

FORCING the Tissue

**FORCING SOFTWOOD CUTTINGS
FROM WOODY STEM SEGMENTS IS
PROVING A RELIABLE METHOD
TO PROPAGATE MANY SPECIES.**

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Many woody shrubs and trees are propagated by rooting green, leafy cuttings (softwood or semihardwood) because of poor rooting response from dormant hardwood cuttings. However, this method limits cutting propagation to a short period each year. As a group of scientists, we've developed a system that allows for production of softwood cuttings during the dormant season, which could free propagation workers for field production during spring and summer.

The initial step in this procedure is to prune lower limbs off mature trees or remove large stems from shrubs. This can be done anytime from January through July. The stems are then cut into 16- to 18-inch-long sections that resemble short logs. However, we now know that the logs can be cut much longer; 6-foot logs require less cutting and force quite well. These are placed horizontally in flats or benches filled with perlite (good drainage is important). The sections are pushed into the medium so the lower half is buried and the upper half exposed (photo, opposite).

Intermittent mist provides the best forcing environment we have tested. We typically have timers set to mist six seconds every six minutes and use the same environment for rooting cuttings. A good greenhouse temperature is 75°. Once each week the area between the logs is drenched with a fungicide such as Banrot 40% Wettable Powder.

During January to April, ambient light is usually supplemented with electric light to extend the photoperiod to 16 hours. Night interruption from 10 p.m. to 2 a.m. has also proved successful for preventing budset on new shoots that develop. In spring and summer, new shoots seem to look better when 50 percent saran shade cloth is used over the mist bench.

Buds from under the bark (latent or epicormic buds) swell visibly in two to four weeks. In five to seven weeks after initial placement of segments under mist, leafy shoots should be sufficiently long to harvest as softwood cuttings (photo, opposite). Shoot elongation varies considerably with species and forcing conditions, but softwood cuttings should measure 2 inches to several inches long. Upon harvest, these cuttings should be treated with an appropriate rooting compound

To produce shoots for microirrigation, stem sections can be watered with a drip system (pictured) or by hand rather than mist.





Five to seven weeks after initial placement of segments under mist, leafy shoots should be long enough to harvest as softwood cuttings.

and rooted under typical humidity or mist conditions used at the nursery (photo, 29). Rooting and hardening off should proceed in a manner typical for that species.

Using this propagation method, we have also been able to force softwood shoots from root sections of sweet gum (*Liquidambar styraciflua*) and oakleaf hydrangea (*Hydrangea quercifolia*). Root harvest is more labor-intensive than harvesting branches, however.

WHAT WORKS — AND DOESN'T. Although stem sections respond well to this procedure when cut 12 inches to 20 inches long, we typically standardize our sections to 16 inches to 18 inches. However, shoots force well when cuttings measure as long as 6 feet. If sections are shorter than 12 inches, few — if any — softwood shoots are produced. We believe cutting sections to approximately 1½ feet long breaks apical dominance within each section, thus promoting outgrowth of epicormic shoots.

We have forced shoots from stem sections of various diameters (photo, page 28). Stem sections of less than one-half-inch caliper typically produce few softwood shoots, elongate poorly and often



Freshly harvested red maple stem segments are placed in perlite for forcing softwood shoots.

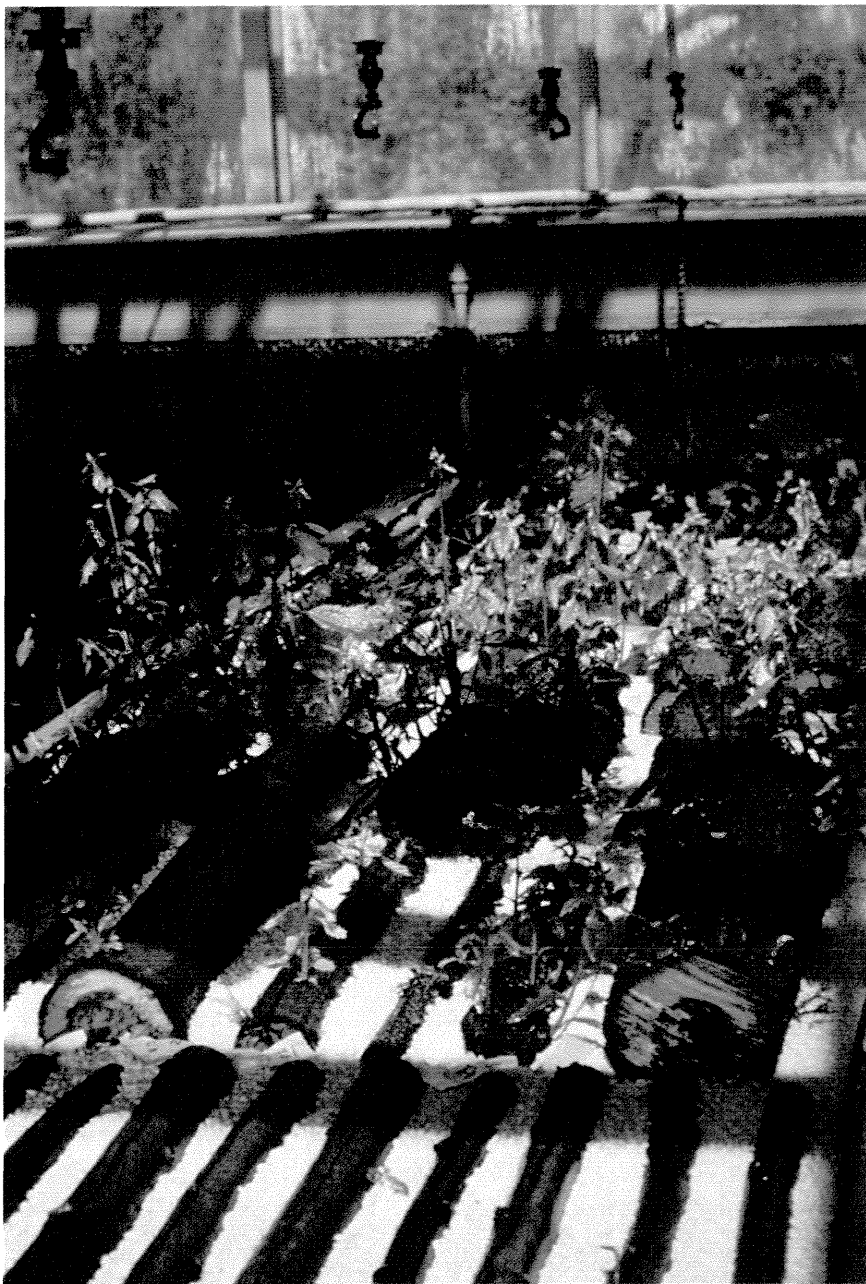
wilt quickly and die before they are sufficiently long enough to be cut for rooting. Larger stem sections, from 1 inch to 10 inches or more in caliper, have produced high-quality shoots. If stem sections are less than 1 inch in diameter, it is often necessary to harvest softwood shoots when they are less than 2 inches long before they wilt.

On a limited basis, we tested cutting oak stem segments in half lengthwise and laying the cut half down into the perlite. There was no significant increase in shoot production related to splitting compared to nonsplit segments, and fungal growth appeared to be greater under the split stem segments than the whole stem segments. Due to increased labor associated with splitting, we do not recommend this procedure.

We have screened many species, in-

cluding: amur maple (*Acer ginnala*), Japanese maple (*A. palmatum*), red maple (*A. rubrum*), sugar maple (*A. saccharum*), silver maple (*A. saccharinum*), white ash (*Fraxinus americana*), American chestnut (*Castanea dentata*), oakleaf hydrangea, black walnut (*Juglans nigra*), sweet gum, swamp white oak (*Quercus bicolor*), Northern red oak (*Q. rubra*) and common lilac (*Syringa vulgaris*). We have been able to produce softwood shoots on each of these plants, although the number and vigor of shoots varies greatly with species.

The plant that has shown the best response to this forcing technique is oakleaf hydrangea. Of all species tested, this



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How to Force Softwood Shoots from Cuttings

- 1) Prune branches that are at least one-half-inch diameter from plants anytime from January through July. (Forcing will be much better if stem segments are greater than 1-inch diameter.)
- 2) Cut branches into 1- to 6-foot lengths and remove side branches using a chain saw, handsaw or lopping shears.
- 3) Fill mist benches or perforated flats with perlite.
- 4) Lay stem segments horizontally on the perlite surface, then push into medium so the lower half is below the surface.
- 5) Place flats under intermittent mist. (Six seconds of mist every six minutes during daylight hours provides satisfactory results.)
- 6) Maintain a greenhouse temperature of 75°. (Within two to four weeks, small, usually reddish buds emerge through the bark, often near the origin of where a side branch was removed. Depending on the species, the first shoots should be sufficiently long for removal and rooting about three weeks after buds are visible.)
- 7) Treat softwood cuttings the same as if they were collected directly from a field-grown stock plant.
- 8) Continue harvesting shoots for rooting as long as stem segments continue to form them. With some species, multiple harvests of softwood shoots are possible.
- 9) Drench thoroughly with Banrot 40% Wettable Powder each week at the rate of 1 ounce per gallon of water.
- 10) Compost stem segments after they stop producing shoots.

Varying diameters of stem segments produce quality shoots for cuttings.

plant is unique in that individual stem segments continue to produce softwood shoots for several successive months. We suspect this longevity may be a function of the unique exfoliating bark. The thin outer layer splits as it exfoliates and reveals green bark beneath. This layer gradually turns tan and splits again, revealing more green bark. This process continues on stem segments. We assume the green bark is photosynthetic, therefore making food to support the continued production of softwood shoots. Another attribute of this species is the forced shoots are easy to root.

We have had poor shoot-forcing results on lilac. Shoots emerged, and if harvested in time, would root. However, once the first shoots on these segments grew 2 inches long, they wilted while

still on stem segments — even when under mist. For this reason, lilac cuttings must be taken when softwood shoots are very short.

On sugar maple, only about 20 percent of the forced stem segments produced shoots, and those that did only produced about one softwood shoot per stem section. Additionally, rooting was possible on this species, but the percentage of rooting was only 15 percent. American chestnut stem sections were forced, but the shoots succumbed to chestnut blight.

Occasionally, we have observed stem segments themselves to root. This rarely happens and does not seem to be detrimental to producing additional shoots. In fact, it may help with water relations in the rooted segments. We have not

tested treatments to stimulate rooting of stem segments, however.

For the purpose of producing shoots for micropropagation (tissue culture), we have forced shoots without mist. We chose to hand-water the perlite between stem segments or use drip irrigation (photo, page 26). Either method works, but shoot production is less when hand-watered or drip irrigated, and shoots do not elongate as well as with mist. Also, when forcing is done without mist, vermiculite works much better than perlite for forcing shoots.

Shoots force in full sunlight or in 50 percent shade. We have been unable to quantify the effect of shading but note it is helpful in keeping stem segments moist, particularly if mist is not used. We have tried continuous flat flooding

as a way to reduce watering frequency. However, this technique was lethal to red maple, sugar maple and black walnut.

The best time of year to force shoots using this stem section technique is from mid-winter to late spring, depending on the species. For all species, proper timing is key for the greatest production of shoots in the least amount of time. It is possible with some plants to force softwood shoots from freshly harvested stem segments until fall. Forcing and rooting softwood shoots in mid- to late winter allow nursery professionals a longer growing season during the year of propagation for plant growth. This could be another advantage over traditional propagation methods.

The only problems we have experienced are during some years, especially when forcing under intermittent mist, there can be black tipburn or necrosis. Maple species, grapes and sweet gum are particularly susceptible. Damage typically begins on leaves and progresses into the stems of softwood shoots. Sometimes problems do not appear until softwood cuttings are rooted. We do not know the cause but have had some success controlling the burn or necrosis by drenching stem segments and softwood shoots thoroughly each week with Banrot 40% Wettable Powder at the rate of 1 ounce per gallon of water.

WHY IT WORKS. Our propagation method works well for many reasons. There are latent buds under the bark of trees and shrubs that normally do not grow unless branches break or are severely pruned. These buds typically form at nodes when the branch or stem first grew (axillary origin) or may have formed at a later time (adventitious origin). When stems are harvested and forced using our technique, epicormic buds are the source of the softwood shoots. The fact buds are preformed may explain why the diameter of stem segments has little effect on the number of softwood shoots, as long as it is at least one inch in diameter. If stems are less than 1 inch in diameter, they will force but they seem to have less stored food than bigger diameter segments. However, when larger than 1 inch in diameter, there is no problem with forcing.

Latent buds appear to be under a different dormancy mechanism than new buds that have formed on current or the previous season's growth. For example, softwood shoots grow from large stem segments in July, whereas they will not grow from stem tips.

The parts of a seed-propagated tree



Treat softwood cuttings with the appropriate rooting compound and root under high-humidity conditions in a perlite/vermiculite medium.

FORCING SOFTWOOD SHOOTS IN MID- TO LATE WINTER ALLOWS FOR A LONGER GROWING SEASON DURING THE YEAR OF PROPAGATION.

or shrub that form first are the most juvenile. As a woody plant ages, these older parts — especially latent buds — retain many juvenile characteristics. Therefore, the inside of a seed-propagated tree is often referred to as the "cone of juvenility." This is easy to see on a specimen that exhibits specific juvenile traits, such as leaf retention throughout winter, as is evident with oak species. Leaves are retained near the trunk on the oldest parts of limbs.

Another common juvenile trait is ease of vegetative propagation, such as rooting of cuttings. Our technique results in forcing softwood shoots from cut up lower — more juvenile — limbs of seed-propagated trees and shrubs. Since epicormic buds typically form at the same time the branch first formed, they also retain juvenile characteristics. This may contribute to their relative ease of rooting. For example, forced softwood shoots from stem segments of red oak and oakleaf hydrangea root better than shoots collected from outdoor-grown stock plants.

Greenhouse forcing of softwood shoots on basal branch segments cut from woody

species offers propagators a method to obtain softwood cuttings from many species during times of the year when these cuttings are otherwise unavailable. This is when the labor pool may be greatest and the demands on employees for field work are the least. Additionally, the ability to root cuttings months earlier can result in a longer first growing season for plants.

Unfortunately, a given tree or shrub can only produce a limited number of stem segments. This forcing technique, however, provides a use for dormant-season prunings other than composting. The occasional blackening of leaves and stems remains an unsolved mystery. No pathogen has yet been isolated; therefore, we are not sure if it is a physiological disorder or a disease problem. Nevertheless, this technique offers propagators another tool that could prove very useful in enhancing production — and profitability.

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