

ing is complete — about 2 to 3 weeks. Rubber strips, tape, raffia, budding patches, or Parafilm can be used. With rubber strips, the tie is started below the bud and is secured by overlapping so no open spaces are showing around the cuts. The bud itself is not covered, with the tie being completed above the top of the perpendicular cut.

In conclusion, these main points should always be kept in mind when “T” or shield budding:

1. Make smooth clean cuts by using a sharp knife.
2. Strive for good cambium contact between bud and understock.
3. Exclude air from around the bud by using a snug, overlapping tie.

Thursday Morning, December 8, 1983

The Thursday morning session convened at 8:00 a.m. with Leonard Savella serving as moderator.

GIRDLING ROOTS, FACT OR FICTION

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It has long been recognized that pot-bound plants are slow to establish after being transplanted. Unless their roots are disrupted from their circular habit of growth, the roots branch poorly and the plants often die from drought, despite being surrounded by moist soil. Close examination of pot-bound or near pot-bound plants that have been lifted, after having been in the ground for several months to several years, often reveals only a few roots originating from the bottom or from the top edge of the root balls. Generally, problems with transplanted container-grown plants occur within the first growing season. However, based on observations made in the Baltimore and Washington area over the past 5 years, it is becoming apparent that there could be long term problems with trees that originated in containers.

Approximately 10 to 20% of Norway maples (*Acer platanoides*) die as they approach 8 to 10 in. (20 to 25 cm) caliper from self-inflicted girdling roots. What causes these girdling roots to occur is unclear. However, in recent years there has been an increasing number of other tree species that have died

as they approach similar caliper measurements. These include: red maple (*Acer rubrum*), pin oak (*Quercus palustris*), little leaf linden (*Tilia cordata*), Bradford pear (*Pyrus calleryana* 'Bradford') and flowering cherries (*Prunus subhirtella*, *P. yedoensis*). The trees that died or are dying had been growing normally in the landscape. In most instances a complete history on the trees is not available because the current owners were not present at the time the trees were transplanted. Since most owners are not willing to have stumps excavated for post-mortem examination, the probable cause of death can only be achieved through the process of elimination. Being able to excavate around the stump or lift the stump from the ground could help in identifying the cause of death.

Based on a very limited number of observations of shade trees affected, girdling roots were found to be the most probable cause of death or decline. After watching this tree death occur, there are several characteristic symptoms that may help indicate possible girdling root problems. Early symptoms include: a gradual shortening of terminal growth over the years despite good growing conditions; small size leaves and sparse looking foliage; lopsided top growth; premature fall coloration of certain branches, primarily in the middle or on one side of the tree; some wilting and dropping of summer green foliage, especially during drought periods; and die-back of branches in sections of the canopy. Death from girdling roots is gradual and may occur over a period of 3 to 5 years.

Evidence of possible root girdling may also be seen by inspecting the trunk of trees near the ground. The trunk of a normal tree is flared uniformly around the base. A tree that is being affected by girdling roots may have one or more flat sides, like a telephone pole, where the trunk enters the ground (Figure 1). This is an indication that girdling roots have prevented normal development of surface roots. However, flaring at the base of the tree trunk is not always assurance that girdling roots do not exist. There have been several instances where callus tissue has formed over the girdling roots giving the appearance that the tree trunks were normal (Figure 2).

If the symptoms are recognized early, it appears that the problem can be corrected by cutting out the girdling root(s) with a mallet and wood chisel. Recovery is slow but surgery does seem to work. However, in most instances, nothing is done until the tree dies. Since post-mortem examinations are not required, the cause of death is often attributed to common diseases or infestation by insects discovered at the time of inspection, or toxic levels of natural gas from leaking underground service lines.

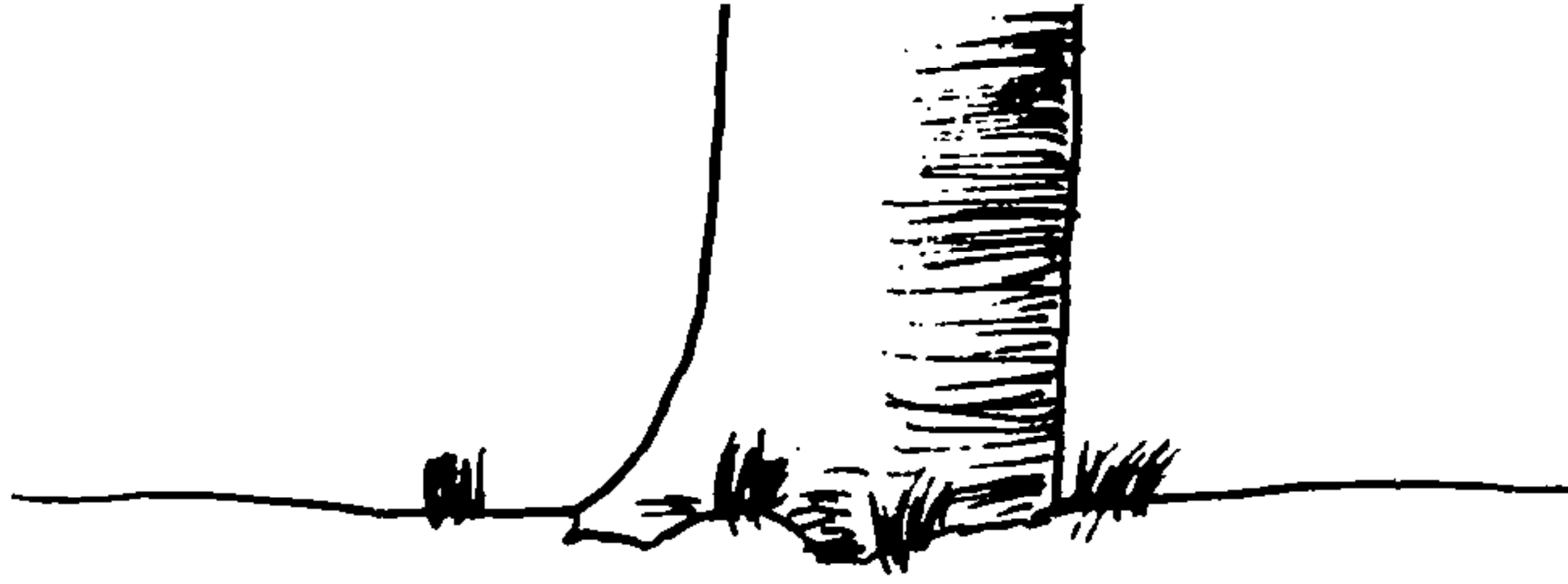


Figure 1. Flat side of tree trunk indicates a possible girdling root located just beneath soil surface. Girdling roots frequently prevent surface roots from developing normally.

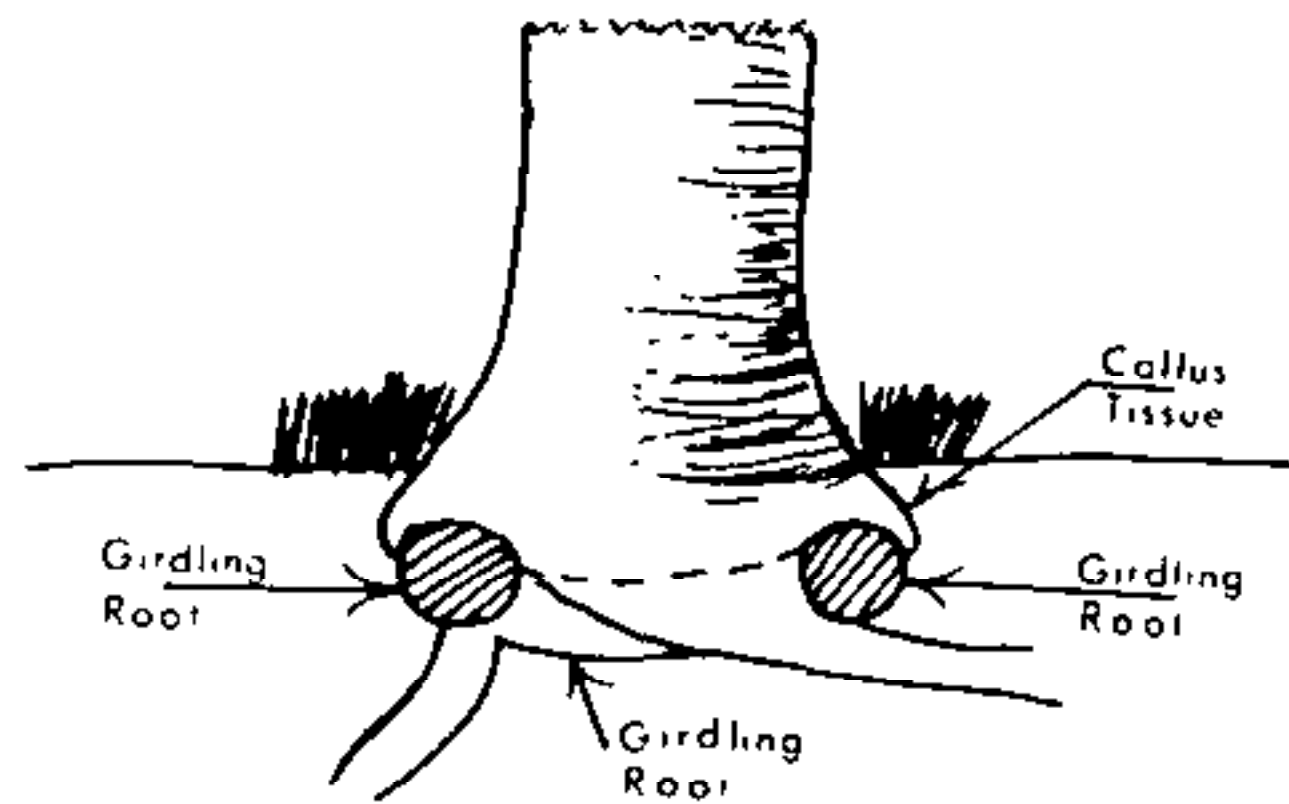


Figure 2. Although the tree trunk appears normally flared, swelling at the base is due to callus tissue forming over the girdling roots.

Container culture of ornamental plants is likely to continue because of its many advantages. However, it is widely acknowledged that plants that are allowed to remain in containers too long become pot-bound. A plant becomes pot-bound when the roots have completely permeated the medium and are growing in a circular pattern forming a near solid mat along the inside walls of the container. Forcing the roots to grow in a circular pattern also occurs when bare-root field-grown plants are jammed into containers or small planting holes. This practice is becoming more common as nurseries expand and winter activities are created. Winter-potting or peat-balling of fall-dug fruit or shade trees without first pruning the roots may have similar effects in encouraging the formation of girdling roots. These plants could become as much of a problem as container-grown plants.

It may not be necessary for container-grown plants or potted field-grown plants to become pot-bound for girdling roots to form. It appears as if once the roots at the top of the root ball develop their circular habit of growth, there exists a potential problem.

Measurements taken of girdling roots uncovered from dead or dying trees appear to indicate that the trees may have

been grown in 6 in. (15 cm) or 8 in. (20 cm) containers. It has long been a recommended horticultural practice to disturb the roots of plants that have been grown in containers when transplanting. This practice is often ignored for fear that disturbing the roots will cause harm to the plant and may even be detrimental. The present recommended horticultural practice of "Butterflying" the rootball (Figure 3) only disrupts the roots at the bottom half of the root-ball. This practice not only stimulates more rapid branching of roots but may also prevent root-rot diseases from becoming established in roots that otherwise would have been planted too deep. Although the practice of "Butterflying" root balls of container-grown plants at planting time has been widely accepted by landscape contractors, it does not help solve the girdling root problem. Cutting and disturbing the roots at the bottom of the root ball does nothing to disrupt the circling roots in the upper half of the root ball.

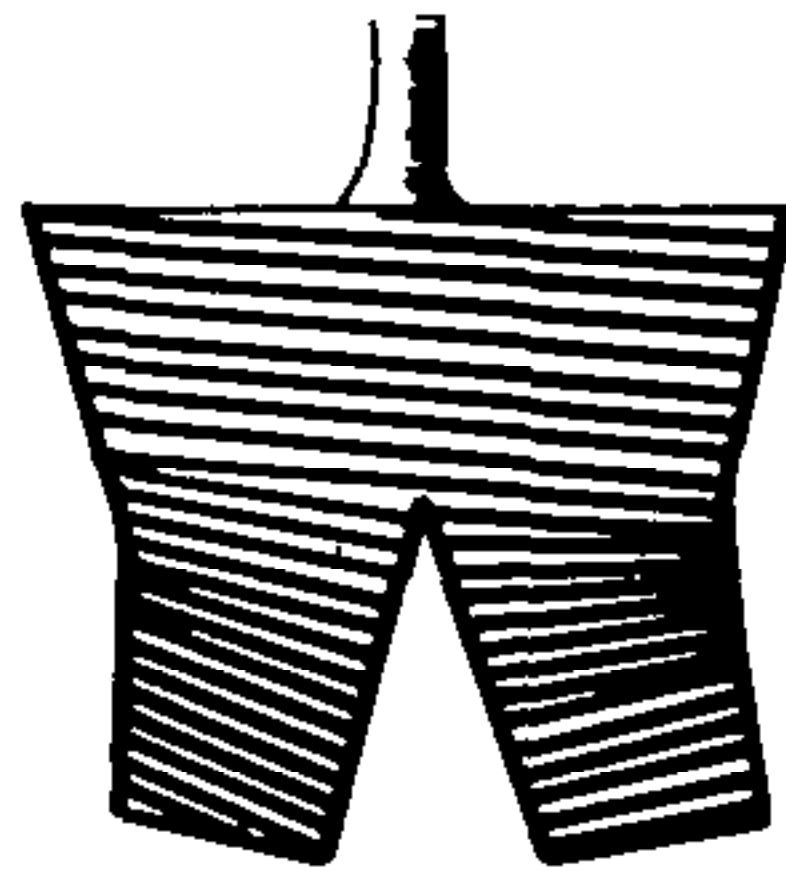


Figure 3. "Butterflying" the rootball only disturbs the roots at the bottom half. It does not destroy the circling roots in the top-half of the rootball that are potential girdling roots.

Current studies indicate that making 4 or more cuts approximately 1 in. deep (2.5 cm) uniformly spaced the length of the root ball at the time of transplanting may be sufficient to solve the problem. The cuts can be made with a sharp knife or the point of a digging spade. Cutting the roots in this fashion does not appear to adversely affect the top growth but stimulates the roots to branch at the cut ends.

Another method of preventing girdling roots from forming is by growing the plants in round containers with protruding ribs, or in square containers. Either type of container will force the roots to grow downward as they touch the inside walls of the container. However, experience has already demonstrated that unless the bottoms of these root balls are "Butterflied" at the time of transplanting, the root system is likely to retain the shape of the container even after having been transplanted for several years.

Regardless of which container is used, it is apparent that an educational program is essential. Propagating containers used for direct sticking should either be square-sided or, if

round, engineered with ribs protruding into the propagating medium to prevent the roots from developing a circular habit of growth. When transplanting seedlings or rooted cuttings into containers, nurserymen should select similar containers in order to avoid root girdling problems in the future.

Educational programs are necessary to teach nurserymen, landscape contractors, and home gardeners the art of transplanting container-grown or potted and peat-balled field-grown plants to promote rapid establishment and to avoid girdling root problems.

RON GIROUARD: I would like to make several recommendations to tie in with what you have said: 1) Use appropriate containers with ridges to direct the roots in the right directions. 2) When you pot up your rooted cuttings don't wait until the roots are 6 in. long.

ART VANDERKRUK: How deep did you make the vertical cuts?

FRANK GOUIN: About one inch because it is the outer roots that are circling.

TED MEYERS: Just a comment. We have used a square 2-in. milk carton type tube and find that it does a good job of directing roots down. We find, however, that the vertical column of roots remains intact and I am not sure that directing the roots down is the total answer.

FRANK GOUIN: We have found with the citrus tube, that if you split the bottom of the root ball and bring the roots up, you get much better survival.

BILL SCHWARTZ: I have been using a one gallon container that has ridges every inch instead of creases. The bottom of the pot is dome shaped and this forces the roots back up. When you cut the bottom roots, root proliferation occurs from everywhere.

LEN SAVELLA: When you cut these roots do you find any diseases developing?

FRANK GOUIN: No.