

Insect Management for Potatoes¹

S. E. Webb²

Chewing insects can cause serious yield and quality losses in potatoes by feeding on the leaves, stems or tubers. Sucking insects can cause direct losses from feeding and indirect losses by transmitting viral diseases. The most important of these insects are described below. A table at the end of the chapter lists insecticides currently registered for potatoes.

Colorado Potato Beetle, *Leptinotarsa decemlineata*

Description

Adult beetles have 10 lengthwise black stripes on yellow-orange wing covers and are approximately $\frac{3}{8}$ to $\frac{1}{2}$ inch long. They are stout and strongly convex in shape. The yellow-orange spindle-shaped eggs are laid in clusters of 10 to 30 on the undersides of leaves. They are very similar to ladybird beetle eggs but are larger. The larvae are hump-backed, red to orange, and have two rows of black spots on each side of their soft bodies.



Figure 1. Colorado potato beetle.

Biology

The major food plant of the Colorado potato beetle is potato. Other crop hosts include tomato and eggplant. Wild hosts found in Florida include horsenettle, groundcherry, and tropical soda apple. Horsenettle is found mainly in North Central and North Florida, which is also where the beetle is generally found. Tropical soda apple is found throughout the state, but it is not clear if the distribution of

1. This document is ENY-469, one of a series of the Department of Entomology and Nematology, UF/IFAS Extension. Original publication date November 2001. Revised September 2007, March 2010, June 2013, and February 2017. Visit the EDIS website at <http://edis.ifas.ufl.edu>.
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CPB has changed following the introduction of this invasive weed. Adults overwinter in fields where they developed as larvae or in uncultivated areas adjacent to fields. They can also overwinter in wooded areas. Only a small proportion of a population leaves its field of origin by flying. Each adult female can produce about 450 eggs. Larvae, which pass through 4 instars, are generally found near the top of the plant and they seldom move far from the plant on which they hatch unless all the leaves are eaten. About two-thirds of all feeding by larvae occurs in the fourth or last instar. When the larvae have completed their development they enter an inactive pupal stage in the soil. After 5 to 7 days, adults emerge and begin to feed on the potato plants. Under ideal conditions, the life cycle can be completed in three weeks. Potato beetles are unaffected by high concentrations of toxic glycoalkaloids, the naturally occurring bitter compounds in potatoes. The efficient detoxification system of the beetle may also play a part in detoxifying insecticides and in the development of insecticide resistance.

Damage

The Colorado potato beetle is a significant problem only in North Florida production regions. High numbers of late instar larvae can defoliate plants. Yield loss is greatest if heavy damage occurs during tuber formation. Bacterial ring rot and potato spindle tuber disease, which are easily spread by mechanical means, can also be transmitted by Colorado potato beetle.

Wireworms, *Melanotus communis*, *Conoderus* spp.

Description

Wireworms are the larvae of the click beetle. They are shiny, slender, hard-bodied and yellow to brown. Adults are large brown beetles that make a clicking sound when they try to right themselves after being turned over.

Biology

Depending on species and soil temperature, wireworm larvae can take from 1 to 5 years to develop. Corn wireworm (*Melanotus communis*), common in Florida, may complete its development in 2 to 3 years in South Florida. Most flight activity occurs in May and June. Females lay eggs in cracks or crevices or burrow into the soil. Larvae tend to move deeper as soil temperatures become hotter and move closer to the soil surface when it is cooler. If temperatures drop further, larvae will again move deeper into the soil. Other wireworms found in Florida (*Conoderus* spp.) can complete their development in a year or less, resulting in up to three

generations per year in South Florida. These species tend to stay close to the soil surface.

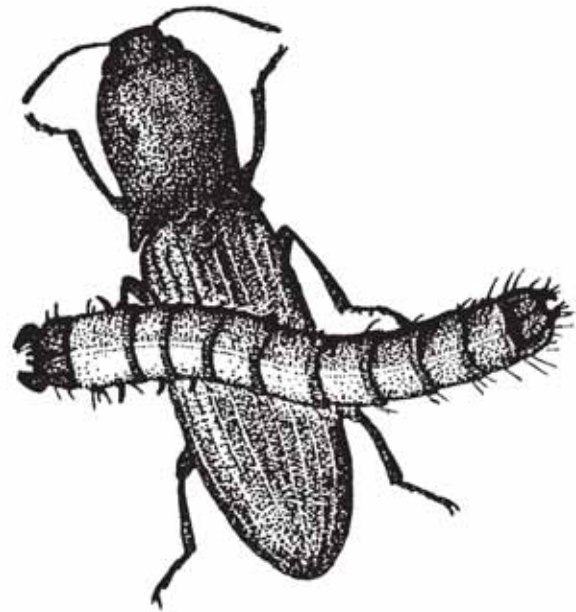


Figure 2. Wireworm larva and adult.

Damage

The adult wireworms do not attack potatoes. However, the larvae (“wireworms”) feed on potato seed pieces and developing tubers. Wounds to seed pieces allow disease organisms, such as fungi and bacteria, to enter. The greatest damage occurs when larvae tunnel into developing tubers, reducing their quality and value. Damaged tubers are often malformed.

Leafminers

Description and Biology

The adult is a small fly, approximately 1/8 inch long, with a black head, yellow between the eyes, a black thorax and a tube-like “ovipositor” at the end of the abdomen used to puncture the upper leaf surface for egg laying. The white, oval egg is inserted in the leaf tissue, but many punctures (called stipples) are used by the adult for feeding and do not contain eggs. The larva, a yellow maggot with black, sickle-shaped mouth hooks, feeds between the upper and lower leaf surface for approximately seven days, leaving a serpentine mine containing a string of black frass (fecal matter). The mature larva exits from the mine and falls to the ground where it molts to a pupa within a golden brown, barrel-shaped, and ribbed puparium from which the adult emerges in seven to 14 days. Generation time is 15 to 28 days depending upon temperature.

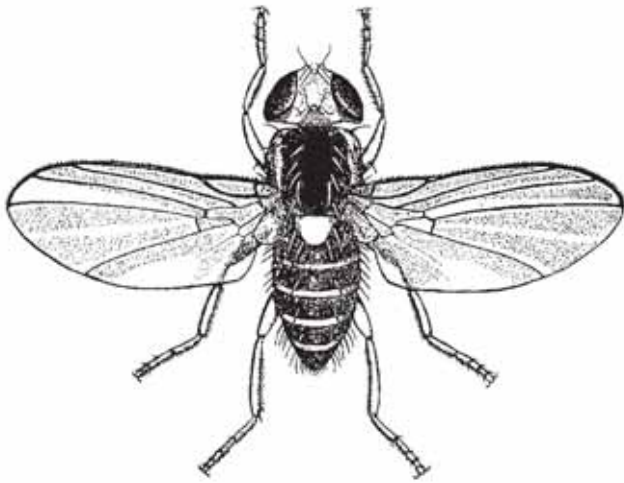


Figure 3. Vegetable leafminer.

Damage

Leafminer damage is only foliar, caused by serpentine mines carved in leaves by feeding leafminer larvae. Heavy damage can reduce photosynthesis and cause leaf desiccation and abscission.

Flea Beetle, *Epitrix hirtipennis*, others

Description

Tobacco flea beetle (Figure 4) is a fairly typical flea beetle pest of potatoes in Florida. Adults are very small, $\frac{1}{12}$ to $\frac{1}{20}$ of an inch long. They are reddish-yellow with a brown abdomen and a brown patch crossing the wing covers. Eggs are elongate and slightly pointed at one end. They change from white to lemon yellow as they get close to hatching. Larvae are whitish except for their yellow or yellow-brown heads and reach a length of $\frac{1}{6}$ of an inch long.

Biology

Tobacco flea beetle feeds on tobacco, potato, tomato, eggplant and other plants in the family Solanaceae. In Florida, at least 4 generations a year can develop. Beetles overwinter as adults under plant debris. If the weather is warm enough, they may remain active all winter. Eggs are laid in the soil near the base of the host plant, in clusters of 5 or 6. Overwintering females can produce up to 200 eggs with later generations producing about 100 eggs per female. Larvae develop through three instars and feed mainly on fine roots near the soil surface. They pupate near the soil surface also. Adults feed on leaves.

Damage

The adult beetle eats small holes partly or completely through the leaves, resulting in the formation of many small

“shot holes” in the leaves. Seedlings are most vulnerable to severe damage. Feeding wounds may serve as a point of entry for pathogens.

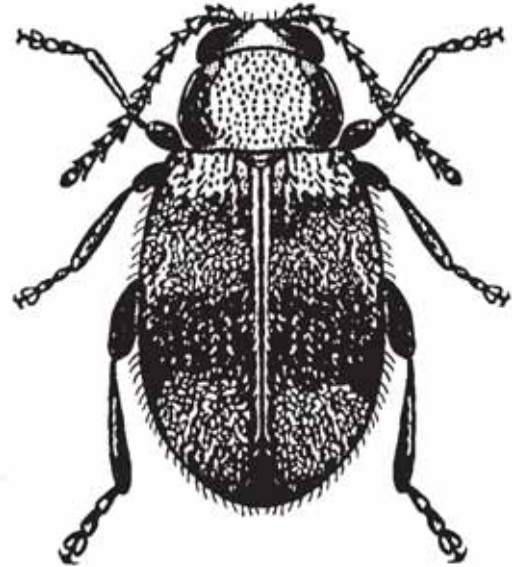


Figure 4. Tobacco flea beetle.

Leafhopper, *Empoasca fabae* and close relatives

Description

The adult potato leafhopper (Figure 5) is pale green with a row of white spots just behind its head. It has a slender body form and is about $\frac{1}{8}$ to $\frac{1}{7}$ inch long. Eggs are transparent to pale yellow and are inserted into the veins and petioles of leaves. Young nymphs are very small (about $\frac{1}{25}$ inch). Wing pads develop from the third through fifth instars.



Figure 5. Leafhopper.

Biology

The adult potato leafhopper overwinters in Gulf Coast States, including Florida, and disperses northward. In Florida, it can complete six generations a year. It feeds on many wild and cultivated plants, but potato is a particularly good host plant. Females can produce 200 to 300 eggs. These hatch in from 7 to 20 days depending on temperature. The average developmental time for nymphs is about 15 days. Adults can live from one to two months. Leafhoppers seem to have few effective natural enemies.

Damage

Leafhopper damage (hopper burn) late in the season is often confused with maturity of the plants (damaged leaves first turn brown along the margins but remaining foliage is often green). The adults and nymphs attack the underside of the leaves and suck the sap. They secrete a toxin into the plant as they feed. This causes the leaves to curl, yellow, and exhibit hopper burn symptoms. Plants may be stunted and yields reduced.

Aphids, *Myzus persicae* and *Macrosiphum euphorbiae*

Description

Aphids are small, soft-bodied insects that reproduce rapidly and feed on plant sap. In Florida, green peach aphid (*Myzus persicae*) (Figure 6) is the most common aphid on potatoes, but potato aphid (*Macrosiphum euphorbiae*) (Figure 7) can also be found. Aphids occur in both winged and wingless forms. The mature wingless form of green peach aphid is egg-shaped, the tubercles at the base of the antennae are prominent and point inward, and the cornicles, tube-like structures on the back of the aphid, are long and unevenly swollen. They can range in color from light green to pink to almost translucent. Potato aphid is larger and more elongated with longer, straight cornicles and can be green, yellow, or pink. The pink form is common in the Hastings area. Its antennal tubercles point outward.

Biology

In Florida, aphids can reproduce without mating all year, as long as host plants are available. They give birth to nymphs rather than laying eggs and their offspring can be producing nymphs of their own in 7 to 10 days depending on temperature. High populations can develop very quickly as plants get crowded. Winged forms develop and fly to new host plants. Aphids have many natural enemies, both general predators such as lacewing and ladybeetle larvae, and more

specific parasitoid wasps. Fungi can kill large numbers of aphids in a short period of time.

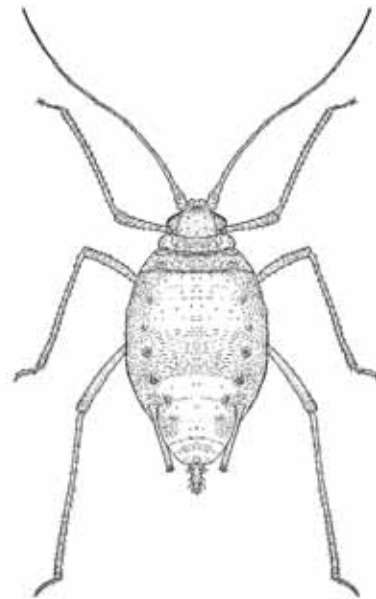


Figure 6. Wingless green peach aphid.

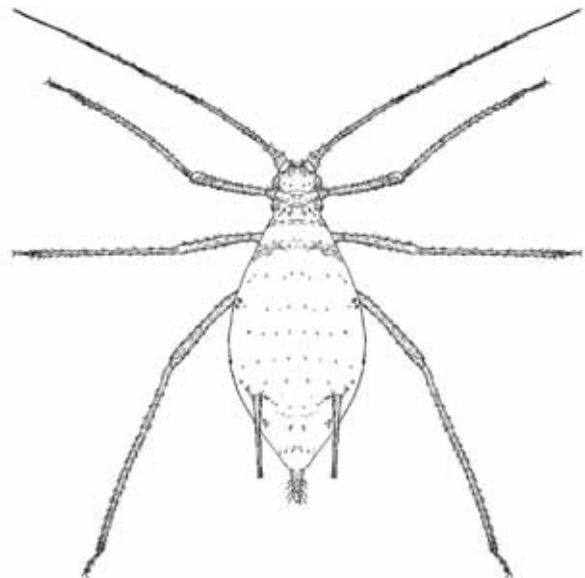


Figure 7. Potato aphid.

Damage

Aphids cause damage by sucking juices from the underside of leaves on the above ground portion of the potato plant. Feeding by potato aphids can cause distortion of young leaves and the dying back of the shoot or stem. Green peach aphid is more common in Florida. Early season infestation is the most damaging and can result in yield loss. Green peach aphid is also an excellent virus vector, transmitting viruses from plant to plant. At this time, potato leafroll virus and potato virus Y, the most important of the aphid-transmitted plant viruses affecting potato, are not common in Florida potato fields. Currently, aphids are managed with systemic insecticides applied at planting.

Caterpillar Pests (beet armyworm, fall armyworm, southern armyworm, cutworms, cabbage looper, etc.)

Larvae of moths can damage and occasionally defoliate potato plants. Two examples are described below.

Cabbage looper, *Trichoplusia ni* (Hübner) (Figure 8), feeds on a variety of crops. The adults (Figure 9) are night-flying moths with brown, mottled forewings marked in the center with a small, silver figure eight. They lay their eggs (small, ridged, round, greenish-white) singly on both upper and lower leaf surfaces. The eggs hatch into larvae that are green with white stripes running the length of their bodies. The caterpillar has three pairs of slender legs near its head and then three pairs of thick prolegs near the end of its body. It moves in a characteristic looping motion, alternately stretching forward and arching its back as it brings the back prolegs close to its front legs. After feeding for two to four weeks, the caterpillar, about 1.25 inches long when fully grown, spins a cocoon and pupates. The adults emerge 10 days to two weeks later. There can be several generations per year depending on climate. They tend to feed on older leaves.

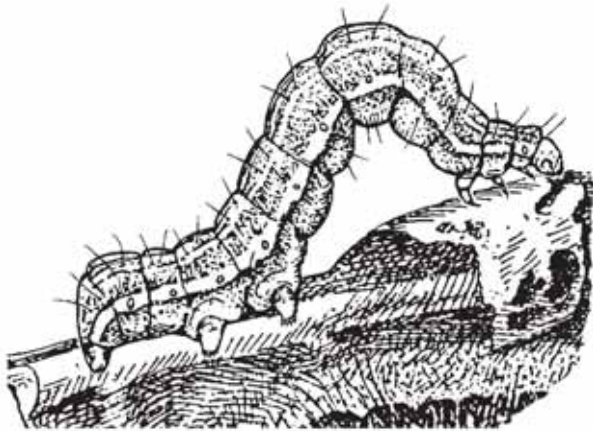


Figure 8. Cabbage looper larva.

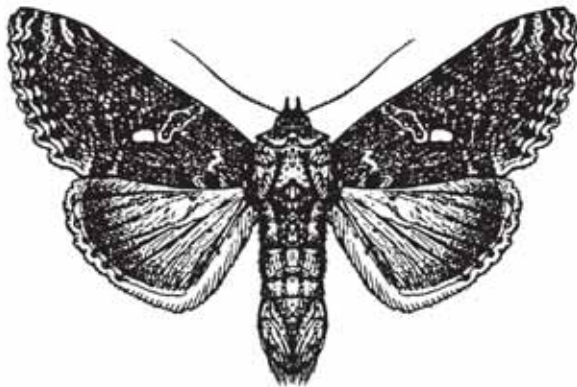


Figure 9. Cabbage looper adult male.

Beet armyworm, *Spodoptera exigua* (Hübner) (Figure 10), also feeds on many crops and weeds. The highly mobile adult moth (Figure 11) has dark forewings with mottled lighter markings and hind wings thinly covered with whitish scales. Each female can lay over 600 eggs, generally in masses of about 100 on the undersides of leaves in the lower plant canopy. Very young caterpillars feed in groups, and then disperse as they grow older (third instar). The dull green caterpillars have wavy, light-colored stripes lengthwise down the back and broader stripes on each side. After feeding from one to three weeks, they construct a cocoon and pupate, emerging as adults about one week later. Beet armyworm survives the winter in South Florida and can complete many generations a year there. From South Florida, adults migrate into North Florida and other parts of the Southeast.

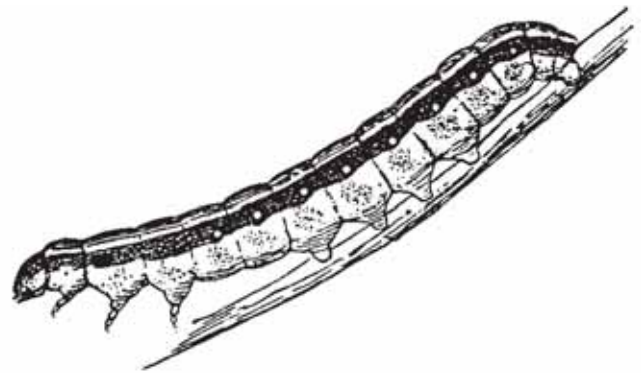


Figure 10. Beet armyworm larva.



Figure 11. Beet armyworm adult.

Table 1. Insecticides approved for managing insect pests of potato.

Labels change frequently. Be sure to read a current product label before applying any chemical. Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code ¹	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes ²
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 4 EC (dimethoate)	0.5-1.0 pt	48	0 if mechanically harvested, 14 otherwise	Highly toxic to bees. Do not apply more than 2 pts 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 ai/acre per season (7 applications at highest rate).
	3A	Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed ² .
	3A	*Mustang (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/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 ai/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.

Table 1. Insecticides approved for managing insect pests of potato. (continued)

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Insects	MOA Code ¹	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes ²
	4A	Admire Pro (imidacloprid)	5.7-8.7 fl oz as soil treatment or as 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 ai 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 ai (16 oz of product) per acre per season.
	4A	Belay Insecticide (clothianidin)	9-12 fl oz (in-furrow or side dress application); 2-3 fl oz (foliar)	12	Foliar: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, side dress 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, 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.
	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 - 7soil - 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.
	4D	Sivanto 200 SL (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.
	9C	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.
	23	Movento (spirotetramat)	4.0-5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	un	Azatin XL (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellent, insect growth regulator.
	un	Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	Insect growth regulator and anti-feedant. OMRI-listed ² .
	un	Requiem EC (extract of <i>Chenopodium ambrosioides</i>)	2-3 qt	4	0	Treat when threshold reached.
	un	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 .
	--	Grandevo (<i>Chromobacterium subsugae</i> strain PRAA4-1)	1-3 lb	4	0	OMRI-listed ² .
	--	M-Pede 49% EC (soap, insecticidal)	1-2% V/V	12	0	OMRI-listed ² .

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Labels change frequently. Be sure to read a current product label before applying any chemical. Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code ¹	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes ²
Caterpillars; armyworm, webworms, cutworms, cabbage looper, corn earworm	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 ai/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 (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/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 ai/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.
	5	Radiant SC (spinetoram)	4.5-8 fl oz	4	7	No more than 4 applications per year.
	11A	DiPel DF (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. For organic production.
	11A	Xentari DF (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	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 (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.
	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.
	un	Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	Insect growth regulator and anti-feedant. OMRI-listed ² .
--	Grandevo (<i>Chromobacterium subsugae</i> strain PRAA4-1)	1-3 lb	4	0	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 (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.
Beetles: blister beetle, flea beetle, Colorado potato beetle, cucumber beetle, whitefringed beetle)	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	Imidan 70 W (phosmet)	1.3 lb	5 days	7	Use only on potatoes to be harvested by machine. Do not apply where bees are foraging.
	1B	*Thimet 20 G (phorate)	See label - varies with soil type and time of application.	48	90	One application per season.

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	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 ai/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	Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed ² .
	3A	*Brigade 2 EC (bifenthrin)	9.6-19.2 oz at-plant (soil); 3.2-9.6 oz at lay-by (soil); 2.1-6.4 oz (foliar)	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 (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/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 ai/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)	5.7-8.7 fl oz as soil treatment or as 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 ai 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 ai (16 oz of product) per acre per season.
	4A	Belay Insecticide (clothianidin)	9-12 fl oz (in-furrow or side dress application); 2-3 fl oz (foliar)	12	Foliar: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, side dress 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 - 7soil - 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 200 SL (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum amount per year=28 fl oz/acre.

Table 1. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
 Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code ¹	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes 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.
	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 1 st and 2 nd instar larvae. Does not control adult CPB. Use lower rate for leafminers. Maximum per acre per season: 1.0 lb.
	22	Avaunt (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.
	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.
	un	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.
	--	M-Pede 49% EC (soap, insecticidal)	1-2% V/V	12	0	OMRI-listed ² .
Fireants	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 three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Leafhopper	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 4 EC (dimethoate)	0.5-1.0 pt	48	0 if mechanically harvested, 14 otherwise	Highly toxic to bees. Do not apply more than 2 pts per acre per year.
	1B	Imidan 70 W (phosmet)	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 ai/acre per season (7 applications at highest rate).
	3A	Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, 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)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/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 ai/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.

Table 1. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical. Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code ¹	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes 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.
	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)	5.7-8.7 fl oz as soil treatment or as 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 ai 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 - 7soil - 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)	0.75-2.25 oz	24	7	Do make more than 2 consecutive or 4 total applications per crop.
	4D	Sivanto 200 SL (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum amount per year=28 fl oz/acre.
	un	Azatin XL (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellent, insect growth regulator.
	--	Grandevo (<i>Chromobacterium subtsugae</i> strain PRAA4-1)	1-3 lb	4	0	OMRI-listed ² .
	--	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)	3-6 qt/100 gal (JMS)	4	0	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed ² .
Leafminer	3A	Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed ² .
	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 non-ionic 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 1 st and 2 nd instar larvae. Does not control adult CPB. Use lower rate for leafminers. Maximum per acre per season: 1.0 lb.
	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.
	un	Azatin XL (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellent, insect growth regulator.

Table 1. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical. Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code ¹	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes ²
	--	Sun Spray 98.8%, JMS Stylet-Oil, others (oil, insecticidal)	3-6 qt/100 gal (JMS)	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 non-ionic 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.
	un	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 .
	un	Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed ² .
	--	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)	3-6 qt/100 gal (JMS)	4	0	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed ² .
Leaf-footed bug, plant bug, stink bug, mealybugs, false cinch bugs	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	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 ai/acre per season (7 applications at highest rate).
	3A	Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellent, 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 ai/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 ai/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.
	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.
	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.
	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.
	9C	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 .
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 ai/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.

Table 1. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical. Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code ¹	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes ²
	3A	*Pounce 25 WP (permethrin)	6.4-12.8 oz	12	14	Do not apply more than 0.8 lb ai/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 (check label for species controlled)	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 than 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.
	un	Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed ² .
	un	Azatin XL (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellent, insect growth regulator.
	un	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 .
	--	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)	3-6 qt/100 gal (JMS)	4	0	See label for tank mix cautions. Organic Stylet-Oil is 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)	5.7-8.7 fl oz as soil treatment or as 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 ai 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 ai (16 oz of product) per acre per season.
	4A	Belay Insecticide (clothianidin)	9-12 fl oz (in-furrow or side dress application); 2-3 fl oz (foliar)	12	Foliar: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, side dress 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.
	4D	Sivanto 200 SL (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum amount per year=28 fl oz/acre.
	4D	Sivanto 200 SL (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum amount per year=28 fl oz/acre.

Table 1. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code ¹	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes ²
	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.
	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.
	un	Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed ² .
	un	Azatin XL (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellent, insect growth regulator.
	un	Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	Insect growth regulator and anti-feedant. OMRI-listed ² .
	un	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 .
	--	Grandevo (<i>Chromobacterium subtsugae</i> strain PRAA4-1)	1-3 lb	4	0	OMRI-listed ² .
	--	Sun Spray 98.8%, JMS Stylet-Oil, others (oil, insecticidal)	3-6 qt/100 gal (JMS)	4	0	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed ² .
Wireworm	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.
	4A	Admire Pro (imidacloprid)	5.7-8.7 fl oz as soil treatment or as 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 ai 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.
	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.
	3	Capture LFR (bifenthrin)	25.5 fl oz			In furrow at planting
	3A	*Brigade 2 EC (bifenthrin)	9.6-19.2 oz at-plant (soil); 3.2-9.6 oz at lay-by (soil)	12	21	Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.
	4A	Belay Insecticide (clothianidin)	9-12 fl oz (in- furrow or side dress application)	12	Foliar: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, side dress 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.

¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups 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 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 the University of Florida Cooperative Extension Service 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.