Evaluation of Control Strategies for Reducing Rooting-Out Problems in Pot-In-Pot Production Systems[1]

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Abstract

Research has shown that a problem in pot-in-pot (PIP) production systems has been the growth of roots out of the planted container, through holes in the holder pot and into the surrounding soil. A study was conducted with *Lagerstroemia indica* x *fauriei* 'Acoma' to evaluate methods for reducing rooting-out problems in a PIP production system. The products tested were Biobarrier™, a geotextile fabric impregnated with trifluralin; Root Control™ fabric bag material; and Spin Out™, a commercial formulation of copper hydroxide (7.1%) in latex paint. Biobarrier™ reduced plant height, shoot dry weight, percent root dry weight outside of the planted container and total biomass compared to the non-treated control. For the control, 7.1% of the total root dry weight was found between the holder pot and planted container compared to 0.2% for the Biobarrier™ treatment. When the holder pot and planted container or the planted container and Root Control™ fabric were both treated with Spin Out™, plant height and shoot dry weight were reduced. Spin Out™ reduced root circling on the sidewalls of the planted containers but not on the bottom of the containers. All treatments except the control reduced rooting-out to a degree which allowed for the manual harvesting of the planted container from the holder pot after seven months in the field.

Index words: container production, Spin Out™, Biobarrier™, trifluralin, root control, growth regulator, copper.

Species used in this study: Crape myrtle (***Lagerstroemia indica*** x ***fauriei*** 'Acoma').

Significance to the Nursery Industry

The pot-in-pot (PIP) production system where a planted container is placed in a holder pot that has been permanently placed in the ground offers advantages such as protection of the root system from extreme temperatures and prevention of windthrow, a common problem with container-grown trees. Previous research has shown that rooting-out from the planted container, through the holder pot and into the surrounding soil is a problem associated with the production of plants in a PIP system. This experiment indicated that all treatments except the control reduced rooting-out to a degree which allowed for the plants to be manually harvested after seven months in the field. Control plants had to be removed from the ground with the assistance of a tractor-mounted boom. Spin Out™ successfully controlled root circling of *Lagerstroemia* on the sidewalls of containers, but not on the bottom of the container. Biobarrier™ was the best treatment for control of rooting-out but also reduced plant growth. The advantages offered by using Biobarrier™ to control rooting-out in a PIP system should be considered in comparison to potential reductions in plant growth.

Introduction

The idea for a PIP container production system was first introduced in 1990 (8) and has been adopted by nurserymen as a new production system. A shortcoming of the PIP system has been the growth of roots out of the planted container, through the holder pot and into the surrounding soil (8, 11). To address this problem, some growers are currently rotating their planted containers periodically to break off any roots which have grown into the surrounding soil.

In recent years a number of root pruning fabrics and/or chemical compounds have been used to control root growth (1, 2, 3, 5, 6, 7, 9, 10, 13). Fabric Root Control™ bags have been useful for restriction of root growth under field conditions (9). With the Root Control™ system, roots which grow through the non-woven fabric are restricted which induces root branching behind the point of restriction. A material initially developed to control root growth into hazardous waste sites is Biobarrier™, a permeable geotextile fabric with trifluralin-impregnated polymer nodules bonded to the fabric. Dinitroanaline herbicides such as trifluralin have been shown to inhibit root growth in container-grown and field-grown nursery stock (5, 6, 7).

Copper-containing materials mixed with paint have been used to modify root growth on conifers (6, 10) and landscape plants (1, 2, 3, 13) grown in containers. Copper-containing materials generally inhibit root elongation, prevent root circling in containers, increase root branching and may have a positive effect on the root:shoot ratio of different species (13). Spin Out™ (Griffin Corp., Valdosta, GA) is a new material containing 100 g $Cu(OH)_2$/l (3.34 oz/qt) which has been effective in modifying root growth on a number of container-grown landscape plants (1,3). The purpose of this study was to evaluate the efficacy of rooting-out reduction treatments on *Lagerstroemia* grown in a PIP production system.

Materials and Methods

The experiment was conducted outdoors under full sun at the University of Georgia Coastal Plain Experiment Station in Tifton, GA. Uniform liners in 2.8 l (#1) containers of *Lagerstroemia indica* x *fauriei* 'Acoma' were potted into 26 l (#7) containers (The Lerio Corporation, Valdosta, Georgia) on March 24, 1992. Potting medium consisted of milled pine bark and sand (6:1 by vol) amended with micronutri-

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Table 1. **Influence of rooting-out control strategies on growth of *Lagerstroemia indica* x *fauriei* 'Acoma' grown in a pot-in-pot production system for seven months.**

Treatment	Height (cm)	Shoot dry weight (g)	Root dry wt. outside planted container[x] (g)	Root dry wt. outside planted container (%)	Combined biomass (g)
Control	54 a[y]	914 ab	72 a	7.1 ab	1975 ab
BB	44 b	614 e	2 c	0.2 c	1527 c
RCF	47 ab	1024 a	72 ab	6.5 ab	2197 a
RCF + Spin Out™	44 ab	802 bcd	82 a	7.7 a	1854 b
HP + Spin Out™	45 ab	811 bcd	69 ab	6.9 ab	1840 b
PC + Spin Out™	50 ab	900 abc	87 a	6.7 ab	2193 a
HP, PC + Spin Out™	44 b	743 cde	42 b	4.1 b	1770 bc
PC, RCF + Spin Out™	41 b	730 de	77 ab	6.4 ab	1930 ab
Significance[z]					
Pr>F	*	**	**	**	**

[z]Significance tests: ** ≤ 0.01, * ≤ 0.05, NS > 0.05.

[y]Mean separation by Waller-Duncan K-Ratio T-Test. Means (n = 7) with different letters are significantly different at $\alpha = 0.05$.

[x]Root dry weight between planted container and holder pot.

ents (Micromax) at 0.9 kg/m^3 (1.5 lb/yd^3) and dolomitic limestone at 3.0 kg/m^3 (5.0 lb/yd^3). Plants were topdressed with Osmocote 18N-2.6P-9.9K (18-6-12, 8–9 month formulation) at 150 g (5.3 oz) per container on March 26, 1992 and 75 g (2.6 oz) on August 3, 1992. Holder pots (#7) were placed in the ground with 2.5 cm (1 in) at the top of the container remaining above grade. Containers planted with *Lagerstroemia* were then placed in the holder pots for the duration of the experiment. Plants were irrigated daily with 160° low volume spot spitters at the rate of 3.8 l (1.0 gal) per container.

The experiment was a completely randomized design with seven single plant replications of eight rooting-out reduction treatments grown in a PIP production system. The eight rooting-out prevention treatments were: 1) no treatment (control), 2) a 46 cm^2 (18 in^2) piece of Biobarrier™ (Reemay, Inc., Old Hickory, TN) placed between the planted container (herbicide beads facing the planted container) and the holder pot (BB), 3) a 46 cm^2 (18 in^2) piece of Root Control™ fabric (Root Control, Inc., Oklahoma City, OK) placed between the planted container and the holder pot (RCF), 4) a 46 cm^2 (18 in^2) piece of Root Control™ fabric treated with Spin Out™ placed between the planted container and the holder pot (RCF + Spin Out™), 5) the holder pot treated with Spin Out™ (HP + Spin Out™), 6) the planted container treated with Spin Out™ (PC + Spin Out™), 7) both the holder pot and planted container treated with Spin Out™ (HP, PC + Spin Out™), and 8) a planted container with Root Control™ fabric, both treated with Spin Out™ (PC, RCF + Spin Out™).

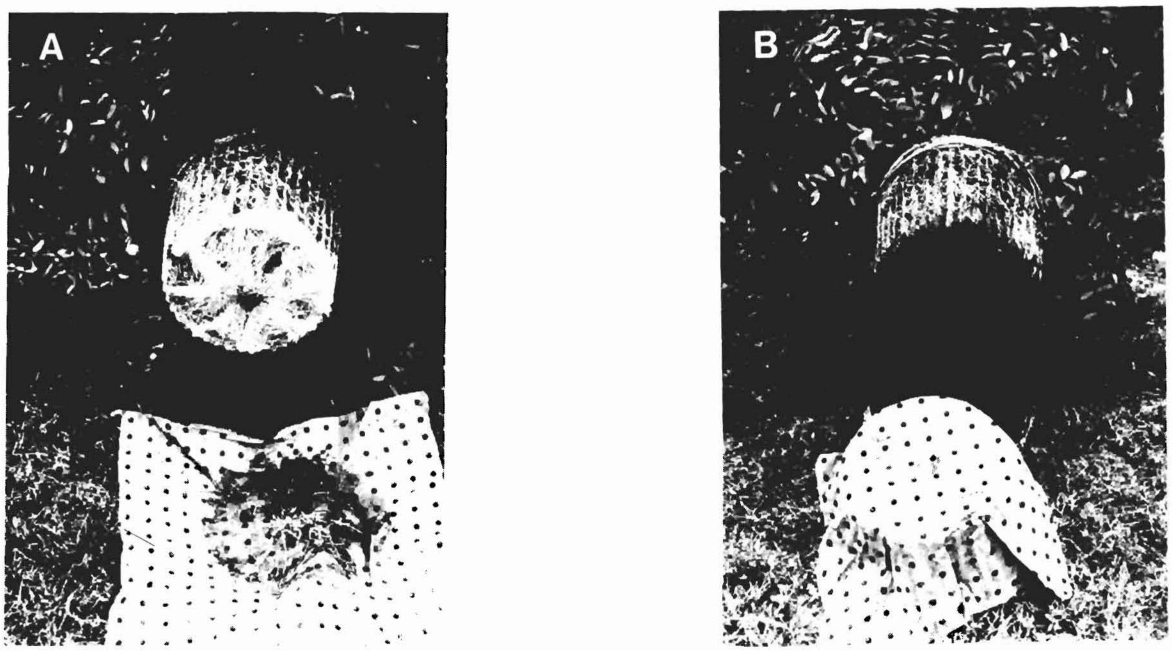


Fig. 1. **Effects of various root-control strategies on root development of *Lagerstroemia*. A). Biobarrier™ placed between the planted container and holder pot. B) Lack of root development in bottom of planted container when Biobarrier™ was placed tightly between the planted container and holder pot, thus not allowing for escape of trifluralin vapors.**

At the termination of the study in October, 1992, height, growth index [(height + width 1 + width 2 (perpendicular to width 1)) ÷ 3], shoot dry weight, root dry weight inside the planted container, and root dry weight between the planted container and the holder pot measurements were taken. Roots which grew into the surrounding soil beyond the holder pot were not harvested. Data analysis for all growth parameters were evaluated by analysis of variance using SAS (12). Means were separated using a Waller-Duncan K-Ratio T-Test.

Results and Discussion

Control plants were taller than plants grown in the following treatments (BB, HP, PC + Spin Out™ and PC, RCF + Spin Out™) (Table 1). Treatment had no effect on the overall growth index of plants in this study (data not shown). The control, RCF, RCF + Spin Out™, and PC + Spin Out™ plants had similar shoot dry weights (Table 1). Biobarrier, HP, PC + Spin Out™, and PC, RCF + Spin Out™ decreased shoot dry weight by 33%, 19%, and 20%, respectively, compared to the control.

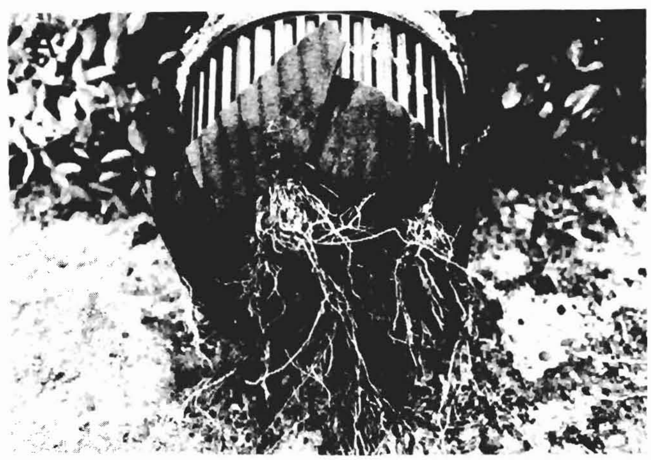
Root dry weight inside the planted container and combined root dry weight (root dry weight inside the planted container + root dry weight between the planted container and the holder pot) were not affected by treatment (data not shown). Root dry weight between the planted container and the holder pot was influenced by treatment (Table 1). The only treatments which reduced root dry weight between containers compared to the control were BB and HP, PC + Spin Out™ which reduced root dry weight 93% and 48%, respectively. For the control, 7.1% of the combined root dry weight was found outside the planted container but within the holder pot (Table 1). In contrast, only 0.2% of the combined root dry weight outside the planted container was found for the BB treatment.

Root:shoot ratio was not affected by treatment (data not shown). The only treatment which had less combined biomass than the control was BB (23% decrease). None of the treatments had increased combined biomass compared to the control (Table 1).

When the plants were harvested, all treatments except the control could be removed from the holder pot by two men. The control containers had to be removed with the assistance of a tractor-mounted boom lift. Roots as large as 1.8 cm (0.8 in) in diameter grew out holes in the holder pot into the surrounding soil. The following observations were made at the time of harvest. For the BB treatment, there was a large mass of white roots at the bottom of the planted container with only a few small roots growing out of the holes in the bottom of the planted container (Fig. 1A). The rootmass observed at the bottom of the planted container in the BB treatment was unlike any other treatment in this study. One BB treatment plant was grown with the herbicide nodules facing the holder pot. The roots at the bottom of the planted container for this one plant were brown and did not have the healthy appearance of roots in the BB treatment (Fig. 1B). It was noted that when the nodules on the Biobarrier™ material were placed facing the holder pot, this resulted in a tighter fit between the holder pot and the planted container. Trifluralin is a volatile herbicide which inhibits root growth (4). The BB treatment may have had enough air space between the planted container and the holder pot to allow loss of trifluralin vapors without damaging roots within the planted container. If a tighter seal occurred when nodules were placed facing the holder pot, root damage inside the planted container due to higher concentrations of trapped trifluralin vapors may have occurred.

With the RCF treatment, roots grew through the fabric (Fig. 2A) and out of the holes in the holder pot into the surrounding soil. The girdled roots growing through the fabric were as large as 0.6 cm (0.2 in) in diameter and readily broke off when the planted container was removed from the holder pot. When RCF was treated with Spin Out™, extensive root branching occurred which made it difficult to remove the fabric due to the large numbers of roots growing in the fabric mesh (Fig 2B). With RCF + Spin Out™, few roots grew through the fabric and into the surrounding soil. For the HP + Spin Out™ treatment, large mats of fibrous roots occurred outside the holes of the planted container where they came in contact with the treated walls of the holder pot.

When Spin Out™ was used on the inside of the planted container (PC + Spin Out™), no roots were found on the surface of the rootball which was in contact with the treated sidewalls of the planted container (Fig 3A). However, there was a mass of roots at the bottom of the planted containers treated with Spin Out™ (Fig. 3B). The vigorous root system development of *Lagerstroemia* in this study may have resulted in uptake of most available Cu from the Spin Out™



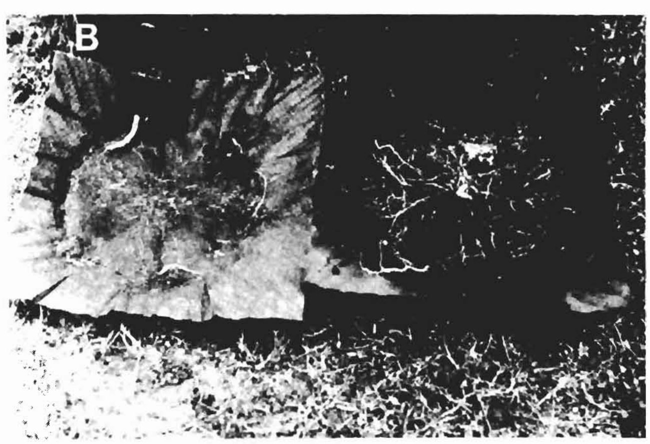


Fig. 2. Effects of various root-control strategies on root development of *Lagerstroemia*. A). Roots growing through Root Control™ fabric. B). Increased root branching when Root Control™ fabric was treated with Spin Out™ (right) compared to non-treated fabric (left).

material allowing root growth to occur. Complete inhibition of root circling in 3.8 l (#1) containers was found to be species dependant (3).

When both the holder pot and the planted container were treated with Spin Out™, root dry weight outside the planted container decreased. Extensive root branching did not occur when roots came in contact with the treated HP as occurred with the RCF + Spin Out™ treatment. The PC, RCF + Spin Out™ treatment had dense, branched roots in the RCF similar to the RCF + Spin Out™ treatment. All treatments which had the PC treated with Spin Out™ had root circling at the bottom of the container as described for the PC + Spin Out™ treatment.

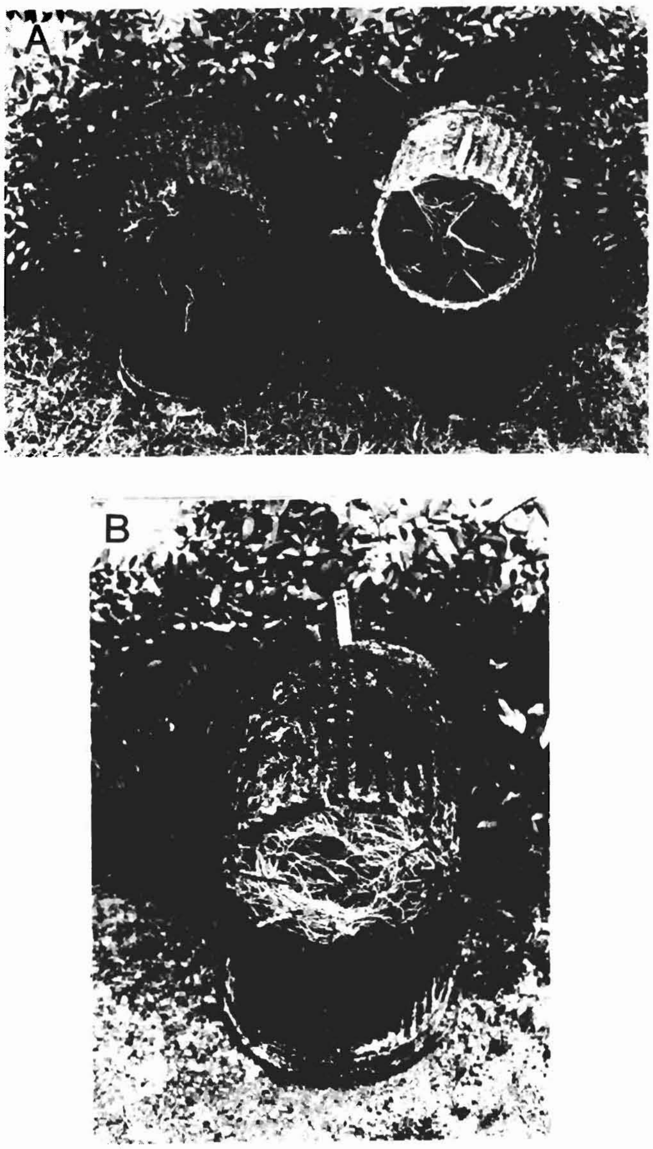


Fig. 2. Effects of various root-control strategies on root development of *Lagerstroemia*. A). Root growth of *Lagerstroemia* in a planted container treated with Spin Out™ (left) compared to non-treated container (right). Note lack of circling roots on Spin Out™ treated plant. B). Loss to root growth inhibition on the bottom but not the sides of Spin Out™ treated containers.

In conclusion, all treatments compared to the control reduced root development into the soil surrounding the holder pot which allowed for the manual harvesting of *Lagerstroemia* grown in a PIP production system. Only the BB treatment stopped all root growth into the surrounding soil. When either the holder pot or the RCF between the holder pot and planted container were treated with Spin Out™ in conjunction with a treated planted container, shoot dry weight decreased. This same effect was also seen for the BB treatment. However, only the BB treatment decreased combined biomass compared to the control. While the BB treatment resulted in the greatest degree of root growth inhibition, its advantages for use in a PIP production system must be weighed against possible decreases in plant growth.

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