

THE PERILS OF PLANTING TREES TOO DEEPLY
Reprinted from ONLA's *The Buckeye*; "CENTS" Edition, January 2003
Stephanie Miller and Drew Todd
Ohio Department of Natural Resources

Trees are the basic building blocks that urban foresters use to enhance the livability of their communities. Foresters spend a great deal of time selecting the appropriate plants, preparing the planting site, properly installing the tree, and providing appropriate after care. This is done to ensure the rapid establishment, survival, and growth of the community's investment. Much has been written about each of these four critical elements, and failure in any single area may adversely affect the success of the planting.

This article will focus on one element of the planting process that is becoming far too familiar in Ohio – the problem of *planting trees too deeply*. Although not readily apparent at the time of installation, the long-term affects of improperly placing the root system in the planting hole is substantial.

What is the problem?

There are both short and long-term problems associated with deeply planted roots. When buried too deeply, tree roots decline in health and condition. Poor tree health results in reduced growth rate, atypical leaf size and color, increased disease susceptibility, and reduced cold hardiness. Trees in poor condition exhibit decay, cracks, and excessive deadwood. Sometimes trees show signs of stress within the first year of planting, but it usually takes several years for the problem to rear its ugly head.

How do tree roots function?

Tree roots have four primary functions:

- Absorbing water and nutrients
- Anchoring the trunk
- Storing food reserves
- Chemical production



Downtown trees in Van Wert, Ohio planted too deeply and with burlap survived less than 5 years.



New roots growing out of buried trunk. Root flare is approximately 6 inches below soil line.

The part of a plant where the stem and root system meet is called the "root collar" which has a "flare" where it transitions between the stem wood and the roots. Four to eleven large roots called "transport roots" radiate from the root collar and function to move water and minerals that are absorbed by smaller roots. Transport roots contain cells that synthesize a variety of substances essential to the normal functioning of the top of the tree as well as help to stabilize the tree. The smaller roots called "absorbing" or "feeder roots" emanate from the transport roots. They have a huge surface area and function to absorb water and minerals from the soil in addition to providing sites for chemical synthesis.

For tree roots to grow vigorously, they require *water*, *oxygen* and *warmth*. An oxygen level of 25% of the soil volume is considered good for root development. At a 5% oxygen level growth stops, and at 2% roots decline and die.

What exactly happens to cause these adverse reactions?

Lack of Water & Oxygen: Tree roots naturally grow quite shallowly in the soil profile. When root systems are buried, less soil oxygen and water is available. As a survival response, trees work to get roots closer to the soil surface where there is a more reliable source of both. The energy that a newly transplanted tree should use to overcome normal transplant stress is instead used just to survive. The tree expends its energy either by forcing its roots to grow upward or by creating totally new roots from dormant buds on the buried trunk. Some plants survive being buried too deeply and live normal lives after developing a functional root system. Others begin a long, slow decline of health resulting in either premature death or sudden failure during wind or ice storms.

Reduced Root Mass: Most trees today are dug with mechanical tree spades. Tree spades, by design, extract soil balls that are wider at the top than at the bottom. The widest part of the ball contains the highest proportion of the volume of the ball and should have the highest proportion of roots. Unfortunately, if the nursery liner's root collar is planted too deeply, the tree spade will be unable to reach a large portion of roots. Although the soil ball may be the correct size for the tree being moved, the actual root mass may be one-half or less of what it should be. Trees with undersized root systems that are planted too deep rarely survive.

To put it into perspective, by volume, 90 to 95% of a field-grown tree's root system is removed during normal transplanting procedures. Fortunately, by weight, approximately 80% of the root system is left. This is where the bulk of the stored food reserves occur. Therefore, the key to survival is for the tree to use these carbohydrates to regenerate a functional root system as quickly as possible.



(Left) Tree Spade;
(Above) Large percentage of roots removed by tree spade on deeply planted tree.



(Above) This tiny root looks harmless now...(Below) 10 to 15 years later it will likely cause this.



Disease Susceptibility: Deeply planted trees often succumb to secondary problems not commonly associated with healthy root systems. Many of these problems, such as root rots, are related to water and oxygen availability. As a general rule, healthy organisms are less susceptible to pathogens than stressed organisms.

Stem-girdling Roots: Another adverse affect related to burying root collar flares is a condition termed stem-girdling roots (SGRs). Roots that grow up toward the soil surface often wrap around or run close to the buried stems. As these roots enlarge over the years, along with normal growth of the buried stems, roots begin to compress and weaken the stem tissues. This creates a weakened point in the stem, along with a general decline of the root system. Over time, the root system declines in health along with a corresponding decline in the canopy.

The compressed areas of the stems are weak points and are frequently sites of failure during wind or ice storms. For instance, following catastrophic windstorms in Minnesota in 1998, storm damage

(Right) Bur oak was an excellent choice for this site, but has suffered for years due to planting depth



research showed that 73.3% of the lindens that were lost actually broke at compression points from SGRs, and most broke below ground.

How deep is too deep?

Based on research conducted by the University of Minnesota's Forest Resource Department, as little as one inch of soil over the root collar flare can disguise stem-girdling roots until it is too late. With Sugar Maple, the significant decline in health began when the soil depth was four inches. A survey of 302 street trees found that buried root systems of street trees were "alarmingly common". They found that the transport roots of all studied species were buried with one to 11 inches of soil. When they rated the condition of these trees, they found a direct relationship between declining tree condition and depth of soil over the roots. In other words, "as main order roots were covered by more and more inches of soil, the condition of all three tree species (that they studied) further declined". They concluded that there is no biological reason to bury root collar flares.

How do you determine if a tree is planted too deeply?

Identifying whether a tree is planted too deeply is fairly simple. One of the first things to look for is whether the trunk of the tree is going straight into the ground – like a pole – or whether it has some flare at the base. Another good clue is to rock the tree a bit. If it simply pushes soil aside and creates a larger hole in the ground, then it is probably buried too deeply. Digging is often necessary to find the root flare. Metal hand spades can cut into the tree, but plastic dandelion pullers and hand spades work well for small-scale root excavation. An Air Spade®, is also a wonderful tool for diagnosing root-related problems.



Air Spade ® uses high-pressure air to remove soil without damaging roots.

How do tree roots get buried?

Sometimes it happens before the trees get to the planting site, sometimes at the time of planting. There are two nursery practices that can result in inadequate roots in the upper part of the ball: "hilling up" around the base of the tree and setting liners deep into the planting beds. The practice of "hilling up" soil around the base of trees was begun many years ago as a method of weed control. When trees were dug by hand, experienced diggers knew that they had to take the time to move the "hilled up" soil away from the base of the tree before digging it. With today's mechanized tree digging, this may no longer be done.

Another nursery practice is to set out liners up to 12 inches deep in the beds to "stabilize" barefoot tree liners and help reduce graft union breakage. Because of the better-structured and textured nursery soils, periodic fertilization and irrigation, and the relatively short time the trees spend in the nursery, this technique is usually harmless. Unfortunately, it becomes an arboricultural problem if transferred to our city streets.

The planting process is another opportunity for problems to occur. It has been a common and acceptable practice to plant with the tree's soil line level with the site's soil line. But, if there is excess soil over the root system when the tree is dug and balled at the nursery, then anyone following the normally accepted installation practice could actually be planting the root system several inches too deep. It only takes a few minutes to find the root flare prior to planting. It is far more efficient to check for it ahead of time and adjust the soil ball than it is to go back later to correct it.

Improper planting is still another means of getting roots too deep in the soil profile. Digging the hole too deeply and then failing to firm the backfill may cause the tree to sink and settle below proper depth. Once again, make sure the root collar flare is visible. If not, reset the tree to the proper depth.

A common practice, often referred to as *volcano* or *teepee* mulching, also contributes to this problem. In addition to subjecting trees to the problems associated with planting too deeply, heat from the composting mulch can literally cook a tree's trunk. Two to three inches of wood chips is the optimum depth to mulch and keep it an inch or two away from the trunk.



**(Left)
Volcano Mulching
(Right)
Proper Mulching**



How do you avoid planting trees too deeply?

The first step to prevent trees from being planted too deeply is to communicate with your nursery supplier and landscape contractor. Clearly explain your expectations for the stock you want to buy and the how you want it planted. Next, write understandable and precise specifications for the purchase and installation of your plant material. One example is the Village of Canal Winchester’s Street Tree Planting Specifications: *Root balls and burlap – All trees balled and burlapped with ball shape and size conforming to ANSI-Z60.1-1990 standards. Root flare will be easily visible on root balls.* Several Northwest Ohio communities have changed their planting specifications to include the clause: *The tree shall be set straight in the hole and with the top of the root flare level with the surrounding soil.* Inspect all incoming trees to make sure they meet your requirements, as well as perform random inspections of their installation. Finally, contract with reputable, qualified, and ethical firms and individuals.

Are we alone with this problem?

This issue is not limited to Ohio. Ralph Sievert, Minneapolis’ City Forester, and the Minnesota Chapter of the International Society of Arboriculture have also been dealing with this problem. According to Mr. Sievert, they have rejected some trees that had 16 inches of soil over the root collar flare. Because of this continuing problem, Minneapolis is now purchasing almost 90% of their trees as bare root. When they do plant B&B stock, they probe each plant for the root collar flare using a surveyors pin and shave off any excess soil as needed. “Of course, this doesn’t help the fact that you now have far fewer roots in the ball”, states Sievert.

In Summary

It is not logical to believe that planting deeper is planting better. Since this does not occur in natural ecosystems, there is no reason to believe it should be successful in our urban environments. We know that the act of transplanting a tree is unnatural and highly disruptive to its root system. Unfortunately, when dug incorrectly and planted too deeply fewer roots will occupy the more habitable upper soil profile where normal root regeneration occurs. The problems associated with planting trees too deeply are numerous, long-term, and difficult to correct. But, they can be prevented. . By understanding how tree roots normally function and respond to transplanting, we can take those actions necessary to ensure that the trees grown for our cities and villages are not short-term liabilities but long lasting community assets.



Deeply planted tree excavated in Minneapolis

Tree Planting Checklist

Select Quality Stock

- Purchase trees from a reputable nursery.
- Select well-trained, healthy trees with good form and labeled with their Latin names.
- Make sure trees are protected during transport.
- One-year guarantee is standard, but some nurseries offer 2 years.

Determine Planting Depth

Dig the Hole

- The wider the better
- Make arrangements to haul away extra soil instead of piling it around the tree.

Remove the Burlap & Twine or Container

- Burlap wicks water away from the roots. Sure, it may *eventually* break down; but what about the most critical first years after transplanting when the trees need a lot of water?
- Twine can girdle the tree as the trunk grows.

Inspect the Roots

- Check for and remove potential girdling roots.

Water

- WATER! WATER! WATER!

Mulch

- 2-3 inches maximum of hardwood bark mulch is the best.
- Leave an inch or two free around the trunk so that the tree doesn't respond as if it is planted too deeply.

Remove Tree Wrap

- We once thought this was for the good of the trees. It actually does little if anything to reduce sunscald and often times ends up holding in moisture.
- Another problem is that a lot of tree wrap is tied on with twine. Folks often forget to take them off resulting in girdled trunks.

Stake Only When Necessary

- Research indicates that staked trees lack the trunk strength of their unstaked counterparts. If you have good stock and the tree is planted correctly, then staking is usually unnecessary.
- Trees planted in sandier soil, on windy sites, or larger trees with a heavy crown may need to be staked for 6-12 months until some roots are established.

