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Chemical Weed Control in Gypsophila

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Abstract. **Postemergence and preemergence herbicides were evaluated for crop phytotoxicity and weed control in seepage-irrigated 'Bristol Fairy' gypsophila (*Gypsophila paniculata* L.). DCPA, napropamide, pronamide, and oryzalin were severely injurious to gypsophila. Metolachlor, oxyfluorfen, alachlor, and oxadiazon provided varying degrees of weed control and did not reduce plant vigor or yield. Best weed control was provided by two applications of 4.48 kg·ha^{-1} oxadiazon. Chemical names used: dimethyl tetrachloroterephthalate (DCPA); 2-(napthoxy)-*N*,*N*-diethylpropionamide (napropamide); 3,5-dichloro(*N*-1,1-dimethyl-2-propynyl)benzamide (pronamide); 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide (oryzalin); 2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide (metolachlor); 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene (oxyfluorfen); 2-chloro-*N*-(2,6-diethylphenyl)-*N*-(methoxymethyl)acetamide (alachlor); 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2(3*H*)-one (oxadiazon).**

Although weed control is an important aspect of field-grown gypsophila, little research has been conducted on the use of herbicides in this crop (1–3). Unfortunately, gypsophila appears to be injured by many herbicides commonly used on other ornamentals (4).

Gypsophila is produced on both raised beds covered with polyethylene mulch and on nonmulched beds. Weed control is a problem primarily in the row middles of mulched beds and throughout the field in nonmulched culture. Herbicides applied to row middles can contact gypsophila foliage directly by wind-blown spray drift. Where produced in nonmulched culture, posttransplant applications often are needed to provide season-long weed control, and the potential for foliar contact is increased. Thus, herbicides selected for use in gypsophila production need to be efficacious on the major weeds found in gypsophila and nonphytotoxic when applied both pre- and posttransplant to gypsophila. Research was conducted to evaluate herbicides for phytotoxicity to gypsophila and weed control efficacy in gypsophila.

One postemergence and 10 preemergence herbicides were evaluated for phytotoxicity to gypsophila in Fall 1984 by applying them twice during the growing season to an Eau Gallie fine sand soil (Aeric Haplaquod) with 0.7% organic matter and a pH of 6.4. Raised beds (18 cm tall, 76 cm wide, 1.4 m apart, center-to-center) were fumigated with 392 kg·ha^{-1} of a 67% methyl bromide and 33% chloropicrin mixture to eliminate weed competition as a factor affecting plant growth. The fumigant was injected 15 to 20 cm deep and beds were covered immediately with white polyethylene mulch. The polyethylene film was removed after 2 weeks and fertilizer was incorporated into the bed at a rate of 67N–29P–56K (kg·ha^{-1}), respectively. Treatments (Table 1) were assigned to 6.1-m plots arranged in a randomized complete block design replicated four times. Ten plants of 'Bristol Fairy' gypsophila were planted 0.6 m apart in a single row in each plot on 27 Sept. 1984. Water was supplied continuously by seepage irrigation. Additional fertilizer was supplied by two sidedressings for a season total of 201N–87P–168K (kg·ha^{-1}), respectively. All plots were hand-weeded weekly. Preemergence herbicides were applied once pretransplant on 27 Sept. 1984 and once posttransplant over the top of the crop on 15 Nov. 1984, while the postemergence herbicide butyl (±)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy] propanoic acid (fluazifop-*p*-butyl) was applied posttransplant on 19 Oct. and 15 Nov. 1984. Herbicides (all emulsifiable concentrate formulations except DCPA and napropamide, which were wettable powders) were applied with a CO_2 backpack sprayer equipped with two 11004 flat fan nozzles operated at a pressure of 1.6 kg·cm^{-2} and a speed of 4.8 km·hr^{-1} delivering 249 liters·ha^{-1}. Gypsophila plant vigor was evaluated 17 Oct. 1984 and 8 Jan. 1985 using a pretransformed (5) 0 to 10 rating scale, where 0 indicates all plants are dead and 10 represents no phytotoxicity and maximum plant growth. Flower panicles were harvested and graded 10 times during the production season with the first harvest on 30 Nov. 1984 and the last harvest on 8 Feb. 1985.

All herbicides, except *S*-ethyl dipropylthiocarbamate (EPTC), fluazifop-*p*-butyl, oxyfluorfen, and oxadiazon reduced gypsophila plant vigor when compared to the untreated check 20 days after application (Table 1). Greatest injury was obtained with DCPA, napropamide, pronamide, and oryzalin. By January, after two applications of each herbicide treatment, the only injury observed occurred in plots treated with DCPA, napropamide, pronamide, and oryzalin. The most injury was obtained with pronamide and oryzalin, which killed most of the gypsophila plants.

Yield reductions obtained for each of the 10 harvests were similar to those for the seasonal total and are not presented. DCPA, napropamide, pronamide, and oryzalin reduced the number and weight of marketable panicles (panicles ≥41 cm), the weight of cull panicles, and the total number and weight of panicles harvested (Table 2). No panicles were produced by plants in plots treated with pronamide and oryzalin. The number of cull panicles was reduced by napropamide, pronamide, and oryzalin. No other yield differences were observed among treatments in this experiment.

Metolachlor, oxyfluorfen, alachlor, and oxadiazon were the most promising preemergence herbicides selected from the phytotoxicity experiment and thus were chosen for further evaluation for phytotoxicity and weed control efficacy in Spring 1985. Although EPTC was not phytotoxic to gypsophila, it was deleted from this experiment because it provided poor weed control in a preliminary experiment conducted in Fall 1984. The experimental area was prepared as in the phytotoxicity experiment, and the cultural procedures were the same. Treatments were an untreated check, a hand-weeded check, and one pre- and one posttransplant application of 2.24 kg·ha^{-1} metolachlor (6 E.C. formulation), 0.56 kg·ha^{-1} oxyfluorfen (1.6 E.C.). 1.68 kg·ha^{-1} alachlor (4 E.C.), and 4.48 kg·ha^{-1} oxadiazon (2 E.C.). Treatments were assigned to 5.5 × 1.6 m plots on 76-cm-wide, 18-cm-high beds with plots arranged in a randomized complete block design with four replications. Prior to application of the treatments, each plot was overseeded with 15 g each of crabgrass [*Digitaria ciliaris* (Retz.) Koel.], goosegrass [*Eleusine indica* (L.) Gaertn.], and smooth pigweed (*Amaranthus hybridus* L.). Herbicide treatments were applied pretransplant on 14 Feb. and posttransplant on 19 Apr. 1985 as previously described. Hand-weeded plots were weeded weekly as needed. Eight plants of 'Bristol Fairy' gypsophila were planted 61 cm apart into each plot in a single row on 14 Feb. 1985, immediately after herbicides were applied.

Gypsophila plant vigor was evaluated 18 Mar. and 7 May 1985. Weed control was evaluated 18 Mar., 7 May, and 5 June 1985 using a pretransformed (4) 0 to 10 rating scale where 0 indicates no control and 10 represents complete control. Gypsophila panicles were harvested and graded four times (similar to the commercial situation) from 30 Apr. to 28 May 1985.

Early season gypsophila plant vigor was not affected by herbicide treatment (Table 3). By midseason, after two herbicide applications, gypsophila plants growing in plots treated with metolachlor were less vigorous than those in the hand-weeded check and in

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Table 1. Effect of herbicide treatments on vigor of 'Bristol Fairy' gypsophila in a phytotoxicity experiment, Bradenton, Fla. 1984–85.

Treatment	Rate (kg·ha^{-1})	Method of initial application	Vigor rating[z] First application	Second application
Untreated check	---	---	9.8 a[y]	8.9 a
Thiobencarb	4.48	Pretransplant	8.2 bc	9.0 a
DCPA	8.96	Pretransplant	3.2 d	4.0 b
Napropamide	2.24	Pretransplant	2.5 de	2.8 b
Metolachlor	2.24	Pretransplant	8.0 bc	7.8 a
EPTC	3.36	Preplant-incorporated	9.0 ab	8.6 a
Fluazifop-*p*-butyl	0.28	Posttransplant	9.6 a	8.0 a
Oxyfluorfen	0.56	Pretransplant	9.5 a	9.2 a
Pronamide	2.24	Pretransplant	0.2 f	0.1 c
Alachlor	1.68	Pretransplant	7.4 c	9.4 a
Oxadiazon	4.48	Pretransplant	9.6 a	9.6 a
Oryzalin	2.24	Pretransplant	2.0 e	0.4 c

[z]Vigor was evaluated on a pretransformed 0 to 10 scale where 0 indicates all plants were dead and 10 represents no injury, optimum growth.
[y]Mean separation within columns by Duncan's new multiple range test, 5% level.

Table 2. Effect of one pretransplant and one posttransplant application of each herbicide treatment on seasonal total yield of 'Bristol Fairy' gypsophila panicles in a phytotoxicity experiment, Bradenton, Fla. 1984–85.

Treatment	Rate (kg·ha^{-1})	Method of initial application	Number of panicles/plot			Weight (g) of panicles/plot		
			Marketable[z]	Culls	Total	Marketable[z]	Culls	Total
Untreated check	---	---	210 a[y]	162 ab	372 a	6535 ab	1846 a	8381 ab
Thiobencarb	4.48	Pretransplant	160 a	142 ab	302 a	4434 b	1582 ab	6016 b
DCPA	8.96	Pretransplant	28 b	27 bc	54 b	1569 c	431 bc	2000 c
Napropamide	2.24	Pretransplant	6 b	0 c	6 b	400 c	6 c	406 c
Metolachlor	2.24	Pretransplant	163 a	131 abc	294 a	6233 ab	1445 ab	7678 ab
EPTC	3.36	Preplant incorporated	215 a	136 ab	351 a	6589 ab	1434 ab	8023 ab
Fluazifop-*p*-butyl	0.28	Posttransplant	165 a	125 abc	290 a	5825 ab	1520 ab	7345 ab
Oxyfluorfen	0.56	Pretransplant	173 a	144 ab	317 a	5406 b	1442 ab	6849 ab
Pronamide	2.24	Pretransplant	0 b	0 c	0 b	0 c	0 c	0 c
Alachlor	1.68	Pretransplant	276 a	160 ab	436 a	8258 a	1955 a	10213 a
Oxadiazon	4.48	Pretransplant	191 a	211 a	402 a	5699 ab	2324 a	8023 ab
Oryzalin	2.24	Pretransplant	0 b	0 c	0 b	0 c	0 c	0 c

[z]Panicles ⩾41 cm in length were marketable, while those <41 cm or those with lesions were graded as culls.
[y]Treatment means within columns followed by the same letter are not significantly different as determined by Duncan's multiple range test, 5% level.

Table 3. Effect of herbicide treatments on plant vigor and weed control in 'Bristol Fairy' gypsophila, Bradenton, Fla 1985.

Treatment	Rate (kg·ha^{-1})	Vigor rating[y]		Weed control rating[z]					
				Early season[x]		Midseason[w]		Late season[w]	
		Early season[x]	Midseason[w]	Grass	Pigweed	Grass	Pigweed	Grass	Pigweed
Weedy check	---	9.1 a[v]	5.0 c	0 b	0 b	1.0 b	1.2 b	0.0 d	0.0 c
Hand-weeded check	---	9.7 a	9.6 a	10.0 a	10.0 a	10.0 a	10.0 a	10.0 a	10.0 a
Metolachlor	2.24	8.5 a	8.1 b	10.0 a	10.0 a	10.0 a	9.4 a	9.9 a	8.9 ab
Oxyfluorfen	0.56	9.2 a	8.7 ab	10.0 a	10.0 a	8.8 a	9.8 a	4.5 c	9.2 ab
Alachlor	1.68	9.1 a	8.9 ab	10.0 a	10.0 a	9.4 a	9.4 a	6.1 b	8.6 b
Oxadiazon	4.48	9.0 a	9.6 a	10.0 a	10.0 a	10.0 a	10.0 a	10.0 a	10.0 a

[z]Weed control was evaluated using a pretransformed 0 to 10 rating scale where 0 represents no control and 10 indicates complete control.
[y]Vigor was evaluated using a pretransformed 0 to 10 rating scale where 0 indicates all plants were dead and 10 represents no injury, optimum growth.
[x]Early season evaluations were made after one pretransplant application of each herbicide treatment.
[w]Mid- and late-season evaluations were made after one pretransplant and one posttransplant application of each herbicide treatment.
[v]Each separation within columns by Duncan's new multiple range test, 5% level.

Table 4. Effect of one pretransplant and one posttransplant application of each herbicide treatment on seasonal total yield of 'Bristol Fairy' gypsophila, Bradenton, Fla. Spring 1985.

Treatment	Rate (kg·ha^{-1})	Number			Weight (g)		
		Marketable	Cull	Total	Marketable	Cull	Total
Weedy check	---	96 b[z]	0.2 c	96 b	3094 b	2.5 c	3096 b
Hand-weeded check	---	128 ab	1.5 bc	130 ab	6388 a	7.5 bc	6395 a
Metolachlor	2.24	142 ab	5.5 ab	147 a	6431 a	31.2 abc	6462 a
Oxyfluorfen	0.56	118 ab	8.8 a	127 ab	5062 ab	50.0 a	5112 ab
Alachlor	1.68	148 a	4.5 abc	153 a	7036 a	35.0 ab	7071 a
Oxadiazon	4.48	158 a	3.0 bc	161 a	6234 a	13.8 bc	6248 a

[z]Mean separation within columns by Duncan's new multiple range test, 5% level.

oxadiazon-treated plots.

Weed pressure was not high in this experiment due to dry soil surface conditions for most of the season. All of the herbicide treatments provided excellent control of both grass and pigweed at the early and midseason evaluations (Table 3). By the end of harvest, grass control was excellent with metolachlor and oxadiazon and was unacceptable (<7.0) with oxyfluorfen and alachlor. Pigweed control was less with alachlor than with hand-weeding or application of oxadiazon; however, it was still acceptable and was comparable to that obtained with metolachlor and oxyfluorfen.

Due to the low weed pressure in this experiment, apparent injury to gypsophila plants sustained as a result of weeding and the growth habit of gypsophila, there was no difference in the numbers of marketable, cull, or total number of panicles harvested from the weedy check and hand-weeded check plots during the season (Table 4). Significantly more marketable panicles were harvested from plots treated with alachlor or oxadiazon than from the weedy checks. More cull panicles were obtained with oxyfluorfen than with hand-weeding or oxadiazon, while treatment with metolachlor, alachlor, or oxadiazon produced a greater total number of panicles than was obtained in the weedy check.

Panicle weights were influenced more by treatment than were numbers (Table 4). Hand-weeding and application of metolachlor, alachlor, or oxadiazon increased the weight of marketable panicles compared to the weedy check plots, whereas oxyfluorfen resulted in a greater production of cull panicles than hand-weeding or oxadiazon. No difference in total weight of panicles produced was observed among the herbicide treatments and the hand-weeded check.

Two applications of alachlor, oxadiazon, or oxyfluorfen were not injurious to gypsophila, and metolachlor was only slightly injurious. Oxadiazon and metolachlor provided the best overall weed control, while none of the herbicides reduced panicle yield. Results with oxadiazon in these experiments are comparable to most of those previously reported (1, 3). Contrary to research reported by Agamalian et al. (1), alachlor was not phytotoxic to gypsophila nor did it reduce yields; however, in their research, rates of alachlor were ≈2 to 4 times higher than used in my test, and their soil was finer-textured. Bing (2) reported satisfactory growth of gypsophila when treated with alachlor, thereby supporting the results of the present research. Based on plant vigor, weed control, and yield, 4.48 $kg \cdot ha^{-1}$ oxadiazon was the best herbicide treatment in the present study.

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Influence of Cultivar on Nectar Sugar Content in Several Species of Tree Fruits

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Abstract. **The nectars of several apple (*Malus domestica* Borkh.), apricot (*Prunus armeniaca* L.), crab apple (*M. baccata* L. and *M. floribunda* Seib.), peach (*Prunus persica* L.), pear (*Pyrus malus* L.), and sweet cherry (*Prunus avium* L.) cultivars were analyzed for sugar contents. 'Skaha' apricot was significantly higher in fructose, glucose, and sucrose than 'Wenatchee Moorpark' or 'Tilton'. 'Lambert' sweet cherry was significantly higher in these sugars than 'Van' or 'Stella'. Sugar levels were higher in 'Bartlett' and 'Spartlett' than 'Anjou'. 'McIntosh' and 'Red Delicious' nectars were higher in the individual sugars than 'Golden Delicious'. An appreciable range of values was found among the crab apples but the sugar content in some were comparable to those of apple.**

Concentrations of sugars in nectar vary from a high of 55% in apples to a low of 2% in pears (11). Both Percival (6) and Wykes (13) have characterized these nectars by the predominance of sucrose (S), glucose (G), and fructose (F). A nectar designated as SFG contains appreciable levels of all three sugars, whereas a sFG nectar would have high levels of fructose and glucose but low levels of sucrose. Apple nectar was classified as SFG, and pear nectar was sFG. No mention was made of cultivar influence on nectar sugars in these reports. Battaglini and Battaglini (1) analyzed the nectars of several apple and plum cultivars, but no cultivar effects were mentioned in the abstracted paper.

Nectars and their composition have been implicated in the level of bee activity. Wyke's (13) work showed an order of preference of sucrose : glucose : fructose when single sugar solutions were given to honeybees. However, the most preferred solution was an equal mixture of the three sugars. Zauralov (14) suggested nectar sucrose levels rather than nectar concentrations as more influential on bee activity. Nectar quantity did not alter appreciably the number of foraging bees in a study by Butler (3) but flowers with high sugar levels were visited more often than those with low levels. It is apparent that not only total sugar content but levels of individual sugars in the nectars of tree fruit blossoms influence bee activity. A study therefore was undertaken to determine whether nectars differed in sugar composition among cultivars within tree fruit species. Such information would be useful in the assessment of cultivars as potential pollinizers.

Blossoms from apricots, sweet cherries, apples, pears, peaches, and crab apples were individually collected from five trees of each cultivar of the tree fruits except for the crab apples, for which only one tree was available per selection. All cultivars within a species were located within the same row or adjacent rows in the orchard of the Summerland Research Station. Trees were mature (≥10 years), except the crab apples, which were

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