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Grown to Die?

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One of the most important aspects of any landscape job is plant establishment. Clients spend hundreds, if not thousands, of dollars on the right plants for the right location, and any wrong step along the way -- from the nursery owner to the landscaper --- can affect a plant's potential in the site.

At Bartlett Tree Research Laboratories, Charlotte, NC, a research and technical support center for Bartlett Tree Experts, we see too many plant fatalities. Some plants die from insect infestation: others succumb to disease. **But some of the reasons behind the decline of trees in the landscape can be traced back to the nurseries, reasons that include root collar disorders, girdling, substandard root balls and weak branches.** By examining the problems we on the maintenance end see, nursery professionals can work to prevent them on the production end.

Stressed, declining and dying trees are a big problem for the landscape industry. A University of Washington, Seattle, study of eight commercial and public landscape projects found only one site satisfactory in appearance and viability. It had only a 4 percent plant failure rate. **One suburban office park experienced a plant failure rate of 85 percent. Some of the failed trees had been planted so deeply that their root collars were covered by as much as 11 inches of soil.** This high plant failure resulted in another $ 250,000.00 spent on plant replacement and treatment. The remaining six sites experienced plant failure rates of 25 percent to 90 percent. In financial terms, restoring the landscapes cost between 10 percent and 144 percent of the original installation costs.

A number of published reports indicate tree and shrub injuries often stem from how the plants were grown. The reports also recommend landscapers look for symptoms that may indicate establishment problems could arise. For example, one 1996 report advises landscapers to inspect root systems upon delivery and reject entire lots of plants if serious defects are found. **Others problems to be aware of included root collars buried too deeply or roots that visibly circle the trunk or perimeter of the root ball. Root restriction, particularly in pot-bound plants results in water stress and girdling of the main stem.** As the popularity of the container-grown plants continues to rise, the concerns of landscapers, arborists and landscape architects follow suit.

Problems with Deep Planting. Many landscape establishment problems arise when trees are planted too deeply. In nature, the root collar is visible above the soil line where it is exposed to air and experiences the cleaning effects of wind and rain. However, nursery plants often have the root flare buried under soil, burlap and twine. In a 1995 study at the University of Rhode Island's Sustainable Landscape Arboretum, Kingston, 25 of 33 trees, representing 24 species from at least seven nurseries, had 3 inches to 12 inches of soil above the root collars.

We at Bartlett Tree Research Laboratories conducted a trial designed to evaluate the extent of root collar problems in Eastern landscapes. In 1991, we asked IPM program technicians in three major markets to locate groups of 2- to 3- inch-caliper, professionally planted trees. If the root collar was obscured by soil or mulch, the technician marked the level on the stem and excavated until the buttress roots were encountered. Of the 417 trees examined during the trial, 93 percent had soil and/ or mulch covering the buttress roots. The average depth of mulch and soil varied greatly with location, but there was rarely less than 2 inches of soil covering the root collars. Although mulch was typically applied by planting crews at installation, the soil depths remained unchanged from that of the nursery in most cases.

To determine the effects of applying between 2 inches and 6 inches of soil on the root collar, we established a trial in Charlotte, NC, using 68 newly transplanted bare-root whips. We used willow oak (*Quercus phellos*) for its availability and durability and planted half the trees with the roots at grade and the other half with the root collars buried 6 inches. In the Piedmont region of the Carolinas, the transplant survival rate of this species is typically very high. After four years, 26 percent of the deeply planted trees had died compared with only 6 percent of those planted at grade. Furthermore, the surviving deeply planted trees had 17 percent less caliper growth than the other half.

We followed the willow oak research with the same trial on white pine (*Pinus strobu*s), but we used eight trees. This species is known to be sensitive to root collar problems. The 2-inch-caliper trees that had been planted 6 inches deep died within six months, while the control trees thrived. White pine is susceptible to disease when planted deeply, and many of the trees probably succumbed to root disease pathogens such as *Phytophthora (*photo, left*), Leptographiu* and *Armallaria.*

Additional signs of stress injury on deeply planted pines are winter injury and decline, but the damage is reversible. In 1989, we did an experiment with Japanese black pine (*Pinus thunbergiana*) on New York's Long Island. Established or declining trees that had been planted deeply three to seven years earlier were either excavated or left with 6 inches of soil against the root collars. A majority of the trees that remained deeply planted experienced winter injury, but none of the excavated trees did. In fact, they exhibited a deeper green needle color and increased shoot growth than the control trees, which continued to decline. **Our research shows many young, declining trees respond rapidly to root collar excavation. Visible improvement can be seen within one growing season.**

There are other repercussions of planting trees too deeply at the nursery. We've found trees that die rapidly in the landscape are often planted deep at the nursery then dug up with a tree spade. If a tree is planted 6 inches deep and dug with a 32-inch tree spade, an additional one-third of the root system is left behind at the nursery. When the tree is planted in the landscape, not only is the potential for root collar problems present due to deep planting, but the root system is undersized. And substandard root systems mean lower starch reserves and fewer roots to absorb water and nutrients. Root-system diameter is, therefore, far more important than the diameter at the top of the root ball.

Even though some trees initially tolerate deep planting, they are by no means assured long-term survival. They can fall prey to girdling, an injurious and even deadly problem. Roots that girdle stems can be found on almost any species, but they are most common on maple (*Acer*). When trees are grown with their root collars exposed, stem-girdling roots cannot develop. When the root collars are buried even a few inches, however, few maples will not develop girdling roots.

Roots, of course, aren't the only things that can choke a plant. "Girdling soil" is a newly recognized element associated with deep planting (photo, page 50). When a trunk is surrounded by soil, it can only push soil outward. If the tree is planted in dense or compacted soil, the pressure exerted by cambial growth is not enough to move the medium, so radial growth is restricted. The resulting smaller annual rings restrict water and nutrient transport. Hormone and growth regulator movement in the phloem also may be disrupted, possibly leading to winter injury.

Other Problems That Stem From Nurseries. There are other nursery practices in addition to deep planting that can affect how plants establish themselves in the landscape. One is topping or severe pruning early in a tree's life, which can lead to poor branch structure. While this may produce a dense canopy that improves tree sales, the long-term effects on many species are damaging. For example, since a proliferation of sprouts occur below the point of topping, branches or co-dominant stems have narrow angles of attachment prone to breakage later in life.

In 1999 we conducted research to measure the strength of co dominant stems. We found narrow crotches with included bark were much weaker than wider crotches. After even moderate windstorms, snowstorms or ice storms, the most common limb breakage appeared at narrow-angle, co-dominant stems. And when a major co dominant stem breaks, the tree is almost always unsalvageable.

Another problem landscapers see from the nursery end is the use and misuse of certain supplies, such as synthetic burlap (photo, page 48) or plant tags. In our 1991 study of newly transplanted trees on three sites, at least 16 percent of 417 trees were found with materials left over from production or planting and had the potential to girdle the tree. **The main problems were synthetic ropes and straps used to secure the burlap, lift the ball or guy the tree. When examining older trees, we still find 10 - to 15-year old synthetic burlap on root balls, girdling tree trunks and roots.** Although the use of synthetic burlap appears to be declining, some nurseries still use it. A switch to biodegradable fibers could save thousands of trees a year.

Additionally, wire baskets are a controversial material in both the nursery and tree-care industries. We occasionally see girdling of the roots and stems when baskets are left intact after planting. Symptoms of decline are most obvious during periods of drought when the tree is still trying to graft over the wire. To avoid girdling the buttress roots, use a basket one size smaller than the plant normally would call for. For example, insert a 32-inch spade-dug root ball into a 28-inch basket and twine over the top instead of using a 32-inch basket. The root collar will be about 6 inches above the top of the basket. The landscaper will then receive a ball that can be planted in its present condition, and the nursery saves on the smaller basket.

Labels and tags also can present problems when left on trees that are being transplanted--especially when attached to the main stem. In the past, metal labels attached with wire were particularly prone to damaging plants because they wouldn't break off. The new plastic tags, however, appear to be less injurious because they become brittle and fall off before causing serious damage. Regardless, it's better to attach labels to lower limbs rather than around the trunk in case the plastic does not break down.

In addition to less harmful tags, we've seen an improvement **in trunk wrapping methods.** Few nurseries wrap trunks with damaging materials before shipping: however, the practice continues on the landscaping end. **Landscapers should avoid black landscape fabric, a material that apparently increases the bark temperature, thereby killing tissue and predisposing the tree to canker fungi and borers.**

Another step in the right direction concerns root circling I container-grown plants. **Root circling was a monumental problem in years past, but it has declined dramatically with the advent of copper treated pots. As more nurseries begin to use these pots, this problem should continue to decrease.**

More important now than ever before, nursery professionals need to produce ready-to-plant landscape material. Labor shortages and high employee turnover rates have resulted in too many untrained or under trained laborers in the industry. And poor communication among workers, supervisors and clients is an increasing problem that leads to plant failure and inferior quality control. If nursery professionals respond by providing plants that require minimum preparation before planting and that have the ability to survive in the long run with minimum remedial treatment, landscapers and their clients will have a much higher level of satisfaction that will foster continued growth of the entire green industry.

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