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Effects of Gallery Applied at Different Growth Stages to Dwarf Burning Bush (*Euonymus alatus* 'Compacta')[1]

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Abstract

The effect of Gallery application timing on dwarf burning bush tolerance was determined in field trials. Gallery was applied foliarly at 0.84, 1.69 and 3.39 kg ai/ha (0.75, 1.5 and 3 lb ai/A) to dwarf burning bush at different growth stages. Gallery applied at the dormant stage and two months after bud-break did not injure dwarf burning bush. Plants treated one month after bud-break with all three rates were injured approximately 30 to 45% at one and three months after herbicide application. Injury symptoms were manifested as decreased leaf size and leaf distortions. Gallery applied at 0.84 and 1.69 kg/ha (0.75 and 1.5 lb/A) one month after bud-break decreased plant width. Shoot-dieback was also observed in plants treated with Gallery at all rates one month after bud-break. Gallery at all three rates applied one month after bud-break caused 60 to 75% of the leaves to defoliate six weeks earlier in the fall compared to the other application timings.

Index words: herbicide tolerance, growth stages.

Species used in this study: dwarf burning bush (*Euonymus alatus* (Thunb.) Sieb. 'Compacta').

Herbicides used in this study: Casoron (dichlobenil), 2,6 dichlorobenzonitrile; Gallery (isoxaben), N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl] 2,6-dimethoxybenzamide.

Significance to the Nursery Industry

The timing of herbicide application relative to the growth stage of nursery crops can affect plant tolerance. Gallery applied one month after budbreak injured dwarf burning bush but not when applied during dormancy or two months after budbreak. Nurserymen should use caution when using Gallery on areas adjacent to dwarf burning bush soon after budbreak.

Introduction

Plant tolerance to herbicides is an important factor in the selection of herbicides by nurserymen. Gallery (isoxaben), a selective preemergence herbicide, has been evaluated for broadleaf weed control in ornamentals, turf, landscape plantings, small grains and in orchard crops (1, 2, 7). Gallery is an alternative preemergent herbicide to Princep (simazine) use in nursery crops because of their similar weed control spectrum (10).

A desirable characteristic of Gallery is the high degree of safety it exhibits for most nursery species (9, 11). However, over-the-top spray applications of Gallery may be phytotoxic to certain nursery crops (4, 6, 8). Jacobsen and Walls (8) reported that Gallery induced foliar injury on iceplant (*Mesembryanthemum crystallinum* L.), gazania (*Gazania rigens* L.) and English ivy (*Hedera helix* L.). Derr and Salihu (4) reported that Gallery applied at 1.12 kg/ha (1 lb/A) reduced new root growth of Japanese holly (*Ilex crenata* Thunb. 'Helleri') after one application and the shoot growth of azalea (*Rhododendron obtusum* Planch. 'Tradition') after three repeat applications.

Studies with deciduous trees have shown that the season of herbicide application greatly affects the amount of injury observed with certain herbicides (3, 12, 14). Neal and Skroch (12) found no injury from spring application of Roundup (glyphosate) to wax leaf privet (*Ligustrum japonicum* Thunb.). Injury to woody nursery crops could be minimized or avoided by adjusting the timing of herbicide application. Dwarf burning bush is injured by Gallery applications (1). However, the growth stage at which it is most injurious to the plant has not been documented yet. Therefore, this experiment was conducted to determine the effect of Gallery application timing on dwarf burning bush tolerance.

Materials and Methods

A field experiment was conducted at a commercial nursery in Waynesboro, VA. The soil type was a Frederick silt loam (clayey, kaolinitic, mesic, Typic Paleudult) with a pH of 6.0 and an organic matter level of 2.6%. The experimental design was a randomized complete block with a factorial arrangement of treatments replicated four times. The two factors were growth stages of dwarf burning bush (application timings) and herbicide rates. The first study included five plants per plot and the second study had three plants per plot. Treatments were applied at three growth stages of dwarf burning bush: when dormant, one month after bud-break [leaves were 2.5 to 3 cm (1 to 1.2 in) long] and two months after bud-break [leaves were 7 to 8 cm (2.8 to 3.1 in long)]. A 75% dry flowable formulation of Gallery was applied at 0.84, 1.69 and 3.39 kg ai/ha (0.75, 1.5 and 3 lb ai/A). These rates correspond to the common use rate, twice and four times the common use rate. A 50% wettable powder formulation of Casoron was applied at 4.48 kg ai/ha (4 lb ai/A) as a comparison herbicide treatment since it is known to possess a similar mode of action as Gallery (5). Herbicides were applied over the top of plants using a CO_2-pressurized backpack sprayer at 2178 gm/cm^2 (30 psi), delivering 230 L/ha (25 gal/A) with 8003 nozzles. The herbicide application information and prevailing environmental conditions are pre-

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Table 1. Herbicide application dates and weather conditions for the field studies.

	Study I	Study II
1st herbicide application	March 14, 1995	March 14, 1996
1st rainfall	March 21, 1995 (0.3 cm)	March 16, 1996 (0.28 cm)
Air temperature	21C	16C
Wind speed	0–8 kmph	0–8 kmph
Cloud cover	3%	80%
2nd herbicide application	April 26, 1995	April 25, 1996
1st rainfall	April 30, 1995 (0.3 cm)	April 27, 1996 (0.1 cm)
Air temperature	24C	21C
Wind speed	0–8 kmph	8–16 kmph
Cloud cover	0%	50%
3rd herbicide application	June 4, 1995	June 25, 1996
1st rainfall	June 11, 1995 (3.3 cm)	July 3, 1996 (0.53 cm)
Air temperature	27C	31C
Wind speed	0–8 kmph	0–8 kmph
Cloud cover	50%	5%

sented in Table 1. The plants in the study were one year old and were spaced 120 × 90 cm (3 × 4 feet) apart. The experiment was repeated in 1996. Plants treated in 1995 and 1996 were evaluated for injury symptoms in 1996 and 1997, respectively. This evaluation was to determine if any injury persisted into subsequent growing seasons.

Data collected include injury ratings at three different time periods, height and width measurements and percent premature defoliation. Percent injury and defoliation data were transformed using arcsine transformation before performing statistical analysis. Data were subjected to factorial analysis of variance with mean separation using the least significant difference at P = 0.05 level. Results from the Gallery treatments were subjected to regression. Year to year differences were insignificant after performing a test of homogeneity of variance, hence data from the two years were averaged.

Results and Discussion

Dwarf burning bush injury did not increase with increasing Gallery rate as no significant linear or quadratic regression was observed. Gallery application rates also did not impact the other growth measurements recorded. However, a herbicide by application timing effect was observed, based on a significant interaction in the analysis of variance (Table 2). No rate of Gallery applied at the dormant stage or at two months after bud-break injured dwarf burning bush when compared to untreated plants. Times of tolerance and amount of injury depends on the herbicide and species. Species like ajuga and azalea were injured at all application timings of Roundup, but wax leaf privet showed maximal injury from spring applications (12). Gallery did not inhibit the initiation of new leaves after the dormant stage application nor were the emerging leaves affected (data not shown). Plants treated one month after bud-break were injured about 35% when evaluated in June regardless of the Gallery rate. Injury symptoms were noticeable even at four months after treatment from this application timing. Casoron did not cause any injury to dwarf burning bush at any stage of application.

The injury symptoms observed following Gallery application at the leaf emergence stage were curling of the leaves and smaller leaf size compared to untreated plants. Downward bending of the stems and shoot dieback were also noticed in these injured plants at five months after treatment (Fig. 1). These injury symptoms were similar to those reported by Jacobsen and Walls in certain ornamentals (8). They

Table 2. Effect of Gallery and Casoron applied at three different growth stages of field-grown dwarf burning bush, averaged over two years.

	Percent Injury[z]								
	June			July			August		
	Growth stage			Growth stage			Growth stage		
Herbicide rates (kg ai/ha)	Dormant	1MAB[y]	2MAB[x]	Dormant	1MAB	2MAB	Dormant	1MAB	2MAB
Gallery 0.8	5a[w]	32b	—[v]	5a	37b	7a	6a	37b	5a
Gallery 1.7	8a	34b	—	4a	41b	5a	5a	42b	9a
Gallery 3.4	1a	36b	—	2a	43b	6a	2a	45b	4a
Casoron 4.5	4a	6a	—	2a	5a	7a	5a	5a	12a

[z]Percent injury was rated on a scale of 0 to 100 (0 = no injury, 100 = dead).

[y]One month after bud-break stage.

[x]Two months after bud-break stage.

[w]Means followed by the same letter within a rating period in a row are not significantly different from each other.

[v]These plants were not yet treated.

observed bronzing of leaves, curled leaves and meristematic shoot death in actively growing plants injured by Gallery. Growth stage appears to be important in the tolerance of dwarf burning bush to Gallery.

The main as well as the interaction effects were not significant for dwarf burning bush height (data not shown). However, the interaction effect of herbicide by application timing was significant for plant width and premature defoliation (Table 3). Gallery applied at all rates, one month after bud-break reduced plant width when measured in August. Shoot dieback following applications made at one month after budbreak were not readily apparent until September. Casoron did not cause reductions in growth of dwarf burning bush at any stage of application.

Premature defoliation of dwarf burning bush plants was observed in plants treated with Gallery one month after bud-break (Table 3). However, Gallery applied at the dormant or two months after bud-break stages did not cause premature defoliation. Applications of glyphosate made early in the season or late in the season results in less peach fruit damage (14). Casoron did not cause premature defoliation when applied at any growth stage. After one year, no injury was observed in the plants treated with Gallery one month after bud-break.

It was determined from this study that dwarf burning bush was tolerant to Gallery applications at the dormant stage and at two months after bud-break. This suggests that either absorption or transport of the herbicide to the site of action is reduced during these tolerant periods. Tolerance to applications made 2 months after bud-break could also possibly be due to a thicker leaf cuticle at this stage as compared to thinner leaf cuticle at one month after bud-break. Tolerance of cranberry (*Vaccinium macrocarpon* Ait.), to clopyralid decreased when applications were made during early shoot growth as compared to applications made to mature shoot tissue (13). In cranberry the actively dividing cells are most susceptible to herbicide application.

Dwarf burning bush was most susceptible to damage from Gallery when applications were made within a few weeks after bud-break. Dwarf burning bush injured by Gallery exhibited distorted leaves, shoot dieback, and premature leaf drop. Only the current season's growth was affected, since no injury was observed one year after application. However, an economic loss would occur with applications made one month after budbreak, due to losing one year's growth. Avoiding Gallery applications to fields adjacent to actively-growing dwarf burning bush may reduce the potential for injury from spray drift. Additional research is needed on the potential for Gallery use in dormant stands of dwarf burning bush and to determine the minimum rate of Gallery that would cause injury to dwarf burning bush.

Fig. 1. Injury in dwarf burning bush from Gallery applied one month after bud-break.

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Table 3. Effect of Gallery and Casoron applied at three different timings on width in August and premature defoliation of dwarf burning bush in September

Herbicides (kg ai/ha)	Width (cm)			Premature defoliation (%)[z]		
	Growth stage			Growth Stage		
	Dormant	1MAB[y]	2MAB[x]	Dormant	1MAB	2MAB
Gallery 0.8	73ab[w]	70b	85a	5b	75a	12b
Gallery 1.7	85a	70b	88a	2b	68a	8b
Gallery 3.4	85a	61b	88a	10b	60a	7b
Casoron 4.5	75b	93a	90ab	10a	5a	8a

[z]Percent premature defoliation was rated on a scale of 0 to 100 (0 = no defoliation, 100 = complete defoliation).

[y]One month after bud-break stage.

[x]Two months after bud-break stage.

[w]Means followed by the same letter in a row are not significantly different from each other for each parameter.

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