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# Pre-emergence Applied Herbicides for Container-Grown Liriope after Division<sup>1</sup>

Christine K. Hayes<sup>2</sup>, Charles H. Gilliam<sup>3</sup>, John W. Olive<sup>4</sup>, Gary J. Keever<sup>3</sup>, and D. Joseph Eakes<sup>5</sup>

Department of Horticulture, Auburn University, AL 36849

## Abstract

Three experiments were conducted to evaluate the effects of preemergence-applied herbicides on growth of liriope [*Liriope muscari* (Decne.) L.H. Bailey 'Big Blue' and 'Variegata'] when applied immediately after division. Overall, most herbicides caused no injury or suppression of root or shoot development. Surflan (oryzalin) and a Surflan + Gallery (isoxaben) combination inhibited root and shoot growth. Predict (norflurazon) caused foliar injury characterized by bleached bands or spots on both old and new foliage.

**Index words:** perennials, propagation, weed control.

**Herbicides used in this study:** Factor 65 WDG (proflam), [N<sup>3</sup>,N<sup>3</sup>-di-n-propyl-2,4-dinitro-6-(trifluoromethyl)-m-phenylenediamine]; Gallery 75 DF (isoxaben), N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide; Image (imazaquin), 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-quinoline carboxylic acid; Regal Kade G (proflam); Ornamental Herbicide 2 3G (oxyfluorfen), 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene, plus (pendimethalin) N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine; Pendulum 2G (pendimethalin); Pendulum 60WDG (pendimethalin); Predict (norflurazon), 4-chloro-5-(methyldimino)-2-(a,a,a-trifluoro-m-tolyl)-3(2H)-pyridazinone; Regal O-O 3G (oxyfluorfen), plus (oxadiazon) 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one; Ronstar 2G (oxadiazon); Ronstar 2G AG (oxadiazon); Ronstar 50 WP (oxadiazon); Snapshot 2.5 TG (isoxaben), plus (oryzalin) 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Regal Star II (oxadiazon + proflam); Surflan 4AS (oryzalin); Surflan + Gallery (oryzalin + isoxaben).

**Species used in this study:** *Liriope muscari* (Decne.) L.H. Bailey 'Big Blue' and *L. muscari* 'Variegata'.

## Significance to the Nursery Industry

Liriope growers often withhold herbicide application until two to four weeks after division and potting because of concerns about root suppression. This delay in herbicide application results in weed infestation and costly hand weeding before application of preemergence applied herbicides. Our data indicate that most preemergence applied herbicides evaluated can be applied to newly divided liriope without suppression of root or shoot growth. Surflan (oryzalin) treated plants had 30% smaller root systems and fewer bolls per container than the non-treated control plants. Predict (norflurazon) caused moderate foliar bleaching on old and new growth.

## Introduction

Liriope is commonly propagated by division. One-gallon (3.8 liter) stock plants are divided into single boll divisions and roots and shoots are cut back to about 5 cm (2 in). Divisions are potted into liner pots and placed under overhead irrigation until sold. A current nursery practice (Flowerwood Nursery, Loxley, AL) is to delay herbicide application until two to four weeks after division. While these newly divided liners are in the nursery, weed infestation commonly occurs, resulting in the need for extensive hand weeding prior to preemergence herbicide application. Delayed application of preemergence applied herbicides is due to concerns that root suppression will occur with use of dinitroaniline (DNA) herbicides and that foliar injury will result following applications of non-DNA herbicides (1). DNA herbicides provide

excellent control of many grass species of weeds and several small seeded broadleaf species. The primary mode of action of DNA herbicides is through root suppression, but these herbicides have a low solubility reducing their movement in the root zone (1). Most of the preemergence applied herbicides used in nursery and landscape crop production are DNA herbicides or contain a DNA herbicide component.

Previous work with DNA herbicides on nursery and landscape crops has demonstrated varying responses. Evaluations of herbicides during propagation of selected woody landscape species suggest potential suppression of root development with several granular DNA herbicides (mainly oryzalin, oxyfluorfen + oryzalin, oxyfluorfen + pendimethalin, and pendimethalin) (2, 6). Davies and Duray (2) showed that pendimethalin [1.4 and 2.8 kg ai/ha (1.3 and 2.5 lb ai/A)] and proflam [3.4 kg ai/ha (3.0 lb ai/A)] reduced root number in hibiscus, and pendimethalin [2.8 kg ai/ha (2.5 lb ai/A)] and oxyfluorfen + pendimethalin [1.1 + 0.6 kg ai/ha (1.0 + 0.5 lb ai/A), 2.2 + 1.1 kg ai/ha (2 + 1 lb ai/A), and 4.5 + 2.2 kg ai/ha (4 + 2 lb ai/A)] reduced percent rooting in Burford holly. However, other species tested were similar in percent rooting, root numbers, and root quality to the non-treated control plants, demonstrating that sensitivity to herbicides in the propagation area was dependent on the herbicide and plant species.

Other research involving herbicide applications in perennials has been conducted, but in most cases herbicides were applied several weeks after potting or applied to well rooted liners, not immediately after division. Stamps and Neal (6) reported several species of perennials, including liriope, were tolerant of pendimethalin [4.4 kg ai/ha (4 lb ai/A)] and proflam [4.4 kg ai/ha (4 lb ai/A)]. Herbicides containing combinations of oryzalin + oxyfluorfen [1.1 + 2.2 kg ai/ha (1.0 + 2.0 lb ai/A)] and pendimethalin + oxyfluorfen [1.12 + 2.24 kg ai/ha (1.0 + 2.0 lb ai/A)] caused foliar injury to liriope, and oryzalin [4.4 kg ai/ha (4 lb ai/A)] reduced root growth. However, in this study (6) herbicides were applied 2 weeks

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<sup>2</sup>Graduate Assistant.

<sup>3</sup>Professor.

<sup>4</sup>Superintendent, Ornamental Horticulture Substation, Mobile, AL.

<sup>5</sup>Associate Professor.

after potting of liners with established root systems. Green et al. (5) applied herbicides to pampas grass 2 days after potting small liners. They reported that some degree of lodging occurred with all DNA herbicides but that granular formulations were safer than liquid formulations. In their experiment, oryzalin treated plants [3.4 kg ai/ha (3.0 lb ai/A)] had severely reduced root development and some mortality. Another test (4) indicated oryzalin [4.5 kg ai/ha (4.0 lb ai/A)], pendimethalin [4.5 kg ai/ha (4.0 lb ai/A)], metolachlor [4.5 kg ai/ha (4.0 lb ai/A)], or simazine [2.7 kg ai/ha (2.4 lb ai/A)] caused no phytotoxicity to liriopse after 2 applications when the first application was made 2 months after potting; however, oryzalin or oryzalin combinations caused suppression of root development. Whitwell and Kelly (8) observed severe injury with oxadiazon [1.1 kg ai/ha (1.0 lb ai/A)] and oxyfluorfen [1.1 kg ai/ha (1.0 lb ai/A)] when applied 3 weeks after potting hosta and daylily; oryzalin did not cause any injury.

Limited research with herbicide use on bare root divisions immediately after potting has been conducted. The objective of our study was to evaluate several preemergent herbicides for injury and root growth suppression of *Liriope muscari* 'Big Blue' and 'Variegata' immediately after division and potting.

## Materials and Methods

**Experiment 1.** In experiment 1, 3 sets of single-bib liriopse divisions were evaluated. 'Big Blue' and 'Variegata' liriopse were divided and potted by Flowerwood Nursery (FN) personnel, in Loxley, AL, on November 7 and 20, 1996, respectively. 'Big Blue' plants were potted in 369 cm<sup>3</sup> (22.8 in<sup>3</sup>) plastic pots (Lerio SR 325, Lerio Co., Mobile, AL), and 'Variegata' plants were potted in 527 cm<sup>3</sup> (32.8 in<sup>3</sup>) plastic pots (S 400-2, REB Plastics, Inc., Orlando, FL). Single bare root bibs with shoots and roots cut back to about 5 cm (2 in) each were divided from 3.8 liter (1 gal) stock plants. Additional 'Big Blue' stock plants were obtained and divided on November 20, 1996, at the Ornamental Horticulture Substation (OHS) in Mobile, AL, where shoots were pruned to 10 cm (4 in) and all bibs had at least 2 main roots that were pruned to about 4 cm (1.5 in).

At the time of herbicide application (November 21, 1996), 'Big Blue' (FN) had been potted 2 weeks and had 1 to 2 new roots 2.5 cm (1 in) long. Herbicides were applied at the following rates: (granular formulations) Regal O-O (oxyfluorfen + oxadiazon) (Regal Chemical Co., Alpharetta, GA) at 3.4 kg ai/ha (3.0 lb ai/A), Ornamental Herbicide II 3G (oxyfluorfen + pendimethalin) (Scotts Co., Marysville, OH) at 3.4 kg ai/ha (3.0 lb ai/A), Pendulum 2G (pendimethalin) (American Cyanamid, Wayne, NJ) at 3.4 kg ai/ha (3.0 lb ai/A), Ronstar 2G (oxadiazon) (Rhone Poulenc, Research Triangle Park, NC) at 4.5 kg ai/ha (4.0 lb ai/A), Snapshot 2.5 TG (trifluralin + isoxaben) (DowElanco, Indianapolis, IN) at 4.5 kg ai/ha (4.0 lb ai/A), (liquid formulations) Factor 65 WDG (prodiamine) (Novartis Crop Protection Inc., Greensboro, NC) at 1.1 kg ai/ha (1.0 lb ai/A), Pendulum 60 WDG (pendimethalin) (American Cyanamid) at 3.4 kg ai/ha (3.0 lb ai/A), and Ronstar 50 WP (oxadiazon) (Rhone Poulenc) at 4.5 kg ai/ha (4.0 lb ai/A). Granular herbicides were applied using a hand held shaker while the liquid formulated herbicides were applied using a CO<sub>2</sub> backpack sprayer with a 8004 flat fan nozzle (R & D Sprayers, Opelousas, LA) at 235 k-Pascals (34 psi) in 187 liter/ha (20 gpa). Treatments

included a non-treated control. Following treatment, containers were placed in a glass greenhouse with a minimum temperature setting of 17C (62F). Containers were handweeded to eliminate weed competition effects. The statistical design for all studies was a randomized block design with 8 replications of 2 plants each for 'Big Blue' and 10 single plant replications for 'Variegata'. Phytotoxicity was rated at 15, 30, and 60 days after treatment (DAT). Phytotoxicity was rated on a scale of 1 to 5 where 1 = no injury, 2 = slight injury, 3 = moderate injury, 4 = severe injury, and 5 = plant death. Roots were counted at the substrate-container interface at 60 DAT. Treatment means were separated using Duncan's multiple range test (P = 0.05).

**Experiment 2.** Experiment 2 was performed similarly to experiment 1 with the following exceptions. On April 22, 1997, 'Big Blue' liriopse was divided, and single bibs were planted in Lerio SR 325 pots at the Paterson Greenhouse Complex, Auburn, AL. Shoots were not cut back and roots were pruned to 8 cm (3 in). Bibs were potted in a pinebark:sand (6:1 by vol) medium amended per m<sup>3</sup> (yd<sup>3</sup>) with 5.93 kg (10 lb) 18N-2.6P-10K (18-6-12) Osmocote (Scotts Co.), 2.97 kg (5 lb) dolomitic lime, and 0.89 kg (1.5 lb) Micromax (Scotts Co.). On April 24, 1997, 2 days after division, herbicides used in experiment 1 except Ronstar 50 WP were applied, and the following herbicides were added: (granular formulations) Regal Kade G (prodiamine) (Regal Chemical Co.) at 1.1 kg ai/ha (1.0 lb ai/A), Ronstar 2G AG (oxadiazon) (Regal Chemical Co.) at 4.5 kg ai/ha (4.0 lb ai/A), Regal Star II (oxadiazon + prodiamine) (Regal Chemical Co.) at 2.7 kg ai/ha (2.4 lb ai/A), (liquid formulations) Gallery 75 DF (isoxaben) (DowElanco) at 1.1 kg ai/ha (1.0 lb ai/A), Image (imazaquin) (American Cyanamid) at 0.6 kg ai/ha (0.5 lb ai/A), Predict 80 DF (norflurazon) (Novartis Crop Protection Inc.) at 3.4 kg ai/ha (3.0 lb ai/A), Surflan 4 AS (oryzalin) (DowElanco) at 3.4 kg ai/ha (3.0 lb ai/A), and Surflan 4 AS + Gallery 75 DF (oryzalin + isoxaben) 3.4 + 1.1 kg ai/ha (3.0 + 1.0 lb ai/A). Following treatment, containers were placed on a gravel bed in full sun and irrigated as needed with overhead irrigation. The statistical design was a randomized complete block with 8 replications of 3 plants each.

At 30, 60, and 90 DAT plant injury, a root rating, and number of bibs was determined. Plant injury was assessed using the same scale as in experiment 1. Roots were rated on a scale of 1-5 where 1-5 = 0, 25, 50, 75, and 100%, respectively, root coverage of the substrate-container interface. At 90 DAT shoot and root fresh and dry weights were determined. Treatment means were separated using Duncan's multiple range test (P = 0.05).

**Experiment 3.** Experiment 3 was similar to Experiment 2 with the following exceptions: liriopse was divided on July 1, 1997, treated on July 3, 1997, and treatments were replicated 4 times with 3 plants each.

## Results and Discussion

**Experiment 1.** At 15 DAT, Ronstar 50 WP and Ronstar 2G treated FN and OHS 'Big Blue' divisions had greater foliar injury ratings compared to all other treated plants (Table 1). Plant injury was characterized by foliar bleaching which was spotty and not severe. Spots were generally 2-3 mm (0.08-0.12 in) in diameter or in bands 3 mm (0.12 in) wide and 3-

**Table 1. Foliar rating and root number of newly divided liriopie treated with 8 preemergent herbicides, experiment 1, Mobile, AL.**

Herbicide	Rate kg ai/ha	Foliar rating, 15 DAT <sup>z</sup>		Root number, 60 DAT <sup>y</sup>		
		BB <sup>x</sup> (FW) <sup>w</sup>	BB (OHS) <sup>y</sup>	BB (OHS)	BB (FW) <sup>u</sup>	'Variegata'
Ronstar 50 WP	4.5	2.1a <sup>1</sup>	2.7a	4.2a	12.2ab	0.8c
Ronstar 2G	4.5	1.4b	1.7b	4.6a	10.9abcd	1.4bc
Pendulum 60 WDG	3.4	1.0c	1.0c	4.6a	11.2abc	1.8bc
Pendulum 2G	3.4	1.0c	1.0c	4.7a	12.4a	1.8bc
Factor 65 WDG	1.1	1.0c	1.0c	4.1a	9.7abcd	1.7bc
OH-2 3G	3.4	1.0c	1.1c	5.2a	7.3d	3.1ab
Regal O-O 3G	3.4	1.0c	1.0c	5.7a	8.6cd	2.1bc
Snapshot 2.5 TG	4.5	1.0c	1.0c	4.8a	8.4cd	3.1ab
Control		1.0c	1.0c	4.1a	9.0bcd	4.9a

<sup>z</sup>1–5 rating scale: 1 = no injury, 3 = moderate injury, and 5 = death; DAT = days after treatment.

<sup>y</sup>Roots at the substrate-container interface were counted.

<sup>x</sup>BB = 'Big Blue' cultivar.

<sup>w</sup>Plants divided at Flowerwood Nurseries, Loxley, AL; herbicides were applied 2 weeks after division.

<sup>y</sup>Plants divided at Ornamental Horticultural Substation, Mobile, AL; herbicides were applied 1 day after division.

<sup>u</sup>Plants divided at Flowerwood Nurseries, Loxley, AL; herbicides were applied 1 day after division. Plants exhibited no injury in any treatment.

<sup>1</sup>Mean separation using Duncan's multiple range test ( $P = 0.05$ ).

4 cm (1.2–1.6 in) long. Plants in all other herbicide treatments exhibited no foliar injury and were similar to non-treated plants (data not shown). 'Variegata' plants exhibited no injury symptoms in any treatment (data not shown).

The OHS 'Big Blue' plants were all statistically similar in number of roots, having an average of 4.7 roots at the substrate-container interface (Table 1). Treated FN 'Big Blue' plants were all similar to the non-treated control plants except Pendulum 2G treated plants which had a higher root count than the control. Although Ronstar caused initial foliar injury, it appeared to cause no injury thereafter; concurring with several studies (2, 3, 5, 7) which report no negative effects from Ronstar on root development of several woody

nursery crops. While not compared statistically, results were similar when herbicides were applied 1 day after division (FN) or when herbicides were applied 2 weeks after division (OHS). These results indicate granular herbicides could be applied to 'Big Blue' liriopie immediately after division without inhibiting root growth or causing long-term phytotoxicity.

Roots of 'Variegata' were more sensitive to herbicide application than 'Big Blue' however, there was no foliar injury observed (Table 1). 'Variegata' treated with Ronstar 50 WP, Ronstar 2G, Pendulum 60 WDG, Pendulum 2G, Factor 65 WDG, or Regal O-O 3G all had significantly fewer roots than non-treated control plants.

**Table 2. Root rating, foliar rating, and bib number per container of newly divided liriopie treated with 15 preemergent herbicides, experiment 2, Auburn, AL.**

Herbicide	Rate kg ai/ha	Root rating <sup>z</sup>		Foliar rating <sup>y</sup>			Bib number	
		60 DAT <sup>x</sup>	90 DAT	30 DAT	60 DAT	90 DAT	60 DAT	90 DAT
Ronstar 2G AG	4.5	1.8bcd <sup>w</sup>	3.0bcd	2.1bcd	1.8bcde	1.5bcd	2.9abc	4.5bcd
Regal O-O	3.4	1.9abcd	3.1bcd	2.4ab	1.9bcd	1.5bcd	2.3bcd	4.0cde
OH-2 3G	3.4	2.0abc	3.4abc	2.3abc	1.8bcde	1.4bcd	2.5abcd	4.7abcd
Kade G	1.1	1.9abcd	2.9cd	1.7e	1.9bcd	1.6bc	2.6abcd	4.5bcd
Snapshot 2.5 TG	4.5	2.0abc	3.8a	1.9de	1.8bcde	1.5bcd	2.7abcd	4.6bcd
Pendulum 2G	3.4	2.2a	3.6ab	1.9de	1.5de	1.3cd	3.3a	5.6a
Star II	2.7	2.0abc	3.3abc	2.0cde	1.9bcd	1.4bcd	2.2cd	4.8abcd
Factor 65 WDG	1.1	1.8bcd	3.1bcd	2.0cde	1.7bcde	1.4bcd	2.4bcd	4.4bcd
Pendulum 60 WDG	3.4	1.8bcd	3.3abc	1.8de	1.7bcde	1.5bcd	2.5abcd	4.5bcd
Surflan 4AS	3.4	1.3e	2.3e	1.7e	1.5de	1.8b	1.9d	3.2e
Predict	3.4	1.6d	3.1bcd	2.6a	2.7a	2.3a	2.9abc	4.3bcd
Gallery	1.1	1.8bcd	3.2bcd	1.8de	1.9bcd	1.5bcd	2.2cd	4.9abc
Image	0.6	1.7cd	3.3abc	2.0cde	1.8bcde	1.8b	2.8abc	5.2ab
Surflan + Gallery	3.4 + 1.1	1.3e	2.6de	2.0cde	2.0bc	1.5bcd	2.0cd	3.8de
Ronstar 2G	4.5	2.0abc	3.8a	2.1bcd	1.7bcde	1.6bc	3.2ab	4.9abc
Control		1.9abcd	3.5ab	1.9cde	1.7bcde	1.25d	2.9abc	4.8abcd

<sup>z</sup>1–5 rating scale = 0, 25, 50, 75, and 100%, respectively, root coverage at the substrate-container interface.

<sup>y</sup>1–5 rating scale: 1 = no injury, 3 = moderate injury, and 5 = dead plant.

<sup>x</sup>DAT = days after treatment.

<sup>w</sup>Mean separation using Duncan's multiple range test ( $P = 0.05$ ).



**Table 3. Root rating and foliar rating of newly divided lirioppe treated with 15 preemergent herbicides, experiment 3, Auburn, AL.**

Herbicide	Rate kg ai/ha	Root rating <sup>z</sup>			Foliar rating <sup>y</sup>		
		30 DAT <sup>x</sup>	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
Ronstar 2G AG	4.5	1.5ab <sup>w</sup>	3.1abc	3.7abc	1.5bcd	1.3b	1.7cde
Regal O-O	3.4	1.5ab	2.8bc	3.2cd	1.9ab	1.8a	2.8a
OH-2 3G	3.4	1.5ab	3.3ab	4.0ab	1.8bc	1.8a	2.3b
Kade G	1.1	1.5ab	2.6c	3.6abc	1.8bc	1.3b	1.8cd
Snapshot 2.5 TG	4.5	1.6a	3.3ab	3.7abc	1.6bcd	1.4ab	1.4cde
Pendulum 2G	3.4	1.5ab	3.2abc	3.8abc	1.5bcd	1.2b	1.8cd
Star II	2.7	1.5ab	3.1abc	3.8abc	1.5bcd	1.6ab	1.8cd
Factor 65 WDG	1.1	1.6a	3.2abc	3.8abc	1.3cd	1.2b	1.6cde
Pendulum 60 WDG	3.4	1.5ab	3.5a	4.0ab	1.7bcd	1.3b	1.5cde
Surflan 4AS	3.4	1.3c	2.0d	3.2cd	1.6bcd	1.4ab	1.7cde
Predict	3.4	1.4bc	3.3ab	3.8abc	2.3a	1.6ab	1.8cd
Gallery	1.1	1.5ab	3.3ab	4.0ab	1.6bcd	1.2b	1.5cde
Image	0.6	1.2c	2.9bc	3.1cd	1.8bc	1.3b	1.7cde
Surflan + Gallery	3.4 + 1.1	1.2c	1.9d	2.6d	1.5bcd	1.3b	1.3de
Ronstar 2G	4.5	1.5ab	3.2abc	3.7abc	1.6bcd	1.3b	1.7cde
Control		1.4ab	3.2abc	4.1a	1.3cd	1.2b	1.3de

<sup>z</sup>1–5 rating scale = 0, 25, 50, 75, and 100% root coverage, respectively, at the substrate-container interface.

<sup>y</sup>1–5 rating scale: 1 = no injury, 3 = moderate injury, and 5 = dead plant.

<sup>x</sup>DAT = days after treatment.

<sup>w</sup>Mean separation using Duncan's multiple range test (P = 0.05).

**Experiment 2.** Root ratings of granular applied preemergent herbicide treated plants were similar to those of non-treated 'Big Blue' controls at both 60 and 90 DAT with the exception of plants treated with Regal Kade at 90 DAT which exhibited a slightly lower root rating than control plants (Table 2). These results differ from work by Whitwell and Kelly (8) that showed oxadiazon and oxyfluorfen applications caused severe injury to hosta and daylily. In our study, plants were smaller, resulting in fewer herbicide granules funneling down and accumulating at the crown. Our data concur with work by Green et al. (5) that reported granular formulations appeared safer to pampas grass than liquid formulations.

'Big Blue' lirioppe treated with Surflan [3.4 kg ai/ha (3.0 lb ai/A)] or Surflan + Gallery [3.4 + 1.1 kg ai/ha (3.0 + 1.0 lb ai/A)] exhibited suppressed root ratings at both 60 and 90 DAT when compared to non-treated control (Table 2). At both 60 and 90 DAT lirioppe treated with Gallery [1.1 kg ai/ha (1.0 lb ai/A)] alone had similar root ratings to non-treated control lirioppe indicating root growth inhibition was caused by Surflan. When evaluating new shoot number (bibs), Surflan treated plants had the lowest number of new shoots at 60 and 90 DAT, with 34% and 33% fewer shoots, respectively, than non-treated control plants. These results are similar to those of Stamps and Neal (6) who reported that Surflan [4.5 kg ai/ha (4.0 lb ai/A)] suppressed root development of five landscape species during container production. Other research (7) with herbicides used during propagation reported Korean boxwood (*Buxus microphylla* var. *koreana* 'Nakai'), Foster's holly (*Ilex x attenuata* 'Foster's #2'), and Compacta holly (*Ilex crenata* Thunb. 'Compacta') experienced root growth suppression when treated with Surflan [3.4 kg ai/ha (3.0 lb ai/A)]. All other herbicide treatments had similar shoot numbers to the control plants.

Plants treated with Predict [3.4 kg ai/ha (3.0 lb ai/A)] exhibited bleached foliage at 30, 60, and 90 DAT with some bleaching on new growth at 90 DAT (Table 2). Plants treated with Regal O-O had a higher foliar rating at 30 DAT, but not

60 or 90 DAT, than did control plants. At 90 DAT, Surflan, Image, or Predict treated plants had greater phytotoxicity ratings than untreated control plants. Injury to Image or Predict treated plants was characterized by bleached spots or bands on the old and new foliage.

**Experiment 3.** Data from the third experiment generally agreed with that of experiment 2 in that granular herbicides had root ratings similar to non-treated control plants (Table 3). Regal O-O treated plants at 90 DAT were the only plants treated with granular herbicides to exhibit root ratings slightly lower than non-treated control plants. Again, Surflan or Surflan + Gallery treated plants had lower root ratings than non-treated control plants at 30, 60, and 90 DAT. Image treated plants had lower root ratings at 30 and 90 DAT than non-treated control plants.

Although not compared statistically, phytotoxicity ratings were generally higher in experiment 3 than in experiment 2. Plants in the third study were in a softer stage of growth when divided, possibly accounting for more injury from herbicides. As in experiment 2, Predict treated plants exhibited bands of bleached foliage and had higher phytotoxicity ratings than control plants at 30 and 90 DAT. Regal O-O and OH-2 which both contain oxyfluorfen caused foliar damage later in the study (60 and 90 DAT). Stamps and Neal (6) also reported moderate to severe damage to oxyfluorfen-treated lirioppe. At 90 DAT Regal Kade, Pendulum 2G, Image, and Regal Star II treated plants also exhibited slight phytotoxicity when compared to control plants.

Results of these 3 tests showed root or shoot growth of 'Big Blue' lirioppe was not affected by granular herbicides when applied immediately after division. Surflan consistently suppressed root growth, while Predict treated plants exhibited bleached foliage on old and new growth. All other spray-applied herbicides were safe when applied immediately after division to 'Big Blue' lirioppe. 'Variegata' appears to be more sensitive to preemergent-applied herbicides. Additional

research should be conducted with 'Variegata' to determine herbicide safety.

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