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Long-Term Impact of Container Size on Tree Establishment

by Michael Arnold, Ph.D.

Some of the most intriguing and useful research projects originate from questions or observations provided by students and industry colleagues, and this project had such an origin. Among the Green Industry and academia, the conventional wisdom was that smaller stock would establish more rapidly than larger trees, but larger trees offered more immediate impact. Our students asked the next obvious question; do the smaller trees ever catch up and if so, how long does it take?

Taxodium distichum (top); Acer rubrum var. drummondii (bottom) in the field.

We tackled the challenge with a grant from TREE Fund and a student worker (now Dr. Lauren Garcia Chance). To eliminate as many production condition differences as possible, all trees were grown by us in a single nursery. Clonal materials were used for each of the three species to eliminate genetic variation among seedlings: *Acer rubrum* var. *drummondii* 'Maroon', *Taxodium distichum* 'TX8DD38', and *Vitex agnus-castus* (test clone). Five container sizes for each species were produced by rooting cuttings in common flats, then sequentially up-canning to produce marketable size trees in #1, 3, 7, 25, and 45 containers.

Once the finished stock of each species in the five sizes were available, we transplanted them to the field. To avoid systematically over or under -watering trees of different sizes, fifteen separate micro-sprinkler irrigation systems were constructed (one for each species/container size combination). Lauren monitored photosynthetic gas exchange, transpiration, mid-day water stress and pre-dawn recovery for two seasons after transplant and we carried out longer term growth measures for five years post-transplant. Dr. Charlie Hall, Dr. Todd Watson, Dr. Andrew King, Dr. Leo Lombardini and Dr. Sean Carver all contributed to this research project, and certified arborist Mr. Jeff Lehde helped instruct us in safe air spade use.

Thanks to Lauren and her dedicated team we were able to learn not only that smaller size stock did truly establish faster across all three species, but that for *Vitex* by the end of the third growing season there were no statistical differences between all five stock sizes. Even though the physiological measures indicated that all species and sizes were largely established in the landscape after the second growing season, there was little growth on the larger #25 and #45 stock until the third growing season after transplant; while smaller stock began growing during the season of transplant. For *Acer* and *Taxodium*, no difference in tree size among the trees from the four largest container sizes was present after four and five years, respectively. There is a lesson, however, about the potential limitations of smaller size stock: the #1 *Acer* were eliminated from the study due to damage from deer predation, which was not apparent on any of the larger stock. Based on replacement costs for the size trees had obtained in the field by the end of the second growing season for all three species, smaller trees from #3 and #7 containers yielded greater economic values during the first two years in the landscape than did the #25 or #45 trees. *(continued on back)*

Certified arborists Jeff Lehde and Dr. Todd Watson instruct in use of air spades.

Long-Term Impact of Container Size on Tree Establishment *(continued from front)*

So, if we get a greater return on investment on smaller trees, why would we plant larger size stock? Does that mean it is unwise to plant larger stock? Of course not! For one thing, some of us would like to be able to sit in the shade now as we may not be around long enough for the smaller stock to catch up! The kids may not want to wait five years to climb the tree or the clientele may wish to have the aesthetic benefits of a larger tree immediately. The greater biomass of the larger stock may help it to survive anomalies in the climatic conditions such as unusually cold winters or exposure to mechanical injury or predation. While in some locations on campus, our grounds folks are taking advantage of the opportunity to plant larger numbers of smaller trees for the cost of fewer larger stock, they still plant larger trees in some locations for aesthetic purposes as well as the challenges that an urbanized campus can place on young trees. Larger stock may help with urban heat island issues more rapidly through greater transpiration of the canopy and greater surface area shaded. Rowdy students, vehicles, and maintenance equipment are less likely to seriously injure larger trees. As always. the decision of the size of plant materials to specify in our built environment is a function of aesthetics, relative advantages of the different size materials for a given site and use, growth rates of the genotypes involved, the economic costs and benefits associated with each size and genotype, and not least the clients' needs and wishes. Thanks to support from TREE Fund we now have additional information to support decisions among these trade-offs with container-grown trees! We gratefully acknowledge their support and yours through your contributions to industry-oriented research and educational organizations such as TREE Fund!

Dr. Michael A. Arnold is a Professor of Landscape Horticulture and Associate Head for Undergraduate Programs in the Texas A&M University Department of Horticultural Sciences where he has been engaged in research, teaching, service and administration for over 25 years. Dr. Arnold's research has focused on container nursery production, landscape and tree establishment, and the development of new plants for the Green Industry. He is a Fellow of the American Society for Horticultural Science where he has served as their President and Chairman of the Board of Directors. Dr. Arnold has published three textbooks, over 90 referred scientific manuscripts, in excess of a 100 popular press or industry-oriented publications, raised over a million dollars in research and teaching support, and provided more than 250 talks or presentations at scientific or industry venues.

Behind the Research: Meet Dr. Mike Arnold

After dealing with the wettest winter and spring and one of the busiest semesters he can recall, Dr. Arnold is eager to visit his trees in the field. As long as he can remember, he has been in and around trees and plants on his grandparents' farm in the hills of the Appalachian Mountains in Ohio, and this year is no different. Mike now lives and teaches in Texas, many miles away from the over 100' tall catalpas and white oak trees that he used to admire and climb. But he has joined those trees in his mind and heart with the old-growth, post oak forest he now carefully and successfully stewards on his property in the savannah-like area of Texas he now calls home. As he put it, Texas is a drought interrupted by periods of intense rain, and with trees that are extremely sensitive to changes in moisture, he is careful to keep his post oaks safe from soil compaction threats and irrigation systems.

Mike is no stranger to hard work either. His grandparents did not use herbicides on their farm, and all idle hands were attached to a hoe and clearing invasives in the fields. You can see this work ethic in everything he does. When he isn't teaching, running the undergraduate program or doing research at Texas A&M, he is also deeply involved in campus grounds care. He was pleased to report that the seventh or eighth biggest post oak in the state of Texas was found in the midst of a new 27-acre teaching garden under construction on campus. Safe to say, they have gone to great lengths to protect it during the garden's development. Outside of Texas A&M, Mike is married and has two children, and he had almost achieved his second-degree black belt in Taekwondo before a doctor told him he needed to stop for the sake of his knees. While he still is involved in teaching Taekwondo to young people, all of this is prompting Mike to embrace his other love which is writing. When he is not writing about his research (he is working on a fourth book right now), he enjoys writing about gardening and hopes someday to transition to writing urban fantasy stories.

Read more about Dr. Arnold's TREE Fund supported research and watch his webinar at www.treefund.org.