Production and Economics

On-Farm Nursery Crop Demonstrations in Western Kentucky

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Nature of Work

Two on-farm nursery crop demonstrations were conducted in western Kentucky to evaluate production methods while providing technical support to the cooperators. Each cooperator agreed to host an evening field day event to share their experiences with other nursery managers. The two cooperatives were located in McCracken and Calloway counties. One demonstration observed the utilization of an aboveground Smart Pot™ growing system, while the other observed the use of supplemental liquid fertigation in a pot-in-pot production system. Each grower was seeking information to enhance his or her current production system.

Results and Discussion

General Summary

At the pot-in-pot nursery cooperator (nursery A), we wanted to determine if the quality plants can be produced in less time by introducing supplemental fertigation while increasing the number of saleable plants per acre of land. The life of a pot-in-pot system was assumed to be 15 to 20 years if properly maintained. If a significant increase of growth per season was observed but production duration remained the same, then would the plant become more valuable to the consumer? Due to the nature of this demonstration, specific production costs were obtained from the cooperator, but only general figures will be documented in this report.

The second cooperator (nursery B) had previously grown shade trees in traditional aboveground container production. As an alternative, fabric bag production was considered. Fabric bag production is not widely used in Kentucky nursery crop production, but the advantages described by Root Control Inc., the maker of the Smart Pot™, seemed worthy of investigation. The Smart Pot™ is designed to be used aboveground, allowing small roots to penetrate into the earth's surface and resist blow-over while creating a fibrous root system favorable for accelerated growth and successful landscape establishment.

Each nursery provided land, trees, labor, and irrigation. A Kentucky Horticulture Council grant from the Kentucky Agriculture Development Board provided a portion of the supplies necessary to carry out the demonstrations.

Nursery A installed an H.E. Anderson J+ Dual Injector for the purpose of the demonstration. Harrell's custom blend polygon fertilizer, formulation 17-8-12 with 6.91% NO^3-, 5.61% NH4+, 4.49% urea an minors package, was top-dressed at manufacture's recommended high rate (269 grams/#15). Pro-Sol™ water soluble fertilizer, formation 20-10-20 with 8% NH4+, 12% NO3-, and minor nutrients, was used as the supplemental solution fertilizer. Solution fertilizer was injected at 150 ppm every third day from April 9 to July 30. A leachate sample was analyzed every other week from block to monitor soluble salt and pH levels. Leachate was obtained by the Virginia Tech Extraction Method (3). The recommended soluble salt levels for combined use of controlled-release and solution fertilizer on container nursery crops are 0.5 to 1.0 mmhos (1). If soluble salt levels were higher than 1.5 mmhos, the amount of solution-free irrigation water was increased. A suggested leaching fraction less than 20% was maintained (2). Growth and pruning demands were observed on first-year *Taxodium, Cercis, Gleditsia*, and *Betula* species, and second year *Acer, Prunus, Betula, Malus*, and *Cercis* species. The demonstration began on April 8, 2005, and concluded following the on-farm demonstration presentation on September 27, 2005.

Nursery B potted potted 15- and 25 gallon Smart Pot™ fabric bags for observation purposes. Cultural observations were conducted on the following species: *Prunus, Pyrus, Liquidamber, Populus*, and *Acer.* Root Control Inc. promoted the use of topsoil in substrate mixes to prevent rapid substrate dryness and to help add weight to the base of the plant to reduce blow-over. Kentucky's native clay base soils, however, have not previously been recommended for container production because of their high water-holding capacity, low pore space, lack of consistency, potential of soil-borne contaminants and complications created by increased weight during planting, harvesting, and shipping. Therefore, cultural observations included production use of a soilless substate (75% pine fines, 15% peat, and 10% sand) and a topsoil mixture substrate (40% Loring Slilt Loam local soil, 40% pine fines, and 20% sand) and monitoring substrate temperature, substrate moisture, and plant growth of each mix. Trees received cyclic low-pressure irrigation. Substrate moisture levels and substrate temperatures were recorded from one representative sample of each group. The data were recorded by a WatchDog™ data logger model 400 every hour and analyzed monthly. A soil moisture probe and a temperature probe were inserted 5 inches below the soil level of each represented group. The project began on March 16, 2005, and is still ongoing through the winter months to monitor winter substrate temperature and plant response. An evening field day on September 19, 2005, focused on observations made to date.

Nursery A Observations

Soluble salt and pH levels were recorded every two weeks, mid-April through July. The leachate was then tested with a hand-held pH and electrical conductivity meter, Hannah 8611. Targeted range: pH 5.5 to 6.1, E.C. 0.5 to 1.5 mmhos/cm from pour-through leachate. Targeted E.C. range of fertigation from emitter at 150 ppm: 1.00 mmhos/cm. Actual leachate recordings are represented in Figure 1.

High E.C. readings were recorded on Prunus in July. Solution-free water was increased for one week to reduce soluble salt buildup. Prunus generally require less water and are more salt sensitive than most species. Once E.C. levels returned to our desirable range, the amount of water supplied to the Prunus block was reduced to accommodate cultural needs. All blocks received 150 ppm solution fertilizer every third day they were irrigated. Although the Prunus received less water and thus less solution fertilizer than other blocks, elevated soluble salts levels remained a concern. Since the fertigation system is not capable of delivering variable solution rates on salt-sensitive species, a lower rate of slow-release fertilizer will likely be applied in the future while a 150 ppm solution rate is maintained on all species. E.C. readings were observed to be higher on second-year crops, but were attributed to higher water demands of the plants. Irrigation duration was increased on second-year crops to accommodate their water needs. Second-year maples began to show nutrient deficiency symptoms in late July. Plant and soil analysis reported high levels outside the acceptable range for phosphorous, potassium, zinc, and manganese in the substrate and phosphorus and manganese in the foliage. No nutrient alterations were made since the problem appeared to be associated with substrate characteristics. Instead, the plants are to be up-potted into larger containers this fall with a more reliable substrate.

Nursery B Observations

Daily substrate moisture levels and substrate temperatures were recorded with the data logger. A representative sample from each block (soilless mix and with soil mix) remained consistent throughout the study. Growth and leachate were observed at the beginning, middle, and end of the trail. Based on the data retrieved from the data logger, there appeared to be no significant difference in the substrate temperature. There was, however, a noticeable difference in the moisture saturation in bags potted with soil versus those without soil versus those without soil. It appeared the water form the irrigation emitter created channels in bags potted with soil, while the soilless mix allowed water to disperse more evenly throughout the bag. As an attempt to correct this problem, all of the original irrigation emitters were replaced with new emitters that would provide even surface-area coverage. The data logger reported substrate moisture levels remained higher than desired by most plants, but the design of the Smart Pot™ appeared to allow the excess water to pass freely through the sides of the bag. This likely contributed to the fact that none of the trees observed in this trial experienced reduced root growth from excessive moisture. We observed good subsurface root anchoring through the bottom of the bag in both substrate mixes in plants potted in late winter and early spring. Plants potted late in the spring did blow over, whereas trees planted earlier did not.

Results and Discussion
Results are based on observations and nursery cooperator reporting experiences.

Nursery A
Birch liners of comparable size, approximately 0.5-inch caliper whips, were potted in 2004 and 2005. The birch liners potted in 2004 had a reported caliper size of 1 inch on average at the end of that year's growing season, a 0.5-inch average caliper increase. Birch liners potted in the spring of 2005 were reported having 1.25-inch caliper trunks as of August 2005, a 0.75-inch average caliper increase. Six-foot, one-year branched Autumn Blaze® maple liners, approximately 0.875-inch caliper, were potted in February 2004. At the end of the 2004 growing season, the caliper was reported as 1.125 inches, a 0.25-inch average caliper increase. The same maples after two growing seasons had a reported caliper size of 2 inches, a 0.875-inch caliper increase. Trees appeared to have fuller and denser canopies; foliage was darker and wider than those without supplemental fertilizer and seemed to have less noticeable leaf disturbances from insects and mites.

Each tree was topped-dressed with Harrell's fertilizer at the recommended medium to high rate 17-8-12 (five-to six-month release) at a cost of $0.61 per tree. ProSol 20-10-20 water soluble fertilizer was used at a cost of approximately $0.08 per tree, not including the cost of the injector. Total cost of fertilizer per plant is estimated to be $0.69.

Although results are preliminary, the data collected during this on-farm evaluation indicate a significant growth increase with the use of supplemental fertigation on birch and Autumn Blaze® maple trees with minimal increases of pruning requirements and fertilizer. The accelerated growth provided the cooperator with marketing options: produce a quality tree in less time or sell a larger plant at a higher cost to the consumer. As a result, catalog prices were adjusted 12.25% for larger caliper; grade A, No. 15 deciduous shade trees, while prices remained the same for traditional plant size. Calculations made from data provided by the cooperator's cash flow report indicated that a 2 to 10% increase of profits to the business could be obtained. Likewise, trees originally scheduled for an 18-month production cycle could potentially be reduced to a 12-month cycle. A shorter production cycle of 12 months verses 18 months could potentially result in one-third more trees produced on one acre of land that is allocated to pot-in-pot production assuming the system is functional for 15 years. In conclusion, this cooperator could potentially gain $65,220 in sales over 15 years on one acre of pot-in-pot with an 18 month productions cycle if a +12.25% value-added price adjustment for increased caliper size was adopted. If the cooperator chooses to reduce the production cycle to 12 months and maintain the value of the crop at the smaller size, then the cooperator could potentially see an $201,095 increase of sales over 15 years on one acre of pot-in-pot.

Nursery B
Deciduous shade trees potted with soil showed no significant differences in trunk or canopy growth than those potted without soil, but root structure development differed. Trees potted with soil created channels of water movement unlike the soilless mix with evenly distributed and dense root mass. Additional root structure and growth trends were examined by comparing Zelkovas produced in Smart Pot™ bags at the cooperators' nursery with pot-in-pot grown Zelkovas from the University of Kentucky Research and Education Center in Princeton. Through visual

observations, it was obvious that Zelkovas grown in the Smart Pot™ bags had larger trunk calipers, canopies, and root masses than the pot-in-pot produced by Zelkovas. The root structure of the Zelkovas grown in a Smart Pot™ was much more dense and evenly branched when compared to the pot-in pot grown Zelkova that showed long unbranched roots with girdling tendencies.

The use of the Smart Pot™ was observed to be more cost efficient for this nursery than the previous method of plastic container production. Trees grown in the Smart Pot™ resisted blow-over by allowing small roots to pass through the bottom of the bag into the upper soil surface. No additional support system was required to prevent blow-over when potted in late winter or early fall. Handling the trees at planting and at harvest showed no difference when soilless mix was used in comparing traditional container and bag production. Trees potted with soil required one additional laborer to maneuver the added weight of soil during planting and at harvest. Consumer demand showed no resistance of the fabric bag when marketed to buyers seeking an alternative to root-bound or girdling roots associated with traditional container production. Consumer demand continues to be based on tree quality, size, price, and service.

Significance to the Industry

Continuing to make production systems more efficient should be a goal for all businesses. Our industry is competitive and constantly changing. Those who embrace change and anticipate shifting trends while closely monitoring costs of production will sustain a vital role in Kentucky wholesale nursery crop production. Sharing valuable education experiences with nursery managers across Kentucky will continue to strengthen networking relationships and help reach our goal to make Kentucky widely known as a producer of quality nursery crops.

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Literature Cited

1) Best Management Practices Manual-Guide for Producing Container-Grown Plants. 2000. Southern Nursery Association. Version 1.0:53-54

2) Tyler, Helen H.,S.L. Warren, and T.E. Bilderback. 1996. Reduced Leaching Fractions Improve Irrigation Use Efficiency and Nutrient Efficacy. J. Environ. Hort. 14(4):199-204

3) Wright, Robert D. 1987. The Virginia Tech Liquid Fertilizer System for Container-Grown Plants. Virginia Tech College of Agriculture and Life Sciences Information Series 86-5.