Growth of Three Species Produced in a Pot-In-Pot Production System

John M. Ruter
University of Georgia, Department of Horticulture, Coastal Plain Experiment Station, Tifton, Georgia 31793

INTRODUCTION

Production of trees and shrubs in containers offers a number of production, marketing and establishment advantages compared to field-grown plant material. A problem associated with the production of container-grown plants is exposure of the root system to extreme temperatures. Roots are not as hardy as foliage and stems, and extreme temperatures limit the production of container-grown plants. Root systems of plants growing in the ground are insulated by the surrounding soil and are not exposed to the large fluctuations in root-zone temperature that occur in containers.

To address some of the problems associated with container production, the idea for a "pot-in-pot" (PIP) production system was developed (Parkerson, 1990). With this production system, a holder pot is permanently placed in the ground. The container-grown plant is then placed inside the holder pot. Using this production system, roots are protected from extreme temperatures, and windthrow problems are reduced.

The purpose of this study was to compare the growth and field establishment of three southeastern landscape plants grown in a PIP system compared to a conventional above-ground container production system.

MATERIALS AND METHODS

The experiments were conducted outdoors over a 2-year period under full sun at the University of Georgia Coastal Plain Experiment Station in Tifton, Georgia. For experiment one, uniform liners in #1 containers of *Ilex* × *attenuata* Ashe 'Savannah', *Lagerstroemia* 'Natchez' (*L.indica* × *L. fauriei*) , and *Magnolia* × *soulangiana* Soul.-Bod. were potted into #7 containers (#070, The Lerio Corporation) on 18 March 1991. Potting medium consisted of 4 milled pine bark : 1 sand (v/v) amended with micronutrients (Micromax, Grace/Sierra) at 1.5 lb/yd^3 and dolomitic limestone at 6.0 lb/yd^3. Plants were top-dressed with High-N 24-4-7 (Grace/Sierra) at the rate of 1.5 lb N/yd^3 on 25 March and 3 June 1991. Holder pots (Lerio #070) were placed in the ground with the top 1 inch of the container above grade. Plants were irrigated daily with 160° low volume spot spitters (Roberts Irrigation Products, Inc.) at the rate of 1.0 gal per container. The experiment was a randomized complete block with three species, two container production systems (PIP and conventional above-ground) and 10 replications. On 1 July 1991, container medium temperatures from 10 containers in each production system were measured using a thermocouple thermometer. The thermocouple probe was placed 1 in. from the container wall on the north, south, east, and west quadrant and in the center quadrant of the container to a depth of 6 in. Temperatures were recorded between 4 to 5 p.m. EST.

The study was terminated in October 1991, and measurements of shoot dry weight, root dry weight, and root dry weight between the holder pot and the planted container were taken for five replications. Root growth in the north, south, east, and west quadrants (n=5) was rated as follows: 1 = 0-20%, 2 = 21-40%, 3 = 41-60%, 4 = 61-80%, and 5 = 81-100% of the rootball covered with white roots. *Magnolia* final height, caliper, and branch number measurements were taken. Growth index measurements of *Ilex* and *Lagerstroemia* were taken.

In experiment 2, four replicate plants of *Ilex* and *Lagerstroemia* from each of the treatments in the container study were planted in the field on 12 February 1992, as a randomized complete block. The container-grown plants were planted in augered holes measuring 24 in. across and 12 in. deep in a Tifton loamy sand. Plants were fertilized on 12 February, 1 April, and 1 June at the rate of 50 lb N/A over a 24-in. circular area with Sta-Green 12-6-6. Plants were watered at the rate of 1.0 inch using drip irrigation when less than 1.0 in of rainfall had occurred during the previous week. In October 1992, final growth index and shoot dry weight measurements were made. The root system of each plant was manually excavated to the diameter of the original planting hole. All roots extending past the original rootball were removed and were weighed separately to obtain a dry weight for roots that regenerated into the surrounding soil as well as a dry weight for the rootball. Data for both experiments were subjected to analysis of variance using SAS. Mean separation is by Waller-Duncan K-Ratio t-Test or mean ± standard error.

RESULTS AND DISCUSSION

In experiment 1, production system had no effect on the height or caliper of *Magnolia*. *Magnolia* plants grown in the PIP system had more branches (22.8±0.6) per plant compared to the conventional production system (20.0±0.8). Height and growth index of *Ilex* were not affected by production system. While the growth index for *Lagerstroemia* was not affected by production system, height of plants grown in the conventional production system were taller (46.8±1.6 in.) than in the PIP system (40.9±1.2 in.).

Shoot dry weight and the root : shoot ratio of *Magnolia* were not affected by production system. Root dry weight inside the planted container, total root dry weight, and total plant biomass were all greater for plants grown in the PIP system (70%, 74%, and 65%, respectively) compared to the conventional production system. Production system had no effect on the growth of *Ilex* in this experiment.

Shoot dry weight and total biomass of *Lagerstroemia* were not affected by production system. Root dry weight inside the planted container, total root dry weight and root : shoot ratio were all greater for the PIP system compared to the conventional production system. Root dry weight inside the planted container increased 47% while the root : shoot ratio increased 87% for plants grown in the PIP system. The percentage of roots on a dry weight basis found outside of the planted container but within the holder pot were 2.1%, 0.4%, and 3.6% for *Magnolia, Ilex,* and *Lagerstroemia*; respectively.

The temperature of the medium in the western quadrant of containers in the conventional production system was approximately 13C (23F) warmer than containers in the PIP system between 4 and 5 p.m. Mean container medium temperature across all quadrants was 39C (102F) for the conventional production system in contrast to 33C (91F) for the PIP system.

The root ratings for all three species were influenced by interactions between production system and quadrant of solar exposure. For all three species in the conventional production system, the south, west and east quadrants had less root coverage compared than the north quadrant. There were no differences between quadrants for species grown in the PIP system.

This study demonstrates that *Lagerstroemia indica* × *L. fauriei* 'Natchez' and *Magnolia* × *soulangiana* benefit from being grown in a "pot-in-pot" (PIP) production system, producing more root dry weight and more uniform root systems. Improved root system development was related to lower container medium temperatures during the growing season. Species with vigorous root systems like *Lagerstroemia* and *Magnolia* root-out through the planted container, through the holder pot, and into the surrounding soil. Periodic rotation of planted containers within the holder pot or use of fabrics and root pruning compounds such as Spin Out™ (Griffin Corporation) or Biobarrier™ (Reemay, Inc.) may be helpful (Ruter, 1994).

In experiment 2, the only measurable difference in growth for *Ilex* after several months in the field was in root regeneration beyond the original rootball. *Ilex* grown in the conventional production system had 57% more root dry weight beyond the original rootball than plants grown in the PIP system. Production system had no effect on the root and shoot growth of *Lagerstroemia* in the field. Root regeneration from plants grown in the conventional production system were less uniform around the circumference of the rootball than plants grown in the PIP system. We hypothesized that lack of root regeneration was caused by high temperature damage to the rootball while in the container. While production system influenced root-system development of *Lagerstroemia*, the initial advantages were not evident after one growing season in the field.

The added expense of producing plants in a PIP system needs to be weighed in terms of the limited benefits seen for field establishment in this study. For a fast-growing species such as *Lagerstroemia*, the initial benefits of being grown in a PIP production system were not evident after being placed in the field. With a slower growing-plant such as 'Savannah' holly, production system had little or no effect on plant growth and establishment. Future research on different species, different container designs, rooting-out control, water management, and fertilizer use efficiency are needed for the PIP production system before large-scale recommendations can be made to growers.

LITERATURE CITED

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