



CMG GardenNotes #636

Tree Planting Steps

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This publication summarizes the tree-planting process. For an in-depth discussion on tree planting, refer to CMG GardenNotes #633, *The Science of Planting Trees*. The science of planting trees is aimed at promoting rapid root growth (regeneration) to reduce water stress imposed by the planting process. Post-planting stress (transplant shock) consists of the stress factors induced by the reduced root system.

Prior to planting, call before you dig. Whether you plan on planting the tree yourself or hiring the work done, the site needs to have underground utilities marked before digging. In Colorado, call the Utility Notification Center of Colorado at 8-1-1 or 1-800-922-1987. It can also be done online at <https://www.colorado811.org/>. Utilities will be marked within 72 business hours.

Step 1. Determine the Depth of the Planting Hole

Planting trees too deep is a common problem that can lead to the decline and death of landscape trees. Trunk-girdling roots, sometimes caused by planting too deep, can lead to early tree failure and loss. Trunk-girdling roots develop when a tree improperly planted at the nursery (often being planted too deep in the ground or container) and/or the root ball is planted too deep in the planting hole. These roots may lead to decline and death some twelve to twenty years after planting and may be located above or below ground.

Depth of Root Ball in Planting Hole

In tree planting, the root ball should sit on undug soil. This prevents the tree from sinking and tilting as the soil settles. If the hole is dug too deep, add backfill, and firm the soil on the bottom of the planting hole to the correct depth. (Roots will grow out laterally from the root ball, not down.)

To deal with the soil texture interface (the differences in soil pore space) between the root-ball soil

and backfill soil, it is imperative that the root ball sit slightly above grade with no backfill soil added over top of the root ball. Measure the height of the root ball and subtract 1 or 2 inches to account for the root ball sitting slightly above grade.

For small (1" caliper) trees, the top of the root ball should sit 1" above grade (subtract 1" from the total height of the root ball). For larger (2-to-4" caliper) trees, the top of the root ball should sit about 2" above grade (subtract 2" from the total height of the root ball).

Backfill soil should cover the "knees" (considered the edges of the root ball) tapering down to grade. **[Figure 1]** If the backfill covers the root ball, water and air may be slow to cross the texture interface. This may also result in decreased soil oxygen levels for roots. **[Figure 2]**

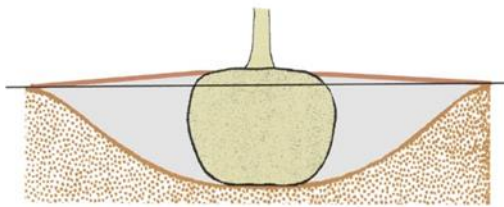


Figure 1. Depth of root ball in planting hole: The top of root ball sits 1-2" above soil grade. No soil is placed over top of the root ball. Backfill soil covers the "knees" tapering downward to the original soil grade. Root ball sits on un-dug, firmed soil to prevent sinking.

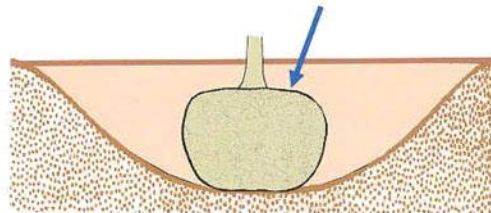


Figure 2. It is imperative that the root ball sits above the soil grade, with no backfill on top of the root ball. When backfill soil is placed over the top of the root ball, the soil texture interface can impede water and air movement into the root ball.

Depth of Tree in Root Ball

- Generally, at least two structural roots should be within the top 1-2" of the root ball, measured 3-4" from the trunk.
- On species prone to trunk-circling roots (crabapples, hackberry, linden, poplar, maple, and other species with fibrous root systems), the top structural root should be within the top 1" of the root ball.

Checking Depth of Tree in Root Ball

- The presence of the root flare is an indication of good planting depth. Be careful not to mistake the swollen graft union as the root flare.
- A good way to evaluate planting depth in the root ball is with a slender implement like a screwdriver. Gently probe the root ball 3-4" out from the trunk to locate structural roots and determine their depth.
- If the tree is planted too deeply in the root ball, excess soil should be removed from the top in the backfill step of the planting process. Adjust the depth of the planting hole to compensate.

Step 2. Dig a Saucer-Shaped Planting Hole 3X the Root Ball Diameter

The top of the root ball should sit 1-2" above grade and sit on undug soil. The width of the planting hole should be three times the width of the diameter of the root ball. A saucer-shaped planting hole 3 times the diameter of the root ball allows the root system to grow rapidly. **[Table 1]**

Table 1. Reference Chart to Determine Planting Hole Depth and Width

Size of tree	Height of root ball (example)	Top of root ball should sit	Depth of planting hole	Width of root ball	Width of planting hole	Depth and width of planting hole
1" caliper	12"	1" above soil grade	11"	20"	60"	11" deep x 60" wide
2" caliper	18"	2" above soil grade	16"	24"	72"	16" deep x 72" wide

Step 3. Set the Tree in Place and Remove Container/Wrappings

In this step, techniques will differ for container-grown trees, balled & burlapped (B&B) trees, and bare root stock.

Techniques for Container-Grown Nursery Stock

The planting techniques in this step will vary with the type of container and extent of root development. Generic steps include:

1. Lay the tree on its side in or near the planting hole.
2. Wiggle off or cut off the container, including removing any fabric. The ideal container-grown tree has a nice network of roots holding the root ball together. If some of the soil falls off (often on the bottom), it may be necessary to adjust the depth of the planting hole. Adjust the depth of the planting hole based on the new height of the root ball. If most of the soil falls off the roots, the tree should be planted as a bare-root tree (see below section on bare roots).
3. Shave off the outer 1-1 ½" of the root ball with a knife or saw. This step is important to deal with circling roots. Discard the shaved roots.
4. Move the tree into place. Limit using the trunk as a handle. The inside curve of the graft union should face north.
5. Check the depth of the root ball in the planting hole to ensure that the root ball is sitting about 1" above the soil grade. If incorrect, remove the tree and correct the planting hole depth, firming any soil added back to the hole.
6. Align the tree vertically, adding soil to the base of the root ball as needed. Check the tree from several angles to ensure the trunk is vertical/straight.
7. Firm a shallow ring of soil around the bottom of the root ball to stabilize it and potentially eliminate the need to stake. **[Figure 3]**



Figure 3. Stabilize the tree by firming a small ring of backfill soil around the base of the root ball.

Techniques with B&B Nursery Stock

B&B trees and shrubs are dug from the production field with the root ball soil intact. An advantage of the wider planting hole is that it gives room for the individual planting to remove the root ball wrappings after the tree is situated in the hole.

Based on research, the standard recommendations are to remove the root ball wrapping materials (burlap, fabric, grow bags, twine, ties, wire basket, etc.) from the upper twelve inches or 2/3 of the root ball, whichever is greater after the tree is set in place. Removing these materials outside of the planting hole and then moving the tree into the hole may cause the root ball to shatter. The materials left in the planting hole are not a concern since roots grow outward, not downward. Actual planting techniques in this step will vary.

Generic steps include:

1. Remove any extra root ball wrappings added for convenience in shipping and marketing (like shrink-wrap, ties, or a container). However, do not remove the burlap, wire basket, and twine that hold the root ball together until the tree is set in place and in the hole.
2. Set the tree in place in the planting hole. The inside curve of the graft faces north.
3. Check the depth of the root ball in the planting hole and ensure the top of the root ball sits 1-2" above the soil grade. If incorrect, remove the tree and correct the planting hole depth, firming any soil added back to the hole.
4. Align the tree vertically and check it from several angles to ensure the trunk is straight. If the tree is crooked, add soil under the root ball.
5. Remove all the wrapping (burlap, fabric, twine, wire basket, etc.) on the upper twelve inches or upper 2/3 of the root ball, whichever is greater.
6. For stability, firm a shallow ring of soil around the bottom of the root ball. This is done to eliminate the need to stake in many situations. **[Figure 4]**
7. If circling roots are found in the root ball, shave off the outer 1-1½ inches of the root ball with a pruning saw and/or pruners. You can also remove these roots with a pair of pruners if the roots are larger.

Leaving burlap, twine, and wire baskets on the sides of the root ball are not acceptable planting techniques.

Techniques to Plant Bare Root Nursery Stock

Bare root trees are planted with the same basic steps as container-grown or B&B stock, with the modification that the roots are spread out on a mound of soil in a horizontal plane in the planting hole. It is critical to minimize exposure of the roots as feeder roots can dehydrate quickly.

Generic steps include the following:

1. Unpack roots to measure horizontal root spread. Cover or repack to protect roots while the hole is dug. Consider re-hydrating roots in a bucket of water for a couple of hours. Do not let them soak for more than half a day.
2. Dig a shallow, saucer-shaped planting hole three times the diameter of the root spread. The depth of the planting hole should accommodate the planting depth standards mentioned previously.
 - a. Create a mound of soil at the base of the planting hole. The mound's height would be based on the tree's root structure and where the first structural roots are located. Generally, at least two structural roots should be within the top 1-2" of the soil

- surface. The mound height will take some trial and error.
- b. On species prone to trunk circling roots (such as crabapples, hackberry, linden, poplar, and maple), the structural roots should be within the top 1" of the root ball soil surface.
 3. Gently spread the roots out on top of the mound on a straight, horizontal plane.
 4. As backfill is added, gently tamp the soil around the roots and gently pull up on the tree to help fill in the air pockets around the roots. Do not stomp the soil with your feet but press on the soil to help secure the tree in place.
 5. Many bare-root trees will need staking.

Labor-Saving Techniques

A labor-saving technique is to dig the hole twice the root ball width with more vertical sides. Place the tree in the hole at the correct depth, firm a ring of soil around the base of the root ball to stabilize it, remove wrappings, and correct for circling roots. Then with a shovel cut the sides of the planting hole to form the saucer-shaped planting hole three times the root ball diameter. With this technique, part of the backfill soil does not have to be removed and shoveled back but falls back into the hole.

Step 4. Underground Stabilization (if Needed)

One option in tree planting is to use underground stabilization of the root ball rather than aboveground staking. Underground stabilization is out of the way and will not damage the trunk's bark. For information on underground stabilization, refer to CMG GardenNotes #634, *Tree Staking and Underground Stabilization*. Staking became a routine procedure when trees were planted in deep holes and the trees sank and tilted as the soil settled. It is also commonly done in public areas. In *The Practical Science of Planting Trees* (Gary W. Watson and E.B. Himelick, International Society of Arboriculture), where trees are set on undisturbed soil and a ring of soil is firmed around the base before backfilling, staking or underground stabilization is not needed in most landscape settings.

Step 5. Backfill

During the backfill process, the best method is to simply return the soil that was removed during digging the hole and let water settle it. Backfill should not be placed on the top of the root ball. The backfill soil should cover the root ball "knees" tapering down to the original soil grade.

Amending the soil in the planting hole is a complex issue and has been researched extensively. In tree planting, it is a common procedure to amend backfill soil with organic matter, such as compost. Amending the backfill soil to be five percent organic matter by volume is acceptable and may be supportive to root growth in the planting hole during the first two years. However, amending the backfill to twenty-five to fifty percent organic matter may also hinder root spread beyond the planting hole, hold excessive amounts of water, and decompose, reducing the total volume of soil in the planting hole.

For rapid root establishment and eliminating post-planting stress, the focus needs to be on creating a planting hole with the correct width and depth. In most situations, amending or not amending the backfill has little significance compared to other planting protocols.

Step 6. Staking (if Needed)

When trees are set on undisturbed soil and a ring of soil is firmed around the base before backfilling, staking is not needed in most landscape settings. In areas with extreme winds, "anchor staking" may be needed for improved wind resilience. In some landscapes, new trees may need "protection staking" to protect trees from human activities (like a soccer game on the lawn).

Step 7. Water to Settle Soil

Watering is done after planting and staking so the gardener does not compact the wet soil by walking on the area. It may take several applications of water to thoroughly soak the backfill and allow the soil to naturally settle so the final soil grade can be established. Watering settles the soil without overly packing it.

Step 8. Final Grade

In the wide, shallow planting hole, the backfill soil is likely to settle during watering. Final grading may be needed after watering.

Step 9. Mulch

A mulch ring of arborist wood chips or bark mulch is suggested around all trees to help protect the trunks from lawnmower and string trimmer damage. Mulch over the rooting area helps conserve moisture, moderate soil temperatures, and helps prevent weeds. Wood/bark chips may also blow away and may not be suitable for open, windy areas. Also consider the location of the trees and practice fire-wise landscaping techniques.

With newly planted trees, do NOT place mulch on top of the root ball. Mulch the backfill area and beyond. Avoid piling mulch against the trunk. Use several inches of arborist chips (four to five inches) to provide the best benefits.

Planting Summary

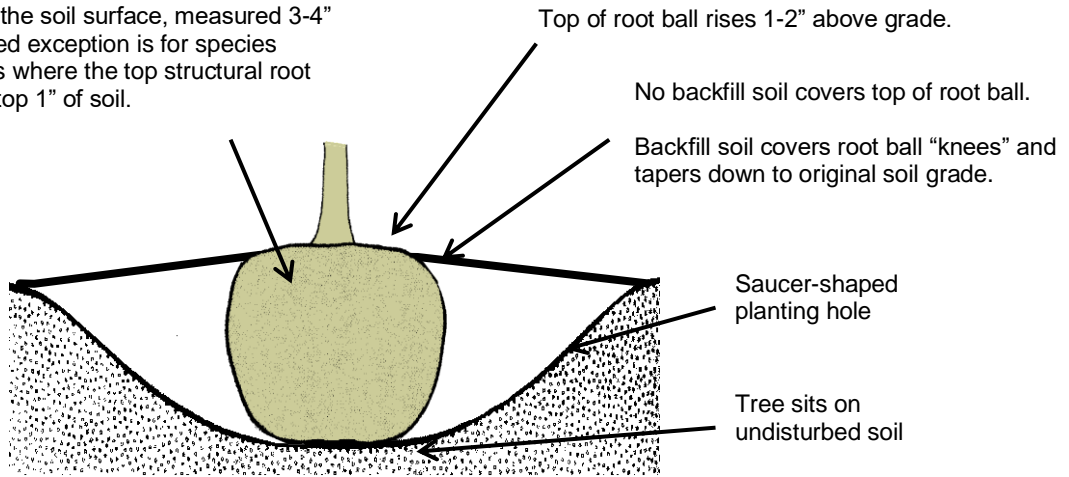
[Figure 4]

1. The tree sits on undisturbed soil.
2. The saucer-shaped hole is 3x the root ball diameter.
3. At least two structural roots are within the top 1-3" of the soil surface, measured 3-4" from the trunk. Species prone to circling roots should have their top structural root within the top 1" of soil.
4. No backfill soil covers the top of the root ball. Soil covers the root ball knees and tapers down to the original soil grade.
5. The top of the root ball rises 1-2" above the original soil grade.

Figure 4. Diagram Showing All Planting Steps.

Generally, at least two structural roots should be within the top 1-3" of the soil surface, measured 3-4" from the trunk. A noted exception is for species prone to circling roots where the top structural root should be within the top 1" of soil.

For best root growth potential, make saucer-shaped planting hole three times root ball diameter.



Authors: David Whiting (CSU Extension, retired), with Alison O'Connor (CSU Extension). Line drawings by David Whiting; used by permission. Reviewed August 2024 by Alison O'Connor.

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