Patience is a Rewarded Virtue with Small Container-Grown Trees

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Arborists, municipal foresters, landscapers, and homeowners transplant millions of container-grown trees each year. One question that often arises is “Does size really matter?” In order to answer this question, it becomes necessary to ask “How soon do you wish the trees to become established?”, “How long are you willing to wait to achieve the desired landscape effect?”, and of course “How much are you willing to pay for the trees and establishment care?”

This research was designed to begin answering how long it takes for different sizes of trees of the same genotype grown under the similar nursery conditions to become established when transplanted to the landscape. This research also tracked subsequent growth in the landscape to determine if initial growth differences associated with a range of container sizes persist in the future as trees continue to grow in the landscape. Our results should assist those planting container-grown trees in determining the likely time frames in which intensive post-transplant care will be required for different stock sizes, as well as when or if smaller size trees might catch up to larger ones in subsequent years after transplanting. It is only with the assistance of industry generated funds that such long term research can be completed.

The size of trees which are transplanted to produce instant landscapes have increased in recent years, and even large box stores, for example Walmart, Lowes, and Home Depot, which sell nursery stock have moved to larger size container-grown trees. These container-grown trees are often produced in light weight substrates with relatively low water holding capacities compared to that in the soil on balled-and-burlapped stock. This has raised the question of the length of time required to establish various size container-grown trees. Several studies have attempted to answer this question, but usually confounded the genetics and growing practices in the source nurseries used to obtain the different size trees with the responses of the transplanted trees. For instance, a comparison of the same container size trees from different nurseries may result in trees that already vary in size, nutritional status, water holding capacity of the substrates, pruning practices, and a myriad number of other factors that are specific to an individual nursery’s production system rather than the characteristics associated with specific container sizes. In addition, if trees were of seedling origin or clonal materials were on seedling rootstocks, then when different size materials are obtained from different nurseries there is a high...
degree of likelihood that the genetic composition of each size class of container-grown trees in a study would not be the same. Provenance differences within a species and even tree to tree variation within open pollinated families of seedlings can be substantial in regard to growth and physiological responses, even when grown under identical growing conditions. Hence, it would be difficult to determine if the observed differences in transplant responses were due to the size of the transplanted stock, or to the genetic and production differences associated with the sources of the different sizes of stock.

A potential solution to these questions would be to propagate stock from clonal rooted cuttings sequentially over a number of years and grow the stock in a common location using consistent substrates, containers, nutrient regimes, and other production practices timed to produce a range of container sizes of trees that are then transplanted to a common landscape location using an appropriate statistical design.

The goal of such a project would be to determine the effects of size on transplant establishment on representative taxa of container-grown trees, while holding other production, field establishment and genetic factors constant.

Clonal trees on their own roots, *Acer rubrum* var. *drummondii* ‘Maroon’ (Drummond red maple, *Vitex agnus-castus* (unnamed white flowering clone of chastetree), and *Taxodium distichum* (a baldcypress test clone TX8DD38), were propagated sequentially over a period of three years. As trees reach saleable sizes in smaller containers they were repotted to successively larger containers until a range of sizes (#1,#3,#7,#25, and #45) of clonal materials grown in a common nursery setting and with consistent inputs from one year’s crop to the next were produced. After a sufficient size range of trees derived from these same clonal stocks and common growing conditions were produced, they were transplanted to in-ground field conditions to determine landscape establishment responses associated with the various container size materials. Trees were arranged in randomized complete block designs for each of the three species in the field and irrigation was provided to each size category of trees within a species via a separate irrigation system by monitoring soil moisture levels associated with each container size group independently. This permitted separation of different irrigation requirements among the various size classes of trees, within a species, from other size related factors affecting establishment. Factors such as growth parameters, photosynthetic capacity, and water relations data were collected periodically during the first two growing seasons after transplant (2013, 2014) to help estimate the time required for each size class of materials to become fully established in the landscape (resume normal growth and water relations). During the landscape evaluation phase (2013-2017) we are determining if the supposition by some experts that smaller trees establish more quickly and thus experience less transplant shock and soon catch up to larger planted stock is true, or if this is a myth and larger size materials continue to maintain a size advantage for an extended time in the landscape. The primary study site is located on the Texas A&M University Horticulture Farm in College Station, Texas, with a replicate study for determining location impacts on general growth responses installed at Mississippi State
University, in Starkville, Mississippi under the direction of Dr. Geoffrey Denny. Details of methodology and analysis are included in Garcia et al. [Arboriculture and Urban Forestry 42(3):170-180] in which we reported the differential responses between the two sites.

Physiological and root growth responses were measured for two growing seasons after transplant and shoot growth was monitored for three growing seasons after transplant. Data collected were statistically analyzed to determine the rapidity of establishment, comparative growth responses among trees from the various container sizes, and monetary values were determined using the replacement method to estimate the economic benefits of the use of the various container stock sizes. Rapidly establishing species such as Vitex agnus-castus were well established from all container sizes by the end of the first or beginning of the second growing season, and by the third growing season trees from all five container sizes for chaste-tree were nearly equivalent in size in the landscape. Smaller #3 and #7 container sizes of Taxodium distichum and Acer rubrum var. drummondii were established in the first or second year, but those from larger containers did not resume vigorous growth until the third growing season. Although some differences were still apparent among the trees from the various container sizes by the third year, the #3 to #45 containers appeared to be converging on a common size in the landscape for both Drummond red maple and baldcypress. The smallest (1) containers of baldcypress and Drummond red maple had poorer survival and resistance to environmental vagrancies and lagged behind the other container sizes. Fastest establishment and growth responses were obtained with 1 to 7 chaste-trees and 3 to 7 Drummond red maples and baldcypress. Economic analysis using a replacement method found the greatest increase in monetary value of the various stock at two years after transplant to be associated with #3 and #7 container grown stock. This suggests substantial savings can be obtained financially by planting smaller stock if an instant effect is not required, however this must be balanced with the loss of larger planting stock benefits such as greater aesthetic value of larger trees, greater biomass present to withstand environmental anomalies, less potential for accidental or malicious mechanical damage, instant shade, and a potentially greater increase in property value. This project was conducted with participation by both graduate and under graduate students and would not be possible without generous support from organizations such as TREE Fund.