NURSERY PRODUCTION ALTERNATIVES FOR REDUCTION OR ELIMINATION OF CIRCLING TREE ROOTS

by Bonnie Lee Appleton

Abstract. Tree roots that circle during nursery production have the potential, once planted in the landscape, to enlarge and become girdling roots that may stress or kill trees. Several nursery production alternatives have been developed to address this problem including in-ground fabric, rigid plastic, and "pot-in-pot" containers, and above-ground modified rigid plastic, "low-profile", "soil sock" and copper-treated containers. Coating the interior wall of rigid containers (above and in-ground) with the root-regulating copper compound appears to be the most effective and economically justifiable alternative.

A problem receiving increased recognition as a stress factor or potential killer of trees is girdling roots. Girdling roots are becoming more apparent as arborists learn to perform root-crown excavations or root-collar inspections in an attempt to diagnosis tree decline.

Girdling roots -- roots that grow around tree stems and other roots -- may shorten a tree's life span by constricting the vascular system and restricting water and nutrient movement, and by failing to adequately anchor trees (15,18,33). Girdling roots may start as roots that circle in rigid plastic production containers (Figure 1), as roots that circle in structurally restrictive planting holes or planting holes with glazed clay walls, or as new lateral roots that develop behind the ends of primary roots cut during field-grown nursery stock harvesting (31).

A common planting recommendation relative to container-grown trees is mechanical disruption of the root ball by slicing through or cutting away any circling roots found when the container is removed (12, 15). The value of these practices is questionable, with limited and contradictory research conducted primarily using shrubs (7,29,35).

While landscape professionals might be expected to mechanically disrupt overgrown or "pot-bound" root balls, it is unrealistic to assume that most homeowners would be alert to tree root abnormalities. To insure greater tree transplant success it therefore seems appropriate to reduce or eliminate circling root formation during nursery production.

In-ground Production Alternatives

Several in-ground alternatives to conventional field production of bareroot and B&B (balled-in-burlap) trees have been developed, including in-ground fabric containers, in-ground plastic containers, and pot-in-pot. Though mainly developed for nursery production purposes -- ease of harvest, increased root harvest, reduced tree blow over, provision of a better (moisture and temperature) soil-root environment -- each of these methods can influence directional root development.

In-ground fabric containers. In-ground fabric containers, or grow bags, are the oldest of several new hybrid field/container production options (24). Numerous comparative studies of these containers vs. conventional field or container production have been conducted, with some tree species

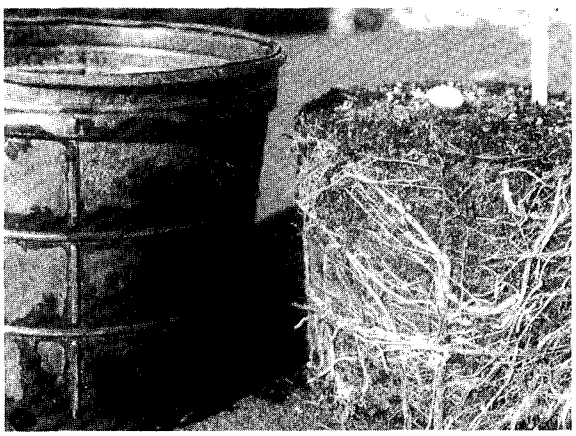

Figure 1. Circling roots that developed on a tree grown in a container.

responding better to in-ground fabric container production, while others responded poorly (13,14,16,17,19).

Though in-ground fabric containers usually prevent circling root formation, circling roots have been observed at the bottom of these containers (personal observation). To address this issue, and to make fabric container removal easier at planting, alternative fabrics and container designs have been developed (Figure 2). One new fabric has holes of a size designed to allow only small roots to penetrate for absorption of water and nutrients from the surrounding soil, but not to impede harvesting (Figure 3).

In-ground plastic containers. For two major reasons, nurserymen have traditionally been discouraged from trying to grow trees in single, nonporous, rigid, plastic containers sunk into the ground. First, drainage of excess precipitation or irrigation water is impeded by the types of drain holes in the containers, often resulting in waterlogged roots. Second, roots are unable to penetrate the containers, preventing them from exploring the soil around the containers for supplemental water and nutrients.

Figure 2. A variety of in-ground container fabrics, and the rigid, in-ground container (left).

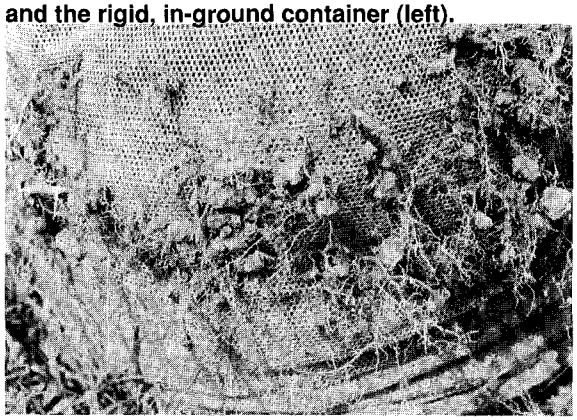

Figure 3. Small roots growing through the in-ground fabric container with the specially designed holes.

A new rigid plastic container has been developed, however, with rows of small holes around the container sides, and throughout the container bottom (Figure 4). Both of the above mentioned problems are minimized, and small roots, which should not impede harvest, can be found growing out through the holes and into the field soil. This container is very new, with no comparative tests thus far having been reported, but the potential for circling root formation appears minimal.

Pot-in-pot. A very different approach to tree growing is the new pot-in-pot system (25). An outer or sleeve pot is sunk into the ground, and a second pot, the actual production pot that is harvested with the tree, is inserted within and rests upon the lip of the sleeve pot. The production container often has vertical basal ribs (Figure 5), or may be copper-treated (see below), to reduce root circling.

Above-ground Production Alternatives

Modified container designs. A variety of approaches have been used to modify conventional straight, smooth-walled, rigid plastic containers to reduce or eliminate circling root formation. Design modifications include container wall ribs, holes, baffles and other root deflecting or pruning de-

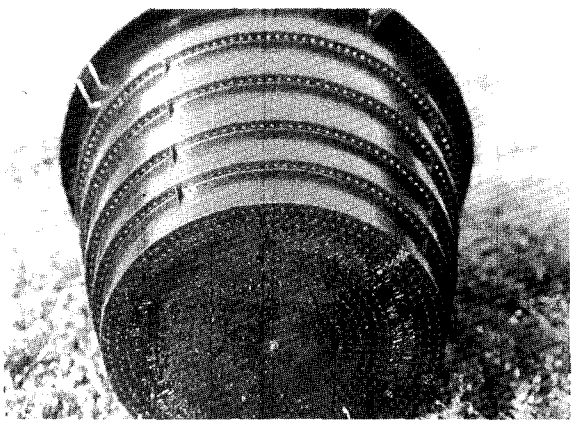

Figure 4. New in-ground rigid plastic container with small holes for excess water drainage and small root exploration.

Figure 5. The plant is harvested with and sold in the inner pot while the sleeve pot stays for additional production.

vices (Figure 6), use of non-rigid containers (poly bags), and use of porous-walled containers.

The various wall modifications and the poly bags have significantly reduced circling root formation on many species of plants (1,2,30,33,34), although sometimes with conflicting results relative to shoot growth (22,33). Once planted to the landscape, the effectiveness of the modifications in enhancing new root generation has been found to be species specific (30).

A porous-walled container with pin-hole perforations randomly punctuating the container walls produced roots superior to those in nonporous smooth and nonporous ridged containers (23). Air-root pruning behind the perforations prevented circling root formation except where the plastic

Figure 6. The low-profile container that can be constructed in a variety of widths.

was denser and container air porosity was limited.

Low-profile container. In the landscape, the bulk of a tree's roots are found in a shallow, broad layer just beneath the soil surface (32). In an attempt to grow nursery-produced trees with a root profile more nearly approximating that found in nature, a container with a lower height and increased width was developed (20,21) (Figure7).

Roots of trees grown in bottomless low-profile containers do not circle, particularly at the base, because roots are air-pruned at the junction between the container wall and the surface beneath the container. Transplant reestablishment is very rapid due to the large number of roots tips that grow radially from the edge and bottom of the shallow root ball.

Soil sock containers. A new above ground container, that combines wire baskets used to protect field-grown tree root balls with a porous foam-rubber liner, is called the "Soil Sock" (28) (Figure 8). While the liner insulates the roots against temperature extremes, it allows air penetration, thereby air-pruning the roots and preventing circling root formation (Figure 9). The container sits above ground for production, but is reported by the manufacturer to be entirely plantable.

Copper-coated containers. One final strategy for the reduction or elimination of circling root formation is the use of rigid plastic containers with copper-coated interior walls (26) (Figure 10). Applied to the walls in a carrier, the copper is

Figure 7. The low-profile container produces a dense, shallow root mat that often can even be rolled up to harvest.

Figure 8. The "Soil Sock" container combining a wire basket with a foam liner.

Figure 9. Air-pruned roots inside a "Soil Sock."

absorbed by the root tips from the carrier. The copper acts as a growth regulator, inhibiting root tip growth and stimulating branching. The manufacturer claims that root tips are not killed by the copper as they are with air-pruning.

The effectiveness of the copper has been demonstrated on a large number of trees and shrubs (4,5,6,8,9,10,11,26,27). Results range from virtually no visible roots on the outside of root balls, to roots whose tendency to circle is stopped after one to two inches of growth (Figure 11). No impairment of root growth out into the surrounding soil has been reported for trees and shrubs after copper-coated container removal and field transplanting.

The only containers thus far developed with copper incorporated into the container walls are fiber (peat/paper) containers. These containers were very effective at preventing root ball matting on azaleas (3), but thus far no reports have been published relative to their effect on tree roots.

Significance to the arboricultural industry

Arborists who have seen tree decline or death

Figure 10. Containers painted with a root-inhibiting copper compound (Spin OutTM).

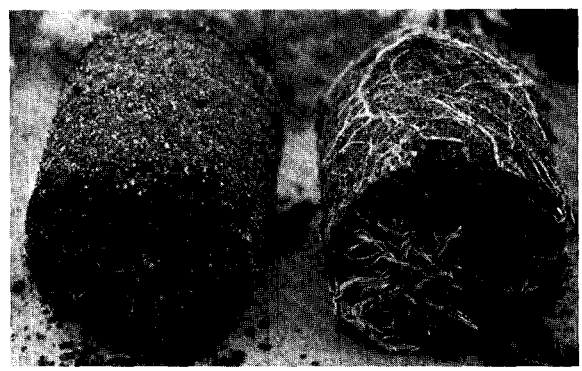

Figure 11. Left - no tree roots on the outside of a root ball from a copper-coated container; Right - roots on the outside of a root ball from an untreated container.

which they feel is partially or totally attributable to girdling roots should be aware that nursery alternatives exist that may reduce or eliminate the formation of circling roots during production. Whenever possible arborists should supply information about these new production alternatives to landscape designers, architects, contractors and engineers who write tree planting specifications. They should suggest that the spec writers consider requiring that trees be grown using one of these nursery production alternatives.

Sources of Nursery Production Alternatives.

In-ground fabric containers

Lacebark Inc., PO Box 2383, Stillwater, OK 74076; (405) 377-3539

Root Control Inc., 7505 N. Broadway, Oklahoma City, OK 83116; (405) 848-2302

In-ground plastic containers

Rootmaker Grounder - Lacebark

Pot-in-Pot

Lerio Corp., Mobile, AL; (800) 457-8112

Nursery Supplies, 250 Canal Road, Fairless Hills, PA 19030; (215) 736-3641

Modified containers

Lerio, Nursery Supplies, others

Low-profile Container

Dr. Dan Milbocker, Hampton Roads Ag. Expt. Station, 1444 Diamond Springs Rd., Va. Beach, VA 23455; (804) 363-3909

The Accelerator - Hold Em, Inc., 1283 Ranchette Rd., West Palm Beach, FL 33415; (407) 683-7608

Soil Sock Container

BetterBilt Products, PO Box 559, Addison, IL 60101 (800) 544-4550

Thomas' Nursery, Rt. 2, Box 180A, Enterprise, MS 39330 (601) 659-9259

Copper coating

Spin Out™ - Griffin Corp., PO Box 1847, Valdosta, GA 31603-1847; (800) 237-1854

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Résumé. Les racines d'arbres qui «cerclent» lors de la période de production en pépinière ont le potentiel, en grossissant, de se transformer en racines strangulantes. Plusieurs alternatives de production en pépinière ont été développées afin de résoudre ce problème à partir de la production en contenants enterrés en tissu (plastique ou géotextile), en plastique rigide ou «pot-en-pot», et de la production en contenants hors sol en plastique rigide modifié, «à profil bas», en «chaussette» ou traités au cuivre.

Zusammenfassung. Baumwurzeln, die sich während der Baumschulproduktion ringeln, haben die Kraft, sich zu vergrößern und Ringelwurzeln zu werden. Einige Produktionsalternativen wurden entwickelt, um diesem Problem zu begegnen, einschließlich Rupfen-, stabile modifizierten stabilen Plastikbehältern, 'Niedrigprofil', Boden- und kupferbehandelten Containern.