

# Avoiding Excessive Soil Over the Root Systems of Trees: A Best Management Practice

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An industrywide working group was formed in 2003 to develop consensus on a complex national issue: tree decline and death in the landscape resulting from excessive amounts of soil over the root system.

When structural roots are too deep below the soil surface, lack of oxygen can kill roots and lead to decline and death of the tree, especially in urban soils. In some species, prolonged moisture at the base of the trunk may increase root and collar rot diseases.

This effort was coordinated by The Morton Arboretum in Chicago, with Gary Watson as chair of the group. The working group currently includes representatives of the American Nursery and Landscape Association (ANLA), the International Society of Arboriculture (ISA), the American Society of Landscape Architects (ASLA), the Associated Landscape Contractors of America (ALCA), Tree Care Industry Association (TCIA), and the American Society of Consulting Arborists (ASCA).

The working group has completed these best management practice (BMP) guidelines based on the practical experience of many professionals and the relevant scientific research available at this time.

## **Applicability of this BMP**

These best management practice guidelines are intended to assist growers, landscape professionals, and arborists learn to recognize, prevent, and take action to correct root systems that are too deep. This BMP focuses on trees being planted and managed in urban and suburban landscapes, generally 2-inch caliper and larger. It is not intended to apply directly to lining-out stock sold in nurseries that will be grown in the field or in containers, though practices used during such production can ultimately affect trees in the landscape. Trees with root balls can be produced by several methods. These guidelines apply to all.

## **How Deep Should Structural Roots Be?**

Generally, on a young tree, the uppermost structural roots (two or more) should be within the top 1 to 3 inches of the soil surface, measured 3 to 4 inches from the trunk. As a tree matures, roots thicken faster on the top side, effectively reducing the amount of soil above the structural roots and forming the root flare. Special situations requiring exceptions to this general guideline include the following:

- Some species may develop more strongly descending root systems; therefore, the structural roots may have to be located nearer the trunk.
- On landscape sites with poorly drained soil, the roots may need to be even shallower for adequate survival. Structural roots may need to be at, or slightly above, the surrounding grade under extreme conditions.
- In some species, the roots regenerated after transplanting can grow back toward the trunk and become girdling roots. Initial research shows that very little soil over the structural roots could be problematic. *Celtis occidentalis* (hackberry), *Fraxinus pennsylvanica* (green ash), *Acer rubrum* (red maple), *Tilia cordata* (littleleaf linden), *Populus* spp. (poplars), and *Malus*

spp. (crabapples) are species for which this is known to be a problem. Other species with aggressive root systems may also exhibit this tendency.

### **How to Locate Structural Roots**

Checking root depth can be done in the nursery before digging (preferred), or in the B&B or container root ball just prior to planting. Presence of a visible root flare is a good indicator that the structural roots are just below the soil surface. However, on grafted trees, be careful not to confuse the swelling of the trunk below the graft union with the actual root flare. A gap around the trunk at the soil line is a sure sign that the first roots are at least several inches below the soil surface.

If none of these easily recognized signs are present in the field, or if the root ball burlap and twine cover the base of the tree, a surveyor's chaining pin or similar tool can be used to quickly and nondestructively probe for the roots. Probing approximately 3 to 4 inches away from the trunk will determine the true depth of the roots, rather than the depth of the enlarged root flare, if present. At least two roots (preferably more) should be located within 1 to 3 inches of the soil surface.

### **Nursery Stock Selection and Handling**

It is possible for trees to leave the nursery with structural roots too far below the surface of the root ball. Depth of structural roots can increase at several stages of nursery production, including planting, cultivating, transplanting, and harvesting, and possible changes in root architecture can occur during the production process. It is always preferable to avoid trees with roots too deep below the soil surface rather than trying to make corrections later.

The American Standard for Nursery Stock (ANSI Z60.1, 2004) states that, for B&B trees, "soil above the root flare ... shall not be included in the ball depth measurement and should be removed." If the resulting depth measurement of the root ball does not meet the minimum provided in the standard, the ball is not deep enough to encompass a sufficient mass of roots for the vigor of the tree in the landscape, and the tree can be rejected. Be sure growers and suppliers understand what is expected. It can be difficult and time consuming to evaluate and adjust root balls on site or to reject nursery stock with root balls of insufficient depth.

### **Planting Process**

When root balls arrive on site, the depth of the structural roots should be checked before placing the tree in the planting hole.

Bud-grafted cultivars, and some seedling trees, are cut back during production. Evidence of the "dog leg" in the stem (Figure 4) and of a change in bark texture should be approximately 1 to 2 inches above the soil surface for a young tree, with a maximum of 4 to 5 inches between the pruning wound and the uppermost structural roots.

If the structural roots have been located within 3 inches of the surface, the root ball should be planted with the surface no lower than the same level as existing grade. One to two inches higher usually is preferable to allow for settling and "pancaking" of the root ball. Unless conditions are extreme, do not plant so high that the cut ends of the structural roots at the edge of the root ball are above the surrounding grade. Planting the tree any higher may expose roots after minor erosion or contribute to surface root formation in the long run.

If the structural roots are found to be deeper than 3 inches below the root ball surface, the root ball and the planting depth will have to be adjusted. Elevate the root ball so that the

structural roots are at the correct depth relative to surrounding grade. It is best to leave B&B root balls intact until placed in the planting hole, rather than to unwrap them and strip the soil off the top before moving the root ball into the planting hole. Moving an unwrapped root ball may cause unnecessary damage.

If there is extra soil over the structural roots, it may be acceptable in some situations to leave the root ball intact, with the extra soil remaining above grade through the guarantee period. Some contractors prefer to leave the burlap, rope, and wire basket in place for a time to keep the root ball more stable and make it easier to straighten later, if needed. If the wrappings are not removed at planting time, the tree should be checked at the end of the guarantee period, and any remnants of the wrappings or excess soil remaining above grade should be removed.

Suddenly removing excess soil could be problematic for other reasons. The extra soil over the structural roots could be filled with fibrous roots which, if removed suddenly, could cause extra stress. There have been reports of cold or sunscald damage of the newly exposed tissue on trees when the extra soil was suddenly removed from the base of the trunk (this could actually be a portion of the original primary root [tap root], in some cases). Late-fall plantings may be the most susceptible to cold damage. Earlier plantings may have time to harden off normally. Thin-barked trees may be most susceptible to sun injury.

Until this situation is more fully understood, exercise caution when removing soil and exposing tissue that had been below grade. Leaving the extra soil in place above grade to be removed slowly or erode away may help to protect sensitive trunk tissues. Mulch can be used to hide the protruding root ball. If the soil is removed, covering newly exposed tissue with organic mulch may help to protect it from sun and cold damage. A trunk wrap may provide some protection from the sun. This material should degrade within one year or must otherwise be removed from the tree in that time period.

## **Mulching**

Mulching is an excellent way to conserve soil moisture, reduce competition from other plants, and prevent lawn mower injury. Two inches of mulch is the appropriate depth for 2- to 3-inch-caliper trees. Later applications to “refresh” the mulch should not increase the depth. Keep the mulch away from the trunk. Avoid thick layers of mulch around the base of the tree (often called “volcano mulching”), as far too often seen in landscapes. Do not pile the extra soil around the base of tree and use mulch to hide it—excess soil should be removed from the planting site. Avoid organic material that can mat down and create a hydrophobic layer.

## **Remediation**

There are many trees already planted in the landscape with the structural roots too deep. These trees are likely to have reduced vigor and shorter life spans if no remedial action is taken. For recently planted trees (less than two to three months of warm soil for root growth), the greatest long-term benefit will be achieved by replanting the tree at the proper depth. For partially established trees, the best remedial treatment may depend on several factors. Replanting a partially established tree will cause additional stress; therefore, the benefits of replanting such a tree must outweigh the risks. If the tree is in good health and growing vigorously, it may be best to do nothing. A tree that appears to be struggling may need to be replanted at the proper depth, as long as the tree is in good enough health to survive the additional stress of replanting. Do not waste money replanting trees that already show signs of

serious decline. Trees on low-quality, poorly drained soils are more likely to need to be replanted than those on high-quality sites.

For larger, fully established trees, a practice being used regularly by arborists is a root collar excavation to remove the excess soil in contact with the trunk. Removal of this soil reduces the possibility of basal and collar rot diseases, and it improves aeration to the structural roots at lower depths.

Roots regenerated after planting originate mostly at the perimeter of the root ball and usually grow up to their natural depth closer to the surface. Do not expose these roots. When the structural roots moved with the tree are too deep, the newly generated roots sometimes have been observed to grow toward the trunk rather than away from the trunk, as is normal. Removing the soil near the trunk can expose these “misdirected” roots and allow their removal so that they do not become girdling roots. The excavated soil is sometimes replaced with well-aerated mulch or gravel.

### **What Next?**

A much deeper understanding of the causes and effects of deep root systems is needed. Studies have been initiated by researchers around the country. As more information becomes available through both research and practical experience, these best management practice guidelines will be updated.

### **Definitions in the BMP** (to be displayed as sidebar near beginning)

**Balled and burlapped (B&B):** Established in the ground and dug with a portion of the root system and undisturbed soil immediately around the roots.

**Container grown:** Grown and marketed in a container.

**Containerized:** Grown in the ground and subsequently dug with a soil ball (described as “balled and processed” by ANSI Z60.1) or bare root (described as “process balled” by ANSI Z60.1) and placed in a container until sold.

**In-ground fabric bag:** A method used to grow trees in the ground using a specially designed fabric bag to restrict root spread.

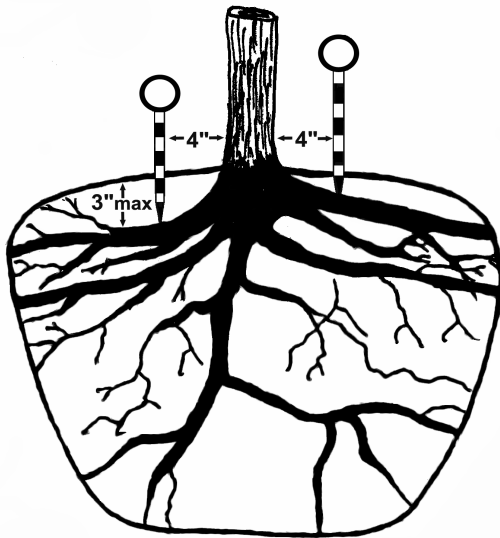
**Root flare, trunk flare:** Interchangeable terms for the area of transition between the vertical stem and structural roots at the base of the tree’s stem or trunk. The “flare” develops over time as the tree grows and may not be evident on young trees.

**Structural roots:** Woody roots relatively large in diameter, giving characteristic form and shape to a root system.

### **Summary** (to be displayed as sidebar near end)

- Generally, uppermost structural roots should be within 1 to 3 inches of the soil surface, measured 3 to 4 inches from the trunk, but there may be exceptions.
- If roots are at the proper depth and the root flare is well-developed, the root flare may be visible. If not, probe the root ball for structural roots with a surveyor’s chaining pin, or similar tool, to check for structural root depth.
- “Soil above the root flare shall not be included in the root ball depth measurement” (ANSI Z60.1, 2004). If the resulting depth measurement of the root ball does not meet the minimum, the tree can be rejected.
- If the structural roots are more than 1 to 3 inches deep, planting depth will have to be adjusted accordingly.

- If soil is removed from the base of the trunk, the newly exposed tissue may be more susceptible to cold and sunscald damage. Exercise caution until more information is known.
- Mulch should be no more than 2 inches deep over the root ball.
- Trees recently planted with too much soil over the structural roots may require replanting.
- For fully established trees, remove excess soil around the base of the trunk without injuring the bark.
- This BMP will be revised as additional information from research becomes available.



A root ball can be probed nondestructively to locate at least two roots within 1 to 3 inches of the soil surface. A surveyor's chaining pin is a convenient tool to use.