Response of *Dianthus barbatus* L. To Preemergence Herbicides[1]

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Abstract

Six different preemergence herbicides including one herbicide combination were applied to container-grown *Dianthus barbatus* L. (Sweet William) and evaluated for their effects on weed control, plant growth and phytotoxicity. Napropamide (Devrinol 10G), oryzalin (Surflan 40.4% AS), oxyfluorfen + oryzalin (Rout GS-3G), oxadiazon (Ronstar 2G), metolachlor (Dual 8EC), simazine (Princep 4G) and Dual and Princep were applied to container-grown Sweet William and studied for a growing season. Weed seeds sown were yellow foxtail, annual bluegrass, common groundsel, common chickweed, and creeping woodsorrel. Devrinol, Surflan, and Rout GS resulted in the best weed control without affecting the overall growth of Sweet Wiliam or resulting in any phytotoxicity at rates applied. Dual and Princep resulted in phytotoxicity at all rates applied on Sweet William to a degree that would make the plants unsalable.

Index words: Herbicides, herbaceous perennials, *Dianthus barbatus*, weed control, preemergence

Introduction

Weed control is a necessary practice in nursery production. Weeds present in container nursery crops can reduce plant density by 30 to 60% when compared to containerized plants without weeds (3). The use of herbicides to control weeds in container nursery crops is becoming the most common method of weed control (2).

Nursery personnel have concerns about the use of herbicides on container-grown herbaceous perennial plants. Considerable research has been reported on herbicide use in container-grown woody plants (1, 4, 5, 6, 7, 8), but little research has been reported on the use of herbicides in herbaceous perennials. Some herbicides tested on container-grown woody plants may provide safe and effective weed control for herbaceous perennials (1).

In this research Sweet William was used as a test plant to determine growth differences, weed control and phytotoxicity from the application of six herbicides, including a combination treatment.

Materials and Methods

Sweet William plants were purchased as 5.6 cm (2.2 in) liners and potted in #1 containers and established for approximately one month in a white polyethylene covered quonset structure. A growing media of sand, Colorado clay loam, native sedge peat and softwood bark (equal parts by volume) was used. The plants were then moved outdoors and placed on wooden frames to elevate them off asphalt paving. Bark chips were added under each of the wooden frames to reduce heat radiation from the asphalt.

Eighteen to twenty-four weed seeds of *Poa annua* L. (annual bluegrass), *Setaria glauca* (L.) Beauv. (yellow foxtail), *Stellaria media* (L.) Villa. (common chickweed), *Oxalis corniculata* L. (creeping woodsorrel) and *Senecio vulgaris* L. (common groundsel) were sown on the media surface in the containers forty-eight hours prior to the herbicide applications. After seed application, 2.5 cm (1 in) of water was added to each container.

The six herbicide treatments and rates are listed in Table 1. Granular herbicides (napropamide, oxyfluorfen + oryzalin, oxadiazon and simazine) were applied by hand to all plant containers from pre-weighed amounts. Liquid herbicide solutions for metolachlor and oryzalin were prepared by mixing the required amount of liquid herbicide with the correct amount of water for the herbicide application and applied with 150 ml (0.14 qt) water as a soil drench.

Measurements were taken monthly from May 30, 1985 to August 15, 1985 for height and width of plants and for number of weeds. Apparent phytotoxicity was observed on a visual ratings scale from 1 to 5 and recorded. On August 15, 1985, all Sweet William plants were cut off at ground level and dry weights of above ground plant biomass recorded.

Two control treatments were utilized to observe the effects of the presence of weeds on Sweet William. The unseeded control (0W) consisted of no weed seeds sown and no herbicide applied. The seeded control (0X) had weed seeds sown but no herbicide application.

A randomized complete block statistical design was used. Analysis of data calculated at the .05 level of the F-test and significant means were separated by Tukey's *w* procedure.

[1]Received for publication April 12, 1988; in revised form June 16, 1988.
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Table 1. Herbicide treatments and rates applied.

Herbicide and Formulation	Rate	kg ai/ha	lb ai/A
Napropramide (Devrinol) 10G	1X	4.48	4
	2X	8.96	
Oryzalin (Surflan) 40.4% AS	1X	3.36	3
	2X	6.72	6
Oxyfluorfen + Oryzalin (Rout GS) 3G	1X	3.36	3
	2X	6.72	6
Oxadiazon (Ronstar) 2G	1X	2.24	2
	2X	4.48	4
Metolachlor (Dual) 8EC	1X	2.24	2
	2X	4.48	4
Metolachlor + Simazine (Dual and Princep)			
Metolachlor 8EC +	1X	2.24	2
Simazine 4G	1X	1.68	1.5
Metolachlor + Simazine (Dual and Princep)			
Metolachlor 8EC	2X	4.48	4
Simazine 4G	2X	3.36	3
Control Treatments			
No herbicide and no weeds	0W	—	—
No herbicide plus weeds	0X	—	—

Results and Discussion

Phytotoxic symptoms were observed on Sweet William only when treated with the Dual and Princep combination. The 2.24 kg ai/ha + 1.68 kg ai/ha (2 lb ai/A + 1.5 lb ai/A) rate (Dual and Princep, resp.) resulted in some plant toxicity, but allowed enough regrowth that the plants were salable by the end of the experiment. The 4.48 kg ai/ha + 3.36 kg ai/ha (4 lb ai/A + 3 lb ai/A) rate (Dual and Princep, resp.) resulted in total plant mortality with no regrowth. The phytotoxicity observed on Sweet William was the typical chlorosis produced by photosynthetic inhibition from the herbicide Princep.

A phytotoxic reaction may also have resulted from the synergistic combination of Dual and Princep. Height and width measurements taken throughout the growing season on Sweet William were significantly reduced by the Dual and Princep treatment at both rates. This may have attributed to the phytotoxic symptoms which resulted from this treatment.

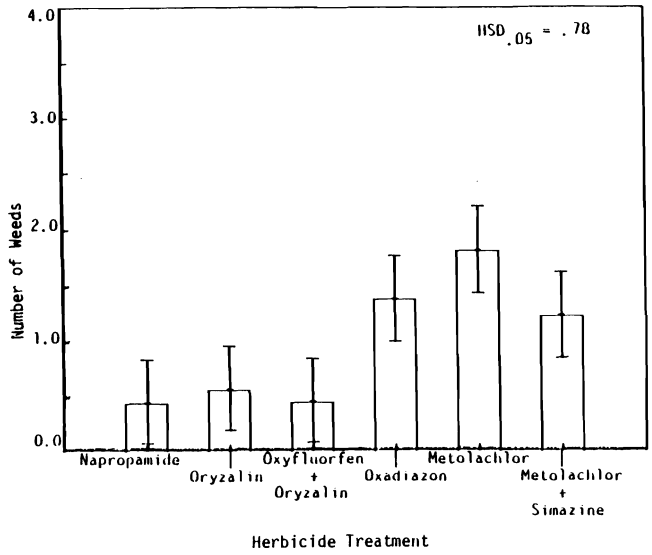

Fig. 1. Total number of grass weeds in container-grown Sweet William on August 15, 1985, as influenced by herbicide treatment applied.

Dry weights of Sweet William were significantly reduced by the Surflan 6.72 kg ai/ha (6 lb ai/A) and Dual and Princep 2.24 kg ai/ha + 1.68 kg ai/ha (2 lb ai/A + 1.5 lb ai/A, resp.) and 4.48 kg ai/ha + 3.36 kg ai/ha (4 lb ai/A + 3 lb ai/A) treatments (Table 2). Previous research has shown that Surflan reduced the top growth and root weight of *Ilex cornuta* 'Burford' holly plants (9). Surflan is mobile in media and often penetrates through the media of a container grown plant fairly quickly with could have caused some root damage. The reduction in dry weights of Sweet William treated with the Dual and Princep treatment is probably due to the phytotoxic effect.

Weed populations were controlled adequately in all herbicide treatments except with Dual treated plants (Table 3). The seeded control treatment did not result in more weeds than the Dual treatment. In some cases, Dual appeared to stimulate the germination of certain broadleaf weeds which resulted in a greater number of weeds in the Dual treatment than in control pots with weed seeds.

Broadleaf and grass weed counts were taken and analyzed separately throughout the duration of the experiment. The 2.24 kg ai/ha (2 lb ai/A) and 4.48 kg ai/ha (4 lb ai/A) rates of Dual resulted in a significantly greater number of broadleaf weeds than the seeded control, which suggests a pos-

Table 2. Dry weight (g) of container-grown Sweet William at the conclusion of the experiment (August 15, 1985), as influenced by herbicide treatment and rate.

	Herbicide Treatment					
Rate	Napropamide (Devrinol)	Oryzalin (Surflan)	Oxyfluorfen + Oryzalin (Rout GS)	Oxadiazon (Ronstar)	Metolachlor (Dual)	Metolachlor and Simazine (Princep)
0W[z]	27.18[y]ab[x]	28.65a	29.93a	25.07ab	25.82ab	27.22ab
0X[z]	29.73a	25.27ab	24.97ab	22.35ab	21.18ab	22.75ab
1X	26.35ab	25.80ab	23.88ab	22.13ab	22.28ab	3.68c
2X	24.25ab	17.48b	24.87ab	25.20ab	26.15ab	3.78c

[z]0W is control consisting of no weed seed sown and no herbicide applied and 0X is control consisting of sown weed seeds, but no herbicide application.

[y]Values equal treatment means.

[x]Like letter designations indicate means are not significantly different according to Tukey's *w* procedure at the .05 level of significance. $HSD_{.05}$ = 10.47.

Table 3. Total number of weeds in container-grown Sweet William on August 15, 1985, as influenced by herbicide treatment and rate.

Rate	Herbicide Treatment					
	Napropamide (Devrinol)	Oryzalin (Surflan)	Oxyfluorfen + Oryzalin (Rout GS)	Oxadiazon (Ronstar)	Metolachlor (Dual)	Metolachlor and Simazine (Princep)
0W[z]	0.00[y]a[x]	0.00a	0.00a	0.00a	0.00a	0.00a
0X[z]	23.53d	26.22e	23.02d	58.29g	15.74b	34.86f
1X	.03a	.05a	0.00a	2.42a	19.97c	.81a
2X	.03a	.05a	0.00a	2.45a	13.27b	.76a

[z]0W is control consisting of no weed seed sown and no herbicide applied and 0X is control consisting of sown weed seeds, but no herbicide application.
[y]Values equal treatment means.
[x]Like letter designations indicate means are not significantly different according to Tukey's *w* procedure at the .05 level of significance. $HSD_{.05}$ = 3.10.

Table 4. Total number of broadleaf weeds recorded on August 15, 1985, in container-grown Sweet William as influenced by herbicide treatment and rate.

Rate	Herbicide Treatment					
	Napropamide (Devrinol)	Oryzalin (Surflan)	Oxyfluorfen + Oryzalin (Rout GS)	Oxadiazon (Ronstar)	Metolachlor (Dual)	Metolachlor and Simazine (Princep)
0W[z]	0.00[y]a[x]	0.00a	0.00a	0.00a	0.00a	0.00a
0X[z]	4.87c	4.48c	4.50c	10.43d	1.80ab	5.98c
1X	.03a	.05a	0.00a	1.60a	8.84d	.11a
2X	.03a	.05a	0.00a	2.45c	5.64c	.17a

[z]0W is control consisting of no weed seed sown and no herbicide applied and 0X is control consisting of sown weed seeds, but no herbicide application.
[y]Values equal treatment means.
[x]Like letter designations indicate means are not significantly different according to Tukey's *w* procedure at the .05 level of significance. $HSD_{.05}$ = 1.93.

Table 5. Total number of *Stellaria media* L. (common chickweed) seedlings in container-grown Sweet William on August 15, 1985, as influenced by herbicide treatment and rate.

Rate	Herbicide Treatment					
	Napropamide (Devrinol)	Oryzalin (Surflan)	Oxyfluorfen + Oryzalin (Rout GS)	Oxadiazon (Ronstar)	Metolachlor (Dual)	Metolachlor and Simazine (Princep)
0W[z]	0.00[y]a[x]	0.00a	0.00a	0.00a	0.00a	0.00a
0X[z]	1.05a	.67a	1.15b	3.61c	.06a	1.21a
1X	0.00a	0.00a	0.00a	.76a	1.28b	.11a
2X	0.00a	0.00a	0.00a	1.13b	.82a	0.00a

[z]0W is control consisting of no weed seed sown and no herbicide applied and 0X is control consisting of sown weed seeds, but no herbicide application.
[y]Values equal treatment means.
[x]Like letter designations indicate means are not significantly different according to Tukey's *w* procedure at the .05 level of significance. $HSD_{.05}$ = 1.10.

sible stimulation of weed seed germination by the herbicide. Dual, Ronstar, and the Dual and Princep combination treatments resulted in a significantly greater number of grass weeds at the end of the experiment than from the other herbicide treatments (Fig. 1).

Broadleaf and grass species counts were analyzed separately. A significantly greater number of chickweed germinated in the Ronstar 2 × and Dual 1 × treatments (Table 5). Rout GS controlled annual bluegrass significantly better than Dual. Annual bluegrass is not specifically listed for control on the Dual label.

The most effective weed control with container-grown Sweet William resulted from Devrinol, Surflan, and Rout GS treatments. The least effective weed control resulted from the Dual treatment followed by Ronstar (Table 3). Dual and Ronstar were the least effective in controlling grass species (Fig. 1). Devrinol and Rout GS were equally effective in controlling grass weeds (Fig. 1). Devrinol at the 4.48 kg ai/ha (4 lb ai/A) and 8.96 kg ai/ha (8 lb ai/A) rates and Rout GS at the 3.36 kg ai/ha (3 lb ai/A) and 6.72 kg ai/ha (6 lb ai/A) rates effectively controlled weeds without any phytotoxic effects (Tables 2 and 3). Surflan at the 3.36 kg ai/ha (3 lb ai/A) rate also controlled weeds effectively without any phytotoxic effects (Tables 2 and 3).

Significance to the Nursery Industry

Weed control is necessary in container perennial production, and the results from this study provide weed control

evaluations for several preemergence herbicides and phytotoxicity data for container-grown Sweet William. The results show that certain herbicides tested on Sweet William can be used without phytotoxicity if lower than manufacturers' recommended rates are applied.

(*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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