

NURSERY PRODUCTION OF TREES IN CONTAINERS¹

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ABSTRACT. --The possibility of growing sizeable shade trees (1½" and over in caliper) in containers is exciting to both arborists and nurserymen. Advantages include reduction in transplant shock, ease of retail storage, extension of the planting and shipping seasons, and less need for nursery space. However, problems include difficulty in overwintering in northern climates, root girdling, potbound trees, and the high cost of growing mix and containers. The suggested best method for cold-weather zones is to re-establish large trees in containers.

THE PRODUCTION OF sizeable shade trees (1½" in caliper and up) in containers has long been a greatly desired goal of arborists and nurserymen alike. It has also been of great interest to the operators of retail garden markets because the storage and handling of bare-root trees at the retail level is a practical impossibility. The arborist is enchanted by the idea of receiving trees thoroughly established in easily removeable containers, trees with every root intact, with a complete balance between root and crown, and not subject to any transplanting shock. Further attractions are the ability to extend the planting season to any time of the year that the ground is not frozen deeply, thus permitting fuller utilization of a smaller, thoroughly experienced planting crew and also permitting additional tree planting whenever budgetary surplusses show up at the close of a fiscal year. Container production also has marked advantages for the grower, the most important one being some relief during brief, hectic digging and delivery seasons, because in effect the trees are "dug " or prepared for shipment when they are planted in the container in which they will be sold. Because container-grown stock can be moved safely throughout the year, the shipping season is enormously extended and the grower can employ a smaller, more stable, and better trained work force. Furthermore it is possible to produce a vastly greater number of trees in containers on an acre of land than on an acre in the open ground, where row spacing must be wide enough to permit cultivation and digging.

¹Metro. Tree Impr. Alliance (METRIA) Proc. 3:15-23, 1980.

With all of these obvious advantages, why has container production of large shade trees not entirely supplanted field production, as container growing is in the process of eliminating the field production of junipers, Japanese hollies, azaleas and many other popular ornamental shrubs? The reason is that there are some difficult problems involved in extending container production to large shade trees. One of the most serious problems is deformation of the root system in container-grown plants. Container-grown shrubs which become "pot-bound" are notoriously slow to re-establish themselves in the landscape planting, but once they do so there are no lasting consequences. Particularly in the case of creeping ground-cover plants like the low-growing junipers and cotoneasters, which root along the stems, the effects of root binding are effectively overcome. Other shrubs are low enough so that their tops do not offer the leverage for wind throw. With root-bound shade trees it is another matter however. At first they may seem to become established and grow off vigorously, and everybody is delighted with the good stand and rapid growth. Only as the trees begin to mature and their tops offer serious wind resistance do the delayed problems emerge. In the case of the city of Santa Barbara in California, all the hundreds of Liquidambar trees originally planted out from 5-gallon cans blew down in wind storms as they began to mature. Furthermore, root girdling, which can cause the decline even of a percentage of shade trees transplanted bare root, can be epidemic in the case of pot-bound shade trees.

There are also some disadvantages in container production for the grower too which are not at first apparent. The first of these is the sheer volume of growing mix which is required to produce 2- or 3-inch caliper shade trees in containers large enough for proper root development. It is one thing to transport, prepare and mix the growing medium for 10,000 1-gallon cans and then to fill them and move them to the growing area. It is quite another matter to go through the same processes for 10,000 containers large enough for 2- or 3-inch caliper trees. In the rapidly expanding container-growing segment of the nursery industry, 10,000 1-gallon containers are grown for every 1,000 2-gallon containers and every 250 3-gallon cans, with still larger sizes representing only a tiny fraction of the whole. These relationships reflect not only the expense of handling large volumes of growing mix, but also a time factor which is a real though not so apparent expense,

Nurserymen in general persistently ignore the time factor and the cost of money in computing their production costs. Field growers are vaguely aware that there is an annual cost for acreage owned or rented for production and that a slow-growing crop must command a higher price per plant than a

rapid one. However liner costs, planting costs and subsequent production costs are relatively low in relation to the very big expense of digging the crop at maturity and preparing it for shipment. In container production, the situation is exactly reversed. All of the big expenses - liners, containers, mix, filling, and planting - occur at the front end of the production cycle, for in effect the crop is "dug" when it is planted. In addition to the costs of watering, feeding and trimming, the initial container, mix and planting costs must be carried until the plant is sold. And these costs must be compounded, in today's financial climate, at 1½% per month. In the warm areas of the South where container production is really big, most 1-gallon cans and some 2-gallon crops can be produced in a year's growing period. Three-gallon crops and larger ones take at least two years and sometimes longer. Two- to 3-inch caliper trees, depending upon the species involved, can take 5 to 10 years to produce, starting with a seedling or rooted cutting, so with such high initial costs involved in container production it is easy to see why field production, despite its serious disadvantages, still presents formidable competition in the area of shade trees.

There is one other important consideration in container production in northern climates and this is over-wintering. It is no accident that the explosive increase in container growing is occurring in virtually frost-free parts of the country. The old adage that you can make money in cans only where palm trees will grow outdoors has a lot of truth in it. Unfortunately almost all of the shade trees of species and races suitable for street-tree planting in northern climates (Zone 6 and north) do not thrive in or will not survive the summer heat of southern production areas. If such trees are to be container grown in areas where they will thrive, then there must be special provisions for over-wintering them. While their tops may withstand temperatures of -10°F or colder with impunity, research has shown that root damage for many species begins at 20°F and accelerates rapidly as the root zone temperature drops. One solution for the northern grower is to over-winter his crop in plastic-covered houses. This is costly but still practical for small plants in 1- to 3-gallon cans, but prohibitively expensive for 12- or 14-foot tall trees. The other solution is to move the containers of big trees together and mulch them deeply as some Canadian cities do with potted street trees used in downtown areas. Such a process is labor-intensive in a large operation and the cost of whatever substance is used for mulching is considerable, especially when a 5- to 10-year growing cycle is contemplated, with protection to be provided each winter. Some utility generating plants in the USA are now actively seeking greenhouse growing establishments to locate adjacent to the power

plants and utilize the waste heat produced as a by-product of generating, and this may offer intriguing possibilities for a few northern container growers to winter their crops outdoors over heated ground areas. However, the economic viability of such a system will require considerably more study and research.

PRACTICAL CONTAINER PRODUCTION

From the observations above it can be seen that genuine container production of shade trees from the liner stage to the 2-inch or larger size needed for street tree planting is a doubtful proposition for the northern grower. In areas of England and the Continent with very mild winter climates, successful over-wintering does not present serious problems. For the southern grower in the USA over-wintering presents no difficulties, but the kinds of trees grown must for all practical purposes be limited to species and races which will thrive in the South. This used to be a real drawback because almost all shade tree planting was done in the thriving northern commercial areas where urbanization and population growth were sustained and vigorous. Both the species which a southern nursery could grow and the cost of shipping the big trees to the North made it impractical to grow for a northern market. Now, however, the trends in population have reversed themselves and it is the "sun belt" regions which are thriving and growing the fastest, so the best sales opportunities are more and more in the southern nurseryman's own local areas.

As previously noted, over-wintering is not a problem in container production in the warm South. Even so, it is still not practical to plant a seedling or rooted cutting in the 2- to 3-foot diameter container that will be the size which is ultimately necessary to produce a 2- to 3-inch caliper shade tree. Since the production cycle will take some years to complete, there is no point in watering so large a container area during the early stages of production when the tree is still small. It is much better to get a year or two of growth in a 2-gallon or 3-gallon can and then shift up to the final size. This economy in space is especially significant in the arid Southwest where water is scarce and expensive, often requiring very costly treatment to get the salt level of the water down to non-phytotoxic levels. Furthermore the intensity and quantity of sunlight in the South degrades plastic much more rapidly than in the North and big plastic containers will be hopelessly brittle and even collapse before the end of a long production cycle. Replacing them prior to shipment is costly and very time consuming. The important thing to remember in producing trees in several successive sizes of

containers is to be sure that shift-ups are made on a timely basis and that roots circling the bottom of the smaller container are cut in several places during the transplanting process. If the younger stages once become root-bound, shifting them to larger containers will not forestall the root problem which will show up later on the city streets.

GROWING MIXES

At this point, virtually all container plants in the USA are being grown in some kind of bark or bark mix. The reasons for this development are good ones. Bark is an inexpensive by-product of lumber or paper mills, it can be ground to a uniform granule size, it is reasonably stable and long lasting, and proper composting processes can both sterilize it and eliminate toxic tannins and acids.

While good-looking plants can be grown in pure bark or the bark-peat or bark-rice hulls used on the West Coast, such all-organic media are not satisfactory for shade tree production. The reason can be seen in any group of leftover plants in a retail plant market, particularly in the South. After a season or two the medium level in such leftovers will be found to have been reduced to one-half or even less of its original volume and the plant will have sunk down to a correspondingly lower level in the can. Bacteria and soil fungi use up the organic matter as food and it gradually disappears into the air in the form of carbon dioxide. Exactly the same disappearance of the bark or peat occurs when a large tree in such a substrate is planted on the city street and the tree can subside to far too great a depth for survival.

It is far better for the ultimate development of the tree if it is grown in the mixes of bark and sand or bark and ground shale used by some nurseries in the Southeast rather than in pure bark. In fact, the higher the proportion of shale or gravel in the mix, the better the tree will grow after planting it out. It is true that the heavy mixes increase transportation costs, but when loading 2-inch trees or larger, the bulk of the tops rather than the weight of the balls or containers determines the size of the load. One hundred to 150 trees 2 inches in caliper is the normal load for a standard open trailer; considerably less in a closed trailer.

pH AND FERTILIZING

The pH of composted bark mixes is normally quite low, which is suitable for oak, magnolia, sweet gum, and other acid soil trees. Even they will grow best at about 6.0 and less well at very low levels, so some pH adjustment is often necessary. Trees like honeylocust, Sophora, and ash which grow best at around pH 7.0 normally require the addition of

ground dolomitic limestone to bark mixes to get the pH up to neutral. Different kinds of bark vary in their trace element contents, so it is wise to add fritted trace elements to a section of the container blocks of each variety of tree to see if growth and leaf color are enhanced.

In the arid sections of the country, especially the Southwest where it so rarely rains during the summer, "constant feed" programs in which small amounts of fertilizer are added to the irrigation water on a constant basis work very well. It takes experience and expertise to set and maintain the feeding level, but if it is properly done the resultant growth is phenomenal. In the Southeast and in the northern states, which can experience prolonged rainy spells in the growing period, "constant feed" culture is a much more chancy affair and some hair-raising growth reductions or even plant losses have occurred. Here a safer program is to top dress with granular or pelleted slow-release fertilizer and let the irrigation or rain do the dissolving. Here again expertise, experience, and a constant desire to experiment are necessary for best results. For example, "slow-release" fertilizers dissolve much more rapidly in the prolonged and intense summer heat of the deep South, as more than one southern container grower learned to his horror in the early days.

NORTHERN PRODUCTION

For the many reasons noted above, principally the problems connected with over-wintering large trees in containers, it does not seem likely that 2-inch or larger shade trees will soon be produced (from the seedling stage up) in containers in northern nurseries. However, it may well be practical to re-establish field-grown trees large enough for street planting in containers. Indeed this practice is already being followed in some retail nurseries as a means of extending the selling season. For the retailer it is economically viable because retail prices per individual tree are so much higher than the wholesale prices for volume orders to the trade or to municipalities. Whether re-establishing trees in containers becomes a common method of wholesale production depends largely upon the relationship between the costs of digging the tree bare root and establishing it in a large container and the cost of digging the same tree with a ball of earth and selling it directly. Currently the costs are quite comparable, with the edge going to the B&B route if good piece-work diggers are available. In any size above 3 inches in caliper, container production is impossibly slow and expensive and B&B production will doubtless forever prevail.

Re-establishing trees has one decided advantage over direct B&B digging in that it can often be done in the winter or during the spring in inclement weather when there is little

alternative work available to be done. Thus it can accomplish the container grower's great "edge" over the field grower, preparing stock for shipment at some other time than the shipping season and extending the shipping season as well. There is one important limiting factor, however. A re-potted tree is really not saleable the first spring or even the first fall after it is potted. The following spring, after the first flush of growth, it is comparable in appearance to a freshly dug B&B tree and of course will suffer little or no transplanting shock. Consequently, since 75% or more of all trees sold are shipped in the spring months, re-established trees must be over-wintered through at least one winter, and this means incurring the expense of moving the trees together container-to-container and mulching the root areas or providing some other means of root protection. Such protection need be quite minimal in Zone 7, not prohibitively expensive in Zone 6, but increasingly crucial and exacting in successively colder climatic zones. It is possible that silage or forage choppers and blowers can be adapted to ease the task of mulching, if the production area is large enough and is laid out with this consideration in mind. Nonetheless, even spoiled hay or straw is expensive and so is labor, and northern production areas suffer a distinct handicap.

It is important here to draw a clear distinction between artificially balled trees and those which are re-established in containers. The former are trees dug bare root and later processed by encasing the roots in some form of mix, usually a mixture of peat and straw or peat and sawdust. This mix is held around the roots by a burlap (hessian) bag or wrapping and that is usually covered by an additional bag of polyethylene film to retain moisture. The method is designed to provide living trees with a prolonged "shelf life" for retail garden centers, and the mix is deliberately kept as light as possible for the convenience of the customer who takes his tree home. Almost invariably however, the root system is compressed and distorted by the artificial balling process in an effort to keep the ball as small and as light as possible. Such trees are living when sold and will survive planting out, but they are certainly inferior to dormant bare root or orthodox B&B trees for street planting. The re-potted tree, if it is in a container of adequate size, is a far better product with a more natural and vigorous root system. Furthermore, while only the very easy-to-transplant trees like poplars, weeping willows, and silver maples give good survival in artificial balls, more difficult species like oaks, lindens, and sugar maples are adaptable to container potting.

The mix for the latter process, like good mixes for container production, must combine perfect drainage with good water and fertility retention. The various bark mixes seem to be satisfactory for these requirements. As noted earlier, mixes with a reasonable content of sand, gravel, or ground shale give the best results after planting out, and their increased weight is not a handicap. Indeed, weight is a decided advantage during wind storms, especially in the summer months when trees are in full foliage. The heavier the containers, the less necessary it is to provide bracing or guying for the trees in production in order to avoid re-setting large blocks of trees after a summer wind storm.

Fertilizing methods can be "constant feed" via the irrigation water or slow-release fertilizer applied on the surface of the containers, with the advantage to the latter in areas with abundant summer rainfall. The general consensus, as in the case of newly benched florist crops, is that fertilizing should be delayed until the trees have made new top growth after being potted. An interesting concept is irrigation via the small black plastic Chapin Tubes which are frequently used for greenhouse production of chrysanthemums and other pot plants. The advantages are accurate metering of adequate water to each container, particularly important for nearly mature container plants where the foliage canopy is so dense as to interfere seriously with overhead sprinkling. One unexpected drawback has occurred wherever rabbits are about. Their instincts to nip off vegetation to clear pathways has resulted in serious losses of container plants which dry out and die before the cut tube is noticed. Furthermore the cumbersome header tubes with their network of laterals are difficult to move and store. Nonetheless, the Chapin system is very economical of water and is especially valuable for crops which are subject to mildew or other diseases if the foliage is frequently wet.

TRIMMING

It should not be necessary to mention that trees re-established in containers benefit from having their tops shaped and reduced at the time of potting. However, an amusing if ill-informed controversy is raging on the subject in the USA at present. Once in a great while the wisdom of ages of experience can be shown to be false, but this is not such an occasion. It is analagous to recommending adultery. Yes, in rare small-scale experiments it seems to result in no harm. No, as a general rule it leads to very unfortunate results!

CONCLUSION

Shade and flowering trees can successfully be produced in containers in suitable climatic zones. This has been an established practice for small-sized trees for many decades. When the production of larger sizes is contemplated, additional problems occur, especially over-wintering of large trees for a number of winters until they reach saleable size if production is attempted in zones with cold winters. For such areas, re-establishing almost fully grown trees in large containers offers a practical compromise between field production and marketing in containers. In all cases, whether shade trees are entirely grown in containers or re-established in them, it is essential that they are not allowed to become pot-bound, because of the dangers of wind-throw in later years when the trees approach maturity on the city streets.