Weed Control with Gallery and Other Herbicides in Field-Grown Nursery Crops[1]

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Abstract

Selected herbicides were evaluated for weed control in a two-year field test with boxwood, holly, viburnum and nandina. Gallery (isoxaben), when applied alone, generally provided inferior grass control during year one compared to Surflan (oryzalin). Surflan in combination with Gallery at 3.4 + 1.1 kg/ha (3.0 + 1.0 lb/A) provided weed control similar to that obtained with traditional herbicide programs of Surflan in combination with Princep (simazine) and/or Goal (oxyfluorfen). Plant size of four woody plant species, treated twice annually with Surflan + Gallery over a two year period, was statistically equivalent to the maximum plant size obtained with any other treatment.

Index words: Herbicides
Species used in this study: *Buxus microphylla* Siebold + Zucc. 'Koreana'; *Viburnum* × 'Chesapeake'; *Ilex aquifolium* × *l. cornuta*; and *Nandina domestica* Thumb.
Herbicides used in this study: Gallery (isoxaben) N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide; Surflan (oryzalin) 3,5-dintro-N^4,N^4-dipropylsulfanilamide; Goal (oxyfluorfen) 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene; Princep (simazine) 2-chloro-4,6-bis (ethylamino)-s-triazine.

Introduction

Achieving satisfactory weed control in field-grown nursery crops generally requires repeated applications of one or more herbicides. Three preemergence-applied herbicides that are commonly used in such programs include Surflan, Princep, and Goal. Surflan is a nonvolatile dinitroaniline herbicide that is typically applied to the soil surface to prevent weed seed germination, and is primarily active against small-seeded annual broadleaf and grass species. Princep, a triazine, is active primarily against broadleaf species. In previous work (9) with field-grown boxwood and photinia, tank mixtures of Surflan and Princep at rates of either 2.2 + 0.8 kg/ha (2.0 + 0.75 lb/A), or 3.4 + 1.0 kg/ha (3.0 + 1.0 lb/A), respectively, were non-injurious, yet provided a maximum degree of weed control. At the close of the three year study, growth indices were equal or superior to the hand weeded control. Several woody plants are not tolerant to Princep applications. Ryan et al. (7) reported that preemergence applications of Princep to roadside plantings at 6.7 kg/ha (6.0 lb/A) were injurious to California privet (*Ligustrum ovalifolium* Hassk.), staghorn sumac (*Rhus typhina* L.), 'Moonlight' broom (*Cytisus* × *praecox* Beam) and baltic ivy (*Hedera helix* L. 'Baltica'). Other plants sensitive to Princep are *Forsythia, Salix, Weigela, Philadelphus, Prunus* (1); and *Buxus, Euonymus*, and *Nandina* (4).

Another herbicide which has performed successfully in container and field grown nursery crops is Goal. Creager (5) evaluated Goal on seven species of container-grown nursery crops for full season weed control, phytotoxicity, and final plant size. Weed control of at least 75% was achieved when Goal was applied at the recommended or higher rates. No plant injury was evident even when applied at four times the recommended rate. Singh et al. (8) evaluated Goal at 1.1, 2.2, 4.5, and 9.0 kg/ha (1.0, 2.0, 4.0, and 8.0 lb/A) for weed control and phytotoxicity in container grown azaleas. While satisfactory weed control was obtained, azalea injury was evident even at the lowest rate evaluated. Annual applications of Goal 2G at 4.5 kg/ha (4.0 lb/A) provided 90% weed control in newly planted or established azaleas grown in raised beds (3, 6). However, the granular formulation of Goal is currently not marketed. The emulsifiable concentrate formulation of Goal has been reported to be injurious to woody nursery crops (3).

Goal use on nursery crop species is limited due to the limited number of species included in the registration, and the perception that this herbicide can be excessively injurious. In light of the perceived phytotoxicity, application of Goal is generally restricted to periods of dormancy.

Recently, Gallery, a new soil-active herbicide, has been introduced. Primary development interest has been in cereal grains. Corn, wheat, and barley have exhibited tolerance at rates up to 0.5 kg/ha (0.5 lb/A) (2). Most pertinent weeds (primarily broadleaves) were controlled at rates of 0.2 kg/ha (0.2 lb/A) or less. Gallery is also under development for use in nursery crops. Since both Goal and Princep may cause injury to certain field grown nursery crops, the availability of a safe broadleaf herbicide to a wide range of nursery crops would be advantageous. A two-year study was initiated to evaluate the efficacy and phytotoxicity of Gallery in nursery crop production, and to compare its performance to selected herbicide systems employed by commercial producers.

Materials and Methods

Uniform liners of boxwood (*Buxus microphylla*) Siebold + Zucc. 'Koreana'), holly (*Ilex* × 'Nellie R. Stevens'), *Nandina domestica* Thunb., and *Viburnum* × 'Chesapeake' were planted in a Hartsells fine sandy loam on March 26, 1986 at the Sand Mountain Substation, Crossville, Ala-

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bama. The test area was heavily infested with crabgrass [*Digitaria sanguinalis* (L.) Scop], redroot pigweed (*Amaranthus retroflexus* L.), entireleaf morningglory (*Ipomea hederacea* var. *integriuscula* Gray), and prickly sida (*Sida spinosa* L.). Plots were 4.6 × 5.5 m (15 × 18 ft) with plants spaced 0.9 × 1.1 m (3 × 3.6 ft). Fertilizer was applied preplant and in November the following year using a 13-5-11 granular fertilizer, resulting in an annual application of 67N-28P-55K kg/ha (60-25-49 lb/A). Ammonium nitrate was applied during May each year at the rate of 67 kg/ha (60 lb/A) N. Weed control treatments were replicated 4 times, with 6 plants per replicate in a randomized block design.

Initial herbicide treatments were applied over the top of the four species one day after planting on March 27, 1986. All treatments were applied again in July 1986 and March and July 1987.

Gallery was applied alone at 1.1 and 2.2 kg/ha (1.0 and 2.0 lb/A) (Table 1). Since Gallery is largely active against broadleaf weeds, it is reasonable to assume that tank mixing with Surflan would enhance the spectrum of weeds controlled, consequently two additional treatments (treatments 3 and 4) consisted of a tank mixture of Surflan + Gallery at 3.4 + 1.1 and 6.7 + 2.2 kg/ha (3.0 + 1.0 and 6.0 + 2.0 lb/A), respectively. Surflan was also applied at 4.5 kg/ha (4.0 lb/A) (treatment 5). The remaining treatments are representative of the herbicide programs commonly used for weed control in nursery crops. Treatments 6 and 7 utilized Princep and Goal, respectively, at 1.1 kg/ha (1.0 lb/A) in a tank mixture with Surflan at 3.4 kg/ha (3.0 lb/A), with the Surflan + Princep combination representing the industry standard in Alabama. Treatment 8 was a compromise between treatments 6 and 7 in that the first application utilized Surflan + Goal (Table 1), while the second application utilized Surflan + Princep. Treatment 9 was similar to treatment 8, however an additional application of Surflan (3.4 kg/ha) (3.0 lb/A) was made in November. Treatment 10 received no herbicides, but was hand weeded twice annually, i.e. at the time of the second herbicide application and end of the growing season. Treatment 11 was a nontreated and a nonweeded check.

Table 1. Description of herbicide treatments and rates (kg/ha) used to evaluate weed control in field-grown nursery crops.

Treatment number	Time of application		
	March	July	November
1	Gallery (1.1)	Gallery (1.1)	—
2	Gallery (2.2)	Gallery (2.2)	—
3	Gallery (1.1) + Surflan (3.4)	Gallery (1.1) + Surflan (3.4)	—
4	Gallery (2.2) + Surflan (6.7)	Gallery (2.2) + Surflan (6.7)	—
5	Surflan (4.5)	Surflan (4.5)	—
6	Surflan (3.4) + Princep (1.1)	Surflan (3.4) + Princep (1.1)	—
7	Surflan (3.4) + Goal (1.1)	Surflan (3.4) + Goal (1.1)	—
8	Surflan (3.4) + Goal (1.1)	Surflan (3.4) + Princep (1.1)	—
9	Surflan (3.4) + Goal (1.1)	Surflan (3.4) + Princep (1.1)	Surflan (3.4)
10	Hand weeded	Hand weeded	—
11	Nontreated		

All herbicides were applied with a tractor-mounted, compressed-air sprayer operating at 32 psi in 140 l/ha (15 gal/A) of water. Data collected included crop injury and weed control ratings, hand hoeing times and growth indices. Weed control ratings and fresh weed weight (grasses and broadleaves) were taken in mid-July, just prior to the second application; plots were uniformly weed free prior to the second application. Ratings were also taken in late August. The average time reequired to hand-hoe each treatment, as well as the fresh weights for grass and broadleaf weeds were determined in early September. Also at this time the growth index [(height + width + width)/3] was determined for each species. All data were subjected to analyses of variance, and the treatment means separated by Duncan's multiple range test at the 5% level of probability.

Results and Discussion

Weed control—grasses. At 2 months after the initial treatment in 1986, Gallery used alone provided 64 and 79% grass control for the 1.1 and 2.2 kg/ha (1.0 and 2.0 lb/A) rates, respectively (Table 2). In contrast to this, Surflan provided 94% visual control. Any herbicide combination that included Surflan provided comparable control and equally low weed weights. At the close of the first season, minimal grass weights were provided by the Gallery + Surflan treatments (treatments 3 and 4); as well as by treatment 7 and 9. In terms of visual control of grasses all herbicide-based treatments except Gallery at the low rate provided equivalent maximum level of control. During the following year (1987—Table 3), at both the early and late season evaluations, all treatments consistently provided 100% control with nearly nil fresh weed weight being produced. The marked reduction in the presence of grasses between the first and second year can in part be attributed to increased competition and ground shading exhibited by the crop during the second year. The treatment that utilized only hand weeding (treatment 11) had significantly lower grass control than the other treatments, yet superior to the untreated control (treatment 12).

Broadleaf weeds. Within the first year and at the first rating, Gallery used alone at the low rate [1.1 kg/ha (1.0 lb/A)] provided only fair (61%) control (Table 2). The higher rate used alone [2.2 kg/ha (2.0 lb/A)] provided 76% control. Surflan either at 4.5 kg/ha (4.0 lb/A) (treatment 5), or in combination with Princep (treatment 6) provided at least 78% control. In contrast to this, Surflan + Goal (treatments 7, 8, and 9) provided at least 86% control. This maximum level of control was also provided by Surflan + Gallery (3.4 + 1.1 kg/ha) (3.0 + 1.0 lb/A). Doubling the rates (treatment 4) increased control by only a modest amount to 93%; the highest numerical level obtained. In terms of weed weights, maximum control was provided by treatment 7 and 8, both of which contained Surflan + Goal. All the remaining treatments provided various degrees of lesser control.

After reapplication, combination of either Surflan + Goal (treatments 7, 8, and 9) or Surflan + Gallery (treatments 3 and 4) provided a maximum degree of visual control. In terms of weed weight, the Surflan + Goal combination (treatment 7) provided complete control.

Table 2. Visual weed control, weed weight and hoeing time as influenced by herbicide application, 1986.

	Grasses				Broadleaf weeds				Hoeing time
	7/15	7/16	8/28	9/08	7/15	7/16	8/28	9/08	(9/08)
Treatment number	Visual control	Fresh weight	Visual control	Fresh weight	Visual control	Fresh weight	Visual control	Fresh weight	Time
	(%)	(kg/100 m^2)	(%)	(kg/100 m^2)	(%)	(kg/100 m^2)	(%)	(kg/100 m^2)	(min/100 m^2)
1	64c[z]	16.1c	89b	2.1b	61d	15.9c	76b	2.5c	15.2c
2	79b	12.0bc	98ab	1.8b	76c	14.1c	83b	0.9b	7.0bc
3	98a	1.2ab	99a	0.2ab	88ab	15.9c	86ab	0.9b	4.7ab
4	98a	0.7a	100a	0.0a	93a	3.6b	91ab	0.5a	2.1a
5	94a	0.8a	98ab	1.3b	79bc	19.0c	84b	0.7ab	5.0b
6	86ab	1.9ab	96ab	1.1b	78c	18.8c	91ab	0.4a	5.2b
7	85ab	2.6ab	97ab	0.7ab	88ab	0.7ab	100a	0.0a	1.2a
8	84ab	2.5ab	99a	2.0b	86ab	0.2a	85ab	0.5a	5.6bc
9	86ab	2.2ab	100a	0.5ab	89a	1.1b	88ab	1.1bc	4.6a
10	0d	32.4e	57c	21.8c	100a	67.5e	25c	4.1c	26.9c
11	0d	—	0d	112.4d	0e	—	0d	21.9e	144.7e

[z]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level as determined by Duncan's multiple range test.

During the second year, visual weed control ratings taken prior to reapplication indicated that all Surflan combinations (treatments 3 thru 9, except 5) provided a maximum degree of control (>85%); Surflan alone (treatment 5) was only slightly less effective (79%). A similar, though not identical trend was evident with the weed weights. Gallery by itself provided consistently inferior control; yet a rate response (not significant) was evident. Gallery in combination with Surflan provided control that was indistinguishable from the best performing treatments. After reapplication, all treatments except Gallery at the low rate, provided the maximum level of control.

The superior performance of the Surflan + Goal treatment was reflected in the least hoeing times during the first year of the study (1.2 min/100 m^2—Table 2). In contrast to this, Gallery when used alone had relatively longer hoeing times, 15.2 and 7.0 min/100 m^2 for the 1.1 and 2.2 kg/ha (1.0 and 2.0 lb/A) rates, respectively. This, however was expected since Gallery provides limited grass control. The higher rate of the Gallery + Surflan combination (treatment 4) resulted in a hoeing time (7.1 min/100 m^2) which was statistically equivalent to that of the Surflan + Goal combination. The remaining treatments which utilized Surflan or other Surflan combinations had intermediate hoeing times. During 1987, hoeing time averaged 1.1 min/100 m^2 among the herbicide treatments (except Gallery at the low rate); no differences between individual treatments were evident. The 'hoeing' treatment and the untreated control had considerably greater hoeing times.

Crop response. None of the treatments (including those containing Goal) resulted in any visual crop injury across

Table 3. Visual weed control, weed weight, and hoeing times as influenced by herbicide application, 1987.

	Grasses				Broadleaf weeds				Hoeing time
	7/1	7/2	8/27	9/30	7/1	7/2	8/27	9/30	9/30
Treatment number	Visual control	Fresh weight	Visual control	Fresh weight	Visual control	Fresh weight	Visual control	Fresh weight	Time
	(%)	(kg/100 m^2)	(%)	(kg/100 m^2)	(%)	(kg/100 m^2)	(%)	(kg/100 m^2)	(min/100 m^2)
1	100a[z]	0.0a	100a	0.0a	48c	15.0bc	89a	1.2ab	3.6b
2	100a	0.0a	100a	0.0a	64bc	17.9c	95a	0.5a	1.6a
3	100a	0.0a	100a	0.0a	89a	4.5ab	99a	0.2a	1.2a
4	100a	0.0a	100a	0.0a	96a	2.5a	100a	0.0a	0.8a
5	100a	0.0a	100a	0.0a	79ab	13.8bc	100a	0.7ab	1.2a
6	100a	0.0a	100a	0.2a	90a	7.0ab	100a	0.2a	0.8a
7	100a	0.0a	100a	0.7a	90a	6.3ab	97a	0.2a	1.5a
8	100a	0.0a	100a	0.0a	85a	7.7ab	100a	0.2a	0.8a
9	100a	0.0a	100a	0.0a	96a	2.2a	100a	0.2a	1.2a
10	8b	—	43b	30.4b	13d	—	66b	4.3b	30.1c
11	23b	45.8b	0c	39.2b	0e	48.9	0c	13.4c	34.4c

[z]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level as determined by Duncan's multiple range test.

all species and both years (data not shown). Growth indices for nandina averaged 54 cm (21.3 in.) in 1985, and 76 cm in 1986, with no treatment differences detected (Table 4). This indicates that nandina is sufficiently vigorous so as not to be influenced by the differential weed control produced by the treatments, and/or none of the herbicide treatments were injurious to nandina. In 1986, all remaining treatments except Gallery alone at the 2.2 kg/ha (2.0 lb/A) rate (treatment 2), hoeing treatment and untreated plants, provided statistically comparable growth indices for boxwood. The following year, all Surflan-containing combinations provided statistically comparable growth indices. With 'Nellie R. Stevens' holly, Surflan alone or in all combinations provided statistically comparable growth indices. Gallery alone followed by the hoeing treatment and the nontreated treatment resulted in progressively lower growth indices. A similar pattern was evident in 1987, except that Gallery (low rate treatment) and Gallery + Surflan (high rate, treatment 4) provided lower growth indices than some of the other treatments.

All herbicide-based treatments provided comparable growth indices of 'Chesapeake' viburnum (average = 33 cm, 13.0 in.) during the initial year of the experiment. No differences in growth indices was detected between any treatment in 1987 (average = 65 cm, 25.6 in.). It is interesting to note that across all species the application of Goal during July did not result in phytotoxicity or suppressed growth indices. This would not have been expected in light of previous research. This may in part be attributable to the semi dormant state that plants enter into during this environmentally stressful period of the year.

Significance to the Nursery Industry

These results indicate that Gallery in combination with Surflan has potential for use as a preemergence applied herbicide in field-grown nursery crops. While weed control obtained from this herbicide was no better than that obtained from existing herbicide programs, satisfactory crop tolerance may allow its use where Princep and Goal combinations cannot be safely used. Further testing is necessary on sensitive nursery crop species with respect to Gallery tolerance.

(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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Table 4. Growth indices as influenced by herbicide system, 1986 and 1987.

Treatment number	Korean Boxwood		Nandina		'Nellie R. Stevens' Holly		'Chesapeake' Viburnum	
	1986	1987	1986	1987	1986	1987	1986	1987
	(growth index)[z]							
1	19ab[y]	37bc	50a	76a	20bc	52cd	29ab	66a
2	18bc	37bc	52a	76a	19bc	56abc	32ab	67a
3	19ab	39abc	53a	76a	23ab	67ab	29ab	68a
4	23a	42ab	59a	78a	21abc	53bcd	34a	68a
5	22ab	44ab	51a	76a	23ab	63abc	32ab	68a
6	20ab	47a	58a	73a	24ab	63abc	36a	59a
7	22ab	41ab	52a	75a	25ab	69a	34a	68a
8	20ab	39abc	53a	75a	27a	66abc	32ab	69a
9	21ab	42ab	55a	75a	23ab	69a	36a	56a
10	15cd	30d	37b	58b	16cd	47d	26bc	56a
11	13d	23d	28c	41c	12d	26e	20c	58a

[z]Growth index = (height + width 1 + width 2)/3.

[y]Mean separation within columns followed by the same letter or letters are not significantly different at the 5% level as determined by Duncan's multiple range test.