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Research Reports:

Preemergent Weed Control in Container and Field Grown Woody Nursery Crops with Gallery[1]

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Abstract

Two container and four field tests were conducted to evaluate Gallery (isoxaben) for preemergent weed control in container and field grown woody nursery crops. Gallery was applied to newly potted nursery crops at 0.56 and 1.1 kg ai/ha (0.5 and 1 lb ai/A) alone and in combination with Surflan (oryzalin) or Treflan (trifluralin). No injury was observed on container grown azalea 'Coral Bells,' *Rhododendron* 'Roseum Elegans,' rockspray cotoneaster, forsythia, potentilla 'Tangerine,' Japanese dwarf garden juniper, 'Old Gold' juniper, or plaintain lily 'Albo-marginata.' Gallery, applied alone, caused no injury to field grown sawara false cypress, honey locust, Japanese yew, California privet, 'San Jose' holly, white pine, Douglas fir, white fir, green ash, or Japanese rose. Gallery injured field grown common lilac. When combined with Surflan, temporary reduction in white fir and Japanese barberry quality resulted. Douglas fir was injured significantly by Surflan, alone or in combination with Gallery. Gallery provided excellent control of many broadleaf weeds including pigweed, common groundsel, and dandelion, but poor control of annual grasses such as crabgrass, goosegrass, and fall panicum. The combination of Gallery plus Surflan provided an expanded spectrum of weed control with excellent safety on most container and field grown woody nursery crops.

Index words: herbicides, oryzalin, simazine, trifluralin, weed control.

Species used in this study: White fir (*Abies concolor* (Gord.) Lindl. ex Hildebr.); Japanese barberry (*Berberris thunbergii* DC 'Atropurpurea'); Sawara false cypress (*Chamaecyparis pisifera* (Siebold & Zucc.) Endl. 'Plumosa'); rockspray cotoneaster (*Cotoneaster horizontalis* Decne.); border forsythia (*Forsythia* X *intermedia* Zab.); green ash (*Fraxinus pennsylvanica* Marsh.); honey locust (*Gleditsia triacanthos* L.); plaintain lily (*Hosta lancifolia* Engl. 'Albo-marginata'); 'San Jose' holly (*Ilex* X *aquipernyi* Gable ex W. Clarke 'San Jose'); Japanese dwarf graden juniper (*Juniperus procumbens* (Engl.) Miq. 'Nana'); 'Old Gold' juniper (*Juniperus* X *media* van Melle 'Old Gold'); California privet (*Ligustrum ovalifolium* Hassk.); White pine (*Pinus strobus* L.); bush cinquefoil (*Potentilla fruticosa* L. 'Tangerine'); Douglas fir (*Psuedotsuga menziesii* (Mirb.) Franco); azalea (*Rhododendron obtusum* (Lindl.) Planch. 'Coral Bells'); catawba rhododendron (*Rhododendron cawtawbiense* Mich. 'Roseum Elegans'); Japanese rose (*Rosa rugosa* Thunb.); common lilac (*Syringa vulgaris* L.); and Japanese yew (*Taxus cuspidata* Siebold & Zucc).

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Weed species used in this study: Barnyardgrass (*Echinochloa crus-galli* (L.) Beauv); crabgrass (a mixture of smooth crabgrass, *Digitaria ischaemum* (Schreb, ex Schwieg.) Schreb. ex Muhl., and large cragrass, *Digitaria sanguinalis* (L.) Scop.); common groundsel (*Senecio vulgaris* L.); common ragweed (*Ambrosia artemisiifolia* Spreng.); common purslane (*Portulaca oleracea* L.); creeping woodsorrel (*Oxalis corniculata* L.); dandelion (*Taraxacum officinale* Weber in Wiggers); fall panicum (*Panicum dichotomiflorum* Michx.); goosegrass (*Eleusine indica* (L.) Gaertn.); horseweed (*Conyza canadensis* (L.) Cronq.); Pennsylvania smartweed (*Polygonum pensylvanicum* L.); pigweeds (mixed stands of redroot pigweed, *Amaranthus retrofexus* L., and Powell amaranth, *Amaranthus powellii* S. Wats.); Virginia pepperweed (*Lepidium virginicum* L.); and witchgrass (*Panicum capillare* L.).

Herbicides used in this study: Gallery (isoxaben), N-[3-(Ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide; Princep (simazine), 6-chloro-N, N′-diethyl-1,3,5-triazine-2,4-diamine; Scotts Ornamental Herbicide 2 (oxyfluorfen), 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene, plus (pendimethalin) N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine; Surflan (oryzalin), 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Snapshot DF (isoxaben + oryzalin); Snapshot TG (isoxaben plus trifluralin), α,α,α-trifluoro-2,6-dinitro-*N*-*N*-dipropyl-*p*-toluidine.

Significance to the Nursery Industry

Gallery (isoxaben) provided excellent broadleaf weed control with excellent crop safety in container and field grown woody nursery crops. Lilac was the only species injured by Gallery in these tests. Snapshot 80DF, a combination of Gallery + Surflan, provided excellent season-long control of annual grasses and broadleaves. This combination injured Douglas fir and lilac, and temporarily stunted barberry and white fir.

Although Gallery was safe on most species in these tests, some injury did occur. It is impossible for Extension Specialists or pesticide industry representatives to test every species in the trade. To avoid crop injury, nurserymen should conduct small scale tests of each new herbicide and crop before large-scale implementation.

Introduction

Numerous preemergent herbicides are labeled for controlling annual grasses in container and field grown woody nursery crops. However, few selective herbicides are available for broadleaf weed control. Princep (simazine) and Goal (oxyfluorfen) are widely used on nursery crops for this purpose; however each injures certain species. Ahrens (2) reported Princep injury on *Ligustrum*, *Forsythia*, *Salix*, *Weigelia*, *Philadelphus*, and *Prunus*. Princep injury has also been reported on *Euonymus*, *Buxus*, *Nandina*, *Rosa*, *Syringa*, and others (1, 2, 5, 6, 8, 13). Goal is used for pre- and postemergent weed control in conifers but will injure many broadleaf evergreens and deciduous nursery crops (10). Scotts Ornamental Herbicide II (Scotts OH-2), a granular formulation containing 1% pendimethalin plus 2% oxyfluorfen, is labeled for use on many nursery crops injured by Goal.[3] This granular product is widely used in containerized production but rarely by field growers due to cost concerns and the difficulty in obtaining uniform distribution of granular herbicides. In addition, some nursery crops are sensitive to Scotts OH-2 including certain cultivars of azalea, *Euonymus*, and *Potentilla*.[3] Thus, there is a need for safe and effective alternatives for broadleaf weed control in container and field grown nursery stock.

Recent research has shown that Gallery (isoxaben) provides excellent broadleaf weed control with good safety on a variety of nursery crops (7, 11). Developed for preemergent control of annual broadleaf weeds in cereals, Gallery controls over 30 species of weeds common to grain crops at 0.125 kg ai/ha (0.112 lb ai/A) (9). In preliminary research we have observed Gallery to be weak on annual grasses, but when combined with Surflan (oryzalin), a broad spectrum of weeds was controlled (11). Gilliam *et al* (7) observed similar results and excellent safety on field grown *Buxus microphylla* 'Koreana,' *Viburnum* X 'Chesapeake,' *Ilex aquifolium* X *cornuta*, and *Nandina domestica*. However, an expanded data base of woody nursery crop safety is necessary before wide spread usage of Gallery may be recommended. Additionally, the herbicide safety in container production should be evaluated. The objectives of these experiments were to evaluate Gallery efficacy and safety on a variety of field and container grown woody nursery crops.

Materials and Methods

Container grown nursery crops. Two experiments were conducted in 1987 and 1988 to evaluate Gallery phytotoxicity to container grown nursery crops at Cornell University's Long Island Horticultural Research Lab, Riverhead, NY. Rooted cuttings, liners, or divisions were potted in 2.8 l containers (1 gal. pots) using a bark + peat + leaf mold + sand medium (1:1:1:1 by vol) and treated 24 hours later. Plants included in the container tests were: rockspray cotoneaster (potted liners), forsythia (rooted cuttings), plantain lily (division of stock plants), Japanese dwarf garden juniper (liners) (1987), 'Old Gold' junipers (liners) (1988), 'Roseum Elegans' rhododendron (rooted cuttings), 'Coral Bells' azalea (liners), and bush cinquefoil (rooted cuttings). Chemical treatments included Gallery 75% water dispersible granule at 1.1 and 2.2 kg/ha (1 and 2 lb ai/A), Gallery 1% granule at 1.1 kg/ha (1 lb ai/A), Surflan at 4.5 kg/ha (4 lb ai/A), Snapshot 80% dry flowable (80DF) (isoxaben + oryzalin pre-mix) at 0.56 + 1.7 and 1.1 + 3.4 kg/ha (0.5 + 1.5 and 1 + 3 lb ai/A), and Scotts OH-2 at 2.2 + 1.1 kg/ha (2 + 1 lb ai/A). In 1988, additional treatments included Snapshot 80DF at 0.84 + 2.5 kg/ha and 1.1 + 3.4 kg/ha (0.75 + 2.25 and 1 + 3 lb ai/A), and Snapshot TG (a granular formulation of isoxaben + trifluralin) at 0.84 + 3.4 kg/ha (0.75 + 3 lb ai/A). Herbicides were applied on June 1, 1987 and May 25, 1988. In 1988, treatments were reapplied on July 26. Herbicide sprays were applied with a CO_2 pressurized sprayer equipped with flat fan nozzles and calibrated to deliver 280 l/ha (30 GPA) at 276 kPa (40 psi) pressure. Granular treatments were applied in pre-weighed aliquots using a hand-held shaker jar. Pots were irrigated with 1.25 cm (½ in) of water within 24 hours after treatment, and thereafter irrigated daily when rain did not occur.

To eliminate weed competition as a confounding factor in plant growth, all pots were maintained weed free by supplemental hand weeding. Seedling weeds were rated for

[3]Scotts Ornamental Herbicide II 1987 product label, ProTurf Division, O.M. Scott and Son Company, Marysville, OH.

Table 1. Location, planting dates, treatment dates, and species for the 4 field tests.

Test Location and Years	Planting Date	Treatment Dates	Species
Riverhead, NY 1986–1987	4/24/86	4/25/86	blue girl—blue boy holly
		5/1/87	California privet
			white pine
			Japanese yew
Riverhead, NY 1987–1988	5/14/87	5/15/87	false cypress
		5/9/88	Japanese rose
Ithaca, NY 1986–1987	5/8/86	5/9/86	honey locust
		5/26/87	Douglas fir[y]
			common lilac
Ithaca, NY 1987–1989[z]	5/18/87	5/19/87	White fir[y]
		8/2487	Japanese barberry
		5/3/88	green ash
	5/1/88[z]	5/9/89	common lilac

[z]In the Ithaca 1987–89 experiment, fir, barberry, and green ash were planted in 1987. Lilac was planted in 1988. The experiment was carried through 1989 to collect two seasons data on lilac.

[y]Douglas fir plants donated for this test were 3-0 seedlings. White fir were 2-2 transplants.

control before hand removal. Herbicide treatments were compared to an untreated, hand-weeded control.

The experimental design was a randomized complete block with four replicates. Each experimental unit contained three plants; thus, means represent the average response of 12 plants (4 reps × 3 plants/plot). Treatment effects were visually evaluated twice during the growing season on a percent vigor scale where 100 = the best growth possible under the test conditions and 0 = dead plants. In addition, above ground fresh weights were measured on July 31, 1987 and August 30, 1988. Data were subjected to analysis of variance and means were separated using the Waller-Duncan least significant difference (LSD) procedure (12).

Field grown nursery crops. Four experiments were conducted, each over two growing seasons, to evaluate isoxaben phytotoxicity to field grown woody nursery crops. Tests were conducted at two locations; (a) Cornell University at Ithaca, NY, Hudson silty clay loam soil (fine-illitic mesic Glossaquic Hapludalf), USDA hardiness zone 4 and (b) Long Island Horticultural Research Lab, Riverhead, NY, Riverhead sandy loam soil (mixed mesic Typic Dystrochrept), USDA hardiness zone 6. In each experiment, bare-root liners were planted, treated within 24 hours, and then irrigated with 2.5 cm (1 in) of water. Thereafter, irrigation was applied on an as-needed basis. Plant spacing was 0.6 m (2 ft) in-the-row and 1.6 to 2 m (5 to 6 ft) between rows. Each treated plot was 1 m (40 in) wide by 8.5 m (26 ft) long and contained three plants of each species. Herbicides were applied as described for the container experiments. Chemical treatments included Gallery at 0.56 and 1.1 kg/ha (0.5 and 1.0 lb ai/A), Princep at 1.1 or 1.7 kg/ha (1 or 1.5 lb ai/A), Surflan at 3.4 kg/ha (3 lb ai/A), Snapshot 80DF at 0.56 + 1.7 and 1.1 + 3.4 kg/ha (0.5 + 1.5 and 1 + 3 lb ai/A), and a combination of Princep + Surflan at 1.1 + 1.7 or 1.7 + 3.4 kg/ha (1 + 1.5 or 1.5 + 3 lb ai/A). The species evaluated in each test, planting dates, and treatment dates are summarized in Table 1.

Plant quality was visually evaluated periodically throughout each growing season on the percent vigor scale described for the container experiments. In addition, weed control was visually evaluated on a percent scale where 0 = no control and 100 = complete control. Evaluations of individual weeds and of overall effectiveness were conducted. Data were analyzed as previously described.

Results and Discussion

Container grown nursery crops. Gallery applied at 1.1 and 2.2 kg/ha (1 and 2 lb ai/A) caused no injury to container-grown azalea, cotoneaster, forsythia, plantain lily, bush cin-

Table 2. Herbicide phytotoxicity to plantain lily and weed control efficacy in containers.

Herbicide	Formulation	Rate (kg/ha)	Rate (lb/A)	Plantain lily fresh weight[z] 1987	Plantain lily fresh weight[z] 1988	Weed Control[y] Grasses	Weed Control[y] Broadleaves
				(gm)	(gm)	(%)	(%)
None (hand weeded)				28	58	100	100
Gallery	75 WDG	1.1	1	28	55	58	90
Gallery	75 WDG	2.2	2	31	43	68	100
Gallery	1 G	1.1	1	31	53	65	90
Surflan	85 DG	4.5	4	38	56	90	95
Snapshot DF	80 DF (Premix)	0.56[x] +1.7	0.5 +1.5	34	54	93	100
Snapshot DF	80 DF	0.84 +2.5	0.75 +2.25	—	51	—	—
Snapshot DF	80 DF	1.1 +3.4	1 + 3	—	71	—	—
Snapshot TG	2.5 G (Premix)	0.84 +3.4	0.75 +3	—	53	—	—
Scotts OH2	3 G (Premix)	2.2 +1.1	2 + 1	17	23	98	100
LSD (0.05)				15	22	16	13

[z]Above ground fresh weights measured on July 31, 1987 and August 30, 1988.

[y]Grasses present in the test were barnyardgrass and goosegrass. Broadleaf weeds included common groundsel, purslane, redroot pigweed, and oxalis.

[x]Rates for premixes are given as kg/ha of each component; Snapshot DF (isoxaben + oryzalin), Snapshot TG (isoxaben + trifluralin), Scotts OH2 (oxyfluorfen + pendimethalin).

Table 3. Herbicide injury to field grown common lilac.

Herbicide	Rate (kg/ha)	Rate (lb/A)	Lilac quality ratings, by experiment and year[z] Ithaca 86–87 1986	Ithaca 86–87 1987	Ithaca 1987–1989 1988	Ithaca 1987–1989 June 89	Ithaca 1987–1989 July 89
None	—	—	80	93	73	88	85
Gallery	0.56	0.5	—	57	53	60	58
Gallery	1.1	1	63	62	63	65	53
Princep	1.1	1	90	83	83	88	100
Princep	2.2	2	—	—	48	50	78
Snapshot DF	0.56[y] +1.7	0.5 +1.5	—	43	40	50	43
Snapshot DF	1.1 +3.4	1 +3	—	48	50	75	65
LSD (0.05)			33	56	23	23	25

[z]Plant quality ratings were on a scale of 0 to 100 where 0 = dead plants and 100 = best growth in the test, regardless of treatment. The ratings were "blind"; i.e.: evaluator did not know the treatments, thus the handweeded does not always receive a 100% rating. Ratings presented are the late season (August or September) ratings except where noted. A dash (—) indicates that treatment was not included.

[y]Rates for Snapshot DF are in kg/ha of each component, isoxaben + oryzalin.

quefoil, rhododendron, or junipers tested (data not shown). Similarly, no injury was observed from Surflan, Snapshot 80DF, or Snapshot TG treatments. These results agree with those of Ahrens (4) who found no injury on field-grown *Rhododendron*. However, in that same test, injury was observed on field-grown cotoneaster with double doses of Snapshot 80DF (4). Scotts OH-2 reduced plantain lily fresh weight by 39% in 1987 and 60% in 1988, when compared to the handweeded plants (Table 2). No phytotoxicity was observed on the other species tested (data not shown). In previous work, granular formulations of oxyfluorfen and oxadiazon (Ronstar) have been shown to be injurious to plantain (3). Granular herbicides will often collect in the whorl of leaves, concentrating at the crown and causing injury. Therefore, it is particularly noteworthy that Gallery 1% G and Snapshot TG were safe on plantain lily. The latter formulation was only evaluated in 1988, and further experiments are needed to confirm its safety.

In the 1987 experiments, control of broadleaf weeds with Gallery was excellent (90 to 100%), but grass control was poor (58 to 65%) (Table 2). Surflan at 4.5 kg/ha (4 lb ai/A), Snapshot 80DF at 0.56 + 1.7 kg/ha (0.5 + 1.5 lb ai/A), and Scotts OH-2 at 2.2 + 1.1 kg/ha (2+1 lb ai/A) each provided excellent control of annual grasses and broadleaves. The grasses present were barnyardgrass and goosegrass. The broadleaf weeds included common purslane, redroot pigweed, common groundsel, and creeping woodsorrel. Insufficient weed populations were present in 1988 to provide reliable efficacy data.

Field grown nursery crops. Gallery at 0.56 or 1.1 kg/ha (0.5 or 1 lb ai/A) caused no injury to field-grown Japanese barberry, Douglas fir, white fir, sawara false cypress, 'San Jose' holly, honey locust California privet, Japanese rose, Japanese yew, or white pine (data not shown). Common lilac was the only species injured by Gallery.

In the 1986–1987 Ithaca experiment, quality ratings for

Table 4. Weed control in field grown woody nursery crops.

Test Identification	Rating Date	Gallery efficacy, by weed type & rate in kg/ha (lb/A): Annual Grasses 0.56 (0.5)	Annual Grasses 1.1 (1)	Annual Broadleaf 0.56 (0.5)	Annual Broadleaf 1.1 (1)	Snapshot DF[z] efficacy: Grasses	Snapshot DF[z] efficacy: Broadleaf	Weeds Present[y]: Grasses	Weeds Present[y]: Broadleaf
		(% control)							
Ithaca, NY 1986–87	9/16/86	—	63*	—	95	—	—	1	5, 6, 7
	7/17/87	65*	70*	84	100	100	99	1	5, 6
Ithaca, NY 1987–89	7/17/87	100	100	100	100	100	100	3	5, 6
	7/27/89	90*	100	99	100	100	100	3	5, 6
Riverhead, NY 1986–87	6/24/86	25**	52**	62**	95	95	100	1, 2	9
	6/29/87	93	95	85	90	100	100	2, 4	5, 8, 9
Riverhead, NY 1987–88	6/15/87	90*	90*	100	100	100	100	1, 4	5, 9, 10, 11, 12
	6/5/88	68*	95	95	98	100	98	4	9, 12

[z]Snapshot DF applied at 1.1 + 3.4 kg/ha (1 + 3 lb/A) of isoxaben + oryzalin.

[y]Weeds present at each rating; 1 = crabgrass, 2 = barnyardgrass, 3 = witchgrass, 4 = fall panicum, 5 = common groundsel, 6 = dandelion, 7 = pigweeds, 8 = common ragweed, 9 = Virginia pepperweed, 10 = common purslane, 11 = Pennsylvania smartweed, and 12 = horseweed.

*, **Means statistically different from the best weed control for each site and weed type at the 0.05 and 0.01 levels of probability respectively.

common lilac treated with Gallery were consistently lower than for hand weeded plants; but, statistically significant differences could not be identified (Table 3). In the 1988–1989 seasons, Gallery at 0.56 or 1.1 kg/ha (0.5 or 1 lb ai/A), alone or combined with Surflan in Snapshot 80DF, reduced common lilac growth and vigor (Table 3). In the same tests, Princep was safe at 1.1 kg/ha (1 lb ai/A) but reduced plant quality at 2.2 kg/ha (2 lb ai/A) (Table 3). The symptoms of injury were similar for both herbicides, consisting of foliar chlorosis and reduced vigor.

Douglas fir, 3-0 seedling transplants, were injured by Surflan at 2.2 and 4.5 kg/ha (2 and 4 lb ai/A), resulting in 50% and 70% reductions in plant quality, respectively (data not shown). Consequently, the Snapshot 80DF treatments were also injurious. In the first season of the Ithaca 1987–1989 test, white fir was also slightly injured (10 to 15% reduction in vigor) by Snapshot 80DF, but plants recovered and were not affected in the 1988 or 1989 seasons (data not presented).

Weed control is summarized in Table 4. In three out of four experiments, Gallery provided less annual grass control than did treatments containing Surflan. Gallery at 1.1 kg/ha (1 lb ai/A) was more effective on grasses than at 0.56 kg/ha (0.5 lb ai/A). Grasses present included large and smooth crabgrass, fall panicum, and witchgrass. At 0.56 kg/ha (0.5 lb ai/A), Gallery provided 62 to 100% control of summer annual broadleaf weeds (Table 4). At 1.1 kg/ha (1.0 lb ai/A), Gallery controlled ≥90% of the broadleaf weeds. Major broadleaf weeds present in these tests included common groundsel, dandelion, and pigweeds (redroot and Powell). Additionally, sporadic populations of common purslane, horseweed, Virginia pepperweed, Pennsylvania smartweed, and others were present. Snapshot 80DF consistently provided 94 to 100% control of grasses and broadleaf weeds.

(*Ed. Note*: This paper reports the results of research only, and does not imply registration of a pesticide under amended FIFRA. Before using any of the products mentioned in this research paper, be certain of their registration by appropriate state and/or federal authorities.)

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