CHAPTER 11

PLANTING AND ESTABLISHING TREES

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Introduction

Planting and establishing trees is all about managing air and moisture in the soil. Manage these correctly and trees will grow quickly following planting. Three of the most common causes of poor plant establishment or tree death are planting too deep, under watering, and over watering. If appropriate trees are planted at the right depth and they are irrigated properly, the planting has a good chance of success. As simple as this appears to be, problems often arise that lead to poor establishment or plant failure.

Ten steps to proper tree planting	
1.	Look up for wires and lights
2.	Dig shallow and wide hole
3.	Find the topmost root and treat root defects
4.	Carefully place tree in hole
5.	Position top root 1-2 inches above landscape soil
6.	Straighten tree
7.	Remove synthetic materials
8.	Add and firm backfill soil
9.	Add mulch
10.	Stake and prune if needed

Ten Steps to Planting Trees

Step 1

Look up

If there is a wire, security light, or building nearby that could interfere with proper development of the tree canopy as it grows, plant elsewhere or plant a tree that has a small canopy or a narrow canopy at maturity. Although small trees remain below the wires, they often have a short life span. If large trees are planted too close to wires, it increases costs of providing electrical service and reduces reliability. Consider moving wires or lights so a larger tree can be planted.

Step 2

Dig shallow and wide planting hole

To estimate the depth of the planting hole, measure the distance between the point where the topmost root emerges from the trunk and the bottom of the root ball. Then dig a hole slightly shallower than this distance (Figure 1). No more than about 2 or 3 inches of the root ball needs to be above the soil unless the site is poorly drained. If the soil is poorly drained, plant even higher. If the hole was inadvertently dug too deep, add soil to the bottom of the hole and compact it with your foot. If the hole fills with water as you dig it, position the bottom of the root ball above the water and mound soil to cover the sides of the ball.

Make the hole at least 1.5 times the diameter of the root ball (Figure 2). Wider holes should be used for compacted soil and wet sites. This helps roots from becoming deformed by the edge of the hole in compacted or clayey soils. Breaking up compacted soil in a large area (out to the drip line of the tree) around the tree provides the newly emerging roots room to expand into loose soil. This will hasten root growth translating into quicker establishment. Do not underestimate the positive effect this technique has on tree establishment in hard soils.

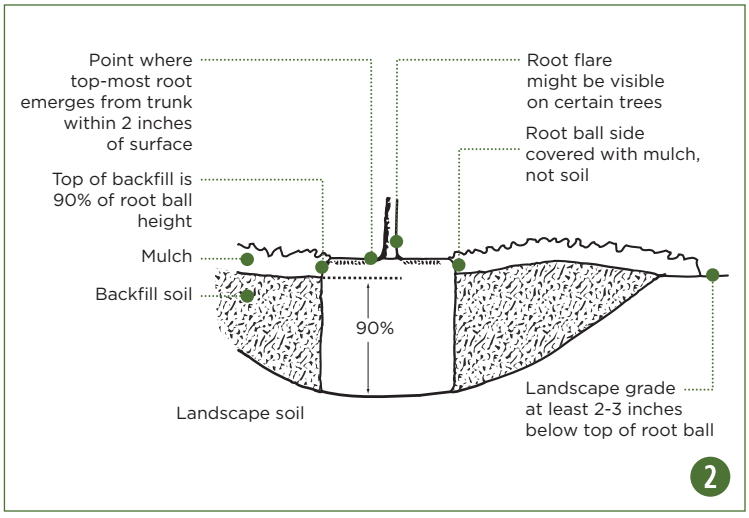

Figure 1

In well-drained soils, the planting hole depth should be 90-95% the distance between the topmost root and the bottom of the root ball.

Figure 2

The planting hole should be at least 1.5 times the diameter of the root ball, but a wider hole is better.

Step 3

Find the topmost root and treat defects

Choose a tree whose topmost root emerges from the trunk visibly, at or slightly above the surface. Not all root balls come from the nursery like that. In the highest-quality root balls, the point where the topmost rootemerges from the trunk should be within 2 inches of the surface (Figure 3). The topmost roots and root flare (if present) in poorer quality root balls are buried down inside the root ball. Trees whose topmost roots are too deep in their root balls have less of a root system than trees whose topmost roots emerge near the surface. If you cannot see the topmost root, remove excess soil to expose it before you plant the tree. As the distance between the topmost root and the soil surface increases, the percentage of the root system harvested from the field nursery decreases.

To check for root defects such as circling and kinked roots in containers or field-grown trees, you might have to displace or remove soil and media from the top of the root ball, especially near the trunk. Cut or spread out any circling or kinked roots growing up above the topmost root. This will prevent these roots from strangling the trunk in the future.

Circling roots can be found on container-grown trees, field-grown (balled-in-burlap, or B&B) trees, or bare-root trees. Eliminate this defect by cutting roots at planting. This can be accomplished on B&B or container trees with pruners before trees are placed in the hole (Figure 4) or by slicing the edge of a container root ball from top to bottom with a balling spade after trees are in the hole. Cut roots that are kinked or any that circle the top of the root ball. If these cut roots are large (larger than about 1/3 trunk diameter), the tree might shock and could die. Be sure to look for roots that circled when trees were in a smaller container. These are difficult to cut because they are hidden in the interior of the ball. Buy from a quality grower to avoid this.

Circling roots do not always result in trunk girdling, however trees may develop a severe lean after a wind storm due to an issue with circling roots (Figure 5). Because few, if any, branch roots develop on the outside of a circling root there may be no support on that side of the

Figure 3

In high-quality root balls, the topmost root emerges within 2 inches of the surface. In the tree shown above, the topmost root is visible at the surface.

Figure 4

Cut roots that circle the outside of the ball. This will not stress the tree if roots are small or if the tree is not overgrown in its container. New roots will grow quickly into backfill soil following cutting, and stem-girdling roots are less likely to form. Roots can be cut with pruners or a balling spade.

Figure 5

This elm tree developed a lean after a storm due to lack of support roots. Support roots have a difficult time stabilizing the tree when circling roots are present.

tree. Cut the circling root at the point before it begins to circle. This will prevent new roots that emerge from the cut from circling the trunk again.

Step 4

Carefully place tree in planting hole

To avoid damage when setting the tree in the hole, lift the tree with straps or rope around the root ball. Do not lift it by the trunk. Special strapping mechanisms need to be constructed to carefully lift trees out of large containers and to handle large B&B trees to prevent bark damage on the trunk and branches. B&B trees should be handled by the root ball. Remove any plastic wrapped around the root ball before planting. If you measure carefully, the root ball will not have to be removed from the planting hole to adjust hole depth. Trees planted from containers may settle more than B&B trees, so you may want to position these an inch or two higher. Larger containers appear to settle more than smaller containers.

Step 5

Position the topmost root 1 to 3 inches above the landscape soil

Position the topmost root about even with or slightly above (about 2 inches above) the top of the landscape soil in well-drained soil. Plant even higher in soil that drains poorly.

Most horticulturists agree that it is better to plant the tree too high than to plant it too deep. Lay a shovel across the top of the planting hole to check root ball depth. If the tree is too deep in the hole, remove it from the hole and firmly pack soil in the bottom of the hole to raise the root ball. If it is only a little bit too deep, tip the ball to one side and slide some soil under it; then tip it back the other way and slide some more soil under the ball. Continue this until it is set at the appropriate depth. Once it is at the appropriate depth, place a small amount of soil around the root ball to stabilize it. A large body of research and experience shows that soil amendments are usually of no benefit. The soil removed from the hole makes the best backfill unless the soil is poor or contaminated.

Step 6

Straighten the tree in the hole

Before you begin backfilling have someone view the tree from two directions perpendicular to each other to confirm the tree is straight. Fill in with some more backfill soil to secure the tree in the upright position. Once you add large amounts of backfill, it is difficult to reposition the tree.

Step 7

Remove synthetic materials

String, rope, synthetic burlap, strapping, plastic, and other materials that will not decompose in the soil must be removed at planting. Synthetic burlap melts into plastic goo, while real burlap flames and turns to ash when lit. If burlap is synthetic, be sure to remove all of it with a pruner, knife or other sharp blade. Roots grow through artificial burlap with little difficulty, but as the roots attempt to expand in diameter, they become girdled or strangled (Figure 6). Artificial and synthetic burlap is not commonly used in the southeastern U.S.

Many contractors leave the treated burlap commonly used by field growers pinned in place. This seems to be all right as long as the topmost root is not too deep and there are no root defects to treat. However, removing burlap from the top of the ball allows you to check for root defects including deep planting in the root ball and circling roots.

Baskets made from wire are typically used to help keep a root ball intact during shipping and handling. Some people attempt to remove some or all of the wire from wire baskets before backfilling; this may void any guarantee that came with the tree. There is no research documenting the detrimental effects of wire baskets on trees. If you decide to remove wire, do so after the tree is positioned in the hole. Stake the tree to stabilize it.

Figure 6

This synthetic burlap is still intact 10 years after planting. Each of these roots is very easy to break off at the burlap because there is very little wood that developed through the synthetic material. Roots grow easily through natural treated burlap so this does not need to be removed from the sides of the ball. Never use synthetic burlap.

Step 8

Add backfill and firm the backfill soil

Slice a shovel down into the backfill 20 to 30 times all around the tree as you add backfill soil. Attempt to break up large soil clumps as much as possible. Do not pack the backfill, instead step firmly on the backfill soil to help stabilize the root ball (Figure 7). When the planting hole is filled with soil, the root ball should remain 1 inch (small trees) to 3 inches (larger trees) above the backfill soil. Do not over-pack the loosened soil, especially when soil is wet.

Add 10 to 20 gallons of water to the root ball and backfill. Fill in any holes or depressions with additional backfill soil. Do not firmly pack backfill soil in an attempt to eliminate air pockets because this could cause too much soil compaction, especially in clay soil. The water infiltrating the backfill soil will eliminate many of the large air pockets. The presence of small air pockets could even be of benefit because they could allow more air to reach the roots.

Step 9

Cover sides of the root ball with mulch

Provide a 3-inch-deep layer of mulch around the tree (Figure 8). Mulches reduce soil temperature fluctuations, prevent packing and crusting, conserve moisture, help control weeds, add organic matter to the soil, and improve the appearance of the landscape. Generally, a 2 to 3 foot diameter circle of mulch per inch of tree trunk caliper will give adequate mulch area for newly planted trees (Figure 9). A thin (1 inch) layer of mulch can be placed over the root ball for aesthetic reasons, but deep layers on the root ball can prevent adequate irrigation and rain from reaching roots. Keep turf as far away from the trunk as possible with mulch or herbicides to aid tree establishment, to prevent mower damage to the trunk, and to prevent soil compaction.

Common mulch materials include leaves, pine needles, compost, bark, and wood chips. Peat and cypress chips should not be used since once dry they are very difficult to wet and may restrict water movement into the soil. Inorganic materials such as gravel and crushed stone have been used. They provide no organic matter, are

Figure 7

The root ball is now surrounded by about 18 inches of loose soil on all sides. No soil was placed over the root ball (top). Never place soil over the root ball (bottom). This places the tree too deeply.

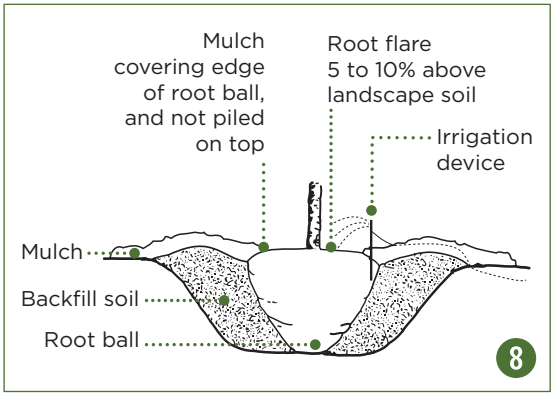

Figure 8

Proper installation showing recommended position of mulch and irrigation device.

Figure 9

Note that the edge of the mulch is beyond the edge of the canopy. This allows for the tree roots to expand without competition from turf roots. This also prevents soil compaction, which restricts root growth.

difficult to keep tidy and clean, and often work their way into the soil.

If turf grass grows up to the trunk, trees often perform poorly. Turf and weeds rob trees of moisture and nutrients and some produce chemicals that inhibit tree growth. Lawn mowing equipment often damages the trunk when mowing turf close to the trunk. This is a good way to kill trees.

Never pile mulch in a volcano-like manner against the trunk (Figure 10). This can rot the trunk, cut off oxygen to roots, keep vital irrigation and rain water out, and can keep roots too wet in poorly drained soils. Roots grow up into this pile of mulch because it is very well aerated and moist. Stem-girdling roots form from this on some trees and cause stress and decline.

If you believe a berm is needed to hold water from a high volume delivery system such as a hose or water truck, use mulch, not soil to construct a berm at the edge of the root ball. If soil is used to construct the berm, it can wash over the root ball and bury the roots too deeply. Plastic edging has also been used to keep water in so it all percolates through the root ball. The berm will ensure that water penetrates to where it is needed most, i.e. in the root ball. If soil is sandy or very well drained, a berm may not be needed. The berm should be removed once the tree is established. Do not push the berm onto the root ball and trunk since this can cause root defects.

Step 10

Stake and prune if needed

Stake the tree if necessary to hold the root ball firmly in the soil. If the root ball moves in the wind, emerging roots could break and trees will establish slowly. Staking to hold a thin, weak trunk upright should not be necessary on trees with a trunk diameter more than about 1.5 inches. If large trees require staking to prevent the trunk from bending, it probably indicates a lesser quality tree. Smaller trees might require staking until enough trunk strength develops.

Figure 11 shows traditional staking systems. The system shown on top consists of three short stakes (2 shown) attached to the trunk with straps. The center system consists of three short

Figure 10

Never mulch in this manner. Deep mulch on the root ball and against the trunk leads to poor establishment, root defects, stress, decline, and in some cases death. Some rodents, such as voles, can also cause damage to the trunk easily if mulch is piled there. Trees could decline from this problem.

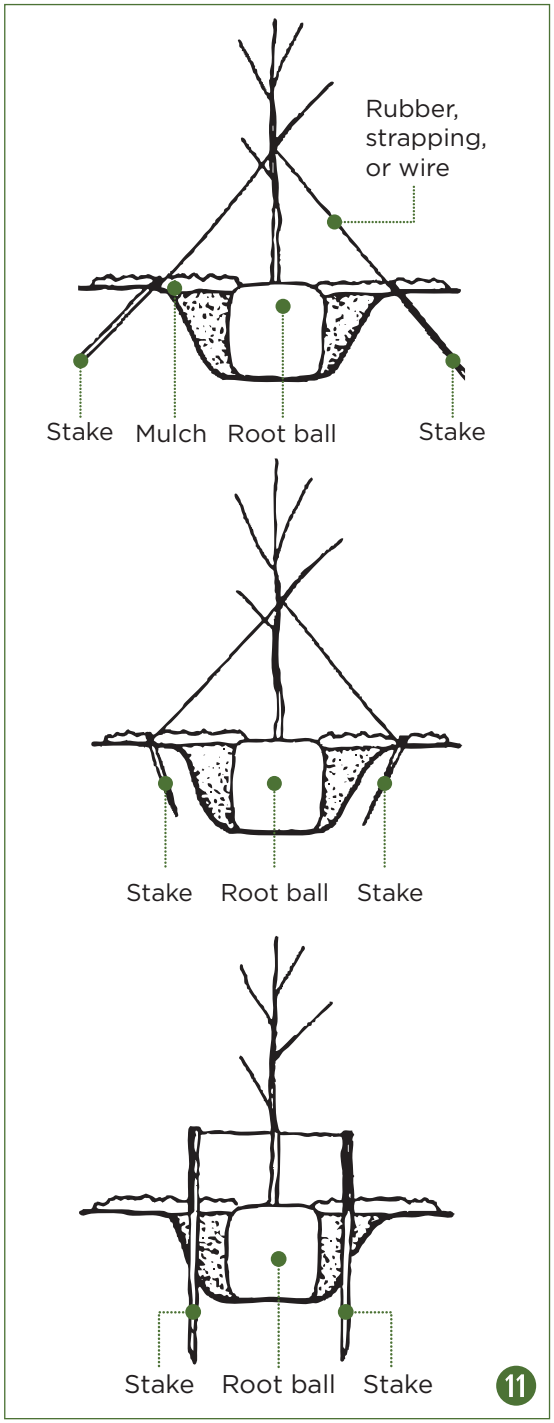

Figure 11

Traditional staking systems require removal within one year after planting. They do not appear as effective as newer designs.

stakes (2 shown) driven into soil in a traditional manner attached to the trunk with stretchable material. The system shown on bottom consists of two or three two-inch by two-inch wood stakes driven through the backfill soil. Recent research shows that stakes driven straight into the ground, not at an angle as shown in Figures 12 (left and center), are most secure in the soil. All three traditional systems require removal within about one year after planting. Figure 12 shows a stiff staking system. These hold trees upright in strong winds, but can restrict growth below the securing point if left on too long.

Root stabilization systems do not need to be removed because they decay within a few years (Figure 13). One system consists of one horizontal two-by-two screwed to two vertical, four-foot-long two-by-twos against the side of the root ball (Figure 13; top and center). Our research shows that these root stabilization systems work very well and are better able to hold trees against strong winds than traditional systems shown in Figure 11.

Prune to remove or reduce stems that compete with the main leader if no pruning is planned in the next couple years. Wait until later if there is pruning planned in the next two years. Broken branches should also be pruned, but do not over-prune to compensate for root loss.

Establishing Trees

Irrigation and Mulch

The establishment period is the time it takes for a tree to regenerate enough roots to stay alive without irrigation. During this period, shoots and trunk grow slower than they did before transplanting. When their growth rates become more or less consistent from one year to the next, the tree is considered established.

In moist climates, by the end of the establishment period a tree has regenerated enough roots to stay alive without supplemental irrigation in a landscape where roots can expand uninhibited by urban structures. In the drier parts of central and western US, the turf and landscape irrigation system may have to supplement rainfall to provide enough water for survival after establishment. Establishment rate is determined by a number of factors (Table 1).

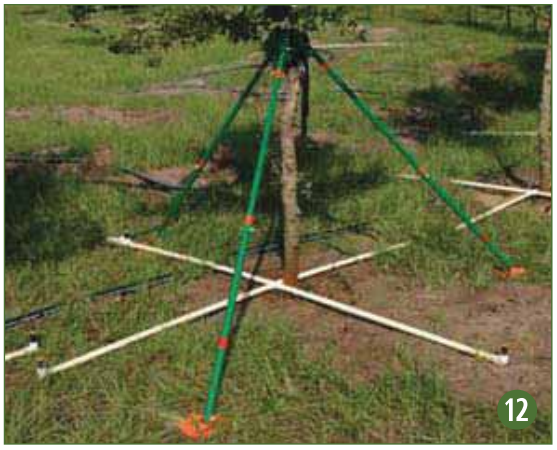

Figure 12

Stiff stabilization systems such as the Brooks Tree Brace work better than systems in Figure 11. Do not leave these on too long since trunk diameter may develop poorly below the securing point.

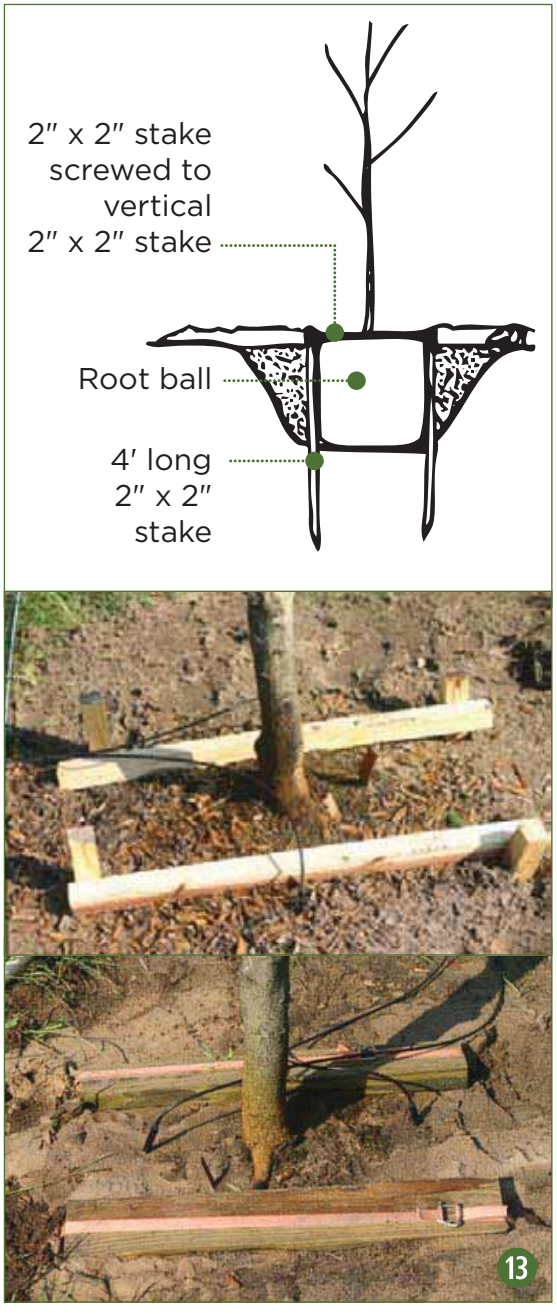

Figure 13

A simple system comprised of untreated two-by-two lumber is inexpensive, easy to install, and a very effective way to stabilize trees in strong winds (top and middle). The Terra Toggle system (bottom) is also very effective for stabilizing trees. There is no danger of trunk girdling in these systems since nothing is attached to the tree.

Table 1. Establishment rate is determined by many factors.

ENCOURAGES GROWTH	LIMITS GROWTH	LITTLE OR NO EFFECT
loose soil	compacted soil	peat or organic matter addition as backfill
proper irrigation management	little or no irrigation	root stimulant products
mulch 8 feet in diameter or more around planting hole	grass and weeds close to trunk	fertilizing at planting
root flare slightly above soil surface	planting too deeply	adding spores of mycorrhizae*
leaving top of tree intact	pruning at planting	water absorbing gels

* Can enhance growth on seedlings under certain circumstances, but does little for landscape-sized trees.

During establishment, trees should be irrigated 2-3 times weekly with 2 gallons per inch trunk caliper. All this water should be applied only to the top of the root ball. Daily irrigation will keep trees healthier. Research shows that frequency of irrigation has a greater affect than irrigation volume (Table 2). This means that you can not make up for lack of frequency by adding large volumes less frequently. Daily irrigation may or may not be necessary when planting in winter, cool climates, or during rainy weather. Irrigation frequency can be reduced to 2-3 times each week instead. Never apply irrigation if the soil is saturated.

Table 2. Irrigation schedules depend on size of nursery stock and desired objective*.

SIZE OF NURSERY STOCK	IRRIGATION SCHEDULE FOR	
	VIGOR	SURVIVAL
Less than 2 inch caliper	**Daily**: 2 weeks **Every other day**: 2 months **Weekly**: until established	Twice weekly for 2-3 months
2-4 inch caliper	**Daily**: 1 month **Every other day**: 3 months **Weekly**: until established	Twice weekly for 3-4 months
greater than 4 inch caliper	**Daily**: 6 weeks **Every other day**: 5 months **Weekly**: until established	Twice weekly for 4-5 months

* Establishment takes approximately 3 months (hardiness zones 10-11) to 4 months (hardiness zones 8-9) per inch trunk caliper.

During establishment mulch should be maintained to control weeds and protect the trunk. Weeds can also be controlled with herbicide. Increase mulch diameter over time to keep pace with root growth for best establishment. Roots normally grow 3 to 10 feet in length the first year after planting. Soil compaction should also be minimized during establishment to allow adequate root expansion. This is best accomplished with wide mulch areas. If staking systems have not been removed, remove them about one year after planting to prevent trunk girdling but keep mulch off the root ball (Figure 14).

Figure 14

Keep mulch off the root ball to discourage formation of stem girdling roots. The trunk flare should be visible as in this photograph.

Root Management

Trees with roots that are touching or circling the trunk (Figure 15, bottom) instead of growing straight away (Figure 15, top) stress the tree by reducing or eliminating vascular flow where the root contacts the trunk. Stress increases with time and can lead to trunk or root decay, or a decline in health.

This can be corrected by removing the root defect, but root removal also stresses the tree. But the stress from root removal will only last for a relatively short period and will decrease with time as the tree recovers from lose of roots. If the cambium has not been permanently damaged where the root touched the trunk then normal vascular flow can return. Irrigation management during this recovery time is likely to reduce stress and help the tree recover in dry soil. You must judge whether eliminating stress by removing the defect outweighs the temporary increase in stress brought on by root removal. Typically, removing the defect is best for the tree.

Certain species such a maple, magnolia, holly, mahogany, gumbo limbo, and tabebuia appear especially sensitive to this defect; however, any tree can be affected by circling or stem girdling roots. Some arborists routinely remove roots that might be one-quarter of the

trunk diameter, or even larger. Cut roots at the point where they begin to circle so new roots that grow from the cut will point more-or-less away from the trunk.

If the defective root circles more than half the trunk diameter and is embedded into the trunk (Figure 16) give careful consideration to whether removal will help the tree. Some defects are so severe that removal may not be possible; or the defect might have already killed the cambium on that side of the tree. Check by carefully penetrating the trunk tissue just above the root defect to see if the tissue is green or brown. If you find no live green tissue on a large portion of the circumference of the trunk then that portion of the trunk is dead and treatment may be futile.

Figure 15

(Top) Roots should grow straight from the trunk for the best health and stability. (Bottom) This trunk will become girdled causing decline and tree death if this root is not removed. Cut it just behind the point where it begins to circle the trunk. Following pruning, the remaining root segment should be straight out from the trunk.

Figure 16

A severe stem girdling root such as this one will be difficult to remove. Portions of it can be cut without removing it.

Additional Resources

Landscape Plants

http://hort.ifas.ufl.edu/woody/planting.html

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