Notes

Efficacy of Fall Applied Herbicides in Pot-in-pot Nursery Tree Production

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Additional index words. PIP, isoxaben, flumioxazin, glyphosate, simazine, weed control

Growing trees in a pot-in-pot (PIP) production system creates several weed control challenges for the nursery manager. Potentially high weed populations within and between PIP rows and on adjacent and surrounding land can lead to increased weed pressure in the growing container. A fall weed control program for field or container nursery production conditions frequently includes a mixture of cultivation, hand pulling, and pre- and postemergence herbicide applications (Derr et al., 1997). Previous weed control research has focused on the efficacy of individual preemergence herbicides and combination products in container and/or field production during the growing season; however, limited research has been conducted on weed control in PIP nursery production (Fare et al., 1998; Sellmer et al., 2002), or on the efficacy of fall applied preemergence herbicides. The following experiment was conducted to determine the efficacy of fall applied herbicides for managing weeds in a PIP production system.

The experiment was conducted at The Pennsylvania State University Landscape Management Research Center PIP nursery at University Park, Pa. The nursery consisted of 400 containerized trees arranged in four nursery blocks oriented northwest to southeast. Each nursery block included 100 trees arranged in five 110-ft-long (33.5-m) rows with each row containing 20 trees. Rows within blocks were 5.5 ft (1.68 m) apart and trees within rows were 5 ft (1.5 m) apart. All trees were grown in 2.8-ft^3 [0.08-m^3 (#20)] polyethylene containers (Nursery Supplies, Inc., Chambersburg, Pa.) in a pine bark–peat–vermiculite–perlite substrate top-dressed with 11.3 oz (320 g) of Osmocote Plus [15N–3.9P–10K (Scotts-Sierra Horticultural Products Co., Marysville, Ohio)]. The trees included: Heritage river birch (*Betula nigra* 'Cully'), paperbark birch (*Betula papyrifera*), 'Whitespire, Senior' gray birch (*Betula populifolia*), european hornbeam (*Carpinus betulus*), fastigiate european hornbeam (*C. betulus fastigiata*), common hackberry (*Celtis occidentalis*), turkish filbert (*Corylus colurna*), american yellowwood (*Cladrastis kentukea*), thornless cockspur hawthorn (*Crataegus crus galli inermis*), Halka thornless common honeylocust (*Gleditisa triacanthos* var. *inermis* 'Christie'), kentucky coffeetree (*Gymnocladus dioicus*), panicled goldenraintree (*Koelreuteria paniculata*), 'Bloodgood' london planetree (*Platanus×acerifolia*), 'Aristocrat' callery pear (*Pyrus calleryana*), bur oak (*Quercus macrocarpa*), pin oak (*Q. palustris*), 'Redmond' american linden (*Tilia americana*), Greenspire littleleaf linden (*Tilia cordata* PNI 6025), silver linden (*Tilia tomentosa*), and Village Green japanese zelkova (*Zelkova serrata* PNI 6957). The caliper of the trees ranged from 0.5 to 1 inch (1.27 to 2.5 cm) at a point 6 inches (15.2 cm) above the soil line.

The herbicide treatments were arranged in a randomized complete block design consisting of four blocks of five rows with each row representing a treatment. Each block received each treatment; however, all trees were not represented in each treatment. Glyphosate [Roundup Pro 4L (Monsanto Corp, St. Louis)] was included as a separate treatment and in combination with each preemergence herbicide treatment at a rate of 1 lb/acre (1.1 kg·ha^{-1}) to eliminate existing weeds. Roundup Pro contains 4.0 lb/gal (0.48 kg·L^{-1}) of the isopropylamine salt of glyphosate. The treatments included: a non-treated control; 1 lb/acre glyphosate; 1.5 lb/acre (1.68 kg·ha^{-1}) simazine [Princep 4L (Syngenta, Greensboro, N.C.)]; 0.67 lb/acre (0.751 kg·ha^{-1}) isoxaben [Gallery 90DF (Dow AgroSciences, Indianapolis)]; and 0.75 lb/acre (0.841 kg·ha^{-1}) flumioxazin [Sureguard 50WDG (Valent Corp., Walnut Creek, Calif.)]. Applications were made with a carbon dioxide (CO_2) test plot sprayer at 30 lb/inch^2 (207 kPa) through an OC04 nozzle on 6 Sept. 2001 in 18-inch-wide (45.7 cm) strips to both sides of each 10-ft (33.5 m) tree row, including the growing container. The temperature was 80 °F (26.7 °C), and winds were 0 to 3 miles/h (4.8 km·h^{-1}) at 3 ft (0.9 m) above the ground. Percent weed coverage and weed-count data were collected from within the containers and evaluated on 7 Dec. 2001 and differences among treatments were subjected to analysis of variance by general linear model procedures followed by Duncan's multiple range test for percent weed coverage and total weeds counted at $P < 0.05$ (SAS Institute, Cary, N.C.).

Twelve weeks after application, marestail (*Hippuris vulgaris*) (35% of the weed population), dandelion (*Taraxacum officinale*) (16%), field pennycress (*Thlaspi arvense*) (14%), persian speedwell (*Veronica peregrina*) (7%), and mouseear chickweed (*Cerastium vulgatum*) (6%) were the most common weeds present among treatments. Within the non-treated control plots twenty different weed

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Journal paper 431 of the Pennsylvania State Univ., Dept. of Horticulture. We extend special thanks to Robert Berghage and David Beattie for reviewing an earlier draft of the manuscript. Use of trade names in this publication does not imply endorsement of products named nor criticism of similar ones not mentioned.

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Table 1. Number of weeds and percent weed coverage found within treated containers in 110-ft (33.5 m) rows of pot-in-pot trees receiving four different preemergence herbicide treatments. Treatments were applied on 6 Sept. 2001 with data collected 12 weeks later and represent the average of four replications.

Treatment (formulation used)	Rate (lb/acre)[z]	Avg total weeds (no.)[y]	Weed cover (%)
Control	0	315.5 a[x]	44.0a
Glyphosate (Roundup Pro 4L)	1	119.0 b	5.0b
Simazine (Princep 4L)[w]	1.5	29.5 bc	1.8b
Isoxaben (Gallery 90DF)[w]	0.67	11.5 c	0.2b
Flumioxazin (Sureguard 50WDG)[w]	0.75	8.8 c	0.2b

[z]1.0 lb/acre = 1.12 kg·ha^{-1}.
[y]Average total weeds collected and identified from within tree containers for each treatment.
[x]Similar letters were not significantly different according to Duncan's multiple range test ($P = 0.05$).
[w]Treatment included glyphosate (Roundup Pro 4L) at 1 lb/acre.

taxa were present including: the most common weeds listed above, carpetweed (*Mollugo verticillata*), broadleaf plantain (*Plantago major*), buckhorn plantain (*Plantago lanceolata*), hedge mustard (*Sisymbrium officinale*), bull thistle (*Cirsium vulgare*), orchardgrass (*Dactylis glomerata*), red sorrel (*Rumex acetosella*), annual sowthistle (*Sonchus oleraceus*), smooth crabgrass (*Digitaria ischaemum*) shepherd's-purse (*Capsella bursa-pastoris*), annual bluegrass (*Poa annua*), common groundsel (*Senecio vulgaris*), hairy bittercress (*Cardamine hirsuta*), annual fleabane (*Erigeron annuus*), and yellow woodsorrel (*Oxalis stricta*). Thirteen weed taxa were present in at least one of the rows treated with glyphosate only, including dandelion, annual sowthistle, hairy bittercress, shepherd's purse, annual bluegrass, persian speedwell, smooth crabgrass, common groundsel, yellow woodsorrel, mouseear chickweed, daisy fleabane, field pennycress, and marestail. Eleven weed taxa were present in at least one of the simazine treated rows, while only seven weed taxa were present in at least one of the isoxaben and flumioxazin treated rows. Dandelion, persian speedwell, smooth crabgrass, common groundsel, mouseear chickweed, field pennycress, and marestail were present in the isoxaben treated rows, while annual sowthistle, annual bluegrass, and daisy fleabane were present in the flumioxazin treated rows, plus marestail, dandelion, mouseear chickweed, and field pennycress.

All herbicide treatments significantly reduced total weed presence within the growing containers compared to the nontreated control (Table 1). Fare et al. (1998) reported similar results for overall preemergence weed control effectiveness on southern magnolia (*Magnolia grandiflora*) and Red Sunset red maple (*Acer rubrum* 'Franksred') for individual applications of simazine and isoxaben.

All herbicide treatments reduced the number of dandelion, annual sowthistle, shepherd's purse, common groundsel, mouseear chickweed, and marestail plants compared to the control. Glyphosate alone reduced weed numbers by over 60% compared to the control. Flumioxazin and isoxaben were more effective in controlling weeds compared to glyphosate only treatments, with 92% and 90% fewer weeds, respectively. Simazine was not significantly more effective than the Roundup Pro only treatment, and was the least effective among the preemergence herbicides applied. Flumioxazin is not presently labeled for woody ornamentals, but Wooten and Neal (2001) reported it safe on most container-grown woody ornamentals. No foliar injury was observed on the european hornbeam, turkish filbert, 'Aristocrat' callery pear, or pin oak trees receiving flumioxazin treatments at a rate of 0.75 lb/acre.

Fall applications of isoxaben or flumioxazin in combination with glyphosate appeared safe and more effective in reducing weed activity in PIP nursery tree production than glyphosate only or simazine and glyphosate in combination. Flumioxazin is a promising new herbicide for use in PIP nursery tree production and provided the greatest weed reduction among the products used.

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