

Pre-Emergent Herbicide Use in Propagation of *Loropetalum chinense* 'Ruby'[®]

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Three herbicides were evaluated during propagation of *Loropetalum chinense* 'Ruby' to determine the effects on rooting and subsequent plant growth. Herbicides evaluated were: Gallery (isoxaben), Ronstar 2G (oxadiazon), and Regal O-O (oxyfluorfen + oxadiazon). Herbicides were applied at three separate times during the propagation process: before sticking, lightly rooted, or fully rooted. Before sticking treatments were applied to flats filled with standard medium prior to the cuttings being stuck. About 1 month later when roots had just begun to emerge [3 to 5 cm (1 to 2 inches) long], a separate group of cuttings (lightly rooted) were treated. Finally, the third application occurred to a separate group of cuttings (not previously treated) once the cuttings were fully rooted. Data was collected at 65, 248, and 342 days after sticking (DAS). One year after sticking, growth indices of 'Ruby' loropetalum were similar regardless of when Gallery was applied. At that time there was no effect on root coverage except when Gallery was applied before sticking, which had 58% root coverage compared to 69% for nontreated plants. With Ronstar and Regal O-O shoot growth was similar about 1 year later; however, root coverage was suppressed with Ronstar applied before sticking and at lightly rooted, while Regal O-O suppressed root coverage on all dates of application.

INTRODUCTION

Cuttings are often propagated in small containers, and previous research suggests weeds are better competitors for water, light, and nutrients in smaller containers than in larger containers (Berchielli-Robertson et al., 1990). With herbicide restrictions, hand weeding is the major form of weed control in propagation but can suppress growth of cuttings through mechanical disruption (Johnson and Meade, 1987). Another restriction with hand weeding is cost of labor. Estimated labor costs ranged from \$246–\$567/acre based on an average hourly wage of \$3.53–\$3.97 (Gilliam et al., 1990). North Carolina's annual weeding labor costs ranged from \$967–\$2,228/acre based on an hourly wage of \$14.75 (Judge et al., 2004).

There is a need for weed control options beyond hand weeding during propagation of nursery crops, especially with rising labor costs and potential labor shortages. Most herbicides available for the nursery industry contain DNA herbicides, which are root inhibiting (Altland et al., 2003; Thetford et al., 1991). In previous research, Ronstar has been shown to cause no reduction in root growth or quality when ap-

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plied during propagation of boxwood (Thetford and Gilliam, 1991). In other work, Ronstar and Regal O-O were reported to cause no reduction in root quality of azalea or hollies during propagation (Cook and Neal, 2001). In more recent work, Altland et al. (2000) showed Gallery to have post-emergent control of bittercress, which is one of the major weeds in propagation. A post-emergent option for bittercress control in propagation would provide a needed option for nursery producers.

Evergreen nursery crops are frequently propagated in outside beds during the summer. Conditions are ideal for germination and growth of many weed species. Eliminating these weed species during propagation will reduce future weed pressure in production areas and promote better crop growth. The objective of our study was to compare Ronstar and Regal O-O with Gallery for effects on rooting of 'Ruby' loropetalum when applied at different times during the propagation process.

MATERIALS AND METHODS

In this study three preemergence herbicides were applied to cuttings of *Loropetalum chinense* 'Ruby' at three different times in the rooting process. Gallery at 1 lb/aia, Ronstar at 4 lb/aia, and Regal O-O at 3 lb/aia were applied either before sticking (2 Aug. 2005), when cuttings were lightly rooted (18 Sept. 2005), or when cuttings were fully rooted (4 Nov. 2005). Terminal cuttings 7 to 9 cm (2.8 to 3.5 inches) were stuck on 2 Aug. 2005, in 9-cm (3.5-inch) containers utilizing a pinebark : sand 6 : 1 (v:v) medium amended with Polyon 17-6-12 @ 9 lbs/yard³, Micromax @ 1.5 lbs/yard³, and dolomitic lime @ 5.0 lbs/yard³. Each cutting was dipped in Dip 'N Grow 1 part : 5 parts water (2000 ppm IBA) for 4 sec prior to sticking. This study was a 3 × 3 factorial with 9 replications of 9 containers per replication in a completely randomized design. All treatments were hand weeded throughout the study to eliminate weed competition effects.

With the before sticking treatment, propagation flats were treated 1 h before cuttings were stuck and watered in with 0.6 cm (0.25 inch) of water. All pots were placed in outdoor cold frames under 47% shade with overhead mist every 5 min for 5 sec from 8:00 AM to 7:00 PM. Thirty-eight days after sticking (DAS), 8 Sept. 2005, a separate group of lightly rooted cuttings not previously treated were pulled from the mist beds prior to mist starting at 8:00 AM, to allow treatment to dry foliage. Thereafter the foliage was lightly brushed off and plants were watered in [0.6 cm (0.25 inch)] and returned to mist. On 4 Nov. 2005 (94 DAS), the final treatment (fully rooted) was applied the same as the second treatment, and plants were left under mist for one additional week before being moved to a retractable shade house for overwintering.

Data were collected 65, 248, and 342 DAS. At 65 DAS, shoot number per cutting and average length of the three longest shoots were recorded for cuttings treated before sticking and lightly rooted. Four plants from each replication were randomly selected to determine number of primary roots, average length of the three longest roots, and root fresh weight. After overwintering, 7 April 2006 (248 DAS), growth indices (height + width at widest point + width perpendicular ÷ 3) and percent root coverage of the propagation container (0–100 scale) were taken prior to potting in full gallon containers. Growth indices and percent root coverage of containers were taken again on 10 July 2006 (342 DAS).

RESULTS

65 DAS Before Sticking. Gallery had no effect on shoot growth or root growth on cuttings of 'Ruby' loropetalum (Table 1). Ronstar and Regal O-O suppressed shoot length by 44% and 37%, and root length by 30% and 16% compared to the nontreated control.

Lightly rooted. Compared to the nontreated control plants there were no herbicide effects on new shoot number, shoot length, or root fresh weight (Table 1). Gallery and Ronstar had slightly less root numbers compared to Regal O-O and nontreated plants. Slight suppression in root length (less than 10%) occurred with Gallery and Regal O-O compared to the nontreated control with the exception of Ronstar.

248 DAS Before Sticking. Gallery- and Ronstar-treated cuttings were similar but were smaller and had less root coverage than the nontreated control plants while Regal O-O caused severe reduction in growth indices (73%) and root coverage (74%) (Table 2).

Lightly Rooted. 'Ruby' loropetalum stem cuttings treated when roots were 2.5 to 5 cm (1–2 inches) long were similar in growth indices regardless of herbicide treatment (Table 2). Root ratings were slightly less for Ronstar and Regal O-O compared to the nontreated control; however, Gallery-treated plants had similar rootball coverage to the nontreated control plants.

Fully Rooted. A slight difference in new growth was observed for all plants treated with herbicides compared to the nontreated control plants (Table 2). Fully rooted cuttings treated with Gallery and the nontreated plants had similar root ratings, while Ronstar and Regal O-O had suppressed root ratings compared to the nontreated control cuttings, with Regal O-O suppressing root growth more than Ronstar.

342 DAS Before Sticking. Approximately 1 year after application all stem cuttings had similar growth indices regardless of herbicide treatment (Table 3). No difference in root coverage was observed between Gallery and Ronstar. All herbicide treatments had less root coverage than the nontreated control plants, with Regal O-O having the greatest root suppression (Table 3).

Lightly Rooted. Plants from all herbicide treatments were similar in shoot size or larger than the nontreated control plants when treated at the lightly rooted stage during propagation (Table 3). Gallery applied to lightly rooted cuttings had similar root coverage compared to the nontreated control plants. Ronstar and Regal O-O had less root coverage than the nontreated plants; however Ronstar treated cuttings had equal root coverage to cuttings treated with Gallery.

Fully Rooted. Gallery, Ronstar, and Regal O-O applied to fully rooted cuttings had similar growth indices compared to the nontreated control 1 year after propagation (Table 3). There was no herbicide affects in percent root growth compared to the nontreated control, with the exception of Regal O-O applied to fully rooted cuttings.

DISCUSSION

In summary, Gallery applied to lightly or fully rooted stem cuttings of 'Ruby' loropetalum did not cause any suppression in shoot or root growth. These data suggest that Gallery could be sprayed over the top of cuttings for post-emergence control of bittercress. Furthermore, application of Gallery before sticking did cause slight

Table 1. The influence of herbicide application during propagation 65 days after sticking on *Loropetalum chinense* 'Ruby' stem cuttings.

	Before sticking ^z			Lightly rooted ^y				
	Gallery	Ronstar	Regal O-O	Control	Gallery	Ronstar	Regal O-O	Control
Shoot Number ^x	3.6a ^t	1.3c	1.4c	3.0b	2.7a	2.7a	2.8a	3.0a
Shoot Length ^w	4.3a	2.3b	2.6b	4.1a	4.5b	3.8b	5.9a	4.1b
Root Number ^v	11.5ab	10.1bc	8.7c	12.6a	10.8b	10.5b	12.7a	12.6a
Root Length ^u	22.7a	15.4c	18.5b	22.0a	19.9b	21.4ab	19.8b	22.0a
Root Weight	0.6a	0.3b	0.4b	0.6a	0.6a	0.5a	0.5a	0.6a

^z Before Sticking = herbicide prior to sticking cuttings.^y Lightly Rooted = herbicide applied to lightly rooted cuttings (1-2 inches).^x Shoot Number = number of new shoots per replication.^w Shoot Length = length of three longest shoots ÷ 3 (cm).^v Root Number = number of primary roots per replication.^u Root Length = length of three longest roots ÷ 3 (cm).^t Means (across columns within application times) with different letters are significantly different, according to Duncan's Multiple Range Test ($\alpha = 0.05$).

Table 2. The influence of herbicide application during propagation 248 days after sticking on *Loropetalum chinense* 'Ruby' stem cuttings.

Herbicide	Growth index ^z		Root coverage ^y	
	Before sticking	Lightly rooted ^x	Fully rooted	Lightly rooted
Gallery	19.8b ^w	30.2a	28.0b	29.5ab
Ronstar	20.5b	42.7a	27.2b	27.8b
Regal O-O	10.2c	22.1a	20.9b	24.5b
Control	38.3a	38.3a	35.4a	35.4a

^z Growth indices = Height + width at widest point + width perpendicular ÷ 3.

^y Root coverage was an estimate of the percentage of the rootball surface covered with roots (0-100 %).

^x Lightly Rooted = herbicide applied to lightly rooted cuttings (1-2 inches).

^w Means (within a column for each factor) with different letters are significantly different, according to Duncan's Multiple Range Test ($\alpha = 0.05$).

Table 3. The influence of herbicide application during propagation 342 days after sticking on *Loropetalum chinense* 'Ruby' stem cuttings.

Herbicide	Growth index ^z		Root coverage ^y	
	Before sticking	Lightly rooted ^x	Fully rooted	Lightly rooted
Gallery	44.1a ^w	47.3a	47.1a	63.3ab
Ronstar	41.3a	44.2b	46.5a	61.3b
Regal O-O	41.1a	45.2ab	51.9a	52.8c
Non-treated	43.7a	43.7b	43.7a	68.9a

^z Growth Indices = height + width at widest point + width perpendicular ÷ 3.

^y Root coverage was an estimate of the percentage of the rootball surface covered with roots (0-100).

^x Lightly Rooted = herbicide applied to lightly rooted cuttings (1-2 inches).

^w Means (within a column for each factor) with different letters are significantly different, according to Duncan's Multiple Range Test ($\alpha = 0.05$).

suppression of root growth compared to the nontreated cuttings; however, by the end of the first growing season, shoot growth was similar to nontreated plants. Cuttings treated with Ronstar and Regal O-O also had similar shoot growth to the nontreated cuttings by the end of the 1st year. Ronstar reduced root coverage when applied before sticking and when cuttings were lightly rooted, while Regal O-O reduced root coverage regardless of application timing. From a grower's point of view, use of herbicides in propagation that causes slight reductions in root coverage at the end of the first growing season may be more acceptable than dealing with weed pressure and added labor cost throughout the life of the crop.

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