3 lb		4	0	OMRI approved. Broad spectrum, repels, reduces fecundity. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	OMRI approved. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
	-	**Neemix 4.5% EC** (azadirachtin)	4.0–16.0 fl oz		12	0	
	-	**PFR-97 20%WDG** (*Cordyceps javanica* Apopka strain 97)	1–2 lb		4	0	
	-	**Venerate** (Heat-killed *Burkholderia rinojensis* strain A396)	1–4 quarts		4	0	OMRI approved. Broad spectrum, degrades exoskeleton, interferes with molting. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
Crickets and cockroaches	1A	**Carbaryl 4 L** (carbaryl)	1–2 quarts	Do not apply more than a total of 10 quarts/A per crop per year.	12	7	Bee restriction: do not apply to target crops in bloom.
	1B	**Diazinon 50W, AG600 WBC** (diazinon)	**50W**: 1–2 lb **AG600 WBC**: 12.75–25.5 fl oz	Make a maximum of one foliar application per crop and one soil application per crop.	3 days	5	
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–3.2 pints **8F**: 1.5–2.0 pints	**8F**: Do not apply more than 8 pints/A per year**.**	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp. 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications.
	15	**Rimon 0.83EC** (novaluron)	9.0–12.0 fl oz	Do not apply more than 36 oz/A per season.	12	1	7-day minimum interval between applications.
	-	**Aza-Direct** (azadirachtin)	See label; 1–2 pints for most pests and crop conditions. Apply 3.5 pints/A under severe pest pressure.		4	0	OMRI approved. Agitation is necessary and mixture should be applied within 8 hr. Check pH of water to be within 5.5–6.5.
	-	**Botanigard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	OMRI approved. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
Fruit fly (vinegar fly) and spotted wing drosophila	3A	***Brigade WSB** (bifenthrin)	6.4–32.0 oz	Do not apply more than 80 oz/A per season.	12	0	
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	Do not apply more than twice a year to the same planting.
	3A	**Evergreen EC 60-6** (pyrethrins + piperonyl butoxide)	2.0–16.0 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label.		12	0	OMRI approved.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	4A	**Actara** (thiamethoxam)	1.5–4.0 oz	Do not exceed a total of 12 oz/A (0.188 lb a.i./A) of Actara or 0.188 lb a.i. of thiamethoxam-containing products per acre per growing season.	12	3	Minimum interval between applications is 10 days. Do not use Actara in nurseries, greenhouses, plant propagation houses, or on any plants grown for use as transplants. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Admire Pro** (imidacloprid)	**Soil**: 10.5–14 fl oz **Foliar**: 1.3 fl oz	Do not apply more than 14.0 fl oz/A for soil and 3.9 fl oz/A for foliar applications per season.	12	**Soil**: 14 **Foliar**: 5	Soil applications may be made as chemigation, as a plant-hole treatment or as a band spray over the row followed by overhead irrigation. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG**: 1.9–6.9 oz **70 WP**: 0.8–3.0 oz	**30 SG**: Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season. **70 WP**: Do not exceed a total of 6.0 oz Assail 70 WP/A per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp. 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz		12	1	For control of spotted wing drosophila.
	-	**Aza-Direct** (azadirachtin)	See label; 1–2 pints for most pests and crop conditions. Apply 3.5 pints/A under severe pest pressure.		4	0	OMRI approved. Agitation is necessary and mixture should be applied within 8 hr. Check pH of water to be within 5.5–6.5.
	-	**Grandevo** (Heat-killed *Chromobacterium subtsugae* strain PRAA4-1 and spent fermentation media)	2–3 lb		4	0	OMRI approved. Broad spectrum, repels, reduces fecundity. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	-	**Venerate** (Heat-killed *Burkholderia rinojensis* strain A396)	2–4 quarts		4	0	OMRI approved. Broad spectrum, degrades exoskeleton, interferes with molting. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
Grubs (see also beetles)	1B	***Govern 4E** (chlorpyrifos)	See label.	Do not apply more than 2 quarts preplant/A per year or 2 quarts foliar/A per year.	24	21	Do not make more than 1 preplant or 2 foliar applications per year. Do not apply after berries form or when berries are present.
	1B	**Lorsban 75WG** (chlorpyrifos)	1.33–2.67 lb	Do not apply more than 2.67 lb/A per year.	24	21	Do not make more than 1 preplant or 2 foliar applications per year.
	3A + 6	**Athena** (bifenthrin + avermectin B1)	8.5–17.0 fl oz at plant	Do not apply more than 68 fl oz in a growing season after transplanting.	12	3	
	4A	**Admire Pro** (imidacloprid)	**Soil**: 10.5–14 fl oz **Foliar**: 1.3 fl oz	Do not apply more than 14.0 fl oz/A for soil and 3.9 fl oz/A for foliar applications per season.	12	**Soil**: 14 **Foliar**: 5	Soil applications may be made as chemigation, as a plant-hole treatment or as a band spray over the row followed by overhead irrigation. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Platinum 75 SG** (thiamethoxam)	1.7–4.01 oz	Do not exceed 4.01 oz/A per growing season.	12	50	
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp. 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications.
	-	**Botanigard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	OMRI approved. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
Mites (including two-spotted spider mite, strawberry spider mite, carmine spider mite, cyclamen mite, broad mite)	1B	**Diazinon 50W, AG600 WBC** (diazinon)	**50W**: 1–2 lb **AG600 WBC**: 12.75–25.5 fl oz	Make a maximum of one foliar application per crop and one soil application per crop.	3 days	5	
	1B	**Dibrom 8-E*** (naled)	1 pint	Do not apply more than 5 pints per season.	48	1	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–3.2 pints **8F**: 1.5–2.0 pints	**8F**: Do not apply more than 8 pints/A per year.	12	3	Make 2 applications 7–10 days apart. If further applications are needed, wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A	***Brigade WSB** (bifenthrin)	6.4–32.0 oz	Do not apply more than 80 oz/A per season.	12	0	Do not apply more than twice a year to the same planting. May be tank-mixed with Dipel DF for armyworm control.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	
	3A + 6	**Athena** (bifenthrin + avermectin B1)	7.0–17.0 fl oz	Do not apply more than 68 fl oz in a growing season after transplanting.	12	3	
	6	**Agri-Mek 0.15 EC*, SC*** (abamectin)	**0.15 EC**: 16 oz **SC**: 3.5 fl oz	**0.15 EC**: Do not apply more than 64 fl oz/A (0.075 lb a.i./A) of Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season. **SC**: Do not apply more than 14 fl oz/A (0.075 lb a.i./A) of Agri- Mek SC or any other foliar-applied abamectin-containing product in a growing season.	12	3	Wait at least 21 days after second application before repeating application. Agri-Mek SC must be mixed with a surfactant approved for use on strawberries. Make 2 applications 7–10 days apart when mites first appear.
	10A	**Onager Optek** (hexythiazox)	6 oz	Do not apply more than 6 oz/A per year.	12	3	Do not make more than 1 application per season.
	10B	**Zeal** (etoxazole)	2–3 oz	Do not apply more than 3.0 oz/A per season.	12	1	Make no more than 4 applications per season.
	12B	***Vendex 50 WP** (fenbutatin oxide)	1.5–2.0 lb	Apply no more than 4 lb/A per season.	48	1	Allow a minimum of 21 days between treatments. Do not make more than 2 applications per year.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	20B	**Kanemite 15 SC** (acequinocyl)	21.0–31.0 fl oz	Do not apply more than 62 fl oz/A per season.	12	1	Allow 14 days between applications.
	20D	**Acramite 50 WS** (bifenazate)	0.75–1.0 lb	Two applications allowed per season; 21 days minimum between applications.	12	1	Acramite is not systemic in action; therefore, complete coverage of both upper and lower leaf surfaces and of fruit is necessary for effective control.
	21A	**Nexter** (pyridaben)	7.5–17 oz	Do not make more than two applications per year. Allow 30 days between sequential applications.	12	10	
	21A	**Portal** (fenpyroximate)	2 pints	Do not apply more than 4.0 pints/A per crop cycle.	12	1	Do not make more than 2 applications per crop season. Allow a minimum of 14 days between applications.
	23	**Oberon 2SC** (spiromesifen)	12.0–16.0 fl oz	Do not apply more than 48 fl oz/A per crop season.	12	3	Active against eggs, nymphs, and adults. Thorough coverage is necessary.
	25	**Nealta** (cyflumetofen)	13.7 fl oz	Do not apply more than 27.4 fl oz/A per season per crop.	12	1	Active against eggs, nymphs and adults. Thorough coverage is necessary. Do not make more than 2 applications per year. Allow a minimum of 14 days between applications.
	-	**Aza-Direct** (azadirachtin)	See label; 1–2 pints for most pests and crop conditions. Apply 3.5 pints/A under severe pest pressure.		4	0	OMRI approved. Agitation is necessary and mixture should be applied within 8 hr. Check pH of water to be within 5.5–6.5.
	-	**Grandevo** (Heat-killed *Chromobacterium subtsugae* strain PRAA4-1 and spent fermentation media)	2–3 lb		4	0	OMRI approved. Broad spectrum, repels, reduces fecundity. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
	-	**JMS Stylet Oil** (paraffinic oil)	3 quarts/100 gal water		4	0	OMRI approved.
	-	**MET52 EC** (*Metarhizium anisopliae* strain F52)	**Drench**: 40.0–80.0 fl oz/100 gal **Foliar**: 0.5 pint–2 quarts		4	0	
	-	**M-Pede** (potassium salts of fatty acids)	See label.		12	0	OMRI approved.
	-	**PFR-97 20%WDG** (*Cordyceps javanica* Apopka strain 97)		1–2 lb	4	0	OMRI approved.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	-	**SuffOil-X** (unsulfonated residue of petroleum oil)	1–2 gallons		4	0	OMRI approved.
	-	**Trilogy** (neem oil)	0.5%–2%		4	0	OMRI approved. Avoid tank mixes with captan, sulfur, or other chemically similar products.
	-	**Venerate** (Heat-killed *Burkholderia rinojensis* strain A396)	2–3 lb		4	0	OMRI approved. Broad spectrum, degrades exoskeleton, interferes with molting. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
Plant bugs, including *Lygus*	1A	**Carbaryl 4 L** (carbaryl)	1–2 quarts	Do not apply more than a total of 10 quarts/A per crop per year.	12	7	
	1A	**Sevin 4F, 80 Solupak** (carbaryl)	**4F**: 1–2 quarts **80 Solupak**: 1.25–2.5 lb	**4F**: Do not apply more than a total of 10 quarts/A per crop per year. **80 Solupak**: Do not apply more than a total of 12.5 quarts/A per crop per year.	12	7	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–3.2 pints **8F**: 1.5–2.0 pints	**8F**: Do not apply more than 8 pints/A per year.	12	3	Make 2 applications 7–10 days apart. If further applications are needed, wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A	***Brigade WSB** (bifenthrin)	6.4–32.0 oz	Do not apply more than 80 oz/A per season.	12	0	Do not make applications less than 5 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67–21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	
	3A	**Evergreen EC 60-6** (pyrethrins + piperonyl butoxide)	2.0–16.0 fl oz		12	0	Allow a minimum of 7 days between applications. Do not make more than 10 applications per season.
	3A	**PyGanic EC 5.0** (pyrethrins)	See label		12	0	OMRI approved. Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	3A + 4A	***Brigadier** (bifenthrin + imidacloprid)	5.1–6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	Do not apply more than twice a year to the same planting. May be tank-mixed with Dipel DF for armyworm control.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	3A + 6	**Athena** (bifenthrin + avermectin B1)	7.0–17.0 fl oz	Do not apply more than 68 fl oz in a growing season after transplanting.	12	3	
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG**: 1.9–6.9 oz **70 WP**: 0.8–3.0 oz	**30 SG**: Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season. **70 WP**: Do not exceed a total of 6.0 oz Assail 70 WP/A per growing season.	12	1	7-day minimum interval between applications.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp. 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications.
	4C	**Transform WG** (sulfoxaflor)	1.5–2.25 oz	Do not exceed 8.5 oz per season.	24	1	
	15	**Rimon 0.83EC** (novaluron)	9–12 fl oz	Do not apply more than 36 oz/A per season.	12	1	Do not apply more than 3 applications per year. Allow a minimum of 7 days between applications.
	29	**Beleaf 50 SG** (flonicamid)	2.8 oz	Do not apply more than 8.4 oz/A Beleaf 50 SG per year.	12	0	Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
	-	**Botanigard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	OMRI approved. Apply in sufficient water to cover foliage, typically 5-100 gallons per acre.
	-	**Grandevo** (Heat-killed *Chromobacterium subtsugae* strain PRAA4-1 and spent fermentation media)	2–3 lb		4	0	OMRI approved. Broad spectrum, repels, reduces fecundity. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	
	-	**PFR-97 20%WDG** (*Cordyceps javanica* Apopka strain 97)	1–2 lb		4	0	Bee restriction: do not apply to target crops in bloom.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	-	**Venerate** (Heat-killed *Burkholderia rinojensis* strain A396)	2–4 quarts		4	0	Can be used in organic production. OMRI-listed. Broad spectrum, degrades exoskeleton, interferes with molting. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
Thrips (including flower thrips, chilli thrips)	1B	**Dibrom 8-E*** (naled)	1 pint	Do not apply more than 5 pints per season.	48	1	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–3.2 pints **8F**: 1.5–2.0 pints	**8F**: Do not apply more than 8 pints/A per year.	12	3	
	3A	**Evergreen EC 60-6** (pyrethrins + piperonyl butoxide)	2.0–16.0 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label.		12	0	OMRI approved. Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	3A + -	**Azera Insecticide** (pyrethrins + azadirachtin)	3.5 pints/A	Do not apply more than 10 times per season.	4	0	OMRI approved. Repeat application as required but not more than every 5-7 days.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG**: 1.9–6.9 oz **70 WP**: 0.8–3.0 oz	**30 SG**: Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season. **70 WP**: Do not exceed a total of 6.0 oz Assail 70 WP/A per growing season.	12	1	OMRI approved. Do not make applications less than 5 days apart except for thrips.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp. 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications.
	4C	**Closer SC** (sulfoxaflor)	4.5 oz	Do not apply more than 17 oz per year.	12	1	Highly toxic to bees! Suppression only. Do not make more than 4 applications per year. Minimum interval between applications is 7 days.
	4C	**Transform WG** (sulfoxaflor)	2.25 oz	Do not exceed 8.5 oz per season.	24	1	
	4D	**Sivanto Prime** (flupyradifurone)	14 oz	Do not apply more than 28 oz/A per year.	4	0	Minimum interval between applications is 10 days.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	5	**Entrust SC Naturalyte Insect Control** (spinosad)	4.0–6.0 fl oz	Do not apply more than 18 fl oz/A/year.	4	1	OMRI approved. Do not make more than 3 applications a year.
	5	**Radiant SC** (spinetoram)	6.0–10.0 fl oz	Do not apply more than a total of 39 fl oz/A per year.	4	1	Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
	6	**Timectin 0.15 EC Ag** (abamectin)	16.0 fl oz	Do not apply more than 16 fl oz/A per application and 64 fl oz/A per season.	12	3	Highly toxic to fish, mammals and aquatic organisms. Minimum interval of 7–10 days required between applications.
	6 + 28	**Minecto Pro** (abamectin + cyantraniliprole)	10.0 fl oz	Do not apply more than 40 fl oz/A per year.	12	3	Toxic to fish, mammals, and aquatic organisms. Minimum application interval is 7 days.
	15	**Rimon 0.83EC** (novaluron)	6.0-12.0 fl oz	Do not apply more than 36 fl oz/A per year.	12	1	Minimum interval between applications is 7 days. Apply when thrips populations begin to build.
	21A	**Apta** (tolfenpyrad)	27.0 fl oz	Do not apply more than 81.0 fl oz/A per year.	12	1	Do not make more than 3 applications per year. Minimum interval between applications is 7 days.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz		12	1	The label for this product contains warnings for the protection of pollinators.
	-	**Aza-Direct** (azadirachtin)	See label; 1–2 pints for most pests and crop conditions. Apply 3.5 pints/A under severe pest pressure.		4	0	OMRI approved. Agitation is necessary, and mixture should be applied within 8 hr. Check pH of water to be within 5.5–6.5.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	
	-	**Captiva Prime** (capsicum oleoresin extract + garlic oil + canola oil)	1–2 pints	Spray every 4–7 days for preventative management.	4	0	OMRI approved.
	-	**Grandevo** (Heat-killed *Chromobacterium subtsugae* strain PRAA4-1 and spent fermentation media)	2–3 lb		4	0	OMRI approved. Broad spectrum, repels, reduces fecundity. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
	-	**MET52 EC** (*Metarhizium anisopliae* strain F52)	**Drench**: 40–80 fl oz/100 gal **Foliar**: 0.5 pint–2 quarts		4	0	OMRI approved. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	
	-	**Neemix 4.5% EC** (azadirachtin)	4.0–16.0 fl oz		12	0	OMRI approved.
	-	**PFR-97 20%WDG** (*Cordyceps javanica* Apopka strain 97)	1–2 lb		4	0	OMRI approved.
	-	**Venerate** (Heat-killed *Burkholderia rinojensis* strain A396)	2–4 quarts		4	0	Can be used in organic production. OMRI approved. Broad spectrum, degrades exoskeleton, interferes with molting. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
Whiteflies	1B	**Malathion 5EC, 8F** (malathion)	**5EC**: 1.5–3.2 pints **8F**: 1.5–2.0 pints	**8F**: Do not apply more than 8 pints/A per year.	12	3	Make 2 applications 7–10 days apart. If further applications are needed, wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A	**Evergreen EC 60-6** (pyrethrins + piperonyl butoxide)	2.0–16.0 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label.	Do not apply more than 10 times per season.	12	0	OMRI approved.
	3A + 4A	***Brigadier** (bifenthrin + imidacloprid)	5.1–6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	
	3A + 6	**Athena** (bifenthrin + avermectin B1)	7.0–17.0 fl oz	Do not apply more than 68 fl oz in a growing season after transplanting.	12	3	
	3A + -	**Azera Insecticide** (pyrethrins + azadirachtin)	3.5 pints	Do not apply more than 10 times per season.	4	0	OMRI approved. Do not make applications less than 5-7 days apart.
	4A	**Actara** (thiamethoxam)	3.0–4.0 oz	Do not exceed a total of 12 oz/A (0.188 lb a.i./A) of Actara or 0.188 lb a.i. of thiamethoxam-containing products per acre per growing season.	12	3	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	4A	**Admire Pro** (imidacloprid)	**Soil**: 10.5–14 fl oz **Foliar**: 1.3 fl oz	Do not apply more than 14.0 fl oz/A for soil and 3.9 fl oz/A for foliar applications per season.	12	**Soil**: 14 **Foliar**: 5	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG**: 1.9–6.9 oz **70 WP**: 0.8–3.0 oz	**30 SG**: Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season. **70 WP**: Do not exceed a total of 6.0 oz Assail 70 WP/A per growing season.	12	1	
	4A	**Platinum 75 SG** (thiamethoxam)	1.7–4.01 oz	Do not exceed 4.01 oz/A per growing season.	12	50	Application restrictions exist for this product because of the risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12.0 fl oz	Do not apply more than 0.26 lb of IRAC Gp. 4A and 0.23 lb IRAC Gp. 15 products per acre/ calendar year. Do not apply more than 35.0 fl oz of product per acre per season.	12	1	Allow a minimum of 7 days between applications.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	2.0–5.0 oz	Do not exceed 15.0 oz/A per growing season.	12	3	10-day minimum interval between applications.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	Maximum allowed per year is 28.0 fl oz/A.	4	0	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	7D	**Esteem 0.86 EC** (pyriproxyfen)	10.0 fl oz	Do not exceed 20 fl oz/A per season.	12	2	Do not make more than 2 applications per crop cycle. Allow at least 10 days between applications.
	16	**Courier SC** (buprofezin)	9.0–13.6 oz	Do not apply more than 27.2 fl oz/A per crop cycle.	12	3	Do not make more than 2 applications per crop cycle.
	21A	**Portal** (fenpyroximate)	2 pints	Do not apply more than 4.0 pints/A per crop cycle.	12	1	Do not make more than 3 applications per crop season.
	23	**Oberon 2SC** (spiromesifen)	12.0–16.0 fl oz	Do not apply more than 48 fl oz/A per crop season.	12	3	

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/Acre)	Rate per Season	REI (Hours)	Days to Harvest	Notes
	-	**Aza-Direct** (azadirachtin)	See label; 1–2 pints for most pests and crop conditions. Apply 3.5 pints/A under severe pest pressure.		4	0	OMRI approved. Agitation is necessary, and mixture should be applied within 8 hr. Check pH of water to be within 5.5–6.5.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	
	-	**Grandevo** (Heat-killed *Chromobacterium subtsugae* strain PRAA4-1 and spent fermentation media)	2–3 lb		4	0	OMRI approved. Broad spectrum, repels, reduces fecundity. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.
	-	**JMS Stylet Oil** (paraffinic oil)	3 quarts/100 gal water		4	0	
	-	**MET52 EC** (*Metarhizium anisopliae* strain F52)	**Drench**: 40.0–80.0 fl oz/100 gal **Foliar**: 0.5 pint–2 quarts		4	0	
	-	**M-Pede** (potassium salts of fatty acids)	See label.		12	0	OMRI approved. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart		4	0	
	-	**Neemix 4.5% EC** (azadirachtin)	4.0–16.0 fl oz		12	0	OMRI approved.
	-	**PFR-97 20%WDG** (*Cordyceps javanica* Apopka strain 97)	1–2 lb		4	0	OMRI approved.
	-	**SuffOil-X** (unsulfonated residue of petroleum oil)	1–2 gallons		4	0	OMRI approved. Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	-	**Venerate** (Heat-killed *Burkholderia rinojensis* strain A396)	2–4 quarts		4	0	OMRI approved. Broad spectrum, degrades exoskeleton, interferes with molting. Tank-mix with a contact insecticide for improved control and resistance management of targeted pests.

[1]Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2 March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.
[2]Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.
*** Restricted use insecticide.**

Table 4. Strawberry fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Natalia Peres, UF/IFAS Gulf Coast Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Angular leaf spot	M1	(copper compounds) **Many brands available:** AmeriCop 40 DF, Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 Flowable, Champ WG, COC DF, C-O-C-S WDG, COC WP, Copper Count-N, CS 2005 Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Cuproxat Flowable, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Mastercop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50 DF, Nu Cop 50 WP, Nu Cop HB, and many others	**SEE INDIVIDUAL LABELS**		1–2	Varies by product from 4 hr to 2 days	Frequent use of copper fungicides may cause foliar burn.
	21	**Actigard 50 WG** (acibenzolar-s-methyl)	0.75 oz	6 oz	0	0.5	Do not apply to plants that are stressed due to drought, excessive moisture, cold weather, herbicide injury, etc.
Anthracnose fruit rot	M4	(captan) **Many brands available:** Captan 50W, Captan 50 WP, Captan 80 WDG, Captec 4L	**SEE INDIVIDUAL LABELS**		1	1	Rate per treated acre. Special label for FL allows up to 24 applications per season.
	M4 + 17	**Captevate 68 WDG** (captan + fenhexamid)	5.25 lb	21 lb	0	1	Do not make more than 2 consecutive applications.
	1 + 3	**Protocol** (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	Do not make more than 2 consecutive applications before rotating to another fungicide with a different mode of action.
	3	**Inspire** (difenoconazole)	7 fl oz	28 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another fungicide with a different mode of action.
	3	(propiconazole) **Many brands available**: Amtide Propiconazole EC, Bumper 41.8 EC, Fitness, Orbit, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	0	0.5	Do not make more than 2 consecutive applications.
	3 + 9	**Inspire Super** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another fungicide with a different mode of action.
	3 + 11	**Quadris Top** (difenoconazole + azoxystrobin)	14 fl oz	56 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another fungicide group, and no more than 4 appl./ crop per year.
	3 + 11	**Quilt Xcel** (propiconazole + azoxystrobin)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive applications and no more than 4 appl./crop.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another non-Group 7, non-Group 11 fungicide.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	Do not make more than 2 consecutive applications, and no more than 5 appl./crop.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	26.8 fl oz	0	0.5	Do not make more than two consecutive applications of Miravis Prime or other Group 7 and 12 fungicides before alternation with a fungicide that is not in Group 7 or 12.
	9 + 12	**Switch 62.5 WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application. See special label for instructions on dipping transplants.
	11	**Aftershock** **Evito** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Do not make more than 2 sequential applications and no more than 4 applications per season, and leave a minimum interval of 14 days between applications.
	11	(azoxystrobin) **Many brands available**: Abound, Aframe, Azaka, Azoxy 2SC, Equation SC, Satori, Trevo	15.4 fl oz	1.92 qt	0	4 hr	Do not make more than 2 sequential applications and no more than 4 appl./crop year. See label for instructions on dipping transplants.
	11	**Cabrio EG** (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	Do not make more than 2 sequential applications and no more than 5 appl./crop year.
	11	**Flint** (trifloxystrobin)	3.2 oz	19.2 oz	0	0.5	Do not apply more than 2 sequential applications of Flint or other Group 11 fungicides. Do not exceed more than 6 total applications of Group 11 fungicides per season.
	19	**Affirm WDG, Ph-D, Oso, Veranda O** (polyoxin-D)	**SEE INDIVIDUAL LABELS**		0	4 hr	Use in alternation with fungicides that have different modes of action. Do not make more than 3 applications per season.
	48	**Zivion** (natamycin)	**SEE LABEL**		N/A	4 hr	For use as preplant dip of transplants.
Botrytis fruit rot	M3	**Thiram Granuflo** **Thiram 24/7** (thiram)	**SEE INDIVIDUAL LABELS**			1	Do not rotate treated crops with other crops for which Thiram is not registered.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	M4	(captan) **Many brands available:** Captan 50W, Captan 50 WP, Captan 80 WDG, Captec 4L	**SEE INDIVIDUAL LABELS**		1	1	Rate per treated acre. Special label for FL allows up to 24 applications per season.
	M4 + 17	**Captevate 68 WDG** (captan + fenhexamid)	5.25 lb	21 lb	0	1	Do not make more than 2 consecutive applications.
	M12	**Fracture** (banda de lupinus albus doce—BLAD)	36.6 fl oz	183 fl oz	1	4 hr	Do not make more than 2 sequential applications.
	1	(thiophanate-methyl) **Many brands available**: Cercobin, Incognito 4.5F, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB	**SEE INDIVIDUAL LABELS**		1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management.
	1 + 3	**Protocol** (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	Do not make more than 2 consecutive applications before rotating to another fungicide with a different mode of action.
	2	(iprodione) **Many brands available**: Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	2 pt	2 pt	N/A	1	Do not make more than 1 application per season. Do not apply after first fruiting flower.
	3 + 9	**Inspire Super** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another fungicide with a different mode of action.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to a fungicide from a different group.
	7	**Kenja 400 SC** (isofetamid)	15.5 fl oz	54 fl oz	0	0.5	Do not plant other crops not registered within 30 days after last application.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another non-Group 7, non-Group 11 fungicide.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	Do not make more than 2 consecutive applications, and no more than 5 appl./crop.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	13.4 fl oz	26.8 fl oz	0	0.5	Do not make more than two consecutive applications of Miravis Prime or other Group 7 and 12 fungicides before alternation with a fungicide that is not in Group 7 or 12.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	9	**Scala SC** (pyrimethanil)	18 fl oz	54 fl oz	1	0.5	Do not make more than 2 consecutive applications. Do not use more than 2 of 6 applications in any one season.
	9 + 12	**Switch 62.5 WG** (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive applications. Do not plant crops not on the label for 30 days after last application. See special label for instructions on dipping transplants.
	17	**Elevate 50 WDG** (fenhexamid)	1.5 lb	6 lb	0	0.5	Do not make more than 2 consecutive applications.
	19	**Affirm WDG, Ph-D, Oso, Veranda O** (polyoxin-D)	**SEE INDIVIDUAL LABELS**		0	4 hr	Use in alternation with fungicides that have different modes of action. Do not make more than 3 applications per season.
Botrytis (suppression only)	3 + 11	**Topguard** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	Do not apply more than 4 applications per year.
	11	**Aftershock** **Evito** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Do not make more than 2 sequential applications, and no more than 4 applications per season; leave a minimum interval of 14 days between applications.
	11	(azoxystrobin) **Many brands available**: Abound, Aframe, Azaka, Azoxy 2SC, Equation SC, Satori, Trevo	15.4 fl oz	1.92 qt	0	4 hr	Do not make more than 2 sequential applications, and no more than 4 appl./crop year. See label for instructions on dipping transplants.
	11	**Cabrio EG** (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	Do not make more than 2 sequential applications and no more than 5 appl./crop year.
	11	**Flint** (trifloxystrobin)	3.2 oz	19.2 oz	0	0.5	Do not apply more than 2 sequential applications of Flint or other Group 11 fungicides. Do not exceed more than 6 total applications of Group 11 fungicides per season.
	11	**Intuity** (mandestrobin)	6 fl oz	12 fl oz	0	0.5	Do not make more than 2 applications per year. Do not apply at intervals of less than 14 days.
Charcoal rot (*Macrophomina phaseolina*)	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Product is to be applied through drip irrigation (see label for chemigation directions).
	48	**Zivion** (natamycin)	**SEE LABEL**		n/a	4 hr	For use as preplant dip of transplants.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Colletotrichum crown rot	1	(thiophanate-methyl) **Many brands available:** Cercobin, Incognito 4.5F, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB	**SEE INDIVIDUAL LABELS**		1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management.
	3 + 11	**Topguard** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	Do not apply more than 4 applications per year.
	7	**Kenja 400 SC** (isofetamid)	15.5 fl oz	54 fl oz	0	0.5	Do not plant other crops not registered within 30 days after last application.
Leaf scorch	1	(thiophanate-methyl) **Many brands available:** Cercobin, Incognito 4.5F, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB,	**SEE INDIVIDUAL LABELS**		1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management.
	1 + 3	**Protocol** (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	Do not make more than 2 consecutive applications before rotating to another fungicide with a different mode of action.
Leaf spot	M4	(captan) **Many brands available**: Captan 50W, Captan 50 WP, Captan 80 WDG, Captec 4L	**SEE INDIVIDUAL LABELS**		1	1	Rate per treated acre. Special label for FL allows up to 24 applications per season.
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	2 pt	2 pt	n/a	1	Do not make more than 1 application per season. Do not apply after first fruiting flower.
	3	**Mettle 125 ME** (tetraconazole)	5 fl oz	20 fl oz	0	0.5	Do not apply same product within 14 days. Do not apply more than 4 applications per season.
	3	**Rally 40WSP** **Sonoma 40 WSP** (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application.
	3	(propiconazole) **Many brands available**: Amtide Propiconazole EC, Bumper 41.8 EC, Orbit, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	0	0.5	Do not make more than 2 consecutive applications.
	3	**Rally 40WSP** **Sonoma 40 WSP** (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3 + 11	**Quadris Top** (difenoconazole + azoxystrobin)	14 fl oz	56 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another fungicide group, and no more than 4 appl./crop per year.
	3 + 11	**Quilt Xcel** (propiconazole + azoxystrobin)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive applications, and no more than 4 appl./crop.
(suppression only)	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
(suppression only)	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another non-Group 7, non-Group 11 fungicide.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	Do not make more than 2 consecutive applications, and no more than 5 appl./crop.
	11	**Cabrio EG** (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	Do not make more than 2 sequential applications, and no more than 5 appl./crop year.
Leather rot	3 + 11	**Topguard** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	Do not apply more than 4 applications per year.
	4	**Metalaxyl 2E AG** **MetaStar 2E AG** (metalaxyl)	2 qt	6 qt	0	2	See label for use in drip irrigation.
	4	**Ridomil Gold EC** **Ridomil Gold SL** **Ultra Flourish** (mefenoxam)	1 pt/ treated acre	1.5 qt/ treated acre	0	2	See label for use in drip irrigation.
	11	(azoxystrobin) **Many brands available**: Abound, Aframe, Azaka, Azoxy 2SC, Equation SC, Satori, Trevo	15.4 fl oz	1.92 qt	0	4 hr	Do not make more than 2 sequential applications, and no more than 4 appl./crop year. See label for instructions on dipping transplants.
	33	**Aliette WDG** **Legion 80WDG** **Linebacker WDG** (fosetyl-Al)	5 lb	30 lb	0.5	0.5	Do not tank-mix with copper fungicides, adjuvants, or foliar fertilizers.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	33	**Alude, Confine Extra, Fosphite, Fungi-Phite, K-Phite, Phorcephite, Phostrol, Rampart** (mono- and dipotassium salts of phosphorous acid)	**SEE INDIVIDUAL LABELS**		0	4 hr	Do not tank-mix with copper fungicides.
Phomopsis leaf blight	3	**Mettle 125 ME** (tetraconazole)	5 fl oz	20 fl oz	0	0.5	Do not apply same product within 14 days. Do not apply more than 4 applications per season.
	3	**Rally 40WSP** **Sonoma 40 WSP** (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application.
(suppression only)	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
(suppression only)	11	**Flint** (trifloxystrobin)	3.2 oz	19.2 oz	0	0.5	Do not apply more than 2 sequential applications of Flint or other Group 11 fungicides. Do not exceed more than 6 total applications of Group 11 fungicides per season.
Phomopsis soft rot	2	(iprodione) **Many brands available**: Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	2 pt	2 pt	n/a	1	Do not make more than 1 application per season. Do not apply after first fruiting flower.
(suppression only)	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
Phytophthora crown rot	4	**Metalaxyl 2E AG** **MetaStar 2E AG** (metalaxyl)	2 qt	6 qt	0	2	See label for use in drip irrigation.
	4	**Ridomil Gold EC** **Ridomil Gold SL** **Ultra Flourish** (mefenoxam)	1 pt/ treated acre	1.5 qt/ treated acre	0	2	See label for use in drip irrigation.
	4 + 49	**Orondis Gold** (mefenoxam + oxathiapiprolin)	62 fl oz	124 fl oz	28	2	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	21	**Actigard 50 WG** (acibenzolar-s-methyl)	0.75 oz	6 oz	0	0.5	Do not apply to plants that are stressed due to drought, excessive moisture, cold weather, herbicide injury, etc.
	33	**Alude, Confine Extra, Fosphite, Fungi-Phite, K-Phite, Phorcephite, Phostrol, Rampart** (mono- and dipotassium salts of phosphorous acid)	**SEE INDIVIDUAL LABELS**		0	4 hr	Do not tank-mix with copper fungicides.
Powdery mildew	M2	(sulfur) **Many brands available:** Acoidal, Cosavet DF, Crusade DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Rebel DF, Sulfur 90W, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not use during hot weather.
	M2 + 33	**Sanction** (potassium phosphate + sulfur)	6 pt	24 pt	n/a	1	Do not apply during hot weather. May cause injury during certain climatic conditions.
	M12	**Fracture** (banda de lupinus albus doce—BLAD)	24.4 fl oz	122 fl oz	1	4 hr	Do not make more than 2 sequential applications.
	1	(thiophanate-methyl) **Many brands available**: Cercobin, Incognito 4.5F, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB	**SEE INDIVIDUAL LABELS**		1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management.
	1 + 3	**Protocol** (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	Do not make more than 2 consecutive applications before rotating to another fungicide with a different mode of action.
	3	**Inspire** (difenoconazole)	7 fl oz	28 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another fungicide with a different mode of action.
	3	**Mettle 125 ME** (tetraconazole)	5 fl oz	20 fl oz	0	0.5	Do not apply same product within 14 days. Do not apply more than 4 applications per season.
	3	**Nova 40W** **Rally 40WSP** **Sonoma 40 WSP** (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application.
	3	**Procure 480 SC** (triflumizole)	8 oz	32 oz	1	0.5	Do not plant leafy vegetables within 30 days, root vegetables within 60 days, or rotational crops not on label for one year after application.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	(propiconazole) **Many brands available:** Amtide Propiconazole EC, Bumper 41.8 EC, Bumper ES, Orbit, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	0	0.5	Do not make more than 2 consecutive applications.
	3	**Rally 40WSP** **Sonoma 40 WSP** (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Do not apply more than 4 applications per year.
	3 + 9	**Inspire Super** (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another fungicide with different mode of action.
	3 + 11	**Quadris Top** (difenoconazole + azoxystrobin)	14 fl oz	56 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another fungicide group, and no more than 4 appl./crop per year.
	3 + 11	**Quilt Xcel** (propiconazole + azoxystrobin)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive applications, and no more than 4 appl./crop.
	3 + 11	**Topguard** (flutriafol + azoxystrobin)	8 fl oz	32 fl oz	0	0.5	Do not apply more than 4 applications per year.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to a fungicide from a different group.
	7	**Kenja 400 SC** (isofetamid)	15.5 fl oz	54 fl oz	0	0.5	Do not plant other crops not registered within 30 days after last application.
	7	**Luna Privilege** (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	Apply through drip irrigation system preventatively. Do not make more than 2 sequential applications before alternating to a fungicide from a different group.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	**Merivon** (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	0.5	Do not make more than 2 sequential applications before alternating to another non-Group 7, non-Group 11 fungicide.
	7 + 11	**Pristine** (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	Do not make more than 2 consecutive applications, and no more than 5 appl./crop.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Aftershock** **Evito** (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Do not make more than 2 sequential applications, and no more than 4 applications per season; leave a minimum interval of 14 days between applications.
	11	(azoxystrobin) **Many brands available**: Abound, Aframe, Azaka, Azoxy 2SC, Equation SC, Satori, Trevo	15.4 fl oz	1.92 qt	0	4 hr	Do not make more than 2 sequential applications, and no more than 4 appl./crop year. See label for instructions on dipping transplants.
	11	**Cabrio EG** (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	Do not make more than 2 sequential applications, and no more than 5 appl./crop year.
	11	**Flint** (trifloxystrobin)	3.2 oz	19.2 oz	0	0.5	Do not apply more than 2 sequential applications of Flint or other Group 11 fungicides. Do not exceed more than 6 total applications of Group 11 fungicides per season.
	11	**Intuity** (mandestrobin)	6 fl oz	12 fl oz	0	0.5	Do not make more than 2 applications per year. Do not apply at intervals of less than 14 days.
	13	**Quintec** (quinoxyfen)	6 fl oz	24 fl oz	1	0.5	Do not make more than 2 consecutive applications or more than 4 applications per crop.
	19	**Affirm WDG, Ph-D, Oso, Veranda O** (polyoxin-D)	**SEE INDIVIDUAL LABELS**		0	4 hr	Use in alternation with fungicides that have different modes of action. Do not make more than 3 applications per season.
	U6	**Torino** (cyflufenamid)	3.4 oz	6.8 oz	0	4 hr	Do not make more than 2 applications per year. Do not apply more than once every 14 days.
	U8	**Prolivo** (pyriofenone)	5 fl oz	16 fl oz	0	4 hr	Do not make more than 2 sequential applications of Group U8 fungicides before rotating to a fungicide with a different mode of action.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with the same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 5. Nonfumigant nematicides for strawberry in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Rates and Procedures
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints (56.0 to 80.0 fl. oz.) per acre a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop and no more than 112 fl oz of product per acre per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/acre using only chemigation into root zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Observe minimum 7-day interval between soil applications. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations for how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 6. Fumigant nematicides for strawberry in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Nematicide	Broadcast Application [1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/ chisel-spaced 12" apart	
Telone II [2,3] Telone EC [2,3]	27 to 35 gal	79 to 102	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17 [2,3]	32.4 to 42 gal	95 to 123	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35 [2,3]	39 to 50 gal	114 to 146	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone InLine [2,3]	29 to 56 gal	-	For drip fumigation, consult the product label for overall rate, drip concentration, and flow-modifying application directions.
Pic Clor 60 [2,3]	19.5 to 31.5 gal	57 to 90	Consult product label for overall rate and chisel flow-modifying application directions.
Pic Clor 60 EC [2,3]	19.5 to 31.5 gal	-	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Vapam HL	75 gal	-	For drip fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions.

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See label details for additional use restrictions based on soil characteristics, buffer zones, requirements for personal protective equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and rate-modifying recommendations with use of highly retentive Totally Impermeable mulch films (TIF).
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named, and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS737

doi.org/10.32473/edis-cv135-2022

Chapter 17. Sweet Corn Production[1]

Ramdas Kanissery, Craig Frey, Anna Meszaros, Nicholas S. Dufault, Johan Desaeger, and Julien Beuzelin[2]

Botany and Planting

Sweet corn—*Zea mays* var. *rugosa,* Poaceae (Gramineae).

Table 1. Planting information for sweet corn.

Planting Dates	
North Florida	Feb–Apr
Central Florida	Jan–Apr
South Florida	Oct–Mar
Planting Information	
Distance between rows (in)	28–36
Distance between plants (in)	6–8
Seeding depth (in)	1.0–1.5
Seed per acre (lb)	6–15
Days to maturity from seed	64–90
Plant population (acre)	24,000–32,000

1. This document is HS737, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 1995. Revised annually. Most recent revision May 2022. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Ramdas Kanissery, assistant professor, Horticultural Sciences Department, UF/IFAS Southwest Florida Research and Education Center; Craig Frey, county Extension director and Extension agent II, UF/IFAS Extension Hendry County; Anna Meszaros, Extension agent II, M.S., UF/IFAS Extension Palm Beach County; Nicholas S. Dufault, associate professor, Plant Pathology Department; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; and Julien Beuzelin, assistant professor, Entomology and Nematology Department, UF/IFAS Everglades REC; UF/IFAS Extension, Gainesville, FL 32611.

Cultivars

Table 2. Description of major sweet corn cultivars currently available.

Type	Genes Controlling Sweetness	Storage Life (Days)	Relative Sugar Content
Sugary	Full complement of sugary	1 to 3	Normal
Sugary Enhanced, also "Modified" and "EH"	Full complement of sugary (su) and half or full complement of sugary enhancer (se)	3 to 5	Slight to moderate or even high levels
Supersweet, also "Ultra," "Extra" sweet	No sugary (su); full complement of shrunken-2 (sh2)	5 to 10	High
Synergistic, also "Sweet-Gene Hybrid"	Full complement of sugary (su) and half complement of shrunken-2 (sh2)	3 to 5	Moderate
Improved Supersweet	Half complement of sugary (su) and full complement of shrunken-2 (sh2)	5 to 10	Very high
ADX	No sugary (su) or shrunken-2 (sh2) genes; full complement of ae, du, and wx genes.	5 to 10	Moderate to high

Table 3. Supersweet (shrunken-2) sweet corn cultivars arranged by kernel color.

Yellow	White	Bicolor
Accentuate	Coronado	Affection
Alliance	Devotion	Awesome XR
Astronaut	Glacial	Battalion
Gallant MXR	Platinum XR	BSS 1075
GSS 1170	3174 XTH	Coastal
Hercules	3380 XTH	Courage MXR
Passion		Honor XR
Primetime		Obsession
Seminole Gold		Salute XR
SV 1077		Seminole Sweet
SV 1446		Starship
		7143

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 4. Herbicides approved for managing weeds in sweet corn. Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
			***** PREEMERGENCE *****
Atrazine Mineral Soil 1.0–2.0 Muck Soil 2.0–3.0	(AAtrex) 4 L Mineral: 2–4 pt Muck: 4–6 pt (AAtrex Nine-0) 90 WDG Mineral: 1.1–2.2 lb Muck: 2.2–3.3 lb	5	Germinating broadleaf and grass weeds. Apply to moist soil. Do not exceed 2.5 lb a.i./A per calendar year. Consult labels for plant-back restrictions on rotational crops.
Carfentrazone up to 0.031	(Aim) 2 EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb a.i./A per season. No pretransplant interval.
Dimethenamid-P 0.56–0.84	(Outlook) 6 EC 12–18 fl oz	15	Annual broadleaf and grass weeds. After application, incorporate into soil by rainfall, sprinkler irrigation, or mechanical tillage. Consult label for rate based on soil texture.
EPTC 4.0–6.0	(Eradicane) 6.7 E 4.75–7.33 pt	8	Annual broadleaf, grass weeds, and nutsedge. Use lower rates on lighter soils (sand). Control of perennial weeds such as bermudagrass or nutsedge is increased through incorporation.
Flufenacet 0.49–0.68	(Define DF) 60 DF 13–18 oz (Define SC) 4 SC 15–19 fl oz	15	Annual broadleaf and grass weeds. Rainfall, irrigation, or light cultivation is required within 7 to 10 days of application. Consult label for rate based on soil texture.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Tank-mix with a residual herbicide to broaden spectrum of weed control. Consult label for individual product directions.
Mesotrione 0.188–0.24	(Callisto) 4 SC 6.0–7.7 fl oz	28	Annual broadleaf weeds. Tank-mix with a preemergence grass herbicide for grass control. Do not exceed 7.7 fl oz/A per season.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Gramoxone) 3 SL 1.3–2.7 pt(Firestorm) 3 SL 1.3–2.7 pt	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown. No more than 3 applications per year. Tank-mix with a residual preemergence herbicide to broaden the spectrum of weed control. Consult label for new restrictions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with soil residual compounds.
Pendimethalin Mineral Soil 0.75–1.0 Muck Soil 1.0–2.0	(Acumen, Prowl) 3.3 EC Mineral: 1.8–2.4 pt Muck: 2.4–4.8 pt (Prowl H20) 3.8 Mineral: 2.0–3.0 pt Muck: 2.0–4.0 pt	3	Broadleaf and grass weeds. Overhead irrigation or rainfall is required within 7 days of application.
Pyraflufen ethyl 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–2.0 fl oz	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
Simazine 2.0	(Princep, Simazine) 4 L 2.0 qt (Princep, Simazine 90 WDG 2.2 lb	5	Broadleaf and grass weeds. If a second application is required do not exceed 2.5 lb a.i./A per calendar year. Simazine 4 L and Simazine 90 DF can be applied to muck soils at 2.5 lb a.i./A. PHI 45 days.

Active Ingredient lb a.i./Acre	Trade Name Product/Acre	MOA Code	Weeds Controlled/Remarks
S-metolachlor 1.0–1.6	(Brawl, Dual Magnum) 7.62 EC 1.0–1.67 pt (Cinch, Dual II Magnum) 7.64 EC 1.0–1.67 pt	15	Annual broadleaf and grass weeds. Use a lower rate on lighter soils. Weed control is increased with 0.5 to 1 in. of rainfall or irrigation. Do not exceed 3.9 pt/A per crop year depending on soil texture.
			***** POSTEMERGENCE *****
Atrazine Mineral Soil 1.0–2.0 Muck Soil 2.0–3.0	(AAtrex) 4 L Mineral: 2–4 pt Muck: 4–6 pt (AAtrex Nine-0) 90 WDG Mineral: 1.1–2.2 lb Muck: 2.2–3.3 lb	5	Broadleaf and some grass weeds. Apply before weeds exceed 1.5 in. tall and before corn exceeds 12 inches in height. Do not exceed 2.5 lb a.i./A per calendar year. Consult label for plant-back restrictions on rotational crops.
Bentazon 0.75–1.0	(Basagran) 4 L 1.5–2.0 pt (Basagran) 5 L 1.2–1.6 pt	6	Certain broadleaf and sedge weeds. Consult label for weeds controlled/weed size table. Do not apply more than 4 pt/A per season.
Carfentrazone 0.008–0.016	(Aim) 2 EC 0.5–1.0 fl oz	14	Emerged broadleaf weeds. Apply up to the 14-leaf stage of corn growth. After the V8 stage of growth, apply as a directed application. Do not apply more than 2.0 fl oz/A per season including preplant burndown and crop application. PHI 3 days.
Halosulfuron 0.03–0.05	(Sandea) 75 DF 0.6–1.0 oz	2	Broadleaf and nutsedge weeds. Apply over the top or with drop nozzles from the spike to the layby stage of corn. A sequential application of 0.66 oz/A may be with drop nozzles to avoid application to the plant whorl. No more than 2 applications per year.
Mesotrione 0.094	(Callisto) 4 SC 3 fl oz	28	Broadleaf weeds. Treat up to 30 in. tall or up to the 8-leaf stage. Include a crop oil concentrate or nonionic surfactant in the spray solution. Slight leaf bleaching may occur. Do not exceed 7.7 fl oz/A per season.
Nicosulfuron 0.03–0.06	(Accent) 75 WDG 0.6–1.3 oz (Accent Q) 54.5 WDG 0.9–1.8 oz	2	Broadleaf and grass weeds. Sensitivity to sweet corn varieties is variable. Do not apply to 'Merit' sweet corn. Do not apply to corn that has previously been treated with 'Counter' or 'Thimet' insecticides because this may result in injury. Consult label for acceptable insecticides. Apply broadcast to corn plants less than 12 in. tall. Apply with drop nozzles to direct spray to corn plants 12–18 in. tall.
Pendimethalin Mineral Soil 0.7–1.0 Muck Soil 1.0–2.0	(Acumen, Prowl) 3.3 EC Mineral: 1.8–2.4 pt Muck: 2.4–4.8 pt (Prowl H20) 3.8 Mineral: 2.0–3.0 pt Muck: 2.0–4.0 pt	3	Broadleaf and grass weeds. Apply after 4 in. tall until corn is 20 to 24 in. tall or the V8 growth stage. Direct the spray to the base of the plants.
S-metolachlor up to 1.9	(Brawl, Dual Magnum) 7.62 EC up to 2.0 pt (Cinch, Dual II Magnum) 7.64 EC up to 2.0 pt	15	Annual broadleaf and grass weeds. Apply after crop emergence up to 40 inches in height. Direct spray to the base of the plants when plants are taller than 5 in. Use a lower rate on lighter soils. Weed control is increased with 0.5 to 1 in. of rainfall or irrigation. Do not exceed 3.9 pt/A per crop year depending on soil texture. PHI 30 days
Tembotrione 0.08	(Laudis) 3.5 EC 3 fl oz	27	Annual broadleaf and grass weeds. Crop tolerance is dependent on variety so apply to a small area if tolerance is unknown. Do not use on 'Merit' or 'Shogun'. May be applied from corn emergence through the V7 stage of growth. Do not exceed 3 fl oz/A per season.
Topramezone 0.020–0.022	(Armezon, Impact) 2.8 0.75–1.0 fl oz	27	Broadleaf and grass weeds. Consult label for maximum size of certain weed species for control. PHI 45 days.

Table 5. Insecticides labeled for management of arthropod pests of sweet corn. Contact: Julien Beuzelin, UF/IFAS Everglades Research and Education Center.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.						
Aphids	1A	***Lannate LV** ***Lannate SP** (methomyl)	**LV:** 0.75–1.5 pt **SP:** 0.25–0.50 lb	48	Ears: 0 Forage: 3 Stover: 21	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1B	**Fyfanon** **Fyfanon 57% EC** (malathion)	1.5 pt	12	5	Maximum of 2 applications per year. Crop injury may occur in the whorl to silking stages.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	1	Maximum of 0.5 lb a.i./acre per season (10 applications at highest rate).
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	1	Maximum of 12.8 fl oz/acre per season or 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Capture LFR** (bifenthrin)	**Preplant incorporated:** 4.0–5.3 fl oz **At plant:** 3.4–13.6 fl oz **Preemergence:** 3.4 fl oz	12	Preplant incorporated, at planting, preemergence application	For mixing with liquid fertilizer. Maximum of 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Delta Gold** (deltamethrin)	1.5–2.4 fl oz	12	Ears and forage: 1 Stover: 21	Maximum of 38.4 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.8–3.8 fl oz	12	3	Maximum of 11.4 fl oz/acre per season.
	3A	***Hero Insecticide** (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	12	3	Maximum of 27.39 fl oz/acre per season (0.266 lb a.i.). See label when using more than one product containing bifenthrin or zeta-cypermethrin.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.8–4.0 fl oz	12	3	Maximum of 24 fl oz/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	24	Ears (foliar):1 For feeding livestock or at-plant applications: 21	Maximum of 30.72 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	24	1	Maximum of 31 fl oz/acre per year.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	3A + 28	***Elevest** (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	12	1	Maximum of 2 applications/acre per year. Maximum of 0.2 lb a.i./acre bifenthrin and 0.2 lb a.i./acre chlorantraniliprole per year.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	4A	**Assail 30SG** **Assail 70WP** (acetamiprid)	**30SG:** 2.1–2.9 oz **70WP:** 0.9–1.2 oz	12	1	**30SG:** Maximum of 11.2 oz/acre or 0.21 lb a.i. per year. **70WP:** Maximum of 4.8 oz/acre or 0.21 lb a.i. per year. Other brands available with same active ingredient.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	9–12 fl oz	12	7	Maximum of 40 fl oz/acre per season or 0.21 lb a.i. acetamiprid and 0.39 lb a.i. novaluron per year.
	4C	**Transform WG** (sulfoxaflor)	0.75–1.5 oz	24	7	Maximum of 3.0 oz/acre per year.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	4	Ears and forage: 7 Stover: 21	Maximum of 28 fl oz/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	2–3 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	4	0	OMRI-listed.[2]
	-	Oil, insecticidal (e.g., **Suffoil-X**)	1–2 gal/100 gal, depending on brand	4	0	OMRI-listed,[2] depending on brand.
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn.
Beetles (includes banded cucumber beetle, flea beetles, sap beetles, seed corn beetle)	1A	***Lannate LV** ***Lannate SP** (methomyl)	**LV:** 0.75–1.5 pt **SP:** 0.25–0.50 lb	48	Ears: 0 Forage: 3 Stover: 21	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	1–2 qt	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	Maximum of 16 qt/acre per crop per year.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	1B	***Counter 15G Lock 'N Load** (terbufos)	**Banded or in furrow:** 6.0–8.0 oz per 1000 ft of row **Postemergence incorporated:** 8 oz per 1000 ft of row at cultivation	48	60	Only one application (at planting, postemergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.
	1B	**Fyfanon Fyfanon 57% EC ULV AG** (malathion)	**Fyfanon, 57% EC:** 1.5 pt **ULV AG:** 4–8 fl oz	12	5	Maximum of 2 applications per year. Crop injury may occur in the whorl to silking stages.
	1B	***Thimet 20-G** (phorate)	4.5–6.0 oz per 1000 ft of row	48	at planting	One application per season, no more than 6.5 lb/acre per season.
	3A	***Ambush 25W** (permethrin)	6.4–16.0 oz	12	1	Do not apply more than 2.0 lb a.i./acre per season. Rates above 12.8 oz are for Florida only.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	1	Maximum of 0.5 lb a.i./acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Maximum of 28 fl oz/acre per season. Maximum of 10 applications.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	1	Maximum of 12.8 fl oz/acre per season or 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Capture LFR** (bifenthrin)	**Preplant incorporated:** 4.0–5.3 fl oz **At plant:** 3.4–13.6 fl oz **Preemergence:** 3.4 fl oz	12	Preplant incorporated, at planting, preemergence application	For mixing with liquid fertilizer. Maximum of 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Declare** (gamma-cyhalothrin)	1.02–1.54 fl	24	Ears: 1 Fodder: 21	Maximum of 24.6 fl oz/acre per crop.
	3A	***Delta Gold** (deltamethrin)	1.0–2.4 fl oz	12	Ears and forage: 1 Stover: 21	Maximum of 38.4 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	3	Maximum of 11.4 fl oz/acre per season.
	3A	***Force 3G** (tefluthrin)	Variable depending on row spacing	0	At planting or cultivation within 30 days of seedling emergence	Only one application per crop. Granules must be incorporated.
	3A	***Hero Insecticide** (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	12	3	Maximum of 27.39 fl oz/acre per season (0.266 lb a.i.). See label when using more than one product containing bifenthrin or zeta-cypermethrin.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	3	Maximum of 24 fl oz/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	**At plant:** 0.33 fl oz/1000 ft of row **Foliar:** 1.28–1.92 fl oz	24	**Ears (foliar):** 1 **Feeding livestock or at-plant applications:** 21	Maximum of 30.72 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	24	1	Maximum of 31 fl oz/acre per year.
	3A + 28	***Elevest** (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	12	1	Maximum of 2 applications/acre per year. Maximum of 0.2 lb a.i./acre bifenthrin and 0.2 lb a.i./acre chlorantraniliprole per year.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	4A	**Assail 30SG** **Assail 70WP** (acetamiprid)	**30SG:** 4.0–5.3 oz **70WP:** 1.7–2.3 oz	12	7	**30SG:** Maximum of 11.2 oz/acre or 0.21 lb a.i. per year. **70WP:** Maximum of 4.8 oz/acre or 0.21 lb a.i. per year. Other brands available with same active ingredient.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	9–12 fl oz	12	7	Maximum of 40 fl oz/acre per season or 0.21 lb a.i. acetamiprid and 0.39 lb a.i. novaluron per year.
	15	**Rimon 0.83EC** (novaluron)	6–12 fl oz	12	1	Maximum of 60 fl oz/acre per season.
	-	**Aza-Direct** (azadirachtin)	1–3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	2–3 lb	4	0	OMRI-listed.[2]
Caterpillars (includes beet armyworm, corn borer, corn earworm, cutworms, fall armyworm, webworms)	1A	***Lannate LV** ***Lannate SP** (methomyl)	**LV:** 0.75–1.5 pt **SP:** 0.25–0.50 lb	48	Ears: 0 Forage: 3 Stover: 21	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1A	***Methomyl 5G** (methomyl)	1.5–3.0 lb	48	Forage: 3 Ears: 21	For corn earworm and fall armyworm control. Apply as a banded application, directing granules to the whorl of the plants. Apply from the 4th leaf stage until tasseling. Maximum of 30 lb/acre or 5 applications per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	1–2 qt	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	Maximum of 16 qt/acre per crop per year.
	1B	***Counter 15G Lock 'n Load** (terbufos)	**Banded or in furrow:** 6.0–8.0 oz per 1000 ft of row **Postemergence incorporated:** 8 oz per 1000 ft of row at cultivation	48	60	Only one application (at planting, postemergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.
	1B	**Fyfanon** **Fyfanon 57% EC** (malathion)	1.5 pt	12	5	Maximum of 2 applications per year. Crop injury may occur in the whorl to silking stages.
	1B	***Mocap 15G** (ethoprop)	See label.	48	at planting	One application per growing season.
	3A	***Ambush 25W** (permethrin)	6.4–16.0 oz	12	1	Do not apply more than 2.0 lb a.i./acre per season. Rates above 12.8 oz are for Florida only.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	1	Maximum of 0.5 lb a.i./acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Maximum of 28 fl oz/acre per season. Maximum of 10 applications.
	3A	***Brigade 2EC** (bifenthrin)	**In-furrow T-band at plant:** 0.15–0.30 fl oz/1000 ft of row **Foliar:** 2.1–6.4 fl oz	12	1	Maximum of 12.8 fl oz/acre per season or 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Capture LFR** (bifenthrin)	**Preplant incorporated:** 4.0–5.3 fl oz **At plant:** 3.4–13.6 fl oz **Preemergence:** 3.4 fl oz	12	Preplant incorporated, at planting, preemergence application	For mixing with liquid fertilizer. Maximum of 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Declare** (gamma-cyhalothrin)	1.02–1.54 fl oz	24	Ears: 1 Fodder: 21	Maximum of 24.6 fl oz/acre per crop.
	3A	***Delta Gold** (deltamethrin)	1.0–2.4 fl oz	12	Ears and forage: 1 Stover: 21	Maximum of 38.4 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	3	Maximum of 11.4 fl oz/acre per season.
	3A	***Force 3G** (tefluthrin)	Depends on row spacing	0	At planting or cultivation within 30 days of seedling emergence	Only one application per crop. Granules must be incorporated.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	3A	***Hero Insecticide** (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	12	3	Maximum of 27.39 fl oz/acre per season (0.266 lb a.i.). See label when using more than one product containing bifenthrin or zeta-cypermethrin.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	3	Maximum of 24 fl oz/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	**At plant:** 0.33 fl oz/1000 ft of row **Foliar:** 1.28–1.92 fl oz	24	**Ears (foliar):** 1 **Feeding livestock or at-plant applications:** 21	Maximum of 30.72 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	24	1	Maximum of 31 fl oz/acre per year.
	3A + 28	***Elevest** (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	12	1	Maximum of 2 applications/acre per year. Maximum of 0.2 lb a.i./acre bifenthrin and 0.2 lb a.i./acre chlorantraniliprole per year.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	4A + 15	**Cormoran** (acetamiprid + novaluron)	9–12 fl oz	12	7	Maximum of 40 fl oz/acre per season or 0.39 lb a.i. novaluron and 0.21 lb a.i. acetamiprid per year.
	5	**Entrust SC** (spinosad)	1.5–6.0 fl oz	4	Ears: 1 Forage: 7 Fodder: 28	Maximum of 29 fl oz/acre per year or 6 applications. OMRI-listed.[2]
	5	**Radiant SC** (spinetoram)	3–6 fl oz	4	Ears: 1 Forage or fodder: 3	Maximum of 36 fl oz/acre per year or 6 applications.
	5 + 18	**Intrepid Edge** (spinetoram + methoxyfenozide)	4–12 fl oz	4	Ears and methoxyfenozide, fodder: 3	Maximum of 51 fl oz/acre per year (1 lb a.i. forage, 21 dry 0.2 lb a.i. spinetoram) or 6 applications.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	1.0–2.0 lb	4	0	Apply when larvae are small for best control. OMRI-listed.[2]
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.[2]

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young. Not for organic production.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.[2]
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. For organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.50 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.[2]
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	6–12 fl oz	12	1	Maximum of 60 fl oz/acre per season.
	18	**Intrepid 2F** (methoxyfenozide)	4–16 fl oz	4	Ears and forage: 3 Dry fodder: 21	Maximum of 64 fl oz/acre per year. Other brands available with same active ingredient.
	22	**Avaunt** **Avaunt eVo** (indoxacarb)	2.5–3.5 oz	12 (14 days for hand harvesting)	Ears: 3 Fodder and stover: 35	Whorl stage through tassel push applications only. Maximum of 14 oz/acre per crop, or 4 applications/acre per crop, or 42 oz/acre per year.
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	4	1	Foliar only. Maximum of 15.4 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per year.
	28	**Vantacor** (chlorantraniliprole)	**In-furrow at plant:** 1.7–2.5 fl oz **Foliar:** 1.2–2.5 fl oz	4	1	Can be applied by overhead sprinkler chemigation system. Maximum of 5.1 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per year.
	32	**Spear-Lep** (GS-omega/kappa-Hxtx-Hv1a)	1–2 pt	4	0	Must be tank-mixed with a *Bacillus thurigiensis* (*Bt*) product. Maximum of 10 gallons/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1–3 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	**Neemix 4.5** (azadirachtin)	4–16 fl oz	4	0	OMRI-listed.[2]

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	Oil, insecticidal	1–2 gal/100 gal, depending on brand	4	0	
Chinch bugs	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	1–2 qt	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	Maximum of 16 qt/acre per crop per year.
	1B	***Counter 15G Lock 'n Load** (terbufos)	**Banded or in furrow:** 6.0–8.0 oz per 1000 ft of row **Postemergence incorporated:** 8 oz per 1000 ft of row at cultivation	48	60	Only one application (at planting, postemergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	1	Maximum of 0.5 lb a.i./acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Maximum of 28 fl oz/acre per season. Maximum of 10 applications.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	1	Maximum of 12.8 fl oz/acre per season or 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Delta Gold** (deltamethrin)	1.5–2.4 fl oz	12	Ears and forage: 1 Stover: 21	Maximum of 38.4 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	3	Maximum of 11.4 fl oz/acre per season.
	3A	***Force 3G** (tefluthrin)	Depends on row spacing	0	At planting or cultivation within 30 days of seedling emergence	Only one application per crop. Granules must be incorporated.
	3A	***Hero Insecticide** (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	12	3	Maximum of 27.39 fl oz/acre per season (0.266 lb a.i.). See label when using more than one product containing bifenthrin or zeta-cypermethrin.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	3	Maximum of 24 fl oz/acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	24	Ears: 1 Feeding livestock: 21	Maximum of 30.72 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	24	1	Maximum of 31 fl oz/acre per year.
	3A + 28	***Elevest** (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	12	1	Maximum of 2 applications/acre per year. Maximum of 0.2 lb a.i./acre bifenthrin and 0.2 lb a.i./acre chlorantraniliprole per year.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	2–3 lb	4	0	OMRI-listed.[2]
Corn silk flies	1B	**Fyfanon ULV AG** (malathion)	6–8 fl oz	12	5	Ultra low volume (ULV) formulation. Maximum of 2 applications per year.
	3A	***Asana XL** (esfenvalerate)	9.6 fl oz	12	1	Maximum of 0.5 lb a.i./acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Maximum of 28 fl oz/acre per season. Maximum of 10 applications.
	3A	***Fastac CS** (alpha-cypermethrin)	2.8–3.8 fl oz	12	3	Maximum of 11.4 fl oz/acre per season.
	3A	***Hero Insecticide** (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	12	3	Maximum of 27.39 fl oz/acre per season (0.266 lb a.i.). See label when using more than one product containing bifenthrin or zeta-cypermethrin.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	3	Maximum of 24 fl oz/acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	1.92 fl oz	24	Ears: 1 Feeding livestock: 21	Maximum of 30.72 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	10 fl oz	24	1	Maximum of 31 fl oz/acre per year.
	4A	**Assail 30SG** **Assail 70WP** (acetamiprid)	**30SG:** 5.3 oz **70WP:** 2.3 oz	12	7	**30SG:** Maximum of 11.2 oz/acre per growing season. **70WP:** Maximum of 4.8 oz/acre or 0.21 lb a.i. per year. Other brands available with same active ingredient.
	4A + 15	**Cormoran** (acetamiprid + novaluron)	12 fl oz	12	7	Maximum of 40 fl oz/acre per season or 0.21 lb a.i. acetamiprid and 0.39 lb a.i. novaluron per year.
Fire ants	3A	***Force 3G Insecticide** (tefluthrin)	Depends on row spacing	0	At planting or cultivation within 30 days of seedling emergence	Only one application per crop. Granules must be incorporated.
	7A	**Extinguish** (S-methoprene)	1–1.5 lb	4	0	Slow-acting insect growth regulator (IGR). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Grasshoppers	1B	**Fyfanon** **Fyfanon 57% EC** (malathion)	1.5 pt	12	5	Maximum of 2 applications per year. Crop injury may occur in the whorl to silking stages.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	1B	**Lorsban 75WG** ***Lorsban Advanced** **Lorsban 15G** (chlorpyrifos)	**75WG:** 0.33–1.33 lb **Advanced:** 0.5–2.0 pt **15G:** 8 oz per 1000 ft of row	24	**75WG, Advanced:** Ears, forage: 21 15G: at planting	Do not feed treated corn silage, forage, or fodder, or allow livestock to graze. Maximum of 3 applications of any product containing chlorpyrifos per season. Other brands available with same active ingredient.
	1B + 3A	***Cobalt Advanced** (chlorpyrifos + lambda-cyhalothrin)	6–42 fl oz	24	21	See label for application methods and many restrictions.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	1	Maximum of 0.5 lb a.i./acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Maximum of 28 fl oz/acre per season. Maximum of 10 applications.
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	1	Maximum of 12.8 fl oz/acre per season or 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Delta Gold** (deltamethrin)	1.0–1.5 fl oz	12	Ears and forage: 1 Stover: 21	Maximum of 38.4 fl oz/acre per season.
	3A	***Fastac CS** (alpha-cypermethrin)	2.8–3.8 fl oz	12	3	Maximum of 11.4 fl oz/acre per season.
	3A	***Hero Insecticide** (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	12	3	Maximum of 27.39 fl oz/acre per season (0.266 lb a.i.). See label when using more than one product containing bifenthrin or zeta-cypermethrin.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.8–4.0 fl oz	12	3	Maximum of 24 fl oz/acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	24	Ears: 1 Feeding livestock: 21	Maximum of 30.72 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	24	1	Maximum of 31 fl oz/acre per year.
	3A + 28	***Elevest** (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	12	1	Maximum of 2 applications/acre per year. Maximum of 0.2 lb a.i./acre bifenthrin and 0.2 lb a.i./acre chlorantraniliprole per year.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	4A + 15	**Cormoran** (acetamiprid + novaluron)	9–12 fl oz	12	7	Maximum of 40 fl oz/acre per season or 0.21 lb a.i. acetamiprid and 0.39 lb a.i. novaluron per year.
	15	**Rimon 0.83EC** (novaluron)	6–12 fl oz	12	1	Maximum of 60 fl oz/acre per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	28	**Coragen** (chlorantraniliprole)	2.0–5.0 fl oz	4	1	Foliar only. Maximum of 15.4 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per year.
	28	**Vantacor** (chlorantraniliprole)	1.2–2.5 fl oz	4	1	Foliar only. Can be applied by overhead sprinkler chemigation system. Maximum of 5.1 fl oz/acre, or 4 applications, or 0.2 lb a.i./acre chlorantraniliprole per year.
Leafhoppers	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	1–2 qt	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	Maximum of 16 qt/acre per crop per year.
	1B	**Fyfanon** **Fyfanon 57% EC** (malathion)	1.5 pt	12	5	Maximum of 2 applications per year. Crop injury may occur in the whorl to silking stages.
	3A	***Ambush 25W** (permethrin)	6.4–16.0 oz	12	1	Do not apply more than 2.0 lb a.i./acre per season. Rates above 12.8 oz are for Florida only.
	3A	***Fastac CS** (alpha-cypermethrin)	2.2–3.8 fl oz	12	3	Maximum of 11.4 fl oz/acre per season.
	3A	***Hero Insecticide** (bifenthrin + zeta-cypermethrin)	4.0–10.3 fl oz	12	3	Maximum of 27.39 fl oz/acre per season (0.266 lb a.i.). See label when using more than one product containing bifenthrin or zeta-cypermethrin.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	3	Maximum of 24 fl oz/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	24	Ears: 1 Feeding livestock: 21	Maximum of 30.72 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	24	1	Maximum of 31 fl oz/acre per year.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	4	Ear and forage: 7 Stover: 21	Maximum of 28 fl oz/acre per year.
	-	**Aza-Direct** (azadirachtin)	1–3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed[2].

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Soil pests (includes corn rootworms, seed corn maggot, white grubs, wireworms)	1A	***Lannate LV** ***Lannate SP** (methomyl)	**LV:** 0.75–1.5 pt **SP:** 0.25–0.50 lb	48	Ears: 0 Forage: 3 Stover: 21	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1A	**Sevin 4F** **Sevin XLR Plus** (carbaryl)	1–2 qt	24 (21 days for detasseling workers)	Ears: 2 Forage: 14 Fodder: 48	Maximum of 16 qt/acre per crop per year.
	1B	***Counter 15G Lock 'n Load** (terbufos)	**Banded or in furrow:** 6.0–8.0 oz per 1000 ft of row **Postemergence incorporated:** 8 oz per 1000 ft of row at cultivation	48	60	Only one application (at-planting, postemergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.
	1B	***Mocap 15G** (ethoprop)	See label	48	At planting	One application per growing season.
	1B	***Thimet 20-G** (phorate)	**At planting or cultivation:** 4.5–6.0 oz/1000 ft of row	48	Ears, forage: 30	Maximum of 6.5 lb/acre per season or one application.
	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	1	Do not apply more than 0.5 lb a.i./acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8–2.8 fl oz	12	0	Maximum of 28 fl oz/acre per season. Maximum of 10 applications.
	3A	***Brigade 2EC** (bifenthrin)	**In-furrow T-band at plant:** 0.15–0.30 fl oz/1000 ft of row **Foliar:** 2.1–6.4 fl oz	12	1	Maximum of 12.8 fl oz/acre per season or 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Capture LFR** (bifenthrin)	**Preplant incorporated:** 4.0–5.3 fl oz **At plant:** 3.4–17.0 fl oz **Preemergence:** 3.4 fl oz	12	Preplant incorporated at planting, preemergence application	For mixing with liquid fertilizer. Maximum of 0.2 lb a.i./acre, per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Force 3G** (tefluthrin)	Depends on row spacing	0	At planting or cultivation within 30 days of seeding emergence	Only one application per crop. Granules must be incorporated.
	3A	***Warrior II** (lambda-cyhalothrin)	**At plant:** 0.33 fl oz/1000 ft of row **Foliar:** 1.28–1.92 fl oz	24	**Ears (foliar):** 1 **Feeding livestock or at-plant applications:** 21	Maximum of 30.72 fl oz/acre per crop. Many other brands with same active ingredient are available.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	24	1	Maximum of 31 fl oz/acre per year.
	3A + 28	***Elevest** (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	12	1	Maximum of 2 applications/acre per year. Maximum of 0.2 lb a.i./acre bifenthrin and 0.2 lb a.i./acre chlorantraniliprole per year.
	3A + -	**Azera** (pyrethrins + azadirachtin)	16–56 fl oz	12	0	OMRI-listed.[2]
	-	Oil, insecticidal	1–2 gal/100 gal, depending on brand	4	0	
Spider mites	1B	***Thimet 20-G** (phorate)	4.5–6.0 oz per 1000 ft of row	48	At planting, see label	One application per season, no more than 6.5 lb/acre per season.
	3A	***Brigade 2EC** (bifenthrin)	5.12–6.4 fl oz	12	1	Maximum of 12.8 fl oz/acre per season or 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Hero Insecticide** (bifenthrin + zeta-cypermethrin)	10.3 fl oz	12	3	Maximum of 27.39 fl oz/acre per season (0.266 lb a.i.). See label when using more than one product containing bifenthrin or zeta-cypermethrin.
	3A + 28	***Elevest** (bifenthrin + chlorantraniliprole)	7.7–9.6 fl oz	12	1	Maximum of 2 applications/acre per year. Maximum of 0.2 lb a.i./acre bifenthrin and 0.2 lb a.i./acre chlorantraniliprole per year.
	6	***Agri-Mek SC** (abamectin)	1.75–3.50 fl oz	12	7	Must be mixed with a nonionic activator-type wetting, spreading, or penetrating adjuvant. Do not use binder or sticker adjuvant. Maximum of 7 fl oz/acre per year. No more than 2 sequential applications.
	23	**Oberon 2SC** (spiromesifen)	5.7–16 fl oz	12	Ears, green forage, silage: 5 Grain or stover: 30	Maximum of 17 fl oz/acre per season or no more than two applications.
	-	**Aza-Direct** (azadirachtin)	1–3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	2–3 lb	4	0	OMRI-listed.[2]
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
Tarnished plant bug	3A	***Asana XL** (esfenvalerate)	5.8–9.6 fl oz	12	1	Maximum of 0.5 lb a.i./acre per season (10 applications at highest rate).
	3A	***Brigade 2EC** (bifenthrin)	2.1–6.4 fl oz	12	1	Maximum of 12.8 fl oz/acre per season or 0.2 lb a.i./acre per season of all bifenthrin products. Many other brands available with same active ingredient.
	3A	***Fastac CS** (alpha-cypermethrin)	2.8–3.8 fl oz	12	3	Maximum of 11.4 fl oz/acre per season.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 fl oz	12	3	Maximum of 24 fl oz/acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28–1.92 fl oz	24	Ears: 1 Feeding livestock: 21	Maximum of 30.72 fl oz/acre per crop. Many other brands with same active ingredient are available.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	6–10 fl oz	24	1	Maximum of 31 fl oz/acre per year.
	3A + 28	***Elevest** (bifenthrin + chlorantraniliprole)	4.8–9.6 fl oz	12	1	Maximum of 2 applications/acre per year. Maximum of 0.2 lb a.i./acre bifenthrin and 0.2 lb a.i./acre chlorantraniliprole per year.
Thrips (check label for species controlled)	1B	***Counter 15G Lock 'n Load** (terbufos)	**Banded or in furrow:** 6.0–8.0 oz per 1000 ft of row **Postemergence incorporated:** 8 oz per 1000 ft of row at cultivation	48	60	Only one application (at planting, postemergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.
	1B	**Fyfanon** **Fyfanon 57% EC** (malathion)	1.5 pt	12	5	Maximum of 2 applications per year. Crop injury may occur in the whorl to silking stages.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5–15.6 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.[2]
	-	**Aza-Direct** (azadirachtin)	1–3.5 pt	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.[2]
	-	**BotaniGard ES** **BoteGHA ES** **Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.2–1 qt	4	0	Apply in sufficient water to cover foliage, typically 5–100 gallon/acre. Compatible in tank mix with some fungicides. Mycotrol ESO OMRI-listed.[2]

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	REI (Hours)	Days to Harvest	Remarks[2]
	-	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	2–3 lb	4	0	OMRI-listed.[2]
	-	**Molt-X** (azadirachtin)	10 fl oz	4	0	OMRI-listed.[2]
	-	Oil, insecticidal (e.g., **Suffoil-X**)	12 gal/100 gal, depending on brand	4	0	OMRI-listed,[2] depending on brand.
	-	**Trilogy** (extract of neem oil)	1.0%–2.0% v/v	4	0	Apply morning or evening to reduce potential for leaf burn.

Table 6. Sweet corn fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Katia Viana Xavier, UF/IFAS Everglades Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Bacterial stalk rot	M1	(copper compounds) **Many brands available:** Badge X2, Copper Count N, Cueva, Kocide 2000, Kocide 3000, Mastercop, Nu-Cop 50 DF, Top Cop w/Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
Damping-off	M3	**Defiant 75WP** (thiram)	5.3 oz/100 lb of seed			1	Seed treatment only.
	M3	**Signet 480FS** (thiram)	5.0 oz/100 lb of seed			1	Seed treatment only.
Damping-off seedling blight	3	**Vortex** (ipconazole)	0.085 fl oz/ 100 lb of seed			0.5	Seed treatment only.
	4 + 3	**Dividend Extreme** (mefenoxam + difenoconazole)	5 fl oz/100 lb of seed			2	Seed treatment only.
	11	**Dynasty** (azoxystrobin)	0.153 fl oz/100 lb of seed			4	Seed treatment only.
	11	**Trilex** (trifloxystrobin)	0.96 fl oz/100 lb of seed				Seed treatment only.
Eye spot	3	(propiconazole) **Many brands available:** Amtide Propiconazole 41.8, Bumper 41.8EC, Fitness, Propiconazole E-AG 41.8EC, Propimax EC, Tilt	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total applications.
	3 + 7 + 11	**Miravis Neo** (propiconazole + pydiflumetofen + azoxystrobin)	13.7 fl oz	44.5 fl oz	14	0.5	Do not make more than 2 sequential applications.
	3 + 11	**Delaro** (prothioconazole + trifloxystrobin)	8 fl oz	32 fl oz	**Forage and ears:** 0 **Fodder:** 14	0.5	Do not make more than 2 sequential applications.
	7	**Vertisan** (penthiopyrad)	24 fl oz	48 fl oz	7	0.5	Soil and foliar treatments. See label for details.
	7 + 11	**Priaxor** (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	11	**Aftershock** (fluoxastrobin)	**Foliar:** 3.8 fl oz	15.27 fl oz	7	0.5	Soil and foliar treatments. See label for details.
	11	**Evito 480SC** (fluoxastrobin)	3.8 fl oz	15.2 fl oz	7	0.5	Do not exceed 2 sequential and 4 total applications.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Headline** (pyraclostrobin)	12 fl oz	72 fl oz	7	0.5	Do not exceed 2 sequential and 6 total applications of Headline or other QoI fungicides.
	11	**Headline SC** (pyraclostrobin)	12 fl oz	72 fl oz	7	0.5	Do not exceed 2 sequential and 6 total applications of Headline or other QoI fungicides.
	11	**Quadris** (azoxystrobin)	15.4 fl oz or 0.8 fl oz/1000 row ft	2.88 qt	7	4 hr	Do not exceed 1 sequential and 4 total applications of Quadris or other QoI fungicides. See label for soil applications.
	11 + 3	**Avaris** (azoxystrobin + propiconazole)	14 fl oz	28 fl oz	14	0.5	See label for details.
	11 + 3	**Evito T** (fluoxastrobin + tebuconazole)	9 fl oz	36 fl oz	7	19	Do not exceed 2 sequential and 4 total applications.
	11 + 3	**Headline AMP** (pyraclostrobin + metconazole)	14.4 fl oz	57.6 fl oz	7	0.5	Do not exceed 2 sequential and 4 total applications of Headline AMP.
	11 + 3	**Helmstar Plus** (azoxystrobin + tebuconazole	10.8 fl oz	43.2 fl oz	7	19	Do not spray after V-8 growth stage.
	11 + 3	**Quilt** (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	**Quilt XCEL** (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	**Stratego** (trifloxystrobin + propiconazole)	12 fl oz	24 fl oz	14	0.5	Do not apply more than 2 sequential applications.
	11 + 3	**Stratego YLD** (trifloxystrobin + propiconazole)	5 fl oz	20 fl oz	14	0.5	Do not apply more than 2 sequential applications.
	11 + 3	**Topguard EQ** (flutriafol + azoxystrobin)	7 fl oz	14 fl oz		3	Make no more than 2 applications per season.
	11 + 3	**Veltyma** (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	See label for details.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	16 fl oz	7	0.5	See label for details.
Gray leaf spot	3	(tebuconazole) **Many brands available:** Folicur 3.6F, Monsoon 3.6F, Orius 3.6F, Tebustar 3.6L, Tebuzol 3.6F, Toledo 3.6F	6 fl oz	24 fl oz	7	0.5	Restricted-entry time is 19 days.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	**Topguard** (flutriafol)	14 fl oz	28 fl oz	7	3	No more than 2 applications per year.
	3	**Xyway LFR** (flutriafol)	5.8–15.2 fl oz	15.2 fl oz	-	0.5	Apply to corn in-furrow at planting or postemergence directed to the soil.
	3 + M2	**Unicorn** (tebuconazole + sulfur)	3.75 lb	15.0 lb	14	19	See label for details and rotational restrictions.
	3 + 7 + 11	**Miravis Neo** (propiconazole + pydiflumetofen + azoxystrobin)	13.7 fl oz	44.5 fl oz	14	0.5	Do not make more than 2 sequential applications.
	3 + 7 + 11	**Revytek** (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	15 fl oz	30 fl oz	21	0.5	See label for details.
	3 + 33	**Viathon** (tebuconazole + potassium phosphite)	3.0 pt	16.5 pt	7	0.5	See label for details and rotational restrictions.
	7 + 11	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	16 fl oz	7	0.5	Alternate with a fungicide of dissimilar mode of action.
Northern blight Southern blight Common rust	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F-45 Rainshield, Dithane M45, Koverall, Manzate DF, Manzate Flowable, Manzate Pro-Stick, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	1.5 lb	24 lb	7	1	Start applications at the first sign of disease.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN	**SEE INDIVIDUAL LABELS**		7	0.5	
	3	(propiconazole) **Many brands available:** Amtide Propiconizole 41.8, Bumper 41.8EC, Fitness, Propiconazole E-AG 41.8EC, Propicure 3.6F, Propimax EC, Propi-Star EC, Shar-Shield PPZ, Tide Propiconazole 41.8 EC, Tilt 3.6EC, Topaz	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total applications.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	3	**Prosaro** (tebuconazole + prothioconazole)	8.2 fl oz	26 fl oz	7	0.5	See label for adjuvant information and rotational restrictions.
	3	(tebuconazole) **Many brands available:** Folicur 3.6F, Monsoon 3.6F, Onset 3.6L, Orius 3.6F, Tebu-Crop, Tebustar 3.6L, Tebuzol 3.6F, Toledo 3.6F	6 fl oz	24 fl oz	7	0.5	Restricted-entry time is 19 days.
	3	**Topguard** (flutriafol)	14 fl oz	28 fl oz	7	3	No more than 2 applications per year.
	3	**Xyway LFR** (flutriafol)	5.8–15.2 fl oz	15.2 fl oz	-	0.5	Apply to corn in-furrow at planting or postemergence directed to the soil.
	3 + M2	**Unicorn** (tebuconazole + sulfur)	3.75 lb	15.0 lb	14	19	See label for details and rotational restrictions.
	3 + 7	**Propulse** (prothioconazole + fluopyram)	27.4 fl oz	13.7 fl oz	0	0.5	Do not make more than 2 sequential applications.
	3 + 7 + 11	**Miravis Neo** (propiconazole + pydiflumetofen + azoxystrobin)	13.7 fl oz	44.5 fl oz	14	0.5	Do not make more than 2 sequential applications.
	3 + 7 + 11	**Revytek** (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	15 fl oz	30 fl oz	21	0.5	See label for details.
	3 + 7 + 11	**Trivapro** (propiconazole + benzovindiflupyr + azoxystrobin)	13.7 fl oz	54.8 fl oz	14	0.5	Use no more than 2 sequential applications before alternating with a fungicide of dissimilar mode of action.
	3 +11	**Delaro** (prothioconazole + trifloxystrobin)	8 fl oz	32 fl oz	**Forage and ears:** 0 **Fodder:** 14	0.5	Do not make more than 2 sequential applications
	3 + 33	**Viathon** (tebuconazole + potassium phosphite)	3.0 pt	16.5 pt	7	0.5	See label for details and rotational restrictions.
	7	**Vertisan** (penthiopyrad)	24 fl oz	48 fl oz	7	0.5	Soil and foliar treatments.
	7 + 11	**Elatus** (benzovindiflupyr + azoxystrobin)	7.3 oz	14.6 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	11	**Aftershock** (fluoxastrobin)	**Foliar:** 3.8 fl oz	15.27 fl oz	7	0.5	Soil and foliar treatments.
	11	**Aproach** (picoxystrobin)	12 fl oz	36 fl oz	7	0.5	See label for details.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	11	**Evito 480SC** (fluoxastrobin)	3.8 fl oz	15.2 fl oz	7	0.5	Do not exceed 2 sequential and 4 total applications.
	11	**Headline** (pyraclostrobin)	12 fl oz	72 fl oz	7	0.5	Do not exceed 2 sequential and 6 total applications of Headline or other QoI fungicides.
	11	**Headline SC** (pyraclostrobin)	12 fl oz	72 fl oz	7	0.5	Do not exceed 2 sequential and 6 total applications of Headline or other QoI fungicides.
	11	**Quadris** (azoxystrobin)	15.4 fl oz or 0.8 fl oz/1000 row ft	2.88 qt	7	4 hr	Do not exceed 2 sequential and 4 total applications of Quadris or other QoI fungicides. See label for soil applications.
	11	**Willowood Azoxy 2 SC** (azoxystrobin)	15.5 fl oz	62 fl oz	7	4 hr	Do not exceed 2 sequential applications.
	11 + 3	**Avaris** (azoxystrobin + propiconazole)	14 fl oz	28 fl oz	14	0.5	See label for details.
	11 + 3	**Custodia** (azoxystrobin + tebuconazole)	12.9 fl oz	51.7 fl oz	21	0.5	See label for details.
	11 + 3	**Evito T** (fluoxastrobin + tebuconazole)	9 fl oz	36 fl oz	7	19	Do not exceed 2 sequential and 4 total applications.
	11 + 3	**Headline AMP** (pyraclostrobin + metconazole)	14.4 fl oz	57.6 fl oz		0.5	Do not exceed 2 sequential and 4 total applications of Headline AMP.
	11 + 3	**Quilt XCEL** (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 + 3	**Stratego** (trifloxystrobin + propiconazole)	12 fl oz	24 fl oz	0	0.5	Do not apply more than 2 sequential applications.
	11 + 3	**Stratego YLD** (trifloxystrobin + propiconazole)	5 fl oz	20 fl oz	0	0.5	Do not apply more than 2 sequential applications.
	11 + 3	**Topguard EQ** (flutriafol + azoxystrobin)	7 fl oz	14 fl oz		3	Make no more than 2 applications per season.
	11 + 3	**Veltyma** (pyraclostrobin + mefentrifluconazole)	10 fl oz	20 fl oz	21	0.5	See label for details.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	16 fl oz	7	0.5	See label for details.
Powdery mildew rust	M2	(sulfur) **Many brands available:** Kumulus DF, Microfine Sulfur, Sulfur 90W, Top Cop w/Sulfur, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
Pythium seedling blight Systemic downy mildew	4	(metalaxyl) **Various brands available:** Acceleron, Acquire, Allegiance, Sebring 2.65ST	3 fl oz/100 lb seed			1	Seed treatment only.
	4	**Apron XL** (mefenoxam)	2.2 fl oz/100 lb seed			2	Seed treatment only.
	33	(mono- and dipotassium salts of phosphorous acid) **Various brands available:** Confine Extra, K-phite	3 qt		0	4 hr	See label for details.
Rhizoctonia root and stalk rot diseases	11	**Aftershock** (fluoxastrobin)	**Soil:** 0.24 fl oz per 1000 ft of row	15.2 fl oz	7	0.5	Soil and foliar treatments. See label for details.
Tar spot	3 + 7 + 11	**Delaro Complete** (prothioconazole + fluopyram + trifloxystrobin)	8 fl oz	32 fl oz	**Forage and ears:** 0 **Fodder:** 14	0.5	Do not make more than 2 sequential applications
	3 + 7 + 11	**Miravis Neo** (propiconazole + pydiflumetofen + azoxystrobin)	13.7 fl oz	44.5 fl oz	14	0.5	Do not make more than 2 sequential applications.
	3 + 7 + 11	**Revytek** (mefentrifluconazole + fluxapyroxad + pyraclostrobin)	15 fl oz	30 fl oz	21	0.5	See label for details.
	3 + 7 + 11	**Trivapro** (propiconazole + benzovindiflupyr + azoxystrobin)	13.7 fl oz	54.8 fl oz	14	0.5	Use no more than 2 sequential applications before alternating with a fungicide of dissimilar mode of action.
	3 +11	**Delaro** (prothioconazole + trifloxystrobin)	8 fl oz	32 fl oz	**Forage and ears:** 0 **Fodder:** 14	0.5	Do not make more than 2 sequential applications
Various seedling diseases	1	**Thiabendazole 4L ST** (thiabendazole)	0.41 fl oz/80,000 kernel			0.5	
	1 + 4 + 11 + 12	**Maxim Quattro** (thiabendazole + mefenoxam + azoxystrobin + fludioxonil)				0.5	Seed treatment only.
	3	**Difenoconazole 3L ST** (difenoconazole)	1.25 fl oz/100 lb of seed			0.5	Seed treatment only.
	3 + 4	**EverGol Energy** (metalaxyl + prothioconazole)	2 fl oz/100 lb of seed			0.5	Seed treatment only.
	4 + 14 + NC	**System 3** (mefenoxam + PCNB + *Bacillus subtilis* GB03)	3 oz/bu of seed			1	Seed treatment only.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[2]
			Appl.	Season	Harvest	Reentry	
	7	**Kernel Guard Supreme** (carboxin + permethrin)				0.5	Seed treatment only.
	11	**Stamina** (pyraclostrobin)	1.6 fl oz/100 lb of seed				Seed treatment only.
	12	(fludioxonil) **Various brands available:** Dyna-Shield, Maxim 4FS, Spirato 480 FS	0.16 fl oz/100 lb of seed			0.5	Seed treatment only.
	14	**Rizolex** (tolclofos-methyl)	0.3 fl oz/100 lb of seed			0.5	Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022 http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 7. Nonfumigant nematicides for sweet corn in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Broadcast or Overall Rates		Row Rates	
	Per Acre	Per 1000 sq ft	Per Acre, 36" Row Spacing	Per 1000 ft of Row, Any Row Spacing
Counter 15G (terbufos)*	---	---	5.4–7.3 lb	6.0–8.0 oz
Mocap 15G (ethoprophos)**	40 lb	0.9 lb	10.8–14.8 lb	0.75–1.0 lb
Velum (fluopyram)	Apply 6.5–6.8 fl oz/acre either by in-furrow spray during planting directed on or below seed, or by chemigation into root zone through low-pressure drip or trickle irrigation. Do not apply more than 6.84 fl oz of Velum (0.446 lb of fluopyram) per acre per year, regardless of formulation or method of application (soil or foliar). Do not apply Velum within 14 days of harvest. Do not allow livestock to graze treated area for 14 days, and do not harvest for food or feed within 14 days of application.			

*Apply banded or in the row not to exceed 8.7 lb/A.
**Do not allow Mocap to come in contract with seed. Apply as a 12 to 15 inch band treatment, incorporating Mocap product according to label instructions.
These products are not as consistently effective against root-knot nematodes as the fumigants but are registered as indicated.

Table 8. Fumigant nematicides for sweet corn in Florida.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/chisel spaced 12" apart	
Telone II[2, 3]	9 to 12 gal	26 to 35	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-17[2, 3]	10.8 to 17.1 gal	31.8 to 50.2	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2, 3]	13 to 20.5 gal	38 to 60	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Pic-Clor 60	19 to 31.5 gal	57 to 90	For any row spacing, application rates should never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Vapam HL	75 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip or in-row chisel fumigation, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier-textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See new label details for additional use restrictions based on soil characteristics, buffer zones, Fumigant Management Plans (FMP), requirements for Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and other rate-modifying recommendations.
[3] Higher application rates are possible in the presence of cyst-forming nematodes.
Rates are believed to be correct for products named and similar products of other brand names when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

HS739

doi.org/10.32473/edis-cv137-2022

Chapter 18. Tomato Production[1]

Craig Frey, Ramdas Kanissery, Hugh A. Smith, Johan Desaeger, and Gary E. Vallad[2]

Botany and Planting

Tomato—*Solanum lycopersicum*, Solanaceae

Table 1. Planting information for tomato.

Planting Dates	
North Florida	July–Aug; Feb–Apr
West-central Florida	Aug–Sept; Jan–Feb
South Florida	Aug–Feb
Planting Information	
Distance between rows (in.)	48–72
Distance between plants (in.)	18–32
Days to maturity	70–90
Plant population per acre	3630–4356

1. This document is HS739, one of a series of the Horticultural Sciences Department, UF/IFAS Extension. Original publication date June 1995. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Craig Frey, county Extension director and Extension agent II, UF/IFAS Extension Hendry County; Ramdas Kanissery, assistant professor, Horticultural Sciences Department, UF/IFAS Southwest Florida REC; Hugh A. Smith, associate professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; and Gary E. Vallad, professor, Plant Pathology Department, UF/IFAS Gulf Coast REC; UF/IFAS Extension, Gainesville, FL 32611.

Cultivars

For more information on tomato varieties, see https://edis.ifas.ufl.edu/publication/HS1189.

Large-Fruited and Beefsteak Types

BHN 602. Early midseason maturity. Fruit are globe-shaped and green-shouldered.

BHN 3353. Continuous yield of large to extra-large fruit on a strong, determinate plant. Great for multiple picks.

Camaro. Medium plant with limited to no pruning. Extra-large globe-shaped fruit.

Everglade. Full-season maturity with deep oblate fruit. Performs well in cool weather conditions.

Florida 47. A late midseason, determinate, jointed hybrid. Uniformly green, globe-shaped fruit.

Florida 91. Midseason variety. Uniformly green fruit borne on jointed pedicels. Determinate plant. Good fruit-setting ability under high temperatures.

Grand Marshall. Midseason vigorous plant with hot set and extra-large to large oblate fruit.

HM 1823. Determinate, round tomato, early maturing variety with a strong plant and large to extra-large round fruit.

Jolene. Early maturing, determinate variety producing large to extra-large fruit with deep, dark interiors. Suitable for mature green or vine-ripe production.

Loretta. Determinate, high-flavor variety for fresh market or gas green production. Fruits have deep, round shape and pinpoint blossom end.

Red Bounty. Medium maturity, good heat set, extra-large globe fruit.

Red Defender. Medium maturity. Vigorous vine with smooth, large, deep-red fruit with excellent firmness and shelf life.

Red Snapper. Determinate, round variety suited for mature green and vine-ripe markets. Versatile across seasons with good hot-set potential.

Skyway. Main-season variety with a strong plant. Extra-large globe-shaped fruit.

Southern Ripe. Full-season maturity with a medium plant. Deep-oblate fruit that are adapted to cooler conditions.

STM2255. Adaptable determinate variety for both mature green and vine ripe. Mid cover with firm fruit and good shelf life.

Summerhaven. Widely adaptable determinate variety with excellent plant cover and extra-large fruit that ship well.

SV 7631. Midseason variety with medium to strong plant with large to extra-large oblate fruit.

Tasti-Lee. Released for the premium tomato market. A midseason, determinate, jointed hybrid with moderate heat tolerance. Fruit are uniformly green with a high lycopene content and deep-red interior color due to the crimson gene.

Thunderbird (STM5187). Hot-set determinate variety with extra-large, very firm fruit that have good shelf life.

Winterhaven. Mature green, determinate variety is adapted to withstand cooler weather.

Plum and Roma Types

BHN 685. Midseason. Large to extra-large, deep-blocky, globe-shaped fruit. Determinate, vigorous bush with no pruning recommended.

BHN 1045.Uniform large fruit and a deep-blocky shape. A strong determinate plant with an excellent disease package.

Daytona. Midseason compact plant. Blocky-elongated large to extra-large fruit.

Mariana. Midseason. Fruit are predominately extra large and extremely uniform in shape. Fruit wall is thick, and external and internal color are very good, with excellent firmness and shelf life. Determinate, small-to-medium-sized plant with good fruit set.

Picus. Main-season, determinate Roma tomato that is widely adapted. Fruits are large, uniform, and blocky, maturing to a deep-red color with great firmness at the red stage. Medium-to-large, vigorous plant that provides good fruit cover and sets well in hot temperatures.

Shelby. Adaptable determinate Roma tomato that can be used in multiple seasons. Fruits are very firm, have low gel, and a good shelf life. Can be used for mature green and vine ripe markets.

Tachi. Midseason variety with classic saladette shape. Determinate midcompact plant. Fruit size predominately extra large, uniform, and very similar to Mariana. Wide adaptability and suited for concentrated harvests for vine-ripe and mature-green markets.

Villa. Mid-early season indeterminate extra-large Roma variety with compact growth habit and mid vigor.

Cherry Types

BHN 268. Early to midseason. Tall bush. An extra-firm cherry tomato that holds, packs, and ships well. Determinate, small-to-medium bush with high yields.

BHN 762. Early determinate variety. Globe-shaped fruit.

Sakura. Early indeterminate hybrid.

Sweet Treats. Early main season with wide adaptability. Strong, vigorous, indeterminate plant. Deep-pink, firm, globe-shaped fruit with outstanding flavor potential. Strong against cracking.

Grape Types

BHN 784. Early-midseason determinate grape hybrid. Heat tolerant.

BHN 785. Midseason determinate grape hybrid with a strong set of very uniformly sized and shaped fruit on a vigorous bush with good cover.

BHN 1022. Determinate "hot-set" variety.

Gold Spark. Mid-late. Indeterminate. High-yield yellow grape with consistent brix, great firmness, and excellent shelf life.

Jolly Girl. Early season. Determinate plant. Extended market life with firm, flavorful grape-shaped fruits. Average 10% brix.

Mountain Honey. Semideterminate plant produces high yields of uniform deep-red fruit with very good flavor and sugars.

Mountain Vineyard. Indeterminate grape with deep red color.

Ruby Crush. Mid-early. Determinate with midcompact growth. Deep-red fruit that are very smooth, uniform and firm with a good flavor profile.

Smarty. Early, vigorous, indeterminate bush with short internodes. Plants are 25% shorter than Santa. Sweet and excellent flavor.

Sweethearts. Early to midseason. Indeterminate bush with intermediate internodes. Brilliant red, firm, elongated grape shaped fruit. Matures between 70 and 75 days. Good flavor, crack-resistant, and high Brix.

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 2. Disease-resistance packages for tomato varieties.

	Disease Resistance[1]
Large and Beefsteak	
Amelia	R to F-R (1, 2, 3), N, S, TSW, and V (1)
BHN 602	R to F-R (1, 2, 3), TSW, and V (1)
BHN 3353	R to FCR, F-R (1, 2), V (1), and TSW IR to TYLCV
Camaro	R to ASC, F-R (1, 2, 3), and V (1) IR to S and TYLC
Everglade	R to ASC, F-R (1,2,3), S, V (1), IR to TYLCV
Florida 47	R to F-R (1, 2), V (1), ASC, and S
Florida 91	R to F-R (1, 2), V (1), ASC, and S
Grand Marshall	R to ASC, F-R (1, 2) IR to S and TYLC
HM 1823	R to FCR, F-R (1, 2), and V (1) IR to S
Jolene	R to FCR, F-R (1, 2), and V (1) IR to TYLCV
Laguna Red	R to ASC, FCR, F-R (1, 2), ToM, and V (1)
Loretta	R to FCR, F-R (1, 2), S, and V (1)
Red Bounty	R to V (1), F-R (1, 2), S, TSWV, and N
Red Snapper	R to ASC, F-R (1,2), and V (1) IR to S, TSW, and TYLCV
Skyway	R to F-R (1, 2) IR to N, TSW, TYLC
Southern Ripe	R to FCR, F-R(1, 2, 2), TSW IR to N
STM2255	R to ASC, FCR, F-R (1, 2), V (1) IR to S, TSW, and TYLCV
Summerhaven	R to FCR, F-R (1, 2), and V (1) IR to TSW and TYLCV
SV 7631	R to ASC, F-R (1, 2), TSW, V (1) IR to N
Tasti-Lee	R to F-R (1, 2, 3), V (1), and S
Thunderbird (STM5187)	R to ASC, FCR, F-R (1, 2), and V (1) IR to S and TYLCV
Winterhaven	R to FCR, F-R (1, 2), and V (1) IR to TSW and TYLCV
Plum	
BHN 685	R to F-R (1, 2, 3), TSW, and V (1)
BHN 1045	R to F-R (1, 2, 3), TSW, TYLCV, and V (1)
Daytona	R to ASC, F-R (1, 2), N, V (1), IR to TYLCV
Mariana	R to ASC, F-R (1, 2), N, and V (1). IR to S
Picus	R to ASC, TSW, F-R (1, 2), V (1), CLS
Shelby	R to ASC, FCR, F-R (1, 2), BSK, and V (1) IR to TSW and TYLCV
Tachi	R to ASC, F-R (1, 2), N, and V (1) IR to TSW
Villa	R to ASC, F-R (1, 2, 3), and V (1) IR to TSW
Cherry	
BHN 268	R to F-R (1) and V (1)
BHN 762	R to F-R (1) and V (1)
Sakura	R to F-R (1, 2), CLS, and TM
Sweet Treats	R to CLS, F-R (1, 2), and ToM IR to FCR and S
Grape	
BHN 784	R to F-R (1)
BHN 785	R to F-R (1)
BHN 1022	R to F-R (1, 2, 3) and TSW
Gold Spark	R to ToM and CLS
Jolly Girl	R to C and V (1) IR to F-R (1, 2)
Mountain Honey	R to F-R and V (1) IR to TSWV and Late Blight

	Disease Resistance[1]
Mountain Vineyard	R to F-R (1, 2, 3) and TSW
Ruby Crush	R to FCR, F-R (1, 2), and ToM IR to S
Smarty	R to F-R (1,2) and V (1)
Sweethearts	R to C, CLS, F-R (1), and TM IR to S

[1] ASC = Alternaria stem canker = *Alternaria alternata* f. sp. *lycopersici*; BSK—Bacterial speck—*Pseudomonas syringae* pv *tomato*; C—Cracking; CLS—Cladosporium leaf mold—*Cladosporium fulvum*; F-R 1, 2, 3—Fusarium wilt race 1, 2, 3—*Fusarium oxysporum* f. sp. *lycopersici* races 1, 2, 3; FCR—Fusarium crown rot—*Fusarium oxysporum* f. sp. *radicis-lycopersici*; N—Root-knot nematode—*Meloidogyne arenaria*, *M. incognita*, and *M. javanica*; S—Gray leaf spot—*Stemphylium solani*; ToM = Tomato mosaic virus; TM = Tobacco mosaic; TSW = Tomato spotted wilt; TYLC—Tomato yellow leaf curl; V (1) = Verticillium wilt—*Verticillium albo-atrom* and *Verticillium dahliae* race 1. R = Resistant; IR = Intermediate Resistance; T = Tolerant.

Table 3. Herbicides approved for managing weeds in tomato. Contact: Ramdas Kanissery, UF/IFAS Southwest Florida Research and Education Center.

Active Ingredient (lb a.i./A)	Trade Name (Product/A)	MOA Code	Weeds Controlled/Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
		*****PREPLANT/PREEMERGENCE*****	
Carfentrazone up to 0.031	(Aim)2.0EC up to 2 fl oz	14	Apply as a preplant burndown for emerged broadleaves up to 4 inches tall or rosettes less than 3 inches across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pretransplant interval.
EPTC 2.6	(Eptam) 7 E 3 pt	8	Annual broadleaves, annual grasses, and suppression of yellow/purple nutsedge. Labeled for transplanted tomatoes grown on low-density mulch. Do not use under high-density, VIF, TIF, or metalized mulches. A 24(c) special local needs label in Florida. 14-day pretransplant interval.
Flumioxazin up to 0.128	(Chateau) 51 WDG up to 4 oz	14	Annual broadleaves and grasses. Apply to row middles of raised plastic-mulched beds that are at least 4 in. higher than the treated row middle and 24 in. bed width. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Tank-mix with a burndown herbicide to control emerged weeds. 0-day pretransplant interval.
Fomesafen 0.25–0.38	(Reflex) 2 EC 1.0–1.5 pt	14	Broadleaves and suppression of yellow/purple nutsedge. Suppression of some annual and perennial grasses. Label is a 24(C) local indemnified label, and a waiver of liability must be signed for use. Transplanted crop only. May be applied to bareground production or to plastic-mulched beds following bed formation but prior to laying plastic. Use shields or hooded sprayers if applying to row middles, and prevent contact with the plastic mulch. 7- and 0-day pretransplant interval on bare ground and plastic mulch, respectively. 70-day PHI.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses, and nutsedge. Apply as a preplant burndown. Consult label for individual product directions.
Halosulfuron 0.024–0.05	(Sandea, Profine) 75 DF 0.5–1.0 oz	2	Broadleaf weeds and yellow/purple nutsedge. Do not exceed 2 applications of halosulfuron per 12-month period. 7-day pretransplant interval. 30-day PHI.
Imazosulfuron 0.19–0.3	(League) 4.0–6.4 oz	2	Broadleaves and suppression of yellow/purple nutsedge. Apply pretransplant just prior to installation of plastic mulch. 1-day pretransplant interval. 21-day PHI.
Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaves. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to row middles only with shielded or hooded sprayers. Contact with green foliage or fruit may cause excessive injury. Drift of Cobra treated soil particles onto plant can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. 30-day PHI.
Metribuzin 0.25–0.5	(Sencor DF, TriCor DF) 75 WDG 0.33–0.67 lb (Sencor 4, Metricor) 4 F 0.5–1.0 pt	5	Small emerged weeds less than 1 inch tall. Apply preplant in transplanted tomatoes only. Incorporate to a depth of 2–4 inches. Maximum of 1.0 lb a.i./A within a season. Avoid application for 3 days following cool, wet, or cloudy weather to reduce possible crop injury. 7-day PHI.
Napropamide 1.0–2.0	(Devrinol DF-XT) 50 DF 2.0–4.0 lb (Devrinol 2-XT) 2–4 quarts	15	Annual broadleaves and grasses. For direct-seed or transplanted tomatoes. Apply to well-worked soil that is moist enough to permit thorough incorporation to a depth of 2 inches. Incorporate same day as applied.
Oxyfluorfen 0.25–0.5	(Goal 2 XL) 2 EC 1.0–2.0 pt (GoalTender) 4 E	14	Broadleaves. Apply pretransplant just prior to installation of plastic mulch. 30-day pretransplant interval. Mulch may be applied any time during the 30-day interval.
Paraquat 0.5–1.0	(Gramoxone) 2 SL 2.0–4.0 pt (Gramoxone) 3 SL 1.3–2.7 pt (Firestorm) 3 SL 1.3–2.7 pt	22	Emerged broadleaves and grasses. Apply as a preplant burndown treatment. Surfactant recommended. Consult label for new restrictions.
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaves and grasses. Apply as a preplant burndown treatment or posttransplant with shielded or hooded sprayers. Product is a contact, nonselective, foliar-applied herbicide with no residual control.

Active Ingredient (lb a.i./A)	Trade Name (Product/A)	MOA Code	Weeds Controlled/Remarks
Pendimethalin 0.48–0.72	(Prowl H_2O) 3.8 1.0–1.5 pt	3	May be applied pretransplant to bed tops just prior to laying the plastic mulch or to row middles. Do not exceed 3.0 pt/A per year. 70-day PHI.
Pyraflufen-ethyl 0.001–0.003	(ET Herbicide) 0.208 EC 0.5–252.0 fl oz	14	Emerged broadleaves less than 4 inches tall or rosettes less than 3 inches diameter. Apply as a preplant burndown treatment. Nonionic surfactant or crop oil concentrate recommended.
Rimsulfuron 0.03–0.06	(Pruvin) 25 WDG (Matrix) SG 2.0–4.0 oz	2	Annual broadleaves and grasses. Suppression of yellow nutsedge. Requires 0.5–1 inch of rainfall or irrigation within 5 days of application for activation. May be applied as a sequential treatment with a PRE and POST application not exceeding 0.06 lb a.i./A in a single season. 45-day PHI.
S-metolachlor 1.0–1.3	(Brawl, Dual Magnum, Medal) 7.62 EC 1.0–1.33 pt if organic matter less than 3%	15	Annual broadleaves and grasses. Suppression of yellow/purple nutsedge. Apply to bed tops pretransplant just prior to laying the plastic. May also be used in row middles. Research has shown that the 1.33 pt may be too high in some Florida soils except in row middles. 30-day PHI. 90-day PHI if rate exceeds 1.33 pt/A.
Sulfentrazone 0.070–0.19	(Spartan) 4F 2.25–6.0 oz	14	Preemergent control of broadleaves and grasses. Applications must be made prior to transplant. Do not apply more than 12 oz per acre per application or per 12-month period.
Trifluralin 0.5	(Treflan, Trifluralin) 4 EC 1 pt (Treflan TR, Trifluralin) 10 G 5 lb	3	Annual broadleaves and grasses. Do not apply in Dade County. Incorporate 4 in. or less within 8 hr of application. Results in Florida are erratic on soils with low organic matter and clay contents. Note that label precautions against planting "nonlisted" vegetable crops within 5 months of application. Do not apply after transplanting.
			*****POSTTRANSPLANT*****
Carfentrazone up to 0.031	(/(Aim) 2.0 EC up to 2 fl oz	14	Emerged broadleaf weeds. Apply as a hooded application to row middles only. Good coverage is essential. May be tank-mixed with other herbicides. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. 0-day PHI.
Clethodim 0.09–0.25 0.07–0.25	(Arrow, Select) 2 EC 6–16 fl oz (Select Max) 1 EC 9–32 fl oz	1	Perennial and annual grasses. Use higher rates under heavy grass pressure or larger weeds. Surfactant or crop oil concentrate recommended. Consult label. 20-day PHI.
DCPA 6.0–7.5	(Dacthal) W-75 8–10 lb (Dacthal) 6 F 8–10 pt	3	Annual grasses and select broadleaves. Apply to weed-free soil 6–8 weeks after crop is established and growing rapidly or to moist soil in row middles after crop establishment. Note label precautions against replanting nonregistered crops within 8 months.
Diquat 0.5	(Reglone Desiccant) 1 qt	22	Broadleaves and grasses. Apply to row middles only. Maximum of 2 applications per season. Prevent drift to crop. Nonionic surfactant recommended. 30-day PHI.
Halosulfuron 0.024–0.05	(Sandea, Profine) 75 DF 0.5–1.0 oz	2	Broadleaf weeds and yellow/purple nutsedge. Apply 14 days after transplant but before first bloom. Following first bloom apply with shielded or hooded applicator. May be applied to row middles with shielded or hooded sprayer. Do not exceed 2 oz per 12-month period. Surfactant recommended. 30-day PHI.
Imazosulfuron 0.19–0.3	(League) 4.0–6.4 oz	2	Apply postemergence 3 to 5 days after transplant through early bloom. Only apply if no pretransplant application was made. Surfactant recommended. PHI 21 days.
Lactofen 0.25–0.5	(Cobra) 2 EC 16–32 fl oz	14	Broadleaf weeds. Apply to row middles only with shielded or hooded sprayers. Contact with green foliage or fruit can cause excessive injury. Drift of Cobra-treated soil particles onto plants can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. Do not apply within 18 days of transplant. Surfactant recommended. PHI 30 days.
Metribuzin 0.25–0.5	(Sencor DF, TriCor DF) 75 WDG 0.33–0.67 lb (Sencor 4, Metricor) 4 F 0.5–1.0 pt	5	Small, emerged weeds. Apply after transplants or seedlings are well established. Apply in single or multiple applications with a minimum of 14 days between treatments. Maximum of 1.0 lb a.i./A within a season. Avoid application for 3 days following cool, wet, or cloudy weather to reduce possible crop injury. 7-day PHI.
Paraquat 0.5	(Gramoxone) 2 SL 2 pt (Gramoxone) 3 SL 1.3 pt(Firestorm) 3 SL 1.3 pt	22	Emerged broadleaf and grass weeds. Direct spray over emerged weeds 1–6 in. tall in row middles between mulched beds. Use low pressure and shields to control drift. Do not apply more than 3 times per season. Nonionic surfactant recommended. 30-day PHI. Consult label for new restrictions.

Active Ingredient (lb a.i./A)	Trade Name (Product/A)	MOA Code	Weeds Controlled/Remarks
Pelargonic acid	(Scythe) 4.2 EC 3%–10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar-applied herbicide with no residual control. May be tank-mixed with several soil residual compounds.
Pendimethalin 0.48–0.72	(Prowl H_2O) 3.8 1.0–1.5 pt	3	Broadleaf and grass weeds. May be applied posttransplant to row middles if previously untreated. Do not exceed 3.0 pt/A per year. 70-day PHI.
Rimsulfuron 0.02–0.03	(Pruvin, Solida) 25 WDG (Matrix) SG 1.0–2.0 oz	2	Broadleaves and grasses. May be applied as a sequential treatment with a PRE and POST application not exceeding 0.06 lb a.i./A in a single season. Requires 0.5–1.0 in. of rainfall or irrigation within 5 days of application for activation. Nonionic surfactant or crop oil concentrate recommended. PHI 45 days.
Sethoxydim 0.19–0.28	(Poast) 1.5 EC 1.0–1.5 pt	1	Actively growing grasses. Do not exceed a total of 4.5 pt/A applied in one season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. 20-day PHI.
S-metolachlor 1.0–1.3	(Brawl, Dual Magnum, Medal) 7.62 EC 1.0–1.33 pt	15	Annual broadleaf, grasses, and yellow/purple nutsedge. Apply to row middles. Label rates are 1.0–1.33 pt/A if organic matter is less than 3%. Use on a trial basis. Surfactant not recommended. 90-day PHI for rates above 1.33 pt/A. 30-day PHI for rates 1.33 pt/acre or less.
Trifloxysulfuron 0.005–0.009	(Envoke) 75 DG 0.1–0.2 oz	2	Broadleaves and yellow/purple nutsedge. Direct spray solution to the base of transplanted tomato plants. Apply at least 14 days after transplanting and before fruit set. 45-day PHI.
			*****POSTHARVEST*****
Diquat 0.5	(Reglone Desiccant) 2.0 pt	22	Minimum of 35 gal/A. Thorough coverage is required. Nonionic surfactant recommended.
Paraquat 0.62–0.94	(Gramoxone) 2 SL 2.4–3.75 pt (Gramoxone) 3 SL 1.3–2.7 pt (Firestorm) 3 SL 1.6–2.5 pt	22	Broadcast spray over the top of the plants after the last harvest. Thorough coverage is required to ensure maximum herbicide burndown. Do not use treated crop for human or animal consumption. Nonionic surfactant recommended. Consult label for new restrictions.

Table 4. Insecticides labeled for management of arthropod pests on tomato. Contact: Craig Frey, UF/IFAS Extension Hendry County.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Aphids (including aphid-transmitted viruses, green peach aphid, potato aphid)	1A	***Lannate LV, *SP** (methomyl)	**LV**: 1.5–3.0 pt **SP**: 0.5–1.0 lb	Do not apply more than 21 pt LV/acre/ crop (15 for tomatillos) or 7 lb SP/acre/ crop (5 lb for tomatillos).	48	1	
	1A	***Vydate L** (oxamyl)	**Foliar**: 2.0–4.0 pt	Do not apply more than 32 pt/A per season.	48	3	
	1B	**Dimethoate 4 EC** (dimethoate)	0.5–1.0 pt	Maximum total rate per year is 1 lb a.i./A.	48	7	Minimum 6-day reapplication interval.
	1B	**Malathion 5** (malathion)	1.0–2.5 pt	10 pints	12	1	
	1B	**Malathion 8 F** (malathion)	1.5 pt				8F can be used in greenhouse.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	2.9–9.6 fl oz	Do not apply more than 0.5 lb a.i. per acre per season, or 10 applications at highest rate.	12	1	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	12	0	
	3A	***Brigade 2EC** (bifenthrin)	2.1–5.2 fl oz	Make no more than 4 applications per season.	12	1	Do not make applications less than 10 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	7–10.67 fl oz	Do not exceed 42.67 fl oz total application/A per season.	24	3	
	3A	***Karate with Zeon** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 oz	Do not apply more than 24 fl oz/A per season.	12	1	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	
	3A	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	See label for limits on each active ingredient.
	3A + 28	***Voliam Xpress** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not apply more than 31.0 fl oz/A per season.	24	5	
	4A	**Actara** (thiamethoxam)	2.0–5.5 oz	Do not exceed a total of 11.0 oz per acre per growing season.	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Minimum interval between applications is 5 days.
	4A	**Admire Pro** (imidacloprid)	7–10.5 fl oz	Maximum allowed on tomato is 10.5 fl oz/A.	12	21	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Admire Pro** (imidacloprid)	0.6 fl oz per 1000 plants		12	Soil: 0	Greenhouse use: 1 application to mature plants, see label for cautions.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz per 10,000 plants		12	21	Planthouse: 1 application. See label.
	4A	**Assail 70WP** (acetamiprid)	0.6–1.7 oz	Do not exceed a total of 6.8 oz Assail 70WP per acre per growing season, including any pretransplant applications of acetamiprid.	12	7	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. Do not make more than 4 applications per season. Do not apply more than once every 7 days.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil**: 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting.	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.	12	30	
	4A	**Safari 20 SG** (dinotefuran)	7.0–14.0 oz		12	1	For transplant production only. Can be applied as foliar spray or soil drench.
	4A	**Scorpion** (dinotefuran)	**Soil**: 9–10.5 fl oz **Foliar**: 2–7 fl oz	Do not apply more than 21 fl oz/A per season as a soil application. Do not apply more than 10.5 fl oz/A per season foliarly.	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.
	4A	**Venom 20 SG** (dinotefuran)	**Foliar**: 1–4 oz/A	Do not apply more than 1.34 lb/A per season.	12	1	Toxic to honeybees.
	4A	**Venom 20 SG** (dinotefuran)	**Soil**: 5–7.5 oz/A	Do not apply more than 2.68 lb/A per season.	12	21	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	Do not exceed a total of 13.0 fl oz/A per growing season.	12	30	Several methods of soil application—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Do not exceed 14 oz/A per season.	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4C	**Transform WG** (sulfoxaflor)	0.75–1.0 oz	Do not exceed 8.5 oz per season.	24	1	
	4D	**Sivanto Prime** (flupyradifurone)	**Soil**: 21.0–28.0 fl oz **Foliar**: 7.0–14.0 fl oz	Do not apply more than 28.0 fl oz per acre per year.	4	**Soil**: 45 **Foliar**: 1	Minimum interval between applications: 7 days.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/acre per crop.	12	0	
	9B	**PQZ** (pyrifluquinazon)	2.4–3.2 fl oz	Do not apply more than 4.8 fl oz per acre per crop cycle.	12	1	Allow a minimum of 7 days between applications.
	9D	**Sefina** (afidopyropen)	3.0 fl oz	Do not apply more than 28 fl oz Sefina per acre per season.	12	0	Minimum retreatment interval: 7 days.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	Do not apply more than 42 fl oz/A per crop cycle.	12	1	Do not apply until at least 14 days after emergence.
	23	**Movento MPC** (spirotetramat)	7.0–8.0 fl oz	Maximum of 16 fl oz/acre per season.	24	1	
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	**Tray drench/ transplant water**: 6.75–13.5 fl oz **Drip**: 6.75–10 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	4	1	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	Do not apply more than 8.4 oz per acre per season.	12	0	Begin applications before pests reach damaging levels. Do not apply more than 2 applications per season. Allow a minimum of 7 days between applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt, if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.		4	0	
	-	**Grandevo** (*Chromobacterium subtsugae*)	1.0–3.0 lb		4	0	Thorough coverage is necessary for effective control.
	-	**Molt-X** (azadirachtin)	10 fl oz		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	OMRI-listed.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.		4	0	OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4.0–16.0 fl oz		12	0	IGR, feeding repellant. OMRI-listed.
	-	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0–2.0 lb		4	0	Repeat applications at 3–10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt	Limited to 10 applications per crop cycle.	4	0	Begin applications before pests reach damaging levels.
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water.		4		OMRI-listed.
	-	**Ultra Fine Oil, Saf-T-Side, JMS Stylet-Oil, others** (oil, insecticidal)	1.0–2.0 gal/100 gal **JMS**: 3.0–6.0 qt/100 gal water		4	0	Do not exceed four applications per season. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Beetles (including beetle larvae, blister beetles, Colorado potato beetle, cucumber beetles, flea beetles)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S**: 0.63–2.5 lb **XLR, 4F**: 0.5–2.0 qt	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	12	3	Do not apply more than seven times.
	1A	***Vydate L** (oxamyl)	**Foliar**: 2.0–4.0 pt	Do not apply more than 32 pt/A per season.	48	3	
	3A	***Ambush 25W** (permethrin)	3.2–12.8 oz	Do not apply more than 76.8 oz/A per season.	12	up to day of harvest	**Do not use on cherry tomatoes.**
	3A	***Asana XL (0.66EC)** (esfenvalerate)	2.9–9.6 fl oz	Do not apply more than 0.5 lb a.i. per acre per season, or 10 applications at highest rate.	12	1	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	12	0	
	3A	***Brigade 2EC** (bifenthrin)	2.1–5.2 fl oz	Make no more than 4 applications per season.	12	1	Do not make applications less than 10 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 43.26 fl oz/A per season.	12	1	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 oz	Do not apply more than 24 fl oz/A per season.	12	1	Do not make applications less than 7 days apart.
	3A	***Pounce 25 WP** (permethrin)	3.2–12.8 oz		12	0	Do not apply to cherry or grape tomatoes (fruit less than 1 inch in diameter). Do not apply more than 0.6 lb a.i. per acre per season.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	3A	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	See label for limits on each active ingredient.
	3A + 4A	***Leverage 360** (beta-cyfluthrin + imidacloprid)	3.8–4.1 fl oz		12	0	
	4A	**Actara** (thiamethoxam)	2.0–5.5 oz	Do not exceed a total of 11.0 oz/A per growing season.	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Minimum interval between applications is 5 days.
	4A	**Admire Pro** (imidacloprid)	7–10.5 fl oz	Maximum allowed on tomato is 10.5 fl oz/A.	12	21	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Assail 70WP** (acetamiprid)	0.6–1.7 oz	Do not exceed a total of 6.8 oz Assail 70WP per acre per growing season, including any pretransplant applications of acetamiprid.	12	7	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. Do not make more than 4 applications per season. Do not apply more than once every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil**: 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting.	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Scorpion** (dinotefuran)	**Soil**: 9–10.5 fl oz **Foliar**: 2–7 fl oz	Do not apply more than 21 fl oz/A per season as a soil application. Do not apply more than 10.5 fl oz/A per season foliarly.	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.
	4A	**Venom 20 SG** (dinotefuran)	**Foliar**: 1–4 oz	Do not apply more than 1.34 lb/A per season.	12	1	Toxic to honeybees.
	4A	**Venom 20 SG** (dinotefuran)	**Soil**: 5–7.5 oz	Do not apply more than 2.68 lb/A per season.	12	21	
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	Do not exceed a total of 13.0 fl oz/A per growing season.	12	30	Several methods of soil application—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Do not exceed 14 oz/A per season.	12	1	Foliar applied. Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	Do not apply more than 28.0 fl oz/A per season.	4	1	Minimum interval between applications: 7 days.
	5	**Entrust** (spinosad)	0.5–2.5 oz	Do not apply more than 9 oz per acre per crop.	4	1	OMRI-listed. For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	No more than 28.8 oz/A per season.	12	7	Do not use in greenhouses, nurseries, plant propagation houses, or on any plants grown for use as transplants.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	15	**Rimon 0.83EC** (novaluron)	9.0–12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Minimum of 7 days between applications.
	17	**Trigard** (cyromazine)	2.66 oz	Do not apply more than 15.96 oz/A per season.	12	0	No more than 6 applications per crop. Does not control CPB adults. Most effective against 1st + 2nd instar larvae.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	Do not apply more than 42 fl oz/A per crop cycle.	12	1	Do not apply until at least 14 days after emergence.
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	4	1	Can be applied by drip chemigation or as a soil application at planting. See label for details.
	28	**Exirel** (cyantraniliprole)	7–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	**Tray drench/ transplant water**: 6.75–13.5 fl oz **Drip**: 6.75–10 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**Neemix 4.5** (azadirachtin)	4.0–16.0 fl oz		12	0	IGR, feeding repellant. OMRI-listed.
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water.		4		OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	-	**Surround WP** (kaolin)	12.5–50 lb		4	0	OMRI-listed.
	-	**Ultra Fine Oil, Saf-T-Side, JMS Stylet-Oil, others** (oil, insecticidal)	1.0–2.0 gal/100 gal **JMS**: 3.0–6.0 qt/100 gal water		4	0	Do not exceed four applications per season.
Caterpillars (including cabbage looper, corn earworm, garden webworm, hornworms, imported cabbageworm, loopers, saltmarsh caterpillar, tobacco budworm, tomato fruitworm; armyworms [beet armyworm, fall armyworm, southern armyworm, true armyworm, yellowstriped armyworm]; cutworms [black cutworm, granulate cutworm])	1A	***Lannate SP** (methomyl)	0.5–1.0 lb		48	1	
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S**: 0.63–2.5 lb **XLR, 4F**: 1.0–2.0 qt	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	12	3	Do not apply more than seven times.
	1A	**10% Sevin Granules** (carbaryl)	20 lb		12	3	Maximum of 4 applications, not more often than once every 7 days.
	1B	***Diazinon AG500 *50W** (diazinon)	**AG500**: 1–4 qt **50W**: 2–8 lb	Do not make more than one soil application per year, regardless of target pest.	48	preplant	Incorporate into soil—see label.
	3A	***Ambush 25W** (permethrin)	3.2–12.8 oz	Do not apply more than 76.8 oz/A per season.	12	up to day of harvest	**Do not use on cherry tomatoes.**
	3A	***Asana XL (0.66EC)** (esfenvalerate)	2.9–9.6 fl oz	Do not apply more than 0.5 lb a.i. per acre per season, or 10 applications at highest rate.	12	1	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	12	0	
	3A	***Brigade 2EC** (bifenthrin)	2.1–5.2 fl oz	Make no more than 4 applications per season.	12	1	Do not make applications less than 10 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	7–10.67 fl oz	Do not exceed 42.67 fl oz total application/A per season.	24	3	
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 43.26 fl oz/A per season.	12	1	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 oz	Do not apply more than 24 fl oz/A per season.	12	1	Do not make applications less than 7 days apart. Consult label for specific species.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	3A	***Pounce 25 WP** (permethrin)	3.2–12.8 oz		12	0	Do not apply to cherry or grape tomatoes (fruit less than 1 inch in diameter). Do not apply more than 0.6 lb a.i. per acre per season.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	
	3A	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	See label for limits on each active ingredient.
	3A + 4A	***Leverage 360** (beta-cyfluthrin + imidacloprid)	3.8–4.1 fl oz		12	0	
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not exceed a total of 31 fl oz of Besiege per acre per year.	24	5	
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total 3.67 Platinum 75 SG/A per growing season.			
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	Do not exceed a total of 13.0 fl oz/A per growing season.	12	30	Several methods of soil application—see label.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Do not exceed 14 oz/A per season.	12	1	Foliar applied. Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	5	**Entrust** (spinosad)	1.5–8.0 oz	Do not apply more than 9 oz per acre per crop.	4	1	OMRI-listed. For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	Do not apply more than 34 fl oz/A per calendar year.	4	1	For thrips, if additional treatment is needed after two applications, switch to an alternate mode of action (not group 5) for at least two applications.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	No more than 28.8 oz/A per season.	12	7	Do not use in greenhouses, nurseries, plant propagation houses, or on any plants grown for use as transplants.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	Do not apply more than 20 fl oz per acre per year.	24	7	This label contains pollinator warnings.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb		4	0	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5–2.0 lb		4	0	Use high rate for armyworms. Treat when larvae are young.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–1.5 lb		4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25–2.0 lb		4	0	Treat when larvae are young. Good coverage is essential. Can be used for organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12–1.5 lb		4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5–2.0 lb		4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production. OMRI-listed.
	15	**Rimon 0.83EC** (novaluron)	9.0–12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Minimum of 7 days between applications.
	18	**Confirm 2F** (tebufenozide)	6–16 fl oz	Do not apply more than 64 fl oz per acre per season.	4	7	Product is a slow-acting IGR that will not kill larvae immediately.
	18	**Intrepid 2F** (methoxyfenozide)	4–16 fl oz	Do not apply more than 64 fl oz per acre per season.	4	1	Product is a slow-acting IGR that will not kill larvae immediately.
	22	**Avaunt eVo** (indoxacarb)	2.5–6.0 oz	Do not apply more than 24 ounces of product per acre per crop. Minimum spray interval is 5 days.	12	3	
	28	**Coragen** (chlorantraniliprole)	3.5–7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	4	1	Can be applied by drip chemigation or as a soil application at planting. See label for details.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	28	**Exirel** (cyantraniliprole)	7–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	5–13.5 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**CheckMate TPW-F** (pheromone)	1.2–6.0 fl oz		0	0	For mating disruption of tomato pinworm. See label for details.
	-	**Grandevo** (*Chromobacterium subtsugae*)	1.0–3.0 lb		4	0	Thorough coverage is necessary for effective control.
	-	**MBI-203 EP** (*Chromobacterium subtsugae*)	4.0–12.0 quarts		4	0	OMRI-listed. Can be used in the greenhouse.
	-	**Molt-X** (azadirachtin)	10 fl oz		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4.0–16.0 fl oz		12	0	IGR, feeding repellant. OMRI-listed.
Fire ants	7A	**Extinguish** (S-methoprene)	1.0–1.5 lb		4	0	Slow-acting IGR (insect growth regulator).
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5–2.0 lb		12	1	Apply when ants are actively foraging.
Lace bugs	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S**: 0.63–2.5 lb **XLR, 4F**: 0.5–2.0 qt	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	12	3	Do not apply more than seven times.
Leafhoppers	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S**: 0.63–2.5 lb **XLR, 4F**: 0.5–2.0 qt	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	12	3	Do not apply more than seven times.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	1B	**Dimethoate 4 EC** (dimethoate)	0.5–1.0 pt	Maximum total rate per year is 1 lb a.i./A.	48	7	Minimum 6-day reapplication interval.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 43.26 fl oz/A per season.	12	1	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 oz	Do not apply more than 24 fl oz/A per season.	12	1	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	
	3A	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	See label for limits on each active ingredient.
	3A + 28	***Voliam Xpress** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not apply more than 31.0 fl oz/A per season.	24	5	
	4A	**Actara** (thiamethoxam)	2.0–5.5 oz	Do not exceed a total of 11.0 fl oz per acre per season.	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Minimum interval between applications is 5 days.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Admire Pro** (imidacloprid)	7–10.5 fl oz	Maximum allowed on tomato is 10.5 fl oz/A.	12	21	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Soil**: 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting.	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			
	4A	**Scorpion** (dinotefuran)	**Soil**: 9–10.5 fl oz **Foliar**: 2–7 fl oz	Do not apply more than 21 fl oz/A per season as a soil application. Do not apply more than 10.5 fl oz/A per season foliarly.	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Venom** (dinotefuran)	**Foliar**: 1–4 oz	Do not apply more than 1.34 lb/A per season.	12	1	Use only one application method (soil or foliar). Limited to three applications per season. Toxic to honeybees.
	4A	**Venom** (dinotefuran)	**Soil**: 5–7.5 oz	Do not apply more than 2.68 lb/A per season.	12	21	Use only one application method (soil or foliar).
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	Do not exceed a total of 13.0 fl oz per acre per growing season.	12	30	Several methods of soil application—see label.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Do not exceed 14 oz/A per season.	12	1	Foliar applied. Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	**Sivanto Prime** (flupyradifurone)	**Soil**: 21.0–28.0 fl oz **Foliar**: 7.0–10.5 fl oz	Do not apply more than 28.0 fl oz per acre per year.	4	**Soil**: 45 **Foliar**: 1	Minimum interval between applications: 7 days.
	6	***Proclaim** (emamectin benzoate)	2.4–4.8 oz	No more than 28.8 oz/A per season.	12	7	Do not use in greenhouses, nurseries, plant propagation houses, or on any plants grown for use as transplants.
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	12	1	Apply when a threshold is reached of 5 whitefly nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**Molt-X** (azadirachtin)	10 fl oz		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	OMRI-listed.
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water		4	0	OMRI-listed.
	-	**Surround WP** (kaolin)	12.5–50 lb		4	0	OMRI-listed.
	-	**Ultra Fine Oil, Saf-T-Side, JMS Stylet-Oil, others** (oil, insecticidal)	1.0–2.0 gal/100 gal **JMS**: 3.0–6.0 qt/100 gal water		4	0	Do not exceed four applications per season.
***Liriomyza* leafminers**	1A	***Vydate L** (oxamyl)	**Foliar**: 2.0–4.0 pt	Do not apply more than 32 pt/A per season.	48	3	
	4A	**Venom 20 SG** (dinotefuran)	**Foliar**: 0.44–0.895 lb	Do not apply more than 1.34 lb/A per season.	12	1	Use only one application method (soil or foliar). Limited to three applications per season. Toxic to honeybees.
	4A	**Venom 20 SG** (dinotefuran)	**Soil**: 1.13–1.34 lb	Do not apply more than 2.68 lb/A per season.	12	21	Use only one application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/acre.
	5	**Entrust** (spinosad)	6.0–10.0 oz	Do not apply more than 9 oz per acre per crop.	4	1	OMRI-listed. For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	Do not apply more than 34 fl oz/A per calendar year.	4	1	
	6	***Agri-Mek 0.15 EC** (abamectin)	8.0–16.0 fl oz	Do not apply more than 48 fl oz per acre per season.	12	7	Do not make more than 2 sequential applications per season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	Do not apply more than 10.25 fl oz/A in a growing season.	12	7	Do not make more than 2 sequential applications of Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	Do not apply more than 20 fl oz per acre per year.	24	7	This label contains pollinator warnings.
	28	**Coragen** (chlorantraniliprole)	**Soil, drip or foliar**: 5–7.5 fl oz		4	1	For control of larvae.
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Foliar applied. Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	**Tray drench/ transplant water**: 6.75–13.5 fl oz. **Drip**: 6.75–10 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	Soil applied.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt	Limited to 10 applications per crop cycle.	4	0	Begin applications before pests reach damaging levels.
Mites (including broad mites, two-spotted spider mites, tomato russett mites, carmine spider mites)	1B	**Malathion 5; 8F** (malathion)	**5**: 1.0–2.5 pt **8F**: 1.5 pt	10 pints	12	1	8F can be used in greenhouse.
	3A	***Brigade 2EC** (bifenthrin)	2.1–5.2 fl oz	Make no more than 4 applications per season.	12	1	Do not make applications less than 10 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	7–10.67 fl oz	Do not exceed 42.67 fl oz total application/A per season.	24	3	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 43.26 fl oz/A per season.	12	1	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	
	3A	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	6	***Agri-Mek 0.15 EC** (abamectin)	8.0–16.0 fl oz	Do not apply more than 48 fl oz per acre per season.	12	7	Do not make more than 2 sequential applications per season.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	Do not apply more than 10.25 fl oz/A in a growing season.	12	7	Do not make more than 2 sequential applications of Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season.
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	Do not apply more than 20 fl oz per acre per year.	24	7	This label contains pollinator warnings.
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	Do not apply more than 62 fl oz/A per season.	12	1	Do not use less than 100 gal of water volume per acre. Make no more than 2 applications at least 21 days apart.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	20D	**Acramite-50WS** (bifenazate)	0.75–1.0 lb	One application allowed per season.	12	3	One application per season. Field grown only. Acramite-50WS is not systemic in action; therefore, complete coverage of both upper and lower leaf surfaces and of fruit is necessary for effective control.
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	12	1	Do not make more than two applications per growing season. Allow 14 days between applications.
	23	**Movento MPC** (spirotetramat)	7.0–8.0 fl oz	Maximum of 16 fl oz/ acre per season.	24	1	
	23	**Oberon 2SC** (spiromesifen)	7.0–8.5 fl oz	Maximum amount per crop: 25.5 fl oz/A.	12	1	No more than 3 applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Grandevo** (*Chromobacterium subtsugae*)	1.0–3.0 lb		4	0	Thorough coverage is necessary for effective control.
	-	**MET52 EC** (*Metarhizium anispoliae* strain F52)	**Drench**: 40–80 fl oz **Foliar**: 0.5 pint–2 qt		0	0	
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	OMRI-listed.
	-	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0–2.0 lb		4	0	Repeat applications at 3–10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI-listed.
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water.		4		OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	-	**Sulfur** (many brands)			24		May burn fruit and foliage when temperature is high. Do not apply within 2 weeks of an oil spray or EC formulation.
	-	**Ultra Fine Oil, Saf-T-Side, JMS Stylet-Oil, others** (oil, insecticidal)	1.0–2.0 gal/100 gal **JMS**: 3.0–6.0 qt/100 gal water		4	0	Do not exceed four applications per season.
Mole crickets	1B	***Diazinon AG500 *50 W** (diazinon)	**AG500**: 1–4 qt **50W**: 2–8 lb	Do not make more than one soil application per year regardless of target pest.	48	preplant	Incorporate into soil—see label.
Plant bugs & tarnished plant bugs	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S**: 0.63–2.5 lb **XLR, 4F**: 0.5–2.0 qt	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	12	3	Do not apply more than seven times.
	3A	***Brigade 2EC** (bifenthrin)	2.1–5.2 fl oz	Make no more than 4 applications per season.	12	1	Do not make applications less than 10 days apart.
	3A	***Mustang Maxx** (zeta-cypermethrin)	2.24–4.0 oz	Do not apply more than 24.0 fl oz/A per season.	12	1	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	
	3A	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	See label for limits on each active ingredient.
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not exceed a total of 31 fl oz of Besiege per acre per year.	24	5	
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Belay 50 WDG** (clothianidin)	**Soil**: 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting.	See label for application instructions. Do not release irrigation water from the treated area.
	4C	**Transform WG** (sulfoxaflor)	1.5–2.25 oz	Do not exceed 8.5 oz per season.	24	1	
	15	**Rimon 0.83EC** (novaluron)	9.0–12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Minimum of 7 days between applications.
	29	**Beleaf 50 SG** (flonicamid)	2.0–2.8 oz	Do not apply more than 8.4 oz per acre per season.	12	0	Begin applications before pests reach damaging levels. Do not apply more than 2 applications per season. Allow a minimum of 7 days between applications.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	OMRI-listed.
Planthoppers	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	12	1	Apply when a threshold is reached of 5 whitefly nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.
Psyllids	4D	**Sivanto Prime** (flupyradifurone)	7.0–14.0 fl oz	Do not apply more than 28.0 fl oz/A per year.	4	1	Minimum interval between applications: 7 days.
	23	**Movento MPC** (spirotetramat)	7.0–8.0 fl oz	Maximum of 16 fl oz/acre per season.	24	1	
	-	**Neemix 4.5** (azadirachtin)	4.0–16.0 fl oz		12	0	IGR, feeding repellant. OMRI-listed.
Stink bugs (including brown stink bug and green stink bug)	1A	**10% Sevin Granules** (carbaryl)	20 lb		12	3	Maximum of 4 applications, not more often than once every 7 days.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S**: 0.63–2.5 lb **XLR, 4F**: 0.5–2.0 qt	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	12	3	Do not apply more than seven times.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	12	0	
	3A	***Brigade 2EC** (bifenthrin)	2.1–5.2 fl oz	Make no more than 4 applications per season.	12	1	Do not make applications less than 10 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	7–10.67 fl oz	Do not exceed 42.67 fl oz total application/A per season.	24	3	
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	4.0–10.3 oz	Do not apply more than 43.26 fl oz/A per season.	12	1	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.3 oz	Do not apply more than 24.0 fl oz/A per season.	12	1	Not recommended for vegetable leafminer in Florida. Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	See label for limits on each active ingredient.
	3A + 4A	***Leverage 360** (beta-cyfluthrin + imidacloprid)	3.8–4.1 fl oz		12	0	
	3A + 28	***Voliam Xpress** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not apply more than 31.0 fl oz/A per season.	24	5	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Actara** (thiamethoxam)	2.0–5.5 oz	Do not exceed a total of 11.0 oz/A per growing season.	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Minimum interval between applications is 5 days.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Scorpion** (dinotefuran)	**Soil**: 9–10.5 fl oz **Foliar**: 2–7 fl oz	Do not apply more than 21 fl oz/A per season as a soil application. Do not apply more than 10.5 fl oz/A per season foliarly.	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.
	4A + 28	**Voliam Flexi** (thiamethoxam + chlorantraniliprole)	4.0–7.0 oz	Do not exceed 14 oz/A per season.	12	1	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	15	**Rimon 0.83EC** (novaluron)	9.0–12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Minimum of 7 days between applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
Thrips: check label for species controlled (includes melon thrips, western flower thrips, Florida flower thrips, eastern flower thrips, foliar feeding thrips, chilli thrips)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S**: 0.63–2.5 lb **XLR, 4F**: 0.5–2.0 qt	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	12	3	Do not apply more than seven times.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	12	0	
	3A	***Brigade 2EC** (bifenthrin)	2.1–5.2 fl oz	Make no more than 4 applications per season.	12	1	Do not make applications less than 10 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	10.3 oz	Do not apply more than 43.26 fl oz/A per season.	12	1	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	***Karate with Zeon** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A	***Mustang** (zeta-cypermethrin)	3.4–4.3 oz	Do not apply more than 25.8 fl oz/A per season.	12	1	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	
	3A	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A + 4A	***Leverage 360** (beta-cyfluthrin + imidacloprid)	3.8–4.1 fl oz		12	0	
	3A + 28	***Voliam Xpress** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not apply more than 31.0 fl oz/A per season.	24	5	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Admire Pro** (imidacloprid)	7–10.5 fl oz	Maximum allowed on tomato is 10.5 fl oz/A.	12	21	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 70WP** (acetamiprid)	0.6–1.7 oz	Do not exceed a total of 6.8 oz Assail 70WP per acre per growing season including any pretransplant applications of acetamiprid.	12	7	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Do not make more than 4 applications per season. Do not apply more than once every 7 days.
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	12	30	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 oz Platinum 75 SG/A per growing season.			
	4A	**Scorpion** (dinotefuran)	**Soil**: 9–10.5 fl oz **Foliar**: 2–7 fl oz	Do not apply more than 21 fl oz/A per season as a soil application. Do not apply more than 10.5 fl oz/A per season foliarly.	12	1	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Venom 20 SG** (dinotefuran)	**Foliar**: 1–4 oz	Do not apply more than 1.34 lb/A per season.	12	1	Use only one application method (soil or foliar). Limited to three applications per season. Toxic to honeybees.
	4A	**Venom 20 SG** (dinotefuran)	**Soil**: 5–7.5 oz	Do not apply more than 2.68 lb/A per season.	12	21	Use only one application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/acre.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	Do not exceed a total of 13.0 fl oz/A per growing season.	12	30	Several methods of soil application—see label.
	4C	**Transform WG** (sulfoxaflor)	2.25 oz	Do not exceed 8.5 oz per season.	24	1	
	5	**Entrust** (spinosad)	0.5–2.5 oz	Do not apply more than 9 oz per acre per crop.	4	1	OMRI-listed. For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	5	**Radiant SC** (spinetoram)	5–10 fl oz	Do not apply more than 34 fl oz/A per calendar year.	4	1	For thrips, if additional treatment is needed after two applications, switch to an alternate mode of action (not group 5) for at least two applications.
	6	***Agri-Mek 0.15 EC** (abamectin)	8.0–16.0 fl oz	Do not apply more than 48 fl oz per acre per season.	12	7	Do not make more than 2 sequential applications per season.
	6	***Agri-Mek SC** (abamectin)	1.75–3.5 fl oz	Do not apply more than 10.25 fl oz/A in a growing season.	12	7	Do not make more than 2 sequential applications of Agri-Mek SC or any other foliar-applied abamectin-containing product in a growing season.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	6 + 28	***Minecto Pro** (abamectin + cyantraniliprole)	5.5–10 fl oz	Do not apply more than 20 fl oz per acre per year.	24	7	This label contains pollinator warnings.
	15	**Rimon 0.83EC** (novaluron)	9.0–12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Minimum of 7 days between applications.
	21A	**Torac** (tolfenpyrad)	17–21 fl oz	Do not apply more than 42 fl oz/A per crop cycle.	12	1	Do not apply until at least 14 days after emergence.
	23	**Movento MPC** (spirotetramat)	7.0–8.0 fl oz	Maximum of 16 fl oz/A per season.	24	1	
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	10.0–13.5 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	
	29	**Beleaf 50 SG** (flonicamid)	4.2 oz	Do not apply more than 8.4 oz per acre per season.		0	Begin applications before pests reach damaging levels. Do not apply more than 2 applications per season. Allow a minimum of 7 days between applications.
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz		4	0	Antifeedant, repellant, insect growth regulator.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.		4	0	Thorough coverage is necessary for effective control.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	-	**Grandevo** (*Chromobacterium subtsugae*)	1.0–3.0 lb		4	0	
	-	**MET52 EC** (*Metarhizium anispoliae* strain F52)	**Drench**: 40–80 fl oz **Foliar**: 0.5 pt–2 qt		0	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	Do not exceed four applications per season.
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart/100 gallons		4	0	Repeat applications at 3–10 days as needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI-listed.
	-	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0–2.0 lb		4	0	Begin applications before pests reach damaging levels.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt	Limited to 10 applications per crop cycle.	4	0	OMRI-listed.
	-	**Suffoil-X** (mineral oil)	1%–2% v/v		4	0	OMRI-listed.
	-	**Surround WP** (kaolin)	12.5–50 lb		4	0	OMRI-listed.
	-	**Ultra Fine Oil, Saf-T-Side, JMS Stylet-Oil, others** (oil, insecticidal)	1.0–2.0 gal/100 gal **JMS**: 3.0–6.0 qt/100 gal water		4	0	
Weevils (vegetable weevil)	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	See label for limits on each active ingredient.
	3A + 4A	***Endigo ZC** (lambda-cyhalothrin + thiamethoxam)	4.0–4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	24	5	Antifeedant, repellant, insect growth regulator. OMRI-listed.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz		4	0	
Whiteflies	1A	***Vydate L** (oxamyl)	**Foliar**: 2.0–4.0 pt	Do not apply more than 32 pt/A per season.	48	3	
	3A	***Asana XL (0.66EC)** (esfenvalerate)	2.9–9.6 fl oz	Do not apply more than 0.5 lb a.i. per acre per season, or 10 applications at highest rate.	12	1	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6–2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	12	0	
	3A	***Brigade 2EC** (bifenthrin)	2.1–5.2 fl oz	Make no more than 4 applications per season.	12	1	
	3A	***Danitol 2.4 EC** (fenpropathrin)	7–10.67 fl oz	Do not exceed 42.67 fl oz total application/A per season.	24	3	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3A	***Hero** (bifenthrin + zeta-cypermethrin)	10.3 oz	Do not apply more than 43.26 fl oz/A per season.	12	1	
	3A	***Karate with Zeon** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A	***Mustang Maxx** (zeta-cypermethrin)	3.2–4.0 oz	Do not apply more than 24.0 fl oz/A per season.	12	1	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92–3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	24	5	
	3A	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5–18.0 fl oz	11.25 pints	12	0	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96–1.92 fl oz	Do not apply more than 23.04 fl oz/A per season.	24	5	
	3A + 28	***Besiege** (lambda-cyhalothrin + chlorantraniliprole)	5.0–9.0 fl oz	Do not apply more than 31.0 fl oz/A per season.	24	5	Do not make applications less than 10 days apart.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Actara** (thiamethoxam)	2.0–5.5 oz	Do not exceed a total of 11.0 oz/A per growing season.	12	0	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Admire Pro** (imidacloprid)	7–10.5 fl oz	Maximum allowed on tomato is 10.5 fl oz/A.	12	21	Greenhouse use: 1 application to mature plants, see label for cautions.
	4A	**Admire Pro** (imidacloprid)	0.6 fl oz per 1000 plants		12	Soil: 0	Planthouse: 1 application. See label.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz per 10,000 plants		12	21	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. Do not make more than 4 applications per season. Do not apply more than once every 7 days.
	4A	**Assail 70WP** (acetamiprid)	0.6–1.7 oz	Do not exceed a total of 6.8 oz Assail 70WP per acre per growing season, including any pretransplant applications of acetamiprid.	12	7	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	**Foliar**: 1.6–2.1 oz	Do not apply more than 6.4 oz per acre per season.	12	7	See label for application instructions. Do not release irrigation water from the treated area.

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4A	**Belay 50 WDG** (clothianidin)	**Soil**: 4.8–6.4 oz	Do not apply more than 6.4 oz per acre per season.	12	Apply at planting.	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides.
	4A	**Platinum** (thiamethoxam)	5–11 fl oz	Do not exceed a total of 11 fl oz Platinum/A per growing season.	12	30	
	4A	**Platinum 75 SG** (thiamethoxam)	1.66–3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.	12	30	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting.
	4A	**Safari 20 SG** (dinotefuran)	7.0–14.0 oz		12	1	For transplant production only. Can be applied as foliar spray or soil drench.
	4A	**Scorpion** (dinotefuran)	**Soil**: 9–10.5 fl oz **Foliar**: 2–7 fl oz	Do not apply more than 21 fl oz/A per season as a soil application. Do not apply more than 10.5 fl oz/A per season foliarly.	12	21	Use only one application method (soil or foliar). Toxic to honeybees.
	4A	**Venom 20 SG** (dinotefuran)	**Foliar**: 1–5 oz	Do not apply more than 1.34 lb/A per season.	12	1	Use only one application method (soil or foliar).
	4A	**Venom 20 SG** (dinotefuran)	**Soil**: 5–7.5 oz	Do not apply more than 2.68 lb/A per season.	12	21	Several methods of soil application—see label.
	4A + 28	**Durivo** (thiamethoxam + chlorantraniliprole)	10–13 fl oz	Do not exceed a total of 13.0 fl oz/A per growing season.	12	30	Soil applied. Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4C	**Transform WG** (sulfoxaflor)	2.0–2.25 oz	Do not exceed 8.5 oz per season.	24	1	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	4D	**Sivanto Prime** (flupyradifurone)	**Soil**: 21.0–28.0 fl oz **Foliar**: 10.5–14.0 fl oz	Do not apply more 28.0 fl oz per acre per year.		**Soil**: 45 **Foliar**: 1	
	7C	**Knack IGR** (pyriproxyfen)	8–10 fl oz	Do not exceed 20 fl oz/A per season.	12	14	
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/acre per crop.	12	0	
	9B	**PQZ** (pyrifluquinazon)	2.3–3.2 fl oz	Do not apply more than 4.8 fl oz per acre per crop cycle.	12	1	
	9D	**Sefina** (afidopyropen)	14.0 fl oz	Do not apply more than 28 fl oz of Sefina per season.			Minimum retreatment interval: 7 days.
	15	**Rimon 0.83EC** (novaluron)	9.0–12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	12	1	Immatures only. Apply when a threshold is reached of 5 whitefly nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.
	16	**Courier 40SC** (buprofezin)	9.0–13.6 fl oz	Do not apply more than 27.2 fl oz/A per crop cycle.	12	1	Do not make more than two applications per growing season. Allow 14 days between applications.
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	12	1	
	23	**Movento MPC** (spirotetramat)	7.0–8.0 fl oz	Maximum of 16 fl oz/ acre per season.	24	1	No more than 2 applications.
	23	**Oberon 2SC** (spiromesifen)	7.0–8.5 fl oz	Maximum amount per crop: 25.5 fl oz/A.	12	1	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	28	**Exirel** (cyantraniliprole)	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./A per crop.	12	1	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between is 5 days.
	28	**Verimark** (cyantraniliprole)	**Tray drench/ transplant water**: 6.75–13.5 fl oz **Drip**: 6.75–10.0 fl oz	Do not apply more than 0.4 lb a.i./A per crop.	4	1	
	29	**Beleaf 50 SG** (flonicamid)	4.2 oz	Do not apply more than 8.4 oz per acre per season.		0	
	-	**Aza-Direct** (azadirachtin)	1–2 pt, up to 3.5 pt if needed		4	0	Antifeedant, repellant, insect growth regulator.
	-	**Azatin XL** (azadirachtin)	5–21 fl oz		4	0	Thorough coverage is necessary for effective control.
	-	**BotaniGard ES** (*Beauveria bassiana* strain GHA)	0.25–1.0 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.		4	0	
	-	**Grandevo** (*Chromobacterium subtsugae*)	1.0–3.0 lb		4	0	
	-	**MET52 EC** (*Metarhizium anispoliae* strain F52)	**Drench**: 40–80 fl oz **Foliar**: 0.5 pt–2 qt		0	0	OMRI-listed.
	-	**Molt-X** (azadirachtin)	10 fl oz		4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	-	**M-Pede 49% EC** (soap, insecticidal)	1%–2% v/v		12	0	

Insect or Mite Pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/Acre)	Max Rate Product per Season	REI (Hours)	Days to Harvest	Remarks
	-	**Mycotrol ESO** (*Beauveria bassiana* strain GHA)	0.25–1 quart per acre. Apply in sufficient water to cover foliage, typically 5–100 gallons per acre.		4	0	OMRI-listed.
	-	**Neemix 4.5** (azadirachtin)	4.0–16.0 fl oz		12	0	Repeat applications at 3–10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI-listed.
	-	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0–2.0 lb		4	0	Begin applications before pests reach damaging levels.
	-	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2–4 qt	Limited to 10 applications per crop cycle.	4	0	OMRI-listed.
	-	**SuffOil-X** (mineral oil)	1–2 gallons per 100 gallons of water.		4		OMRI-listed.
	-	**Ultra Fine Oil, Saf-T-Side, JMS Stylet-Oil, others** (oil, insecticidal)	1.0–2.0 gal/100 gal **JMS**: 3.0–6.0 qt/100 gal water		4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Wireworms	1B	***Diazinon AG500 *50 W** (diazinon)	**AG500**: 1–4 qt **50W**: 2–8 lb	Do not make more than one soil application per year regardless of target pest.	48	preplant	

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2 March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with the same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned. OMRI-listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 5. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. Contact: Gary E. Vallad, UF/IFAS Gulf Coast Research and Education Center.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Please refer to Chapter 19 for information on biopesticides, including materials labeled for certified organic production.							
Anthracnose	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies from 4 hr to 2 days	Mancozeb enhances the bactericidal effect of fixed copper compounds.
	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	
	M3	**Ziram 76DF** **Ziram XCEL** (ziram)	4 lb	23.7 lb	7	2	Do not use on cherry tomatoes.
	M3 + M1	**ManKocide** (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3	**Cevya** (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	Limit is 3 applications per year. Supplemental label expires Oct. 30, 2023.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Limit is 4 applications per season.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
(suppression)	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	For disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
(suppression)	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per a year.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	11	(azoxystrobin) **Many brands available:** AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	**Flint** **Gem 500 SC** (trifloxystrobin)	**Flint**: 4 oz **Gem**: 3.8 fl oz	**Flint**: 16 oz **Gem**: 16 fl oz	3	0.5	Limit is 5 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone- or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
	11 + 7	**Pageant** (pyraclostrobin + fluxapyroxad)	23 oz	69 oz	0	0.5	**Greenhouse production only**: Limit is 3 applications per crop cycle. No sequential applications; must rotate to another fungicide with a different mode of action.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	11 + 27	**Tanos** (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
(suppression)	19	**Ph-D WDG** **Oso 5% SC** (polyoxin D zinc salt)	**Ph-D**: 6.2 oz **Oso**: 13 fl oz	**Ph-D**: 31.0 oz **Oso**: 78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	27 + M5	**Ariston** **Cymbol Advance** (cymoxanil + chlorothalonil)	1.9 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	Limit is 4 applications per season; no more than 2 sequential applications. Not labeled for transplants.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
Bacterial canker	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	Mancozeb enhances the bactericidal effect of fixed copper compounds.
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	
(suppression)	11 + 27	**Tanos** (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
Bacterial spot and bacterial speck	M1	(copper compounds) **Many brands available:** Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	Mancozeb enhances the bactericidal effect of fixed copper compounds.
	M3	(mancozeb) **Many brands available**: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	Bacterial spot control only when tank-mixed with a copper fungicide.
	M3 + M1	**ManKocide** (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	3.2 lb	12 lb	5	2	Combine with a fixed-copper fungicide. Limit is a single application before alternating to a non-FRAC group 11 fungicide.
(suppression)	11 + 27	**Tanos** (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	25	**Agri-mycin 50 AG Streptomycin Harbour** (streptomycin sulfate)	200 ppm	-	-	0.5	See label for details. For transplant production only. Many isolates are resistant to streptomycin.
	P	**Actigard** (acibenzolar-S-methyl)	0.75 oz	4.75 oz	14	0.5	Begin applications within one week of transplanting or emergence. Make up to 8 weekly, sequential applications.
Bacterial wilt (*Ralstonia solanacearum*)	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
Black mold (*Alternaria* spp.)	3	**Cevya** (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	Limit is 3 applications per year. Supplemental label expires Oct. 30, 2023.
	3	**Mentor** (propiconazole)	8 oz/100 gal or /50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. See label for details.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Limit is 4 applications per season.
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	3 + 12	**Chairman** (propiconazole + fludioxonil)	32 fl oz/100 gal or /50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. Lower rates for small diameter fruit. See label for details.
	7	**Endura** (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides; see label.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per a year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per year.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	11	(azoxystrobin) **Many brands available**: AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
	11 + 7	**Pageant** (pyraclostrobin + fluxapyroxad)	23 oz	69 oz	0	0.5	**Greenhouse production only**: Limit is 3 applications per crop cycle. No sequential applications; must rotate to another fungicide with a different mode of action.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	12	**Scholar SC** (fludioxonil)	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	0	0	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of fruit rots. Must be used in tank mixture with propiconazole. Not for processed tomato.
	27 + M5	**Ariston Cymbol Advance** (cymoxanil + chlorothalonil)	1.9 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
(suppression)	39	**Magister SC** (fenazaquin)	36 fl oz	36 fl oz	3	0.5	Also labeled as an acaricide. Limit to 1 application per year.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	Limit is 4 applications per season; no more than 2 sequential applications. Not labeled for transplants.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Botrytis, Gray mold	M5	(chlorothalonil) **Many brands available**: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3 + 12	**Chairman** (propiconazole + fludioxonil)	32 fl oz/100 gal or /50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. Lower rates for small-diameter fruit. See label for details.
(suppression)	7	**Endura** (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7	**Luna Privilege** (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per a year.
(suppression)	7 + 11	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
(suppression)	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9	**Scala SC** (pyrimethanil)	7 fl oz	35 fl oz	1	0.5	Use only in a tank mix with another effective non-FRAC code 9 fungicide; has a 30-day plant-back with off-label crops.
	9	**Vango** (cyprodinil)	7 oz	28 oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 9 for at least 2 sequential applications; no more than 4 applications per year. Can be applied via chemigation.
	9 + 12	**Alterity 62.5WG** **Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 applications, alternate with non-FRAC code 9 or 12 fungicides for next 2 applications. Has a 30-day plant-back with off-label crops.
(suppression)	11	**Cabrio 2.09 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential applications allowed. Limit is 6 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11 + 7	**Pageant** (pyraclostrobin + fluxapyroxad)	23 oz	69 oz	0	0.5	**Greenhouse production only**: Limit is 3 applications per crop cycle. No sequential applications; must rotate to another fungicide with a different mode of action.
	12	**Scholar SC** (fludioxonil)	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	0	0	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of fruit rots. Must be used in tank mixture with propiconazole. Not for processed tomato.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	12	**Spirato GHN** (fludioxonil)	7 fl oz	28 fl oz	0	0.5	**For use in greenhouse and other enclosed structures only.** Limit to 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	14	**Botran 75 W** (dicloran)	1 lb per 100 gal	5.33 lb	10	0.5	**Greenhouse use only.** Limit is 4 applications. Seedlings or newly set transplants may be injured.
	17	**Decree 50 WDG** (fenhexamid)	1.5 lb	6 lb	0	0.5	**Transplant and greenhouse use only.** Do not make more than 2 consecutive applications.
	19	**Ph-D WDG** **Oso 5% SC** (polyoxin D zinc salt)	**Ph-D**: 6.2 oz **Oso**: 13 fl oz	**Ph-D**: 31.0 oz **Oso**: 78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	27 + M5	**Ariston** **Cymbol Advance** (cymoxanil + chlorothalonil)	1.9 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Buckeye rot Phytophthora fruit rot (*Phytophthora* spp.)	M1 + 4	**Ridomil Gold Copper** (copper hydroxide + mefenoxam)	2 lb	6 lb	14	2	Limited to 3 applications per season. Tank-mix with mancozeb.
	11	(azoxystrobin) **Many brands available**: AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11	**Cabrio 2.09 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential applications allowed. Limit is 6 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group; see label.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
(suppression)	11 + 27	**Tanos** (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	See label.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8.0 fl oz	32 fl oz	1	4 hr	Do not use Orondis Ultra following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Ultra should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. See label for greenhouse instructions.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
Early blight	M1	(copper compounds) **Many brands available**: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days.	Mancozeb or maneb enhances bactericidal effect of fix copper compounds. See label for details.
	M3	(mancozeb) **Many brands available**: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	
	M3	**Ziram 76DF** **Ziram XCEL** (ziram)	4 lb	23.7 lb	7	2	Do not use on cherry tomatoes.
	M3 + M1	**ManKocide** (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
	M5	(chlorothalonil) **Many brands available**: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3	**Cevya** (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	Limit is 3 applications per year. Supplemental label expires Oct. 30, 2023.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Limit is 4 applications per season.
	3	**Tebucon 3.6F** **TebuStar 3.6L** **Tebuzol 3.6F** **Toledo 3.6F** (tebuconazole)	8 fl oz	48 fl oz	7	0.5	Limit is 6 applications/crop. Minimum application interval of 7 days.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	4 + M5	**Ridomil Gold Bravo 76.4 W** (mefenoxam + chlorothalonil)	3 lb	12 lb	14	2	Limit is 4 applications/crop.
	7	**Endura** (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7	**Luna Privilege** (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per year.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9	**Scala SC** (pyrimethanil)	7 fl oz	35 fl oz	1	0.5	Use only in a tank mix with another effective non-FRAC code 9 fungicide. Has a 30-day plant-back with off-label crops.
	9	**Vango** (cyprodinil)	7 oz	28 oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 9 for at least 2 sequential applications; no more than 4 applications per year. Can be applied via chemigation.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	9 + 12	**Alterity 62.5WG** **Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 applications alternate with non-FRAC code 9 or 12 fungicides for next 2 applications. Has a 30-day plant-back with off-label crops.
	11	(azoxystrobin) **Many brands available**: AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	**Aftershock** **Evito** **Tepera** (fluoxastrobin)	5.7 fl oz **Tepera**: 12.6 fl oz	22.8 fl oz **Tepera**: 12.6 fl oz	3	0.5	Limit is 4 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	**Cabrio 2.09 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential applications allowed. Limit is 6 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11	**Flint** **Gem 500 SC** (trifloxystrobin)	**Flint**: 4 oz **Gem**: 3 fl oz	**Flint**: 16 oz **Gem**: 16 fl oz	3	0.5	Limit is 5 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	**Reason 500 SC** (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group. See supplemental label for restrictions and details.
	11 + IRAC 3	**Tepera Plus** (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	3	0.5	Contains bifenthrin insecticide. Limit is 4 appl./year. Minimum 10-day interval. No use in greenhouse.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
	11 + 7	**Pageant** (pyraclostrobin + fluxapyroxad)	23 oz	69 oz	0	0.5	**Greenhouse production only**: Limit is 3 applications per crop cycle. No sequential applications; must rotate to another fungicide with a different mode of action.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	11 + 27	**Tanos** (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	12	**Spirato GHN** (fludioxonil)	7 fl oz	28 fl oz	0	0.5	**For use in greenhouse and other enclosed structures only.** Limit to 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	19	**Ph-D WDG** **Oso 5% SC** (polyoxin D zinc salt)	**Ph-D**: 6.2 oz **Oso**: 13 fl oz	**Ph-D**: 31.0 oz **Oso**: 78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	
	22 + M5	**Zing!** (zoxamide + chlorothalonil)	36 fl oz	288 fl oz	5	0.5	Limit is 8 applications per season. No more than 2 sequential applications before alternating to a different mode of action.
	27 + M5	**Ariston** **Cymbol Advance** (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	28	**Bruin** **Previcur Flex** **Promess** (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	Must tank-mix with chlorothalonil or mancozeb.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	Limit is 4 applications per season; no more than 2 sequential applications. Not labeled for transplants.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Fusarium wilt (*Fusarium* spp.) (suppression)	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	Make first application within 7–14 days after planting and the second application 14–21 days later.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
Gray leaf spot (*Stemphylium* spp.)	M1	(copper compounds) **Many brands available**: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days.	Mancozeb or maneb enhances bactericidal effect of fixed copper compounds.
	M3	(mancozeb) **Many brands available**: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	
	M3 + M1	**ManKocide** (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
	M5	(chlorothalonil) **Many brands available**: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	
	4 + M5	**Ridomil Gold Bravo 76.4 W** (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	Limit is 4 applications/crop.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per a year.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	11	**Flint** **Gem 500 SC** (trifloxystrobin)	**Flint**: 4 oz **Gem**: 3.8 fl oz	**Flint**: 16 oz **Gem**: 16 fl oz	3	0.5	Limit is 5 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to a 1-year plant-back restriction for certain off-label crops.
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	
	27 + M5	**Ariston** **Cymbol Advance** (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 applications per season; no more than 2 sequential applications. Not labeled for transplants.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Late blight	M1	(copper compounds) **Many brands available**: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
	M3	(mancozeb) **Many brands available**: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	
	M3 + M1	**ManKocide** (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
	M5	(chlorothalonil) **Many brands available**: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	4 + M1	**Ridomil Gold Copper 64.8 W** (mefenoxam + copper hydroxide)	2 lb	6 lb	14	2	Limit is 3 applications/crop. Tank-mix with mancozeb fungicide.
	4 + M3	**Ridomil Gold MZ** (mefenoxam + mancozeb)	2.5 lb	7.5 lb	5	2	Limit is 3 applications/crop.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	4 + M5	**Ridomil Gold Bravo 76.4 W** (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	Limit is 4 applications/crop.
(suppression)	11	**Aftershock** **Evito** **Tepera** (fluoxastrobin)	5.7 fl oz **Tepera**: 12.6 fl oz	22.8 fl oz **Tepera**: 12.6 fl oz	3	0.5	Limit is 4 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
(suppression)	11 + IRAC 3	**Tepera Plus** (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	3	0.5	Contains bifenthrin insecticide. Limit is 4 appl./year. Minimum 10-day interval. No use in greenhouse.
	11	(azoxystrobin) **Many brands available**: AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	**Cabrio 2.09 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential applications allowed. Limit is 6 appl./crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	**Flint Gem 500 SC** (trifloxystrobin)	**Flint**: 4 oz **Gem**: 3.8 fl oz	**Flint**: 16 oz **Gem**: 16 fl oz	3	0.5	Limit is 5 appl./crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	**Reason 500 SC** (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone- or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
(suppression)	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11 + 27	**Tanos** (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	19	**Oso 5% SC** (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	21	**Ranman** (cyazofamid)	2.75 oz	16 oz	0	0.5	Limit is 6 applications/crop.
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	
	22 + M5	**Zing!** (zoxamide + chlorothalonil)	36 fl oz	288 fl oz	5	0.5	Limit is 8 applications per season. No more than 2 sequential applications before alternating to a different mode of action.
	27	**Curzate 60DF** **Cymbol** (cymoxanil)	5 oz	30 oz per year	3	0.5	Must tank-mix with another effective product.
	27 + M5	**Ariston** **Cymbol Advance** (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	27 + 28	**Cymbol Balance** (cymoxanil + propamocarb hydrochloride)	21 fl oz	168 fl oz	5	0.5	Limit is 8 applications per season.
	28	**Bruin** **Previcur Flex** **Promess** (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	Must tank-mix with chlorothalonil or mancozeb.
	33	**Aliette 80 WDG** (fosetyl-al)	5 lb	20 lb	14	0.5	See label for warnings concerning the use of copper compounds.
	33	**Alude** (mono- and dipotassium salts of phosphorous acid)	1.5 qt/acre/25 gal	-	-	4 hr	For transplants only.
	40	**Forum** (dimethomorph)	6 oz	30 oz	4	0.5	Only 2 sequential applications. See label for details.
	40	**Micora** (mandipropamid)	8 fl oz/5,000 sq ft	16 fl oz/5,000 sq ft	n/a	4 hr	Micora is only labeled for transplant and retail sale to consumers.
	40	**Revus** (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	No more than 2 sequential applications. Rotate with another effective fungicide. See label.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 applications per season; no more than 2 sequential applications. Not labeled for transplants. See label.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz per season	2	0.5	4 applications per season; no more than 2 sequential applications. 10-day spray interval; tank-mix with another labeled non-FRAC code 43 fungicide; 18-month rotation with off-label crops; see label.
	45 + 40	**Zampro** (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Addition of a spreading or penetrating adjuvant is recommended to improve performance. Limit of 3 applications per season.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8.0 fl oz	32 fl oz	1	4 hr	Do not use Orondis Ultra following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Ultra should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. See label for greenhouse instructions.
Leaf mold	M3	(mancozeb) **Many brands available**: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5		

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	M5	(chlorothalonil) **Many brands available**: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group.
	11 + 27	**Tanos** (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	19	**Oso 5% SC** (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	
	27 + M5	**Ariston** **Cymbol Advance** (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 applications per season; no more than 2 sequential applications. Not labeled for transplants.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Phytophthora crown rot **Phytophthora root rot** (*Phytophthora* spp.)	4	**Metastar 2E** **ReCon 4F** **Xyler FC** (metalaxyl)	**Metastar**: 2 qt **ReCon**: 2 qt **Xyler**: 2.9 qt	**Metastar**: 2 qt **ReCon**: 6 qt **Xyler**: 4.3 qt	2	28	Must be soil applied. See labels.
	4	**Ridomil Gold SL** **Ultra Flourish** (mefenoxam)	**Ridomil**: 1 pt **Ultra Flourish**: 2 pt	**Ridomil**: 3 pt **Ultra Flourish**: 6 pt	**Ridomil**: 28 **Ultra Flourish**: 7	2*	Do not apply more than 1.5 lb mefenoxam/A per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	11	**Reason 500 SC** (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group. (*Phytophthora capsici* suppression only)
	14	**Terramaster 4EC** (etridiazole)	7 fl oz	27.4 fl oz	3	0.5	**Greenhouse use only.**
	21	**Ranman** (cyazofamid)	2.75 fl oz	16.5 fl oz	0		Apply to the base of plant at the time of transplanting. Make additional applications on a 7-to-10-day schedule if conditions are favorable for disease.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	28	**Previcur Flex** (propamocarb hydrochloride)	**SEE LABEL**		5	0.5	**Greenhouse application**: 6 applications/crop cycle. Do not mix with other products. Can cause phytotoxicity if applied in intense sunlight.
	33	**Aliette 80 WDG** **Linebacker WDG** (fosetyl-aluminum)	5 lb	2 lb	14	0.5	See label for warnings concerning the use of copper compounds.
	33	**Alude** (mono- and dipotassium salts of phosphorous acid)	1.5 qt/acre/25 gal	-	-	4 hr	For transplants only.
	43	**Presidio** (fluopicolide)	4 fl oz	12 fl oz	2	0.5	4 applications per season; no more than 2 sequential applications. 10-day spray interval; tank-mix with another labeled non-FRAC code 43 fungicide; 18-month rotation with off-label crops.
	45 + 40	**Zampro** (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Addition of a spreading or penetrating adjuvant is recommended to improve performance. Limit of 3 applications per season.
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	55 fl oz	55 fl oz	7	2	Soil applications cannot be combined or followed by foliar applications of Orondis Opti or Orondis Ultra. Not labeled for greenhouse use.
	49 + 40	**Orondis Ultra** (oxathiapiprolin + mandipropamid)	8.0 fl oz	32 fl oz	1	4 hr	Do not use Orondis Ultra following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Ultra should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. See label for greenhouse instructions.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
Powdery mildew	M2	(sulfur) **Many brands available**: Cosavet DF, Kumulus DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 6L, Sulfur 90W, Super Six, That Flowable Sulfur, Thiolux Jet, Thiosperse 80%, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Follow label closely; may cause leaf burn if applied during high temperatures.
	3	**Cevya** (mefentrifluconazole)	5 fl oz	15 fl oz	0	0.5	Limit is 3 applications per year. Supplemental label expires Oct. 30, 2023.
	3	**Rally 40WSP** **Sonoma 40WSP** (myclobutanil)	4 oz	1.25 lb	0	1	Note that a 30-day plant-back restriction exists.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Limit is 4 applications per season.
	3	**Terraguard** **Trionic 4SC** (triflumizole)	4 fl oz/100 gal	16 fl oz	1	0.5	**Greenhouse production only**. Limit is 4 applications per season.
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7	**Velum Prime** (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	For soil application only; the first foliar fungicide application following Velum Prime should be from a different FRAC group.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per year.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9	**Vango** (cyprodinil)	7 oz	28 oz	0	0.5	Limit is 5 applications per season with no more than rotating to a non-FRAC group 9 for at least 2 sequential applications; no more than 4 applications per year. Can be applied via chemigation.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	9 + 12	**Alterity 62.5WG** **Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 applications, alternate with non-FRAC code 9 or 12 fungicides for next 2 applications. Has a 30-day plant-back with off-label crops.
	11	(azoxystrobin) **Many brands available**: AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11	**Cabrio 2.09 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential applications allowed. Limit is 6 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	**Flint** **Gem 500 SC** (trifloxystrobin)	**Flint**: 4 oz **Gem**: 3.8 fl oz	**Flint**: 16 oz **Gem**: 16 fl oz	3	0.5	Limit is 5 applications/crop; must alternate or tank-mix with a fungicide from a different FRAC group.
	11	**Heritage** **Quadris FL** **Equation** **Satori** (azoxystrobin)	6.2 fl oz **Heritage**: 3.2 oz	37 fl oz **Heritage**: 1.6 lb	0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; use of an adjuvant or tank-mixing with EC products may cause phytotoxicity.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to a 1-year plant-back restriction for certain off-label crops.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone- or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	12	**Spirato GHN** (fludioxonil)	7 fl oz	28 fl oz	0	0.5	**For use in greenhouse and other enclosed structures only**. Limit to 4 applications per year. No more than 2 sequential applications before rotating to a different mode of action for 2 applications.
	19	**Ph-D WDG** **Oso 5% SC** (polyoxin D zinc salt)	**Ph-D**: 6.2 oz **Oso**: 13 fl oz	**Ph-D**: 31.0 oz **Oso**: 78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
(suppression)	39	**Torac** (tolfenpyrad)	21 fl oz	42 fl oz	1	0.5	Primarily an insecticide. Limit 2 applications per season; 4 applications per year. 14-day minimum application interval.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 applications per season; no more than 2 sequential applications. Not labeled for transplants.
	50	**Prolivo** (pyriofenone)	5 fl oz	16 fl oz	0	4 hr	No more than 2 sequential applications. Limit is 4 applications per year.
	50	**Vivando** (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	3 applications per season; no more than 2 sequential applications. Do not mix with horticultural oils.
	U6	**Torino** (cyflufenamid)	3.4 oz	10.2 oz	0	4 hr	3 applications per season with at least 14 days between applications.
Pythium diseases (*Pythium* spp.)	4	**Ridomil Gold GR** **Ridomil Gold SL** **Ultra Flourish** (mefenoxam)	**GR**: 20 lb **SL, Ultra**: 2 pt	**GR**: 40 lb **SL**: 3 pt **Ultra**: 6 pt	**GR**: 28 **SL, Ultra**: 7	2*	Do not apply more than 1.5 lb mefenoxam/A per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4	**Metastar 2E** **ReCon 4F** (metalaxyl)	**Metastar**: 4 qt **ReCon**: 2 qt	**Metastar**: 6 qt **ReCon**: 3 qt	2	28	Must be soil applied. See labels.
	14	**Terramaster 4EC** (etridiazole)	7 fl oz	27.4 fl oz	3	0.5	**Greenhouse use only.**
	21	**Ranman** **Segway O** (cyazofamid)	3 fl oz/100 gal	-	0	-	**Greenhouse transplant production only**; make a single application to the seedling tray 1 week prior up to the time of transplanting. Do not use any surfactant.
	28	**Bruin** **Previcur Flex** (propamocarb hydrochloride)	**SEE INDIVIDUAL LABEL**		5	0.5	**Greenhouse application**: 6 applications/crop cycle. Do not mix with other products. Can cause phytotoxicity if applied in intense sunlight.
	28	**Bruin** **Previcur Flex** **Promess** (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	(Root rots and seedling diseases) Applied to lower portion of plant and soil, or as a soil drench or drip irrigation.
	33	**Alude** (mono- and dipotassium salts of phosphorous acid)	1.5 qt/acre/25 gal	-	-	4 hr	For transplants only.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	49 + 4	**Orondis Gold** (oxathiapiprolin + mefenoxam)	55 fl oz	55 fl oz	7	2	Soil applications cannot be combined or followed by foliar applications of Orondis Opti or Orondis Ultra. Not labeled for greenhouse use.
Rhizoctonia root rot **Rhizoctonia fruit rot** (*Rhizoctonia solani*)	M5	(chlorothalonil) **Many brands available**: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	7	**Fontelis** (penthiopyrad)	1.0–1.6 fl oz/1000 row-ft	24 fl oz	0	0.5	Apply at plant, preplant incorporated, in-furrow, as a transplant drench, or by drip irrigation.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per a year. See label for surfactant precautions. Not labeled for greenhouse use.
(suppression)	11	**Cabrio** (pyraclostrobin)	16 oz	96 oz	0	0.5	Limit is 2 sequential applications before alternating to another effective fungicide from a different FRAC group.
(suppression)	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	14	**Blocker 4F** **Terraclor 75 WP** (PCNB)	**SEE INDIVIDUAL LABELS**		Soil treatment at planting	0.5	See label for application type and restrictions.
	14	**Par-Flo 4F** (PCNB)	12 fl oz per 100 gal	2 appl.	Soil drench	0.5	Limited to only container-grown plants in nurseries or greenhouses.
	27 + M5	**Ariston** **Cymbol Advance** (cymoxanil + chlorothalonil)	1.9 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Rhizopus rot	3 + 12	**Chairman** (propiconazole + fludioxonil)	32 fl oz/100 gal or /50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. Lower rates for small diameter fruit. See label for details.
	12	**Scholar SC** (fludioxonil)	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	32 fl oz/100 gal or 16 fl oz/ 50,000 lb of fruit	0	0	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of fruit rots. Must be used in tank mixture with propiconazole. Not for processed tomato.
Septoria leaf spot	M1	(copper compounds) **Many brands available**: Americop 40 DF, Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, Champ DP, Champ F2 FL, Champion WP, Champ WG, C-O-C DF, C-O-C-S WDG, C-O-C WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop 50WP, Nu Cop HB, Previsto	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
	M3	(mancozeb) **Many brands available**: Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5		
	M3	**Ziram 76DF** **Ziram XCEL** (ziram)	4 lb	23.7 lb	7	2	Do not use on cherry tomatoes.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	M3 + M1	**ManKocide** (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
	M5	(chlorothalonil) **Many brands available**: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	4 + M5	**Ridomil Gold Bravo 76.4 W** (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	Limit is 4 applications/crop.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7	**Luna Privilege** (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per a year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per a year.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	11	(azoxystrobin) **Many brands available**: AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	**Cabrio 2.09 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential applications allowed. Limit is 6 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	**Flint** (trifloxystrobin)	4 oz	16 oz	3	0.5	Limit is 5 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	**Reason 500 SC** (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 b	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone- or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Up to a 1-year plant-back restriction for certain off-label crops.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	11 + 27	**Tanos** (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	22 + M3	**Gavel 75DF** (zoxamide + mancozeb)	2.0 lb	16 lb	5	2	
	27 + M5	**Ariston Cymbol Advance** (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 applications per season; no more than 2 sequential applications. Not labeled for transplants.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Sour rot (*Geotrichum candidum*)	3	**Mentor** (propiconazole)	8 oz/100 gal or /50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. See label for details.
	3 + 12	**Chairman** (propiconazole + fludioxonil)	32 fl oz/100 gal or /50,000 lb of fruit	-	-	-	Apply as a postharvest dip, drench, or high-volume spray for the postharvest control of certain rots. Lower rates for small-diameter fruit. See label for details.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
Southern blight	7	**Fontelis** (penthiopyrad)	1.0–1.6 fl oz/1000 row-ft	24 fl oz	0	0.5	Apply at-plant, preplant incorporated, in-furrow, as a transplant drench, or by drip irrigation.
(suppression)	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	11	**Aftershock** **Evito** **Tepera** (fluoxastrobin)	5.7 fl oz **Tepera**: 12.6 fl oz	22.8 fl oz **Tepera**: 12.6 fl oz	3	0.5	Limit is 4 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
(suppression)	11	**Cabrio** (pyraclostrobin)	16 oz	96 oz	0	0.5	Limit is 2 sequential applications before alternating to another effective fungicide from a different FRAC group.
	11 + IRAC 3	**Tepera Plus** (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	3	0.5	Contains bifenthrin insecticide. Limit is 4 appl./year. Minimum 10-day interval. No use in greenhouse.
(suppression)	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	14	**Blocker 4F** **Terraclor 75 WP** (PCNB)	**SEE INDIVIDUAL LABELS**		Soil treatment at planting	0.5	See label for application type and restrictions.
(suppression)	19	**Oso 5% SC** (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
Target spot	M5	(chlorothalonil) **Many brands available**: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3	**Rhyme** (flutriafol)	7 fl oz	28 fl oz	0	0.5	Limit is 4 applications per season.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	3 + BM 01	**Regev** (difenoconazole + tea tree oil)	8.5 fl oz	34 fl oz	2	0.5	Limit is 4 applications per year. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group.
	4 + M5	**Ridomil Gold Bravo 76.4 W** (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	Limit is 4 applications/crop.
	7	**Endura** (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides.
	7	**Fontelis** (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
	7 + 3	**Aprovia Top** (benzovindiflupyr + difenoconazole)	13.5 fl oz	53.6 fl oz	0	0.5	No more than 2 sequential applications on a 7-day interval before rotating to a non-FRAC group 7 fungicide; subsequent applications on no shorter than a 14-day interval. Limit of 4 applications per year. See label for surfactant precautions. Not labeled for greenhouse use.
	7 + 9	**Luna Tranquility** (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per a year.
	7 + 12	**Miravis Prime** (pydiflumetofen + fludioxonil)	11.4 fl oz	22.8 fl oz	0	0.5	No more than 2 sequential applications before rotating to a non-FRAC group 7 or non-FRAC group 12 fungicide; no more than 2 applications at maximum rate per year; can be applied via chemigation in 0.1–0.25 inches/A of water. Not for use in transplant or greenhouse production.
	9	**Scala SC** (pyrimethanil)	7 fl oz	35 fl oz	1	0.5	Use only in a tank mix with another effective non-FRAC code 9 fungicide; has a 30-day plant-back with off-label crops.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	9 + 3	**Inspire Super** (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 applications/season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to an 8-month plant-back restriction with off-label crops.
	9 + 12	**Alterity 62.5WG** **Switch 62.5WG** (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	See 2 (ee) label. After 2 applications alternate with non-FRAC code 9 or 12 fungicides for next 2 applications. Has a 30-day plant-back with off-label crops.
	11	**Aftershock** **Evito** **Tepera** (fluoxastrobin)	5.7 fl oz **Tepera**: 12.6 fl oz	22.8 fl oz **Tepera**: 12.6 fl oz	3	0.5	Limit is 4 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11	(azoxystrobin) **Many brands available**: AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
	11	**Cabrio 2.09 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential applications allowed. Limit is 6 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
	11 + IRAC 3	**Tepera Plus** (fluoxastrobin + bifenthrin)	15.4 fl oz	61.6 fl oz	3	0.5	Contains bifenthrin insecticide. Limit is 4 appl./year. Minimum 10-day interval. No use in greenhouse.
	11 + M3	**Dexter Max** (azoxystrobin + mancozeb)	1.6 lb	12 lb	5	2	Limit is a single application before alternating to a non-FRAC group 11 fungicide.
	11 + M5	**Quadris Opti** (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 + 3	**Quadris Top** (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 applications per season with no more than 2 sequential applications. Must tank-mix or alternate with another effective fungicide from another FRAC group. Has up to a 1-year plant-back restriction for certain off-label crops.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11 + 3	**Topguard EQ** (azoxystrobin + flutriafol)	8 fl oz	32 fl oz	0	0.5	Limit is 4 applications per season. Do not use adjuvants or EC formulated tank-mix partners. The addition of silicone or oil-based additives may cause injury at high temperatures. Do not exceed 0.125% (v/v) adjuvant levels.
	11 + 7	**Pageant** (pyraclostrobin + fluxapyroxad)	23 oz	69 oz	0	0.5	**Greenhouse production only**: Limit is 3 applications per crop cycle. No sequential applications; must rotate to another fungicide with a different mode of action.
	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.
	11 + 27	**Tanos** (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank-mix with other FRAC group 11 fungicides.
	27 + M5	**Ariston Cymbol Advance** (cymoxanil + chlorothalonil)	3.0 pt	17.5 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 + 3	**Revus Top** (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 applications per season; no more than 2 sequential applications. Not labeled for transplants.
	49 + M5	**Orondis Opti** (oxathiapiprolin + chlorothalonil)	2.5 pt	10 pt	0	4 hr	Do not use Orondis Opti following a soil application of another oxathiapiprolin product. No more than 2 sequential applications before rotating to another mode of action; 7-day minimum application interval. Applications of Orondis Opti should not exceed more than 33% of the total foliar fungicide applications, or 4 applications per crop, whichever is fewer. Limit on multiple crops is 6 applications per acre per year. Not labeled for greenhouse use.
Timber rot, Sclerotinia stem rot, or white mold (*Sclerotinia sclerotiorum*) (suppression)	7 + 11	**Luna Sensation** (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 applications per a year.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (Active Ingredients)	Max Rate/Acre		Min. Days to		Remarks[3]
			Application	Season[2]	Harvest	Reentry	
	11	(azoxystrobin) **Many brands available**: AFrame, Arius, AzoxyStar, Azoxystrobin 100ST, Azoxyzone, Azteroid FC, Dynasty, Gold Rush, Heritage, Mazolin, Quadris FL, Satori, Tetraban, Trevo, Willowood Azoxy 2SC	**SEE INDIVIDUAL LABELS**		0	4 hr	Must alternate or tank-mix with a fungicide from a different FRAC group; see specific label for mixing instructions and precautions.
(suppression)	11	**Cabrio 2.09 F** (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential applications allowed. Limit is 6 applications/crop. Must alternate or tank-mix with a fungicide from a different FRAC group.
(suppression)	11 + 7	**Priaxor** (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 applications per season; no more than 2 sequential applications. See label about compatibility with other formulated products and adjuvants.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2022; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Always double-check labels regarding maximum application limits. Many labels are changing from a maximum rate per a season (or crop cycle) to a maximum rate per a year.

[3] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 6. Nonfumigant nematicides for tomatoes in Florida. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Product	Application Directions
Vydate L (a.i. oxamyl)	Apply ½ to 1 gal/acre at planting, preferably via drip application. Make additional applications on a 10-to-14-day interval. Do not apply more than 3 gal per acre per season. Minimum retreatment interval is 7 days unless a longer interval is stated. Do not make more than 8 applications per season.
Nimitz (a.i. fluensulfone)	All applications must be incorporated either physically or via drip or overhead irrigation. Make preplant applications at a rate of 3.5 to 7 pints (56.0 to 80.0 fl oz) per acre a minimum of seven days before planting. Do not plant any unlisted crops into treated land for 365 days after application of the product. Do not apply more than one application per crop, and no more than 112 fl oz of product per acre per year (365 days). Provides control only for nematodes. Growers applying Nimitz must consult the product label to observe the plant-back (recropping) intervals for a variety of leafy vegetables and brassica crops, onions, bananas, sugarcane, and other crops.
Velum (a.i. fluopyram)	Apply max 6.84 fl oz/acre using only chemigation into root-zone through low-pressure drip, trickle, microsprinkler, or equivalent equipment. Observe minimum 7-day interval between soil applications. Do not apply more than 13.7 fl oz of Velum (0.446 lb fluopyram) per acre per year, regardless of formulation (Velum and/or Luna) or method of application (soil or foliar). For soil application, to limit the potential for development of disease resistance to this chemical class, the first foliar fungicide application after Velum should be a product from a different FRAC group.
Vydate is an insecticide/nematicide; Velum is a fungicide/nematicide; Nimitz is a true nematicide. Unlike fumigants, these products are not volatile and will move through the soil via water; depending on the water solubility, these products will have different recommendations as far as how to best apply them (see specific label recommendations); when nematode pressure is high, they may not be as consistently effective against root nematodes as the fumigants.	

Table 7. Fumigant nematicides for tomatoes in Florida.

Nematicide	Broadcast Application[1]		In-the-Row Applications
	Gallons or lb per Acre	fl oz/1000 ft/ chisel-spaced 12" apart	
Telone II[2,3]	27 to 35 gal	79 to 102	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone EC[2,3]		-	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Telone C-17[2,3]	32.4 to 42 gal	95 to 123	For any row spacing, application rates given may be concentrated in the row but shall never exceed the labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone C-35[2,3]	39 to 50 gal	114 to 146	For any row spacing, application rates given may be concentrated in the row but shall never exceed labeled maximum for broadcast applications. Consult the product label for additional detail.
Telone InLine[2,3]	29 to 56 gal	-	For drip fumigation, consult the product label for overall rate, drip concentration and flow-modifying application directions.
Pic Clor 60[2,3]	19.5 to 31.5 gal	57 to 90	Consult product label for overall rate and chisel flow-modifying application directions.
Pic Clor 60 EC[2,3]	19.5 to 31.5 gal	-	For drip fumigation, consult product label for proportionately reduced overall rates, drip concentration, and drip flow-modifying directions and procedures.
Vapam HL	75 gal	-	For drip fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions and procedures.
KPam HL	60 gal	-	For drip fumigation and crop termination, consult product label for proportionately reduced overall rates, drip concentration, and flow-modifying directions.
Allyl Isothiocyanate (AITC) Dominus	40 gal	-	For drip or in-row fumigation and crop termination, consult product label for overall rates, drip concentration, and flow-modifying directions

[1] Gallons/acre and fl oz/1000 feet provided only for mineral soils. Higher rates may be possible for heavier textured (loam, silt, clay) or highly organic soils.
[2] All of the fumigants mentioned are for retail sale and use only by state-certified applicators or persons under their direct supervision. New supplemental labeling for the Telone products must be in the hands of the user at the time of application. See label details for additional use restrictions based on soil characteristics, buffer zones, requirements for Personal Protective Equipment (PPE), mandatory good agricultural practices (GAPs), product and applicator training certification, and rate modifying recommendations with use of highly retentive Totally Impermeable mulch films (TIF).
[3] Higher application rates are possible in the presence of cyst-forming nematodes.

Rates are believed to be correct for products named and similar products of other brand names, when applied to mineral soils. Higher rates are required for muck (organic) soils. However, the **grower** has the final responsibility to see that each product is used legally; **read the label** of the product to be sure that you are using it properly.

UF | IFAS Extension
UNIVERSITY of FLORIDA

CV295

doi.org/10.32473/edis-cv295-2022

Chapter 19. Biopesticides and Alternative Disease and Pest Management Products[1]

Natalia Peres, Gary Vallad, Johan Desaeger, and Hugh A. Smith[2]

The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at https://sfyl.ifas.ufl.edu/find-your-local-office/.

Table 1. Biopesticides labeled for management of arthropod pests of many crops. Contact: Hugh A. Smith, UF/IFAS Gulf Coast Research and Education Center.

Trade Name (Active Ingredient)	MOA Code[1]	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI-Listed	Remarks
Agree WG, **Xentari** (*Bacillus thuringiensis* subspecies *aizawai*) **Biobit HP**, **Deliver**, **DiPel DF**, **Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	11A	Caterpillars	0	4	Yes	Apply when larvae are small for best control. Can be used in greenhouse.
Aza-Direct (azadirachtin)	-	Aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, whiteflies	0	4	Yes	Antifeedant, repellant, insect growth regulator.
Azera (pyrethrins + azadirachtin)	3A + -	Aphids, beetles, caterpillars, leafminers, whiteflies	0	12	Yes	Apply when larvae are small for best control. Can be used in greenhouse.
BotaniGard ES (*Beauveria bassiana* strain GHA)	-	Aphids, leafhoppers, mealybugs, mites, plant bugs, planthoppers, thrips, whiteflies	0	4	No	Works by contact. Spores attach to insects, germinate, and penetrate insect cuticle. May be used in greenhouses.

1. This document is CV295. Original publication date August 2013. Revised annually. Most recent revision June 2023. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Natalia Peres, professor, Plant Pathology Department, UF/IFAS Gulf Coast Research and Education Center; Gary E. Vallad, professor, Plant Pathology Department, UF/IFAS Gulf Coast REC; Johan Desaeger, assistant professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; and Hugh A. Smith, associate professor, Entomology and Nematology Department, UF/IFAS Gulf Coast REC; UF/IFAS Extension, Gainesville, FL 32611.

Trade Name (Active Ingredient)	MOA Code[1]	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI-Listed	Remarks
BotaniGard Maxx (*Beauveria bassiana* strain GHA + pyrethrins)	3A + -	Aphids, leafhoppers, leafminers, plant bugs, thrips, whiteflies	0	12	No	
Captiva (*Capsicum oleoresin* extract, garlic oil, soybean oil)	-	Leafhoppers, mites, thrips, whiteflies	0	4	No	
Captiva Prime (*Capsicum oleoresin* extract, garlic oil, canola oil)	-	Leafhoppers, mites, thrips, whiteflies	0	4	Yes	
Des-X (soap, insecticidal)	-	Aphids, mites, plant bugs, whiteflies	0	12	Yes	
Entrust SC (spinosad)	5	Beetles, caterpillars, thrips	See label	4	Yes	See label for resistance management and for maximum allowed amount per season.
Grandevo WDG (*Chromobacterium subtsugae* strain PRAA4-1)	-	Aphids, mites, plant bugs, whiteflies	0	4	Yes	
JMS Stylet Oil (paraffinic oil)	-	Aphids, leafhoppers, leafminers, mites, whiteflies	0	4	No	
Met52 EC (*Metarhizium anisopliae* strain F52)		Mites, thrips	0	12	Yes	Composed of spores of insect pathogenic fungus *Metarhizium anisopliae* strain F52.
M-Pede 49% EC (soap, insecticidal)	-	Aphids, leafhoppers, mites, thrips, whiteflies	0	12	Yes	
Mycotrol ESO (*Beauveria bassiana* strain GHA)	-	Aphids, leafhoppers, whiteflies	0	4	Yes	
Mycotrol WPO (*Beauveria bassiana* strain GHA)	-	Aphids, leafhoppers, whiteflies	0	4	Yes	
Neemix 4.5 (azadirachtin)	-	Aphids, leafminers, whiteflies	0	12	Yes	IGR and feeding repellant. Greenhouse and field.
Organic JMS Stylet Oil (paraffinic oil)	-	Aphids, leafhoppers, leafminers, mites, whiteflies	0	4	Yes	
PFR-97 20% WDG (*Isaria fumosoroseus* Apopka Strain 97)	-	Aphids, leafminers, mites, plant bugs, psyllids, weevils, whiteflies	0	4	Yes	Can be used on vegetables grown for transplant. Do not mix with fungicides or apply within 5 days of fungicide applications other than copper. Dust/mist respirator must be used for mixing and applying.
Pyganic 5.0 (pyrethrins)	3A	Aphids, beetles, leafhoppers, leafminers, mealybugs, mites, plant bugs, planthoppers, psyllids, stink bugs, thrips, weevils, whiteflies	0	12	Yes	Harmful to bees. Can be used in greenhouses.
Seduce Insect Bait (spinosad)	5	Caterpillars	See specific crops on label	4	Yes	
Suffoil-X (mineral oil)	-	Aphids, leafhoppers, thrips, whiteflies	0	4	Yes	Thorough coverage is essential.

Trade Name (Active Ingredient)	MOA Code[1]	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI-Listed	Remarks
Trilogy (extract of neem oil)	-	Aphids, mites, thrips, whiteflies	0	4	Yes	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment.
Venerate XC (heat-killed *Burkholderia* spp. strain A396 cells and spent fermentation media)	-	Corn earworm, mealybugs, mites, stink bugs, weevils, whiteflies	0	4	Yes	

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 10.2 March 2022. Number codes (1 through 29) are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. - = unknown, or a mode of action that has not been classified yet.

Table 2. Biopesticides and other alternative products labeled for plant disease management. Contact: Gary E. Vallad, UF/IFAS Gulf Coast Research and Education Center.

Product (Active Ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to:		OMRI-Listed	Remarks[2]
			Harvest	Reentry		
Labels change frequently. Be sure to read a current product label before applying any pesticide. Refer to crop-specific tables for conventional pesticides labeled for disease and pest management.						
2-3-2 Companion (*Bacillus subtilis* strain GB03)	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	4 hr	No	Do NOT mix with copper-based fungicides, concentrated acids such as sulfuric acid, solvents, oxidizing agents or bactericides. Do not mix with products with a pH below 4 or above 9. Consult specific product labels for additional information or restrictions concerning tank mixing.
ActinoGrow Actinovate (*Streptomyces lydicus* WYEC 108), NC	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	1 hr	Yes	See label for specific rates and application recommendations.
Afla-guard GR (*Aspergillus flavus* NRRL 21882), NC	Sweet Corn	Aspergillus	-	4 hr	No	Do not exceed 20 lb/acre per growing season. See label for specific application instructions.
AgriPhage (bacteriophage), NC	Tomato, Pepper	Bacterial spot, Bacterial speck	0	0	No	Bacterial strains must be characterized periodically by manufacturer to correctly formulate the bacteriophage mixture.
Aviv (*Bacillus subtilis* strain IAB/BS03)	Vegetables & Strawberries	Broad-spectrum fungicide	0	4 hr	Yes	See label for specific rates and application recommendations.
(*Bacillus subtilis* strain QST 713), 44 **Many brands available:** Cease, Minuet, Rhapsody, Serenade ASO, Serenade Opti,	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	4 hr	Yes	For foliar applications, mix with copper compounds or other effective fungicides for improved disease control. See label for details regarding specific foliar and soil applications and target diseases.
BioCover (oil, petroleum), NC	Vegetables & Strawberries	Powdery mildew, Rust	0	4 hr	No	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Bionatrol-M (soybean oil)	Vegetables & Strawberries	Powdery mildew, Botrytis, Rust, Sour rot	0	0	Yes	Do not apply any copper, sulfur, or others within 12 days of Bionatrol-M application. Do not spray when freezing temperatures are anticipated within 48 hours and do not apply above 95°F. Do not mix with foliar fertilizers.

Product (Active Ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to:		OMRI-Listed	Remarks[2]
			Harvest	Reentry		
BIO-TAM **Tenet WP** (*Trichoderma asperellum* strain ICC 012 + *Trichoderma gamsii* strain ICC 080), NC	Vegetables & Strawberries	*Fusarium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp., *Sclerotinia* spp., *Sclerotiumrolfsii*, *Thielaviopsisbasicola*, and *Verticillium* spp.	-	1 hr	Yes	See label for additional rates and recommendations for transplant production and details for specific diseases. Check label for product incompatibility with certain chemical fungicides.
Botector (*Aureobasidium pullulans* strain DSM 14940, 14941)	Tomatoes & Strawberries	Anthracnose, Botrytis, Phomopsis, Rhizopus	0	4 hr	Yes	See label for specific rates and application recommendations. Check label for precautions regarding incompatibility with fungicides.
BotryStop (*Ulocladium oudemansii* U3 strain), NC	Vegetables & Strawberries	Botrytis, Sclerotinia	0	4 hr	No	See label for specific rates, application recommendations, and precautions regarding fungicide compatibility.
Cinnerate (cinnamon oil), NC	Vegetables & Strawberries	Powdery mildew, Botrytis, Rusts	0	0	Yes	See label for specific rates and application recommendations.
Contans WG (*Coniothyrium minitans* strain CON/M/91-08)	Vegetables & Strawberries	*Sclerotinia sclerotiorum* and *Sclerotinia minor*	0	4 hr	Yes	See label for specific rates and application recommendations.
Cyclops (olive and cinnamon oils), NC	Vegetables & Strawberries	Broad-spectrum fungicide	0	0	Yes	See label for specific rates and application recommendations. Ingredients are exempt from FIFRA.
Debug ON **Debug Optimo** **Debug Tres** **Debug Turbo** (fats and glyceridic oils Mongosa, Azadirachtin), NC	Vegetables & Strawberries	Powdery mildew, Rust, *Rhizoctonia*, *Sclerotinia*, *Sclerotium rolfsii*	0	4 hr	Yes	See labels for specific rates, application recommendations, and precautions regarding use with other pesticides.
Double Nickel 55 **Double Nickel LC** **Triathlon BA** (*Bacillus amyloliquefaciens* strain D747), 44	Vegetables & Strawberries	*Alternaria* spp., Anthracnose, Bacterial diseases, Botrytis, Early blight, *Fusarium* spp., Late blight, *Phytophthora* spp., Powdery mildew, *Pythium* spp., *Rhizoctonia*	0	4 hr	Yes	See label for additional rates and recommendations for foliar and soil application rates and details for specific diseases. Use as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment. See label for details.
EcoSwing (extract of *Swinglea glutinosa*), NC	Vegetables & Strawberries	*Alternaria alternata*, *Monilinia fructicola*, *Monilinia laxa*, *Botrytis cinerea*, *Erysiphaceae* spp., *Erwinia carotovora* subspp., *Aspergillus niger*, *Alternaria tenuis*, *Cladosporium herbarum*, *Rhizopus arrhizus*, *Penicillium* spp.	0	4 hr	Yes	See label for specific rates, application recommendations, and greenhouse use.
Glacial Spray Fluid (oil, petroleum), NC	Vegetables & Strawberries	Powdery mildew, Rust	0	4 hr	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.

Product (Active Ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to:		OMRI-Listed	Remarks[2]
			Harvest	Reentry		
GreenClean PRO PerCarb (sodium carbonate peroxyhydrate), NC	Vegetables & Strawberries	Broad-spectrum fungicide/bactericide	0		No	See label for specific rates and application recommendations.
Howler (*Pseudomonas chlororaphis* strain AFS009), NC	Vegetables & Strawberries	*Rhizoctonia, Pythium, Fusarium, Phytophthora, Sclerotinia, Colletotrichum,* and *Botrytis.*	0	4 hr	Yes	See label for specific rates and application recommendations.
(Hydrogen peroxide + peroxyacetic acid), NC **Many brands available:** GreenClean Liquid, Jet-Ag, OxiDate, Purpose Plus, Rendition, SaniDate, SporeQuell, StorOx, TerraClean, TerraStart, ZeroTol	Vegetables & Strawberries	Broad-spectrum fungicide	0	1 hr for enclosed areas; until spray dries in open-field areas.	No	See labels for specific rates, application recommendations, and precautions regarding use with other pesticides. Some formulations can be used as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment or for postharvest treatments.
JMS Stylet-Oil Organic JMS Stylet-Oil (paraffinic oil), NC	Vegetables & Strawberries	Potato Virus Y, Tobacco Etch Virus, Cucumber Mosaic Virus	0	4 hr	Yes, but only for one label	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
LEAPES (*Bacillus thuringiensis* subsp. *kurstaki*, strain ABTS-351 and methyl salicylate)	Tomato & Pepper	*Xanthomonas* spp.	0	0.5	No	Apply before disease is observed in the field; should be used as part of a plant pathogen control program. See label for details regarding insecticidal activity.
LifeGard (*Bacillus mycoides* isolate J)	Vegetables	Broad-spectrum fungicide		4 hr	Yes	See label for specific rates and application recommendations.
Mildew Cure (cotton, corn, and garlic oils), NC	Vegetables & Strawberries	Powdery mildew	0	0	Yes	See label for specific rates and application recommendations. Ingredients are exempt from FIFRA.
(mineral oil), NC **Many brands:** 440 Superior Spray Oil, BioCover, Glacial Spray Oil, Omni Supreme Oil, PureSpray Green, SuffOil-X, TriTek, Ultra-Pure Oil	Vegetables & Strawberries	Powdery mildew	0	4 hr	Yes	See label for specific rates, application recommendations, precautions, and fungicide compatibility.
Mycostop (*Streptomyces* sp. strain K61)	Vegetables & Strawberries	Broad-spectrum fungicide	0	4 hr	No	See label for specific rates and application recommendations.
Nutrol (potassium phosphate), NC	Cucurbits, Peppers & Tomatoes	Powdery mildew	0	0	No	Do not mix with copper fungicides or other products affected by low pH (<5.5). See label for specific rates and application recommendations.

Product (Active Ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to:		OMRI-Listed	Remarks[2]
			Harvest	Reentry		
OxiPhos (mono- and dipotassium salts of phosphorus acid + hydrogen peroxide), 33 & NC	Vegetables & Strawberries	*Alternaria* spp., Anthracnose, Bacterial diseases, Botrytis, Early blight, *Fusarium* spp., Late blight, *Phytophthora* spp., Powdery mildew, *Pythium* spp., Rhizoctonia	0	1 hr for enclosed areas; until spray dries in open-field areas.	No	See label for additional rates and recommendations for transplant production and details for specific diseases. Use as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment.
PlantShield HC RootShield WP (*Trichoderma harzianum* Rifai strain KRL-AG2), NC	Vegetables & Strawberries	*Cylindrocladium* spp., *Fusarium* spp., *Pythium* spp., *Rhizoctonia* spp., *Thielaviopsis* spp.	0	PlantShield: 4 hr; RootShield: 0 hr if soil-applied; until spray dries	Yes	See label for specific rates, application recommendations, and precautions regarding use and fungicide compatibility.
(potassium bicarbonate), NC **Many brands available:** Armicarb 100, Armicarb "O", Carb-O-Nator, Eco-mate, Kaligreen, Milstop	Vegetables & Strawberries	Broad-spectrum fungicide	0	4 hr	Yes	See label for specific rates and application recommendations.
(potassium phosphite; mono- and dipotassium salts of phosphorous acid), 33 **Many brands available:** Alude, Appear, Confine Extra T&O, Fosphite, Fungi-Phite, Helena Prophyt, K-Phite 7LP AG, Phiticide, Phorcephite, Phostrol, Rampart, Reveille	Vegetables & Strawberries	*Alternaria* spp., Anthracnose, Bacterial diseases, Downy mildew, *Fusarium* spp., Late blight, Leaf blights caused by *Cercospora* and *Septoria* spp., *Phytophthora* spp., Powdery mildew, *Pythium* spp., *Rhizoctonia* spp., Root rots	0	4 hr	No	See label for details, specific recommendations, and precautions for tank mixing with copper-based fungicides.
Prev-Am (sodium tetraborohydrate decahydrate), NC	Vegetables & Strawberries	Downy mildew, Botrytis, Powdery mildew, Late blight, White rust, White mold	0	0.5	No	See label for details, crop-specific recommendations, and precautions.
ProBlad Verde (Banda de Lupinus albus doce (BLAD))	Vegetables & Strawberries	Anthracnose, Botrytis, Powdery mildew, Southern blight, White mold	1	4 hr	Yes	See label for details, crop specific recommendations, and precautions.
Procidic BerryCare (citric acid), NC	Vegetables & Strawberries	Broad-spectrum fungicide	0	0	No	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Purespray Green (oil, petroleum), NC	Vegetables & Strawberries	Powdery mildew, Rust	0	4 hr	Yes	See label for specific rates, application recommendations, and precautions regarding use.

Product (Active Ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to:		OMRI-Listed	Remarks[2]
			Harvest	Reentry		
Pvent **LALSTOP G46 WG** (*Gliocladium catenulatum* strain J1446), NC	Vegetables & Strawberries	Broad-spectrum fungicide	0	4 hr	Yes	See label for details, crop specific recommendations, and precautions.
Regalia **Regalia Rx** **Pacesetter** (extract of *Reynoutria sachalinensis*), P	Vegetables & Strawberries	Bacterial canker, Bacterial speck, Bacterial spot, Botrytis, Early blight, Late blight, *Phytophthora* spp., Powdery mildew, Target spot	0	4 hr	Yes	Tank-mix with other effective fungicides for improved disease control under heavy pressure. See label for details.
Romeo (Cerevisane; cell walls of *Saccharomyces cerevisiae* strain LAS117)	Vegetables & Strawberries	Alternaria leaf spot, Anthracnose, Botrytis, Downy mildew, Fusarium, Late blight, Phytophthora, Powdery mildew, Rhizoctonia, Scab, Sour rot	0	4 hr	Yes	See label for details, crop specific recommendations, and precautions.
RootShield Granular **RootShield Home & Garden** (*Trichoderma harzianum* Rifai strain T-22), NC	Vegetables & Strawberries	*Cylindrocladium* spp., *Fusarium* spp., *Pythium* spp., *Rhizoctonia* spp., *Thielaviopsis* spp.	0	0	Yes	See label for specific rates, application recommendations, and precautions regarding use and fungicide compatibility.
RootShield Plus Granular **RootShield Plus WP** (*Trichoderma harzianum* Rifai strain T-22 and *Trichoderma virens* strain G-41), NC	Vegetables & Strawberries	*Cylindrocladium* spp., *Fusarium* spp., *Pythium* spp., *Rhizoctonia* spp., *Thielaviopsis* spp.	0	4 hr	Yes	See label for specific rates, application recommendations, and precautions.
Seican (cinnamaldehyde)	Vegetables & Strawberries	Botrytis, Powdery mildew, Rusts	0	4 hr	No	See label for details, crop specific recommendations, and precautions.
Serifel Biofungicide **Serifel NG Biological Fungicide** **Subtilex NG** (*Bacillus amyloliquefaciens* strain MBI 600), NC	Vegetables & Strawberries	Broad-spectrum fungicide	0	4 hr	Yes	See label for details, crop specific recommendations, and precautions.
Sil-Matrix (potassium silicate), NC	Vegetables & Strawberries	Broad-spectrum fungicide	0	4 hr	No	Must be used in a rotational program with other fungicides when conditions are conducive for disease development. See label for details.
Soilgard (*Gliocladium virens* GI-21), NC	Vegetables & Strawberries	Fusarium root and crown rot, *Phytophthora capsici*, *Pythium* spp., Rhizoctonia, *Sclerotinia* spp., *Sclerotium* spp.	0	0	Yes	For best results, apply to transplants or as a drench during transplanting. Subsequent applications can be made as drench, directed spray, or by chemigation. See label for precautions regarding use and fungicide compatibility.
Sonata (*Bacillus pumilus* QST 2808), NC	Vegetables & Strawberries	Early blight, Downy mildew, Late blight, Powdery mildew, Rust	0	4 hr	Yes	Mix or alternate with other effective fungicides for improved disease control. See label for details.

Product (Active Ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to:		OMRI-Listed	Remarks[2]
			Harvest	Reentry		
Sporatec (oils of clove, rosemary and thyme), NC	Vegetables & Strawberries	Bacterial spot, Botrytis, Early blight, Gray mold, Late blight, Powdery mildew	0	0	Yes	Exercise care when applying. Begin applications once disease is observed. Use of a spreader and/or penetrant adjuvant recommended for improved performance. Do not apply when temps are above 90°F. See label for details. Ingredients are exempt from FIFRA.
Stargus (*Bacillus amyloliquefaciens* strain F727 cells and spent fermentation media)	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	4 hr	Yes	See label for specific rates and application recommendations.
Taegro ECO (*Bacillus amyloliquefaciens* strain FZB24), NC	Vegetables	**Foliar diseases**: Downy mildew, Powdery mildew, *Pseudomonas* spp., *Xanthomonas* spp. **Soilborne diseases**: *Fusarium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp., *Sclerotinia* spp.	-	1	No	See label for specific instructions regarding soil injected, spray, or incorporated applications. Maximum of 12 applications per season. For best efficacy, product should be applied prior to disease or disease establishment. May be applied to greenhouse-produced crops.
Thyme Guard (thyme oil extract), NC	Vegetables & Strawberries	Broad-spectrum bactericide and fungicide	0	0	-	See label for specific rates, application recommendations, and precautions regarding use with other pesticides. Ingredients are exempt from FIFRA.
Thymox Guarda (thyme oil)	Vegetables & Strawberries	Broad-spectrum fungicide	0	0	-	See label for specific rates and application recommendations. Ingredients are exempt from FIFRA.
Timorex ACT (tea tree oil), BM 01	Vegetables & Strawberries	Broad-spectrum fungicide	2	4 hr	Yes	See label for specific rates and application recommendations.
Trilogy (clarified hydrophobic extract of neem oil), NC	Vegetables & Strawberries	*Alternaria* spp., Anthracnose, Botrytis, Early blight, Powdery mildew	0	4 hr	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Ultra-Pure Oil (mineral oil), NC	Vegetables & Strawberries	Powdery mildew	0	4 hr	Yes	See label for specific rates, application recommendations, precautions, and fungicide compatibility.
Vacciplant (laminarin), P	Vegetables & Strawberries	Anthracnose, Bacterial speck, Bacterial spot, Early blight, Phytophthora blight, Powdery mildew	0	4 hr	No	Start applications preventatively, when weather conditions are favorable for disease development. Repeat applications until disease conditions end. Add a labeled copper product to VacciPlant if the disease symptoms appear.
Veg'Lys, Brandt (garlic oil), NC	Vegetables & Strawberries	Broad-spectrum bactericide and fungicide	0	0	Yes	See label for specific rates and application recommendations and precautions. Do not apply when temps are above 90°F. Ingredients are exempt from FIFRA.
Zayin (geraniol)	Vegetables & Strawberries	Powdery mildew	0	0		See label for specific rates and application recommendations.

Product (Active Ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to:		OMRI-Listed	Remarks[2]
			Harvest	Reentry		
Zivion S (natamycin)	Strawberries	Anthracnose, Verticillium, Charcoal rot	4 hr	0	No	Apply prior to plant as a preplant transplant root or whole-plant dip treatment. Do not apply after or to harvestable commodities.

[1] FRAC code (fungicide group): Number (33 and 44) and letters (NC and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. However, products with NC or P are considered low risk and don't require any rotation unless specifically directed on the label. NC = not classified, includes mineral oils, organic oils, potassium bicarbonate, and other materials of biological origin; P = host plant defense inducers. Source: FRAC Code List 2022 http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 3. Biopesticides labeled for management of nematode pests of many crops. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Pest	MOA Code	Active Ingredient	Product(s)	Rate	Days to Harvest	REI (Hours)	Remarks
Nematodes	n/a	Azadirachtin	AzaGuard, Ecozine Plus, Molt-X	See label	0	4	OMRI-listed.
	n/a	*Burkholderia rinojensis* heat-killed	Majestene	4–8 qt	0	4	OMRI-listed.
	n/a	Mustard oil + capsaicin	Dazitol	6.25 gal	0	4	OMRI-listed. Apply 3–5 days preplant or ¼ rate postplant.
	n/a	*Myrothecium verrucaria* fermentation product	DiTera	See label	0	4	OMRI-listed
	n/a	*Purpureocillium lilicanus*	MeloCon LC	10.25 fl oz	0	4	OMRI-listed.
	n/a	Saponins of *Quillaja saponaria*	Nema-Q	See label	0	4	OMRI-listed.
	n/a	Thyme oil	Nemakill, Promax, Thyme Guard	See label	0	4	OMRI-listed.