Determination of the Optimum Species for Ohio Tree Liner Production in Retractable Roof Greenhouses: Year 2

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Significance to Industry: Nursery tree production is a significant part of the green industry in Ohio. Currently, Ohio growers import nearly all of their tree liners, most from the West Coast. More that $50 million worth of liners are imported annually. Most growers in Ohio feel they cannot produce a liner that would compete with a liner brought in from the West Coast. However, work done by Stoven et al., with the use of the Ohio Production System (developed by Dr. Dan Stuve and others at The Ohio State University) proved that quality "bread and butter" species of liners can be produced in Ohio in one growing season. The objective of this study was to expand that work by growing harder to grow, niche type species, and to see if different environments affect growth.

Materials and Methods: The data represented in this summary is the second year of a two year study (the same trial replicated in time). Five species were selected after consultation with some Ohio nurseries, yellowwood (*Cladrastis kentuckea*), red oak (*Quercus rubra*), stewartia (*Stewartia pseudocamellia*), Japanese tree lilac (*Syringa reticulata* 'Ivory silk'), and littleleaf linden (*Tilia cordata* 'Greenspire'). Seedlings of yellowwood, red oak, stewartia, and the tree lilac were upshifted to copper treated 3 gal. (11.4 l) containers in October, 2005. Littleleaf linden, because of their size, were potted into copper treated 250-XL containers. All of the plants were then put into a peak-roof retractable roof greenhouse (RRG) (Cravo Equipment Ltd., Brantford, OT, Canada). The roof on the RRG was set to open at 38 °F (3 °C). Temperatures were kept above 25 °F (-4 °C) in the RRG by a forced air heater. Plants were watered twice monthly during the cold season. On March 15, 2006, all of the plants were fertilized with 3 tablespoons 19-5-8 Osmocote® (Scott's Co., Marysville, OH) slow release fertilizer. They were then moved to their respective environments: one-third of the plants were kept in the peak-roof RRG, one-third were moved to the flat-roof RRG, and one-third were moved to a polyhouse covered with 6-mil, milky poly. Also on March 15, 2006, settings in the peak-roof and flat-roof RRG were changed. The sidewalls were set to open at 55 °F (13 °C) in both environments. The roofs remained closed unless temperatures exceeded 75 °F (24 °C) through the remainder of the growing season. On April 1, 2005, sidewalls and were reset to open at 65 °F (18 °C), and on April 15, 2005, sidewalls were set to open at 75 °F (24 °C) and kept that way for the remainder of the season. However, if temperatures exceeded 85 °F (29 °C) during the day, then the roof was set to close for shading, and the sidewalls remained open for air circulation. On May 15 (frost free day for Columbus, OH), poly was removed from the polyhouse. Growth was evaluated in June and August and will be evaluated again in October by taking leaf area, caliper, height, and dry weights of shoots and roots. Evapotranspiration rates were also measured just prior to each growth evaluation. Liners were top pruned once they reached the height that they achieved in 2005 (Oak, or at four feet (some didn't make four feet in 2005).

Results and discussion: No statistical differences can be made with one year of data; however, we can make valid inferences. Averaged over all species, liners grown under

the peak-roof RRG had the best growth for all parameters except height (which was very similar to the flat-roof RRG) (Table 1). Height is important up to a certain point, and then caliper growth becomes more important. Averaged over environments, Japanese tree lilac had the best growth from each parameter taken; however, the root:shoot ratio was the best for the Oak (Table 2). Growth was similar between environments for all species except the Yellowwood (data not shown), which had greatly reduced growth in the polyhouse as to those that grew in the flat- and peak-roof RRG. This explains that when averaged across species, the polyhouse produced liners with lower heights, calipers, and shoot weights.

This study helps to prove that even harder to grow species can be produced in Ohio with good results. The RRG provides the benefits of manipulating the growing environment and scattering light, which helps with the growth of the plant. However, the RRG is more expensive than a polyhouse, which deters many growers from getting the RRG. We wanted to include the polyhouse to prove that it can also be used to grow the liners. There is more work that can be done to improve the OPS using RRG's; best management practices should be studied with the RRG. "Double cropping" is also something that can be studied with RRG's, since many liners reach acceptable height by late June if grown in the RRG.

Table 1. Average Growth of Linden 'Greenspire', Yellowwood, Red oak, Stewartia, and Japanese tree lilac from Three Different Environments in Ohio in August 2006

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Environment	Height (cm)	Caliper (mm)	Shoot weight (g)	Root weight (g)	Leaf area (sq. rt.)	Root:shoot ratio
Peak roof RRG	121.23	8.71	48.25	22.74	47.26	0.53
Flat roof RRG	122.11	8.45	47.12	17.62	39.52	0.47
Polyhouse	106.86	7.83	43.67	19.64	43.4	0.45

Table 2. Growth of Linden 'Greenspire', Yellowwood, Red oak, Stewartia, and Japanese tree lilac Averaged over Three Environments in Ohio in August 2006

Species	Height (cm)	Caliper (mm)	Shoot weight (g)	Root weight (g)	Leaf area (sq. rt.)	Root:shoot ratio
Yellowwood	51.20	4.19	16.73	9.94	34.57	0.40
Oak	82.78	7.31	28.00	18.65	41.47	0.74
Stewartia	102.39	7.67	35.51	19.30	42.25	0.57
Japanese Tree Lilac	196.01	11.40	110.93	36.65	56.07	0.35
Linden	151.29	11.06	40.56	15.47	42.61	0.38