Response of Nine Herbaceous Flowering Perennials to Selected Herbicides[1]

W.A. Skroch, C.J. Catanzaro, and M.H. Yonce[2]
Department of Horticultural Science
North Carolina State University
Raleigh, NC 27695-7609

Abstract

Nine herbicides registered for use on turf and ornamentals were applied semiannually for 2 years to 9 species of field grown herbaceous flowering perennials. The herbicides used were Balan (benefin), Betasan (bensulide), Dacthal (DCPA), Devrinol (napropamide), Fusilade (fluazifop), Ornamental Herbicide 2 (oxyfluorfen + pendimethalin), Pennant (metolachlor), Poast (sethoxydim), and Ronstar (oxadiazon). The perennials included fernleaf yarrow, shasta daisy, coreopsis, dianthus, daylily, candytuft, red hot poker, statice, and phlox. Betasan produced no visual phytotoxicity. All other treatments, excluding Ornamental Herbicide 2 (OH-2), caused less than 20% injury to all species tested. OH-2 caused 40%, 39%, and 30% injury to daylily, yarrow, and red hot poker, respectively. Economically tolerable (less than 25%) injury was exhibited by phlox and shasta daisy treated with OH-2, by daylily treated with Pennant, and by phlox treated with Ronstar. OH-2 increased flowering of coreopsis and statice by 97% and 235%, respectively, while it reduced plant area of phlox by 53% and flowering of phlox by 34%. Both Pennant and OH-2 reduced flowering of dianthus by nearly 30%.

Index words: phytotoxicity, weed control, crop efficacy
Herbicides used in this study: Balan, (benefin), *N*-butyl-*N*-ethyl-2,6-dinitro-4-(trifluoromethyl)benzenamine; Betasan, (bensulide), *O,O*-bis(1-methylethyl)*S*-[2-[(phenylsulfonyl)-amino]ethyl]phosphorodithioate; Dacthal, (DCPA), dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate; Devrinol, (napropamide), *N,N*-diethyl-2-(1-naphthalenyloxy)propanamide; Fusilade, (fluazifop), (±)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid; OH-2, (oxyfluorfen), 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene + (pendimethalin), *N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine; Pennant, (metolachlor), 2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide; Poast, (sethoxydim), 2-[1-(ethoxyimino)butyl]-5-[2(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one; and Ronstar, (oxadiazon), 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3*H*)-one.
Perennials used in this study: *Achillea filipendulina* Lam. (fernleaf yarrow); *Chrysanthemum maximum* Ramond 'Alaska' (shasta daisy); *Coreopsis grandiflora* Hogg. 'Sunray' (coreopsis); *Dianthus plumarius* L. (dianthus); *Hemerocallis* sp. L. 'Aztec Gold' (daylily); *Iberis sempervirens* L. (candytuft); *Kniphofia uvaria* (L.) Oken (red hot poker); *Limonium latifolium* (Sm.) O. Kuntze (statice); and *Phlox subulata* L. (phlox).

Significance to the Nursery Industry

This study provides further evidence that a majority of the more commonly used herbicides can be safely applied to many herbaceous flowering perennials under the appropriate cultural conditions. Betasan is currently labeled for weed control in candytuft, but not for use in the remainder of the perennial species included in this study. These data suggest that Betasan could be labeled for use in the remainder of these perennials. Similarly, the Balan, Devrinol and Dacthal labels could be expanded. The Pennant and Ronstar labels could be expanded to include the more tolerant species tested. Damage from OH-2 suggests that it should not be used in perennials, although some species tested had high tolerance. Fusilade and Poast are widely labeled for use in perennials. These data confirm the safety of this use of Fusilade and Poast for postemergent grass control. Clearly, a broadening of herbicide labels to include many field grown herbaceous perennials is justified, and could become reality following additional field evaluations.

(*Ed. Note:* This paper reports the results of research only, and does not imply registration of a pesticide under FIFRA. Before using any of the products mentioned in this research paper, be certain of their registration by appropriate state and/or federal authorities.)

[1]Received for publication June 27, 1989; in revised form September 18, 1989. Paper No. 12248 of the Journal Series of the North Carolina Agricultural Research Service (NCARS), Raleigh, NC 27695-7643.

[2]Professor, Graduate Research Assistant, and former Graduate Research Assistant, resp.

Introduction

Several researchers have evaluated a range of herbicides for potential use on herbaceous flowering perennials. At moderate rates, several herbicides are generally safe for use on selected field grown perennial species.

Smith et al. (6) compared the effects of several preemergence herbicides on selected herbaceous perennials. Devrinol 5G (napropamide) at 4.5 kg ai/ha (4.0 lb ai/A) was the least injurious chemical treatment to the greatest number of species, which included *Achillea filipendula* Lam. 'Parkers Variety' (yarrow) and *Chrysanthemum maximum* Ramond 'Alaska' (shasta daisy). Treflan 5G (trifluralin) at 4.5 kg ai/ha (4.0 lb ai/A) and Surflan 75W (oryzalin) at 2.2 kg ai/ha (2.0 lb ai/A) also produced little phytotoxicity on these crops. All herbicides caused phytotoxicity in excess of 30% to *Phlox decussata* L. Injury to shoot meristems of plants treated with Devrinol 50W and 5G and Goal 1G (oxyfluorfen) was only temporary, but persisted on plants treated with Treflan 5G at 4.5 and 17.9 kg ai/ha (4.0 and 16.0 lb ai/A) and Surflan 75W at 2.2 and 9.0 kg ai/ha (2.0 and 8.0 lb ai/A).

Ahrens (1) found that a majority of 22 species of newly planted perennials suffered no more than 20% injury fol-

lowing herbicide treatment. Treatments included Devrinol 10G at 4.5 kg ai/ha (4 lb ai/A), Enide 50WP (diphenamid) at 4.5 kg ai/ha (4 lb ai/A), Ronstar 4G (oxadiazon) at 2.2 kg ai/ha (2 lb ai/A), Dacthal (DCPA) at 10.1 kg ai/ha (9 lb ai/A), Surflan 75WP at 1.7 kg ai/ha (1.5 lb ai/A), Ronstar 2G + Devrinol 2G at 2.2 + 2.2 kg ai/ha (2 + 2 lb ai/A), and Lasso 15G (alachlor) at 4.5 kg ai/ha (4 lb ai/A). *Phlox divaricata* L. (wild sweet william) was injured by Ronstar and Ronstar + Devrinol.

Gilreath (4) evaluated 17 pre- and posttransplant herbicide treatments for toxicity to field grown *Limonium sinuatum* (L.) Mill. 'Midnight Blue' (statice). Ronstar at 4.5 kg ai/ha (4.0 lb ai/A), Eptam (EPTC) at 3.4 kg ai/ha (3.0 lb ai/A), and Dacthal at 9.0 kg ai/ha (8.0 lb ai/A) were noninjurious, whereas Lasso at 1.7 kg ai/ha (1.5 lb ai/A), Devrinol at 2.2 kg ai/ha (2.0 lb ai/A), and Surflan at 2.2 kg ai/ha (2.0 lb ai/A) stunted plants and resulted in low panicle yields. Gilreath (5) also conducted experiments to determine the effect of soil residues of selected preemergence herbicides on field grown 'Midnight Blue' statice. Residues of a seasonal application of 9.0 kg ai/ha (8 lb ai/A) Surflan or Pennant (metolachlor), or 6.7 kg ai/ha (6 lb ai/A) Lasso reduced vigor of statice, but similar soil residues were not deleterious in a subsequent experiment.

On field grown *Hemerocallis* (daylily) species, Bing (2) reported that 2.2 and 4.5 kg/ha (2 and 4 lb ai/A) Goal 1G caused foliage burn, or discoloration, from which plants did not completely recover, whereas plants outgrew injury from Surflan 75WP at the same rates.

In a test conducted at Mountain Horticultural Crops Research Station, Fletcher, NC, four varieties of *Hemerocallis* sp. were treated with Devrinol 50W and Enide 90W at 6.7 kg/ha (6 lb ai/A), and Ronstar 50W and Surflan 75W at 4.5 kg/ha (4 lb ai/A). No apparent injury was noted, and fresh weights of treated plants were not significantly different from weights of the controls (unpublished data).

This study was conducted to provide additional information on the tolerance of nine common species of flowering perennials to nine herbicides. At present these herbicides are registered for use on selected species of turf and woody ornamentals, but on few herbaceous perennials.

Materials and Methods

Field bed preparation of a Cecil clay soil at North Carolina State University Research Unit 4, Raleigh, NC, included incorporation of 7.5 cm (3 in) of pine bark humus and subsequent fumigation of the raised beds with methyl bromide at 73 g/m^2 (1.5 lb/100 ft^2). The pH was adjusted to approximately 6.5 using lime, and fertility was adjusted to fall within the levels for field grown perennials recommended by Tucker and Rhodes (7). Individual plots 3.7 × 1.5 m (12 × 5 ft) were laid out in a randomized complete block design with 4 replications.

One-inch plugs of each species were potted into 10 cm (4 in) containers using a medium of 3 pine bark humus:1 sand (by volume) and grown for two months under 50% shade. Three plants of each species were subsequently transplanted into each plot of the field bed. The preemergence herbicides (Ronstar, OH-2, Betasan, Balan, Devrinol, Dachthal, and Pennant) were applied on Sept. 10, 1986, two to six weeks following transplanting to the field. Application was repeated on May 1 and Sept. 17, 1987, and March 17, 1988. Fusilade (fluazifop) and Poast (sethoxydim) were applied on May 1, August 21, and Sept. 17, 1987, and May 2, 1988.

Granules (preemergence treatments) were applied using the shaker jar method. Liquid treatments were applied over the top of plants with a CO_2 backpack sprayer and 49 × 49 whirljet nozzles delivering 168 liters/ha (18 gpa) at 138 kPa (20 psi). Treatment area was 5.57 m^2 (60 ft^2).

Visual phytotoxicity evaluations were taken on April 17, 1987 using a scale of 0–100 where 0 = no damage and 100 = dead plants. During the 1988 growing season, data were collected for each species at flowering peak (determined visually). Due to the diverse growth and flowering habits of the nine species tested, data were recorded as follows: coreopsis—flower number; daylily, red hot poker and yarrow—flower stem number; statice—flower stem number and dry weight of panicles; candytuft, dianthus, phlox and shasta daisy—plant area and percentage of total plant area in flower. Data were analyzed using the Pesticide Data Management Program, Micro Simplified, Inc., Indianapolis, IN.

Results and Discussion

Herbicides. Betasan (bensulide) produced no visual phytotoxicity (data not shown). Phytotoxicity from the 8 remaining herbicides was species dependent. Data for those species which exhibited statistically significant phytotoxicity are included in Table 1. Only OH2 (oxyfluorfen + pendimethalin) produced injury at levels greater than 25%. At 25% injury, crops exhibit pronounced but only temporary discoloration or stunting (3). Injury ratings in excess of 25% are generally considered to be economically unacceptable by industry standards.

OH-2 increased flowering of coreopsis and statice by 97% and 235%, respectively, while it reduced flowering of dianthus and phlox by 28% and 34%, respectively (Table 2). Pennant caused a 29% reduction in flowering of dianthus. Of the 4 species for which plant surface area was recorded, only phlox treated with OH-2 had a surface area significantly (53%) less than that of the controls (data not shown). No significant differences were exhibited for those species for which flower stem counts were taken (data not shown).

Candytuft. Candytuft exhibited a high degree of tolerance (less than 10% injury) to all herbicide treatments (data not shown).

Coreopsis. Coreopsis showed no injury from any herbicide treatment after one application (data not shown). Following the fourth application, mean flower number of plants treated with OH-2 was 103 (97%) higher than that of the controls.

Daylily. Phytotoxicity ratings from OH-2 and Pennant were 40% and 15%, respectively.

Dianthus. Both Pennant and OH-2 reduced percentage of total plant area in flower by nearly 30%.

Phlox. Ronstar caused 13% injury and OH-2 caused 10% injury after one application. Plant area was reduced 666 cm^2 or 53% after four applications of OH-2 (data not shown), while percentage of total plant area in flower was reduced 34%. Both components of OH-2, Goal and Prowl (pendimethalin), may contribute to this injury. Goal, as well as 2

Table 1. Visual evaluation of phytotoxicity to selected herbaceous flowering perennials.

Treatment	Formulation	Rate lb ai/A	Visual Rating[z] daylily	phlox	red hot poker	shasta daisy	yarrow
Ronstar	2G	4	0	13	0	0	4
OH-2	2+1G	3	40	10	30	15	39
Betasan	7G	13	0	0	0	0	0
Balan	2.5G	3	4	4	0	0	0
Devrinol	5G	4	0	0	9	0	0
Dacthal	5G	15	3	0	19	0	0
Pennant	5G	3	15	3	13	0	8
Fusilade + 0.25% AG-98	1E	0.19	0	0	0	0	0
Poast + 1% Crop Oil	1.53E	0.19	0	3	0	0	0
Check, Weed Free			0	0	0	0	0
LSD (0.05)			12	9	20	8	20

[z]Visual ratings were on a percent scale where 0 = no damage, 25 = economically tolerable damage, 100 = dead plants. Ratings were taken 218 days after the first application of all treatments, excluding Fusilade and Poast.

dinitroaniline herbicides other than Prowl, Treflan and Surflan, have been reported to cause damage to phlox (6).

Red hot poker. OH-2 caused 30% injury after one application.

Table 2. Effect of herbicides on selected flowering characteristics of perennials.

Herbicide	%Flower[z] dianthus	phlox	Flower count coreopsis	Panicle dry wt (g) statice
Ronstar	84	60	102	26.3
OH-2	60	40	209	89.7
Betasan	86	86	112	18.7
Balan	86	60	117	15.6
Devrinol	96	71	61	36.2
Dacthal	66	60	62	35.2
Pennant	59	68	141	20.5
Fusilade + 0.25% AG-98	83	73	71	21.2
Poast + 1% Crop Oil	73	65	64	15.9
Check, Weed Free	88	74	106	26.8
LSD (0.05)	25	22	102	39.5

[z]Visual ratings were on a percent scale where 0 = no flowering and 100 = total plant area in flower. Data were collected for each species at flowering peak (determined visually).

Shasta daisy. Injury from OH-2 was statistically significant but economically tolerable (15%).

Statice. OH-2 increased dry weight of panicles by 62.9 g or 235%.

Yarrow. OH-2 caused 39% injury after one application.

Literature Cited

1. Ahrens, J.F. 1981. Preemergence herbicides for transplanted herbaceous perennials. Proc. Northeast. Weed Sci. Soc. 35:267–272.

2. Bing, A. 1983. Weed control on perennials. Proc. Northeast. Weed Sci. Soc. 37:352–356.

3. Camper, N.D. (ed.). 1986. Research methods in weed science. Southern Weed Science Soc., Champaign, IL.

4. Gilreath, J.P. 1985. Response of statice to selected herbicides. HortScience 20:1068–1069.

5. Gilreath, J.P. 1986. Response of gladiolus, statice, and gypsophila to residues of preemergence herbicides. Proc. Fla. State Hort. Soc. 99:275–278.

6. Smith, E.M., G. Gibson, and S.A. Treaster. 1983. Effects of preemergence herbicides on selected herbaceous perennials. Ornamental plants—1983: A summary of research. Ohio Agri. Res. Dev. Ctr., Res. Circ. 274:31–33.

7. Tucker, M.R., and R. Rhodes. 1987. Crop fertilization based on N.C. soil test. Agronomic Division, North Carolina Department of Agriculture Cir. No. 1.