Weed Management with Fluazifop (Fusilade), Haloxyfop (Verdict), Sethoxydim (Poast) and Oxyfluorfen (Goal) in Groundcovers and Woody Landscape Plants[1]

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Abstract

Annual preemergence applications of granular Goal (oxyfluorfen) [2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene] at 4.5 kg/ha (4.0 lb/A) were applied on several kinds of woody landscape plants alone or with a subsequent postemergence treatment of either Fusilade (fluazifop) [(±)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid], Verdict (haloxyfop) [2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid] or Poast (sethoxydim) [2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] at 0.3 kg/ha (0.25 lb/A) or 0.6 kg/ha (0.5 lb/A). The postemergence treatments were also applied without previous applications of Goal. The investigation was conducted at Beltsville, Maryland, from 1983 through 1985. Application of Goal (oxyflurofen) alone reduced the yearly growth of broadleaf and grass weeds, however, over-time horseweed (*Conyza canadensis* (L.) Cronq.) and white heath aster (*Aster pilosus* Willd.) increased their contribution to the weed cover. Annual grass weeds including fall panicum (*Panicum dichotomiflorum* Michx.), large crabgrass (*Digitaria sanguinalis* (L.) Scop.), giant foxtail (*Seteria faberi* Herrm.), and stinkgrass (*Eragrostis cilianensis* (All.) E. Mosher) were significantly reduced by applications of Fusilade, Verdict, and Poast. Weed cover reductions up to 60% resulted from treatments by Goal followed by any one of the three grass herbicides. Hinocrimson azalea was injured by applications of Fusilade at 0.3 kg/ha (0.25 lb/A) and Verdict at 0.6 kg/ha (0.5 lb/A).

Index words: Granular herbicide, postemergence herbicide, grass control

Introduction

The quality of woody landscape and groundcover species in permanent and production environments is enhanced by the absence of weeds. Presently used systems for weed management are frequently time consuming and costly.

Postemergence grass herbicides have been investigated alone and in combination with broadleaf herbicides for efficacy and tolerance by landscape and groundcover species (2, 3, 6, 12). A 2-year investigation of preemergence applications of granular Goal (Oxyfluorfen) followed by postemergence spray applications of Poast (Sethoxydim) resulted in 80% reduction of weeds with no injury to established landscape plants (6). Ahrens (1) reported that conifer seedbeds tolerated applications of Poast, Fusilade (Fluazifop), and Verdict (Haloxyfop) at rates that controlled weedy grasses. A number of researchers (9, 10, 12) also reported satisfactory tolerance by landscape plants to postemergence grass herbicides. Selected varieties of flowering annuals (11) and gladiolus (3) were also tolerant of herbicidal rates of Poast and Fusilade. Timing of herbicide applications may result in more effective and less costly weed control. Chernicky (5) reported that young grass plants were more susceptible than older plants to applications of Poast, whereas Buhler and Burnside (4) found that Fusilade and Verdict possessed residual herbicidal activity.

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The objectives of this investigation were to characterize responses of; (1) grass and broadleaf weeds, and (2) seven landscape and groundcover species, to applications of Goal, Fusilade, Verdict, and Poast, applied alone and in selected combinations.

Materials and Methods

Field investigations were conducted at Beltsville, in 1983, on a Keyport silt loam (Aquic Hapludult), and continued through 1985. One to 3-year old nursery stock were transplanted into a clean cultivated field in the spring of 1983. Two plants each of the following seven species were planted on 1.2 m (3 ft) centers in each plot: Low-fast cotoneaster (*Cotoneaster dammerii* Schneid.), Hinocrimson azalea (*Rhododendron* x Hinocrimson), Andorra juniper (*Juniperus horizontalis* 'Plumosa' Rehd.), Hicks yew (*Taxus media* 'Hicksii' Rehd.), periwinkle (*Vinca minor* L.), Japanese spurge (*Pachysandra terminalis* Sieb. and Zucc.), and English ivy (*Hedera helix* L.). Plots were 3 x 11 m (10 x 36 ft). The experimental design was a randomized complete block with all treatments including controls replicated three times. Controls included an unweeded treatment and a monthly handweeded treatment. Fertilizer adequate for plant growth and development was incorporated prior to transplanting. Mean soil pH was 5.6. Plots were hand hoed weed-free each spring prior to herbicide applications. Irrigation was provided as needed.

A single treatment of 1 or 2% granular Goal was applied each spring at 4.5 kg/ha (4.0 lb/A) ai to weed-free plots, using a hand held spinner spreader. All plants were actively growing at time of application. Application dates were July 1, 1983, June 11, 1984, and June 1, 1985. After Goal was applied rain occurred 3, 7, and 4 days [0.4 cm (0.15 in), 2.0 cm (0.8 in and 3.2 cm (1.2 in)] in 1983, 1984, 1985. Goal was applied alone as the only preemergence herbicide treatment or followed later by postemergence applications of Fusilade, Verdict, or Poast. Fusilade and Verdict were applied at 0.3 and 0.6 kg/ha (0.25 and 0.5 lb/A), whereas, Poast was applied at 0.3 kg/ha (0.25 lb/A) only. The postemergence treatments were also applied alone without previous Goal applications. Postemergence treatments were applied when grasses were approximately 25 to 35 cm (10 to 14 in) tall using a bicycle mounted boom sprayer at 207 kPa (30 psi) with #8004 flat fan nozzles, in a final volume of 374 L/ha (40 gpa). These treatments were applied on July 31, July 19, and July 31 in 1983, 1984, and 1985. Rainfall occurred 3, 2, and 0 days after herbicide application at 0.4 cm (0.15 in), 2.4 cm (0.95 in) and 1.0 cm (0.4 in) in 1983, 1984, 1985, respectively. Crop oil concentrate containing 85% paraffin base petroleum oil and 15% surfactant blend was mixed with all postemergence grass herbicides at 1% v/v.

Percent weed cover and major weed species and classifications were estimated each fall. Test plants were rated for phytotoxicity on a scale of 0 to 10, with 0 = no effect and 10 = plant death. Values greater than three reflect nonmarketable plants. Plant growth was documented by height and width measurements. Statistical analyses were accomplished by analysis of variance procedures and appropriate mean comparison tests. Mean comparison tests (FLSD) were done only when there was a significant F test.

Table 1. Major weed species in experimental plots at Beltsville, 1983 to 1985.

Dicots	Monocots
Common dandelion *Taraxacum officinale* Weber	Fall panicum *Panicum dichotomiflorum* Michx.
Common lambsquarters *Chenopodium album* L.	Giant foxtail *Setaria faberi* Herrm.
Common ragweed *Ambrosia artemisiifolia* L.	Goosegrass *Eleusine indica* (L.) Gaertn.
Corn cockle *Agrostemma githago* L.	Large crabgrass *Digitaria sanguinalis* (L.) Scop.
Curley dock *Rumex crispus* L.	Stinkgrass *Eragrostis cilianensis* (All.) E. Mosher
Hemp dogbane *Apocynum cannabinum* L.	Yellow nutsedge *Cyperus esculentus* L.
Horseweed *Conyza canadensis* (L.) Cronq.	
Knawel *Scleranthus annuus* L.	
Pennsylvania smartweed *Polygonum pensylvanicum* L.	
Smallflower galinsoga *Galinsoga parviflora* Cav.	
Rough fleabane *Erigeron strigosus* Muhl.	
Virginia copperleaf *Acalypha virginica* L.	
White heath aster *Aster pilosus* Willd.	
Yellow rocket *Barbarea vulgaris* L.	

Table 2. Percent contribution to weed cover of annual grass, annual broadleaf and perennial broadleaf weeds in established landscape and groundcover plots.[z]

Treatment	Rate		Annual broadleaf			Perennial broadleaf			Annual grass		
	kg/ha	(lb/A)	1983	1984	1985	1983	1984	1985	1983	1984	1985
			%								
Untreated control	—	—	5cde	11de	13ns	6cd	13cd	11bcd	89a	74a	64a
Fusilade	0.3	(0.25)	13bcd	28abc	17	13bc	19bc	12bcd	53bc	40b	43ab
	0.6	(0.5)	18ab	29ab	24	21ab	31ab	25abc	44bcd	21bc	18bcd
Goal followed by Fusilade	4.5 0.3	(4.0) (0.25)	9cde	16b-e	15	3cd	1de	10cd	41cd	1c	1d
	4.5 0.6	(4.0) (0.5)	4cde	11de	15	7cd	4de	16bcd	24cde	0c	0d
Goal	4.5	(4.0)	3de	12cde	24	2d	3de	14bcd	75ab	37b	32bc
Verdict	0.3	(0.25)	15abc	40a	19	22a	36a	39a	51bc	13c	9cd
	0.6	(0.5)	24a	43a	29	12bc	34a	19bcd	54bc	2c	0d
Goal followed by Verdict	4.5 0.3	(4.0) (0.25)	6cde	7de	16	8cd	4de	11cd	32cde	3c	1d
	4.5 0.6	(4.0) (0.5)	12bcd	16de	15	7cd	4de	24abc	30cde	0c	0d
Poast	0.3	(0.25)	18ab	22bcd	14	25a	30ab	30ab	29cde	40b	26bcd
Goal followed by Poast	4.5 0.3	(4.0) (0.25)	4de	12de	24	7de	6de	13bcd	19de	5c	4cd

[z]Within columns, values followed by same letter or letters are not significantly different at 5% level according to FLSD mean comparison test; ns = no significant differences.

Results and Discussion

Percent weed cover. Major weeds occurring throughout the investigation are shown in Table 1. Estimated contributions of annual grass, annual broadleaf and perennial broadleaf weeds to total weed cover are presented in Table 2. No perennial grasses were observed during this investigation. Yellow nutsedge, which occurred in several treatments ≤ 5% was included in the annual grass estimate.

Annual grass weeds dominated the untreated control plots and restricted establishment of annual and perennial broadleaf weeds (Table 2). Annual and perennial broadleaf weeds made their largest contribution to weed cover in plots that received only Fusilade, Verdict or Poast (Tables 2 and 3). Preemergence treatments of Goal alone resulted in annual reduction of all weeds, although annual and perennial broadleaf weeds generally increased their contribution to weed cover from 1983 to 1985 as annual grass weeds decreased. However, specific broadleaf species such as curly dock, common lambsquarters and smallflower galinsoga tended to decrease their contribution to overall weed cover with the inclusion of Goal in the herbicide treatment. On the other hand, white heath aster and horseweed did not consistently respond to herbicide treatments, and increased in contribution to weed cover from 1983 to 1985.

Annual grass weeds were reduced more by treatments with Verdict alone than by treatments with Fusilade or Poast alone, in 1984 and 1985 (Table 2). This probably resulted from Verdict's residual activity and consequent ability to control annual grass weeds that germinated after herbicide applications. Large crabgrass was controlled 1.5 times more effectively with Verdict than with either Fusilade or Poast. Both Verdict and Fusilade controlled stinkgrass 4.5 times more effectively than Poast. Fall panicum and giant foxtail were equally well controlled by all three grass herbicides.

Combinations of Goal with any of the three grass herbicides resulted in lower weed covers than those obtained with any herbicide applied alone (Table 3). These weed cover reductions should result in approximately 60% savings in labor needed for weed control during the growing season.

Plant Growth. There were no significant differences in growth of periwinkle, Japanese spurge, and English ivy from 1983 to 1985. Of these 3 species, only English ivy growth differed significantly among treatments. English ivy plants in herbicide treated plots grew significantly more (64%) than those in unweeded control plots (data not shown).

There were no significant treatment effects on the growth of cotoneaster, juniper, yew, and azalea. However, all four species grew significantly from 1983 to 1985 (data not shown).

Generally the landscape species tolerated all herbicide treatments for the duration of the investigation (phytotoxicity values < 3.0; ≥ 3.0 commercially unacceptable). However, in 1984 and 1985 Hinocrimson azalea appeared to be intolerant of Verdict applications at 0.6 kg/ha (0.5 lb/A) (Table 4). Injury included leaf discoloration and leaf loss, combined with reduced plant vigor and commercially unacceptable regrowth. A similar response was observed when Goal was followed by Verdict in 1985. Earlier research by several workers (2, 7, 8) reported injury to Hinocrimson azalea by Fusilade applications. In 1985, Hinocrimson azalea was apparently injured by application of Fusilade at 0.6 kg/ha (0.5 lb/A), and by combinations of Goal and Fusilade at 0.3 kg/ha (0.25 lb/A) (Table 4), although there were no phytotoxic responses in 1983 and 1984. Combinations of factors in 1985 may have contributed to the

Table 3. Percent contribution to weed cover of annual grass, annual broadleaf, and perennial broadleaf weeds, combined and averaged over 3 years and total weed cover per year, in established landscape and groundcover plants.[z]

Treatment	Rate kg/ha	Rate (lb/A)	Annual broadleaf	Perennial broadleaf	Annual grass	1983	1984	1985
Untreated Control	—	—	10d	10de	76a	100a	98a	88a
Fusilade	0.3	(0.25)	19bc	14cd	45bc	78a-d	88a	72ab
	0.6	(0.5)	24ab	26ab	29de	83abc	82a	67ab
Goal followed by Fusilade	4.5 0.3	(4.0) (0.25)	13cd	5ef	14e-h	53b-f	18cd	25cd
	4.5 0.6	(4.0) (0.5)	10d	9de	8gh	35ef	15cd	32cd
Goal	4.5	(4.0)	13cd	6ef	48b	81a-d	53b	70ab
Verdict	0.3	(0.25)	25ab	32a	24def	88ab	90a	67ab
	0.6	(0.5)	32a	21bc	19d-g	90ab	78a	48bc
Goal followed by Verdict	4.5 0.3	(4.0) (0.25)	10d	7def	12fgh	45def	13cd	28cd
	4.5 0.6	(4.0) (0.5)	14cd	12de	10fgh	48c-f	20cd	38bc
Poast	0.3	(0.25)	18bcd	28ab	32cd	72a-f	92a	70ab
Goal followed by Poast	4.5 0.3	(4.0) (0.25)	14cd	9de	9fgh	30fg	23c	42bc

[z]Within columns, values followed by same letter or letters are not significantly different at 5% level according to FLSD mean comparison test.

Table 4. Phytotoxicity ratings[z] of Hinocrimson azalea to herbicide treatments applied annually over a 3-year period.[y]

Treatment	Rate kg/ha	Rate (lb/A)	1983	1984	1985
Untreated control	——	——	1.2ns	0.3b	2.7ns
Handweeded control	——	——	0.8	0.0b	1.2
Fusilade	0.3	(0.25)	0.1	0.0b	3.3
	0.6	(0.5)	1.0	0.0b	3.0
Goal followed by Fusilade	4.5 0.3	(4.0) (0.25)	0.7	0.0b	5.2
	4.5 0.6	(4.0) (0.5)	0.1	0.0b	2.5
Goal	4.5	(4.0)	1.0	0.2b	2.8
Verdict	0.3	(0.25)	1.4	0.0b	2.7
	0.6	(0.5)	1.2	4.2a	4.5
Goal followed by Verdict	4.5 0.3	(4.0) (0.25)	0.0	1.3b	0.5
	4.5 0.6	(4.0) (0.5)	0.0	1.5b	4.7
Poast	0.3	(0.25)	2.3	0.5b	2.3
Goal followed by Poast	4.5 0.3	(4.0) (0.25)	0.2	0.0b	0.2

[z]Phytotoxicity ratings on scale of 0-10, where 0 = no injury, 10 = plant death and ≥ 3 = commercially unacceptable.

[y]Within columns, values followed by same letter or letters are not significantly different at 5% level according to FLSD mean comparison test; ns = no significant differences.

adverse responses of Hinocrimson azalea to treatments with Fusilade and Verdict. These factors include (1) temperature and moisture stress, (2) sensitization of the species by previous treatments with the same herbicide, and (3) an inherent intolerance to the herbicides.

Significance to the Nursery Industry

The application of a granular formulation of Goal followed by timely application of either Fusilade, Verdict, or Poast, reduced weed cover in 7 established groundcover and landscape plant species, and reduced the need for hand labor by approximately 60%. In addition, this investigation revealed that Hinocrimson azalea may not be tolerant of annual applications of Verdict and Fusilade. Although Poast applications were successfully tolerated by Hinocrimson azalea, varietal screening should be done prior to annual applications of postemergence grass herbicides for weed management in azalea. Furthermore, granular formulations of Goal are commercially available only in combinations with Prowl (pendimethalin) N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine or Surflan (oryzalin) 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide.

(*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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