Chemically Controlling Root Escape in Pot-in-pot Production of River Birch and Yoshino Cherry

J. Roger Harris¹, Alex X. Niemiera², Robert D. Wright³, and Charles H. Parkerson⁴

Additional index words. Betula nigra, ‘Heritage’, Prunus × yedoensis, Biobarrier, trifluralin, container production, circling roots, Keeper Upper, trees

Summary. Three experiments were conducted to determine the feasibility of using Biobarrier, a landscape fabric with trifluralin herbicide-impregnated nodules, of various sizes to prevent root escape of trees from the drainage holes of 56-liter containers in below-ground pot-in-pot (P&P) and above-ground Keeper Upper (KU) nursery production systems. In addition, side holes or slits were cut in some container walls to test the effect of Biobarrier on the prevention of circling roots. In Expt. 1 (P&P), Betula nigra L. ‘Heritage’ (river birch) trees with no Biobarrier had root ratings for roots escaped through drainage holes that indicated a 5-fold increase in numbers of roots than for treatments containing Biobarrier. All Biobarrier treatments reduced root escape and resulted in commercially acceptable control. In Expt. 2 (KU), control and the Biobarrier treatment river birch trees (30 nodules) had commercially unacceptable root escape. In Expt. 3 (P&P), control and 10-nodule treatment Prunus × yedoensis Matsum. (Yoshino cherry) trees had commercially unacceptable root escape, but treatments containing 20 and 40 nodules resulted in commercially acceptable control. Biobarrier did not limit shoot growth in any of the experiments. The results of these experiments indicate that Biobarrier did not prevent circling roots, but sheets containing at least 8 or 20 nodules of trifluralin acceptably prevented root escape from drainage holes in the pot-in-pot production of 56-liter container river birch trees and Yoshino cherry trees, respectively.

¹Assistant professor, Department of Horticulture, 301 Saunders Hall, Virginia Polytechnic and State University, Blacksburg, VA 24061.
²Associate professor, Department of Horticulture, 301 Saunders Hall, Virginia Polytechnic and State University, Blacksburg, VA 24061.
³Professor, Department of Horticulture, 301 Saunders Hall, Virginia Polytechnic and State University, Blacksburg, VA 24061.
⁴President, Lancaster Farms Nursery, Inc. 5800 Knotts Neck Road, Suffolk, VA 23436.

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Parker (1990) recently promoted a system of container tree production that is currently being used by an increasing number of nurseries. This system, known as pot-in-pot (P&P), consists of a permanent socket container that is placed into the ground with the top lip about 5 cm above grade and a plant-growing container that is placed within the socket container and removed along with the tree at harvest (Fig. 1). The P&P system surmounts many of the limitations of conventional above-ground container production such as the need for winter protection structures, supra optimal root-zone temperatures, and container windthrow. Temperatures of −11°C at the Virginia Tech P&P nursery resulted in no discernible winter injury on nonprotected trees such as Acer saccharum Marsh. (sugar maple), Quercus rubra L. (red oak), and Laburnum × wateri (Kirchn.) Dipp. (unpublished data). Ruter (1993) found that root-zone temperatures were lower during summer months and root growth was greater on P&P-grown Lagerstroemia indica × fauriei ‘Natchez’, Ilex × attenuata ‘Savannah’ and Magnolia × soulangiana compared to conventional above-ground container-grown trees.

One of the major production concerns with the P&P system is root escape through the drainage holes (Fig. 1) (Yeager et al., 1994; Ruter, 1994). Roots often grow through the dark humid space between the growing and
the socket containers and into the ground below. In such cases, harvest is problematical, and the socket pot often is destroyed. Breaking these roots at harvest could result in plant water stress, especially when trees are harvested in leaf. Biobarrier (Remay, Old Hickory, Tenn.) is Typar geotextile fabric with nodules impregnated with time-released trifluralin herbicide (Fig. 2). The trifluralin volatilizes and prevents root elongation at concentrations of 7.6 ppm or greater in the soil air space (promotional literature, Remay). Biobarrier is an effective barrier to tree roots when applied in sheets in the soil (Knight et al., 1992) and initially was marketed as a barrier to tree roots that may disturb sidewalks, landfill barriers, septic fields, etc. Ruter (1994) showed that Biobarrier sheets could prevent root escape effectively on Lagerstroemia indica × fauriei ‘Acoma’ growing in 28-liter P&P containers when sheets containing 234 nodules per socket pot were used. However, height and shoot dry weight were lower compared to nontreated P&P trees.

Another recently developed production system uses an above-ground shell [Keeper Upper (KU), Lerio, Mobile, Ala.] that potentially buffers container temperatures and prevents windthrow. This system has possible utility for use when high water tables or poorly drained soils prevent economical installation of the P&P system. The shell has the form of a square-based, bottomless, flat-topped pyramidal, with an opening for a plant-growing container and two ventilation holes on the top edge (Fig. 3). This system essentially resembles an above-ground P&P system.

The purpose of this research was to investigate the effect of sheets of Biobarrier containing various numbers of trifluralin herbicide nodules on root escape of 56-liter P&P river birch and Yoshino cherry and 56-liter KU river birch. In addition, the potential for a concomitant prevention of circling roots, thought by some to limit post-transplant success (Appleton, 1993; Warren and Blazich, 1991), was tested by cutting slits or drilling holes in a vertical line on opposing sides of growing container sidewalls.

Materials and methods

Plant material. Plant material used in Expts. 1 and 2 was 3- to 4-m multistem (three stems per plant) Betula nagra ‘Heritage’ (river birch), obtained from J. Frank Schmidt and Sons, Boring, Ore. Trees were fall dug and held in winter storage until shipment to the experimental site at Lancaster Farms Nursery, Suffolk, Va. Plant materials used in Expt. 3 were 1.2 to 1.5 m Prunus × yedoensis (Yoshino cherry), grown in 12-liter containers at the Virginia Tech nursery in Blacksburg, Va.

Experiment 1. Bare-root river birch liners were planted into 56-liter containers (no. 15, Lerio) in 100% milled pine bark substrate in mid-February 1994, at Lancaster Farms Nursery, Suffolk, Va. All trees then were put into P&P production in a completely random statistical design with 16 replicates of 5 treatments. Each treatment except controls included a double row of 6.5-mm-diameter holes, drilled through the plant-growing container walls and evenly spaced about 1 cm apart, beginning 5 cm from the bot-
tom to just under the top lip on opposing sides of the container. Treatments included 1) no Biobarrier, without side holes, 2) no Biobarrier, with side holes, 3) Biobarrier containing eight nodules, with side holes, 4) Biobarrier containing 16 nodules, with side holes or 5) Biobarrier containing 32 nodules, with side holes. All replicates were placed in P&P production, and Biobarrier sheets corresponding to treatments were placed flat side down in the bottom of the socket pots, directly beneath the growing container. About 5 cm of space existed between the production container bottom and the Biobarrier sheets. Irrigation was supplied by micro-spray nozzles, and fertility was maintained with one application of 190 g of Osmocote 18–6–12 (O.M. Scott, Maryville, Ohio). Overall height and stem diameter of the largest main stem, taken 10 cm above the substrate level, were recorded at planting. On 27 July 1994 height and stem diameter were recorded again, and root escape was measured using a root rating. Roots were rated according to the number of roots which extended at least 1 cm beyond the production container. The rating design was 0 = 0 roots, 1 = 1–4 roots, 2 = 5–8 roots, and 3 = more than 8 roots. Roots were rated on the same scale as in Expt. 1.

Experiment 2. Trees in Expt. 2 were planted in mid-February 1994 at Lancaster Farms Nursery into containers and substrate similar to those in Expt. 1. Beginning height and stem diameter were recorded as in Expt. 1. All replicates were placed into above-ground KU production, placed directly on native soil (no groundcloth). There were 16 replicates of three treatments arranged into a completely random design. Treatments were 1) no Biobarrier, without side holes, 2) no Biobarrier, with side holes, and 3) Biobarrier containing 32 nodules, with side holes. Height, stem diameter and root ratings were taken on 27 July 1994. Roots were rated on the same scale as in Expt. 1.

Experiment 3. In Expt. 3, Yoshino cherry trees were planted into containers and substrate similar to those in Expt. 1, except that plant-growing containers had one slit cut through each opposing sidewall (two total) with a jigsaw instead of the series of holes as in Expts. 2 and 3, in early June, 1993 at the P&P nursery near the campus of Virginia Tech in Blacksburg, Va. There were six replicates of five treatments arranged into a completely random design. Fertility was maintained with a single application of 150 g of Osmocote 18-6-12. There were eight replicates arranged into a completely random design. Treatments were 1) no Biobarrier, with no side slits, 2) no Biobarrier, with side slits, 3) Biobarrier containing 10 nodules, with side slits, 4) Biobarrier containing 20 nodules, with side slits, and 5) Biobarrier containing 40 nodules, with side slits. Roots were rated on 30 July 1994 in the same reamer as in Expts. 1 and 2, except that the upper and lower sections of the side slits were combined into one reading. No shoot growth parameters were measured.

Results and discussion

Experiments 1 and 2. Neither the presence of side holes nor Biobarrier affected height, stem diameter, or a visual assessment of market quality (data not shown). Biobarrier also did not affect the number of roots escaping from the side holes (Table 1). A visual inspection of the rootballs of trees from both production systems indicated that circling roots were unaffected by treatments. Holes were drilled

Table 1. Mean root escape ratings of roots from the lower and upper sections of side holes and through bottom drainage holes of river birch grown in the pot-in-pot production system with Biobarrier sheets containing various numbers of trifluralin nodules (Expt. 1).  

<table>
<thead>
<tr>
<th>Side holes</th>
<th>Trifluralin nodules</th>
<th>Lower sides</th>
<th>Upper sides</th>
<th>Drainage holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>1.7 (0.06)*</td>
</tr>
<tr>
<td>Yes</td>
<td>1.4 (0.06)</td>
<td>1.3 (0.07)</td>
<td>2.6 (0.04)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.3 (0.06)</td>
<td>1.3 (0.07)</td>
<td>0.2 (0.03)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.2 (0.05)</td>
<td>1.3 (0.07)</td>
<td>0.1 (0.03)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.6 (0.06)</td>
<td>0.9 (0.05)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

*Root rating scored as 0 = 0 roots, 1 = 1–4 roots, 2 = 5–8 roots, 3 = more than 8 roots.
*Growing container had a double line of holes drilled through the side walls, one double line on each opposing side, or no holes.
*Lower and upper side data represent combined root ratings from each of the two lower or two upper sections of the two opposing double lines of side holes.
*Number in parentheses represents the standard error of the mean, n = 16.
Table 2. Mean root escape ratings of roots from the lower and upper sections of side holes and through bottom drainage holes of river birch grown in the Keeper Upper production system with and without Biobarrier sheets containing 32 trifluralin nodules (Expt. 2).  

<table>
<thead>
<tr>
<th>Side* holes</th>
<th>Trifluralin nodules</th>
<th>Lower* sides</th>
<th>Upper* sides</th>
<th>Drainage holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2.8 (0.04)*</td>
</tr>
<tr>
<td>Yes</td>
<td>32</td>
<td>0.2 (0.03)</td>
<td>0</td>
<td>2.3 (0.07)</td>
</tr>
</tbody>
</table>

*R Root rating scored as 0 = 0 roots, 1 = 1–4 roots, 2 = 5–8 roots, 3 = more than 8 roots.
* Growth containers had a double line of holes drilled through the side walls, one double line on each opposing side, or no holes.
* Lower and upper side data represent combined root ratings from each of the two lower or two upper sections of the two opposing double lines of side holes.

Table 3. Mean root escape ratings of roots from side slits and through bottom drainage holes of Yoshino cherry grown in a pot-in-pot production system with Biobarrier sheets containing various numbers of trifluralin nodules (Expt. 3).  

<table>
<thead>
<tr>
<th>Side* slits</th>
<th>Trifluralin nodules</th>
<th>Pot-in-Pot</th>
<th>Drainage holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>--</td>
<td>--</td>
<td>2.5 (0.23)*</td>
</tr>
<tr>
<td>Yes</td>
<td>--</td>
<td>1.8 (0.27)</td>
<td>1.9 (0.39)</td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>1.7 (0.51)</td>
<td>1.7 (0.52)</td>
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<tr>
<td>Yes</td>
<td>20</td>
<td>1.8 (0.22)</td>
<td>0.9 (0.13)</td>
</tr>
<tr>
<td>Yes</td>
<td>40</td>
<td>2.0 (0.24)</td>
<td>0.2 (0.13)</td>
</tr>
</tbody>
</table>

* Root rating scored as 0 = 0 roots, 1 = 1–4 roots, 2 = 5–8 roots, 3 = more than 8 roots.
* Growing containers had single slits through the side walls extending from below the top lip to just above the bottom, one on each opposing side, or no slits.
* Data are combined root ratings for both slits per container.
* Number in parentheses represents the standard error of the mean; n = 6.
The results of these experiments indicate that chemical control can be accomplished with Biobarrier sheets containing as few as eight nodules of trifluralin for river birch in a one-season production cycle. Although commercially acceptable control was achieved with Biobarrier sheets containing 20 nodules, sheets containing 40 nodules were required to give control for Yoshino cherry (root rating = 0.2) in a two-season production cycle similar to that for river birch in a single-season production cycle.

Literature Cited


