Effect of Prodiamine and Oxadiazon on Growth of Bedding Plants and Ground Covers[1]

Janet C. Henderson-Cole[2] and Michael A. Schnelle[2]
Department of Horticulture and Landscape Architecture
Oklahoma State University
Stillwater, OK 74078

Abstract

Four bedding plant species, rose periwinkle, petunia, geranium, and scarlet salvia; four ground cover cultivars, golden Japanese barberry, common periwinkle, Bowles periwinkle, and greater periwinkle; and pots seeded with two weed species, crabgrass or pigweed were sprayed with 0, 1.1 or 4.5 kg ai/ha (0, 1.0 or 4.0 lb/A) prodiamine (Barricade) or 2.2 kg ai/ha (2.0 lb/A) oxadiazon (Ronstar). Heights or dry weights or both of all bedding plant species decreased linearly with increasing prodiamine (Barricade) application rates. Ground covers were not affected by oxadiazon (Ronstar) or prodiamine (Barricade) except for a reduction in root dry weight of common periwinkle with prodiamine (Barricade) applications. Crabgrass and pigweed were completely controlled by prodiamine (Barricade) throughout the growing season, but oxadiazon (Ronstar) lost its effectiveness after three months.

Index words: herbicides, annuals, ground covers, phytotoxicity

Herbicides used in this study: Barricade (prodiamine) [2-4-dinitro-N^3,N^3,-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine]; Ronstar (oxadiazon) {3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3 *H*)-one}.

Weed species used in this study: large crabgrass (*Digitaria sanguinalis* (L.) Scop.); redroot pigweed (*Amaranthus retroflexus* L.).

Species used in this study: rose periwinkle (*Catharanthus roseus* (L.) G. Don 'Bright Eye'); petunia (*Petunia* × *hybrida* Hort. Vilm.-Andr. 'Celebrity Mix'); geranium (*Pelargonium* × *hortorum* L.H. Bailey 'Orbit Red'); scarlet salvia (*Salvia splendens* F. Sellow ex Roem. & Schult. 'Top Red'); golden Japanese barberry (*Berberis Thunbergii* DC. 'Aurea'); common periwinkle (*Vinca minor* L.); Bowles periwinkle (*Vinca minor* L. 'Bowles'); greater periwinkle (*Vinca major* L.).

Significance to the Nursery Industry

Increasing labor costs have forced nursery and landscape managers to reevaluate common landscape maintenance practices to reduce costs. Chemical weed control can decrease labor costs by reducing the need to hire people for the tedious task of removing weeds from pots or planting beds. The preemergence herbicide oxadiazon (Ronstar) is currently widely used in the nursery industry and has been proven safe on a diverse group of woody species; however, additional preemergent herbicides labelled for use on herbaceous and woody landscape plants would be helpful to expand the weed control spectrum. In addition, preemergent herbicides which control weeds for longer time periods are needed to assure weed suppression throughout a growing season. Prodiamine (Barricade) has been recently labelled for use on turf, but its effect on woody and herbaceous ornamental species is not well documented. While prodiamine (Barricade) had little effect on woody species in this study, it reduced growth of the herbaceous plants. These results suggest that care must be used when applying prodiamine (Barricade) near herbaceous plants to avoid damage.

Introduction

The diversity of plants in nurseries and landscapes makes chemical weed control risky since a given chemical may have no effect on one species while damaging another. Prodiamine (Barricade) is effective in controlling annual grasses and broadleaf weeds in turfgrasses and landscape plants (2, 3, 5). It has recently been labelled for use on turf and has had no effect on several woody species (4, 7) but damaged others, particularly at higher rates (7, 8). The objectives of this study were to determine whether phytotoxicity from prodiamine (Barricade) would occur on a variety of herbaceous landscape species and perennial ground covers when compared to oxadiazon (Ronstar), and to determine the effect of prodiamine (Barricade) and oxadiazon (Ronstar) on control of crabgrass and pigweed.

Materials and Methods

Greenhouse study. Seeds of rose periwinkle, petunia, geranium and scarlet salvia were sown in a peat:perlite mix (1:1 by vol) and transplanted to 13.3 × 13.3 × 5.9 cm (5.3 × 5.3 × 2.3 in) plastic six packs at the first true leaf stage. Seedlings were subsequently transplanted and grown for six weeks in Fafard Growing Mix no. 2 (Conrad Fafard, Springfield, MA). Plants were watered as needed and received constant fertilization with 300 mg/L (0.04 oz/gal) of 20N-4.3P-16.6K (20-10-20). The seedlings were maintained at 28 ± 4°C (82 ± 7°F) and 18 ± 2°C (64 ± 3°F) day and night temperatures, respectively.

After six weeks, plants were treated with prodiamine (Barricade) at 0, 1.1 and 4.5 kg ai/ha (0, 1.0 and 4.0 lb/A) (0, 1 or 4 times the label rate) or oxadiazon (Ronstar) at 2.2 kg/ha (2.0 lb/A) (label rate). Prodiamine (Barricade) was applied with a CO_2 pressurized backpack sprayer with an output of 0.2 L/m^2 (213 gal/A), while granular oxadiazon (Ronstar) was spread over the medium surface. Plants were not irrigated for 24 hr after treatment to expose plants to the chemicals for an extended time comparable to what they

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[2]Assistant Professor.

might receive in a landscape application. Two weeks after treatment, plant heights from the soil surface to the apex of the terminal leaf were measured. Plant shoots were harvested, dried at 45°C (113°F) for 72 hr and weighed. This experiment was first conducted during the spring and repeated twice during the fall of 1990.

Nursery study. Forty rooted cuttings of golden Japanese barberry, common periwinkle, Bowles periwinkle and greater periwinkle were planted May 21, 1990 in 3.8 L (1 gal) containers in composted pine bark:sand (4:1 by vol) amended with 4.3 kg/m^3 (8.9 lb/yd^3) 17N-3.6P-10K (17-7-12) slow release fertilizer, 0.9 kg/m^3 (1.5 lb/yd^3) Micromax, 2.3 kg/m^3 (4.0 lb/yd^3) dolomite and 2.3 kg/m^3 (4.0 lb/yd^3) gypsum. Plants received the herbicide treatments described above 24 hr after planting and were not irrigated for 24 hr after treatment. Plants were harvested October 1, 1990. Shoots and washed roots were separated and dried at 45°C (113°F) for seven days.

In a concurrent study, 3.8 L (1 gal) pots containing the bark medium previously described were seeded with 50 seeds of large crabgrass or redroot pigweed to determine herbicide efficacy. Pots were treated with prodiamine (Barricade) and oxadiazon (Ronstar) as described above and observed periodically for seed germination and growth.

Statistics. A randomized complete block design with ten single plant replications and four treatments was used for all studies. Analysis of variance and paired *t* tests were used to determine differences among oxadiazon (Ronstar) and prodiamine (Barricade) treatments. Linear regression was used to determine linear and quadratic relationships among prodiamine (Barricade) application rates.

Results and Discussion

Greenhouse study. Results of the three experiments in the greenhouse were similar, therefore, only data for the final study are presented. All bedding plants treated with prodiamine (Barricade), except petunia, were shorter than those treated with oxadiazon (Ronstar) (Table 1). Rose periwinkle and geranium were shorter regardless of prodiamine (Barricade) application rate compared to oxadiazon (Ronstar). Flowers of rose periwinkle were visibly reduced in quantity and quality with both prodiamine (Barricade) application rates (data not shown). Plants of rose periwinkle and geranium treated with prodiamine (Barricade) were slightly chlorotic even at the low application rate. Prodiamine (Barricade) at 4.5 kg ai/ha (4.0 lb/ha) reduced shoot dry weight of rose periwinkle and petunia in comparison to oxadiazon (Ronstar). Plant height of rose periwinkle, geranium and scarlet salvia, and shoot dry weight of rose periwinkle, petunia and geranium decreased linearly with increasing prodiamine (Barricade) concentrations (Table 1).

Nursery study. Of the woody species tested, only the Bowles periwinkle treated with prodiamine (Barricade) was smaller than that treated with oxadiazon (Ronstar) (Table 2). This decrease in size, however, was not due to prodiamine (Barricade) since the untreated control (prodiamine (Barricade), 0 kg ai/ha, 0 lb/A) plants were also smaller than the oxadiazon (Ronstar)-treated plants. Prodiamine (Barri-

Table 1. Influence of oxadiazon (Ronstar) and prodiamine (Barricade) on height and shoot dry weight of rose periwinkle, petunia, geranium and scarlet salvia.

			Rose periwinkle		Petunia		Geranium		Scarlet salvia	
	Rate									
Treatment	(kg ai/ha)	(lb ai/A)	Height (cm)	Shoot dry weight (g)	Height (cm)	Shoot dry weight (g)	Height (cm)	Shoot dry weight (g)	Height (cm)	Shoot dry weight (g)
Oxadiazon	2.2	2.0	13.3	9.9	15.1	15.7	15.4	3.4	17.0	3.9
Prodiamine	0.0	0.0	13.5	9.2	14.3*	15.5	15.9	4.3	16.9	3.4
	1.1	1.0	12.4**[z]	9.8	14.7	15.1	14.4**	3.6	16.8	3.2
	4.5	4.0	10.6**	7.6*	14.6	13.0**	14.1**	3.3	15.7**	3.2
Linear			**	*	NS	*	**	*	**	NS
Quadratic			NS	NS	NS	NS	*	NS	NS	NS

[z]Nonsignificant or significant at P = 0.05 or 0.01 relative to oxadiazon (Ronstar) treatment or in respect to linear or quadratic responses.

Table 2. Influence of oxadiazon (Ronstar) and prodiamine (Barricade) on height and shoot dry weight of golden Japanese barberry, common periwinkle, Bowles periwinkle and greater periwinkle.

			Golden Japanese barberry		Common periwinkle		Bowles periwinkle		Greater periwinkle	
	Rate									
Treatment	(kg ai/ha)	(lb ai/A)	Height (cm)	Shoot dry weight (g)	Height (cm)	Shoot dry weight (g)	Height (cm)	Shoot dry weight (g)	Height (cm)	Shoot dry weight (g)
Oxadiazon	2.2	2.0	2.2	3.0	17.0	28.6	14.6	44.3	36.8	72.0
Prodiamine	0.0	0.0	2.1	3.2	18.2	49.0	9.9*	16.8	33.4	76.0
	1.1	1.0	1.8	2.2	12.1	19.1	9.2*	8.5*	37.2	55.9
	4.5	4.0	1.3	2.4	12.2	12.0	5.9*	5.0*	34.2	53.4
Linear			NS[z]	NS	NS	*	NS	NS	NS	NS
Quadratic			NS	NS	NS	NS	NS	NS	NS	NS

[z]Nonsignificant or significant at P = 0.05 relative to oxadiazon (Ronstar) treatment or in respect to linear or quadratic responses.

cade) application rate had no significant effect on shoot or root dry weight of any ground cover except common periwinkle, in which root dry weight decreased linearly with increasing prodiamine (Barricade) rate. There was, however, a tendency for shoot dry weights to be smaller in prodiamine (Barricade)-treated plants than in the untreated controls. There were no visible phytotoxicity symptoms on any woody species evaluated.

Prodiamine (Barricade) provided 100 percent control of crabgrass and pigweed at both 1.1 and 4.5 kg ai/ha (1.0 and 4.0 lb/A) throughout the growing season and into a second growing season. Weed control with oxadiazon (Ronstar), however, declined after three months.

Oxadiazon (Ronstar) is widely used for weed control in the container nursery industry, and provides effective control of many weed species with minimal phytotoxicity to most landscape species (1, 6). Weed control is decreased toward the end of the growing season. Prodiamine (Barricade) is also effective in controlling a large number of weed species (2, 3, 5), but its effect on woody and herbaceous landscape plants has not been as widely evaluated. Prodiamine (Barricade) is safe for use on golden Japanese barberry and several woody periwinkle cultivars. Prodiamine (Barricade) reduced plant height or shoot dry weight or both in rose periwinkle, petunia, geranium and scarlet salvia; therefore, it should not be used on these species at these rates.

(*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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