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Postemergence Applied Herbicides for Use On Ornamental Grasses[1]

Charles H. Gilliam, Gary J. Keever, D. Joseph Eakes, and Donna C. Fare[2]
Department of Horticulture
Alabama Agricultural Experiment Station
Auburn University, AL 36849

Abstract

Postemergence-applied, grass-active herbicides registered for use in the landscape were applied over-the-top of four ornamental grass species to evaluate tolerance in 1990 and 1991. All herbicides caused some injury to all grass species. Growth indices of dwarf fountain grass (*Pennisetum alopecuroides* L.K. Spreng. 'Hameln)' and pampas grass (*Cortaderia selloana* Schult. & Schult. f. Asch & Graebn. 'Rosea') treated with the low rate of Poast (sethoxydim) was similar to that of the nontreated plants in both years. Acclaim (fenoxaprop-ethyl) caused less injury to purple maiden grass (*Miscanthus sinensis* Anderss. 'Purpurescens') and maiden grass (*M. sinensis* Anderss 'Gracillimus') than Poast and Fusilade 2000 (fluazifop). Both Acclaim rates resulted in similar growth indices to that of nontreated plants. Flowering was reduced in three of the four grass species with all grass active herbicide treatments; the fourth species did not flower.

Index words: weed control, grass control, phytotoxicity

Herbicides used in this study: Fusilade (fluazifop), (R)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid; Poast (sethoxydim), 2-[1-ethoxyimino)butyl]-5[2(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one; Acclaim (fenoxaprop-ethyl), (±)-ethyl-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy]propanoate.

Species used in this study: dwarf fountain grass (*Pennisetum alopecuroides* L. K.Spreng. 'Hameln'); pampas grass (*Cortaderia selloana* Schult. & Schult.f. Asch. & Graebn. 'Rosea'); maiden grass (*Miscanthus sinensis* Anderss. 'Gracillimus'); and purple maiden grass (*M. sinensis* Anderss. 'Purpurescens').

Significance To The Nursery Industry

Application of a postemergence, grass-active herbicide to ornamental grasses will likely cause significant injury. The amount of injury varies with herbicide, rate, and grass species. Poast (sethoxydim) and Acclaim (fenoxaprop-ethyl) herbicides caused less injury than Fusilade 2000 (fluazifop) to most of the grasses. Pampas grass and dwarf fountain grass treated with the low rate of Poast (0.25 lb ai/A) began to outgrow injury symptoms about 60 DAT and had similar growth to the nontreated plants by the end of the growing season. The maiden grasses had less injury when treated with Acclaim, and growth indices at the end of the season were similar when comparing either Acclaim application rate with nontreated plants. While not evaluated, it appears that postemergence herbicide application made later in the season could be detrimental to ornamental grasses because of the time needed for recovery. Postemergence-applied herbicides should be a last line of defense in controlling weeds in ornamental grasses; however, when their use is required nurserymen and landscape maintenance personnel should anticipate plant injury and reduced flowering during the growing season of application.

Introduction

Demand for ornamental grasses in the landscape has been increasing. Competition from annual and perennial grasses reduces growth of ornamentals and detracts from the aesthetic value of a landscape. Three postemergence-applied herbicides, Poast (sethoxydim), Fusilade (fluazifop), and Acclaim (fenoxaprop-ethyl) have undergone extensive evaluation for use in landscape plantings (2, 3, 5, 6) and are registered for a wide range of landscape plants for annual and perennial grass control. In addition, Poast is registered for selective use in some turf species. The labels of the aforementioned grass-active herbicides did not specify ornamental grasses as tolerant crops, and information is lacking on the response of ornamental grass species to

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[2]Professor, Associate Professor, Assistant Professor and Research Associate, respectively.

these herbicides. Hubbard and Whitwell (5) demonstrated tolerance of some ornamental grasses to grass-active, postemergence applied herbicides. Other research has demonstrated differential tolerance of targeted grass species to these postemergence-applied herbicides (1, 4, 7). Season-long effects of postemergence applied herbicides on ornamental grasses have not been evaluated. The objective of this research was to evaluate the season-long effects of three postemergence-applied grass-active herbicides applied over-the-top on ornamental grasses.

Materials and Methods

Liners of four ornamental grasses: dwarf fountain grass (*Pennisetum alopecuroides* 'Hameln'); pampas grass (*Cortaderia selloana* 'Rosea'); maiden grass (*Miscanthus sinensis* 'Gracillimus'); and purple maiden grass (*M. sinensis* 'Purpurescens') were potted into 3.8-1 (#1) plastic containers in May 1990. The medium was pinebark/sand (6:1 by vol) amended per m^3 (yd^3) as follows: 8.3 kg (14 lb) Osmocote 18N-2.6P-10K (18-6-12), 3.0 kg (5.0 lb) dolomitic limestone, and 0.9 kg (1.5 lb) Micromax. All plants were grown in full sun and irrigated as needed. Poast or Fusilade was applied in June to the four ornamental grasses at 0.28 or 0.56 kg ai/ha (0.25 or 0.50 lb ai/A). Ortho X-77 (nonionic surfactant) was added to Fusilade at 0.25%, while Prime oil (crop oil concentrate) was added to Poast at the same rate. A nontreated control treatment was included for comparison. Broadleaf and grass weeds were removed by hand from all herbicide treatments. Herbicides were applied in 187 l/ha (20 gpa) of water with a backpack CO2 sprayer using a 8004 nozzle operated at 30 psi. Ambient air temperature was 31 degrees C (87F) with 75% relative humidity at the time of application. Data collected included visual injury [15 and 30 days after treatment (DAT)] estimated on a percentage scale of 0 to 100% with 0 = no injury and 100% = dead plant. Growth indices [(height + width1 + width2)/3] of all ornamental grasses were measured 60 DAT. Treatments were assigned at random to eight single-plant replicates of each grass species. A randomized complete block design within species or cultivars was used. Grass control data are not presented since the activity of these herbicides is well documented (1, 2).

In 1991, the study was repeated with the same species. Liners were potted in May 1991, with medium and cultural practices similar to the 1990 test (eight single-plant replicates). The same treatments used in experiment 1 plus Acclaim (fenoxaprop-ethyl) at two rates (0.28 and 0.56 kg/ha) (0.25 and 0.50 lb/A) were applied on May 16, 1991. Additional data collected included flower number taken at 30 day intervals when flowering began. Data are shown for peak flowering dates (120 DAT for pampas, maiden, and purple maiden, and 60 DAT for dwarf fountain grass). Plants were larger in 1991 due to the use of larger liners and taking of growth indices 30 days later (90 DAT).

Results and Discussion

Some injury occurred with all postemergence applied herbicides across all grass species tested at some point in the two years of evaluation. In general, injury was greater with the higher rate of the three herbicides, and greater with Fusilade compared to Poast (Table 1). Pampas grass treated with the low Poast rate had the least injury when comparing herbicide treatments except for 30 DAT in 1991 when the high Poast rate and the low Fusilade 2000 rate caused similar injury (Table 1). In three of the four ratings (both 1990 dates and 15 DAT in 1991), there were no difference in injury between plants treated with the low Poast rate and nonsprayed control plants. Purple maiden grass (1990 and 1991) had greater than 50% injury with both rates of Poast and Fusilade 2000, while injury with the low Acclaim rate was about 25%. Fusilade 2000 caused greater than 50% injury on all four grasses 30 DAT when applied at the low rate. These data concur with other reports which have shown Fusilade causes injury to most grass species (4, 7). By 60 DAT in both years, most plants not killed by the herbicide

Table 1. Phytotoxicity of selected herbicides to ornamental grasses[z].

		% Visual injury[y]															
		Pampas grass				Dwarf fountain grass				Maiden grass				Purple maiden grass			
		1990		1991		1990		1991		1990		1991		1990		1991	
	Rate	15	30	15	30	15	30	15	30	15	30	15	30	15	30	15	30
Herbicide	lb/ai/A	DAT		DAT		DAT		DAT		DAT		DAT		DAT		DAT	
Poast + 0.25% COC[x]	0.25	10	0	8	26	35	9	46	45	22	71	42	36	61	66	50	63
Poast + 0.25% COC	0.50	34	34	26	34	53	48	54	56	51	93	59	56	72	81	67	78
Fusilade + 0.25% X-77	0.25	46	89	50	61	56	76	29	52	30	92	50	61	69	79	50	73
Fusilade + 0.25% X-77	0.50	69	69	97	31	60	69	94	46	73	41	98	58	81	91	61	86
Acclaim + 0.25% X-77	0.25	—	—	43	50	—	—	44	68	—	—	55	54	—	—	25	26
Acclaim + 0.25% X-77	0.50	—	—	50	61	—	—	48	78	—	—	53	58	—	—	38	67
Weeded check	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LSD[w]		10.2	12.2	17.5	13.4	8.5	9.7	10.2	12.0	8.7	5.4	8.0	7.0	8.8	6.0	8.7	9.9

[z]Treatments were applied on June 19, 1990, and May 16, 1991.

[y]Visible injury was rated on a scale of 0 to 100%, with 0 = no injury and 100% = dead plant.

[x]COC = Crop oil concentrate (Prime Oil).

[w]LSD = Least significant difference, P = 0.05.

Table 2. Effects of herbicides on growth indices of ornamental grasses in 1990 and 1991.

Herbicide	Rate lb ai/A	Growth indices[z], cm: Pampas grass 1990	Pampas grass 1991	Dwarf fountain grass 1990	Dwarf fountain grass 1991	Maiden grass 1990	Maiden grass 1991	Purple maiden grass 1990	Purple maiden grass 1991
Poast + 0.25% COC[y]	0.25	85.2	136.8	49.8	100.4	56.0	124.5	34.8	69.6
Poast + 0.25% COC	0.50	62.9	130.2	38.0	103.4	45.0	115.9	30.2	62.0
Fusilade + 0.25% X-77	0.25	34.1	112.2	31.5	95.4	46.3	68.4	28.7	64.2
Fusilade + 0.25% X-77	0.50	24.8	61.2	26.6	50.5	44.7	54.6	23.1	51.4
Acclaim + 0.25% X-77	0.25	—	128.5	—	78.5	—	120.7	—	81.3
Acclaim + 0.25% X-77	0.50	—	117.3	—	37.3	—	118.2	—	72.7
Weeded check	—	88.1	137.3	53.0	106.3	85.6	115.1	42.3	80.6
LSD[x]		13.3	19.7	6.6	23.4	8.3	10.1	6.9	11.7

[z]Growth indices (height + width + width)/3 was measured 60 DAT (July 24) in 1990 and 90 DAT (Aug. 21) in 1991.
[y]COC = Crop oil concentrate (Prime Oil).
[x]LSD = Least significant difference, P = .05.

treatments had initiated new growth and exhibited normal growth through the rest of the growing season.

The authors observed damage to existing growth at the time of application; however, about 60 DAT many of the plants grew past initial injury and new growth caught up with the nontreated control plants before the end of the growing season. Growth indices of pampas and dwarf fountain grass (both years), treated with 0.28 kg/ha (0.25 lb/A) of Poast were similar to those of the nontreated control grasses (Table 2). Maiden grasses were more sensitive to the low Poast rate with reduced plant growth occurring in 1990 but not in 1991. One reason for growth differences between the two years may be that herbicide application occurred one month earlier in 1991 (June 19 vs May 16). Consequently, in 1991, plants had an extra month to resume normal growth. These data concur with previous reports of maximum injury occurring within four weeks of application (5). Growth indices of grasses treated with 0.56 kg/ha (0.50 lb/A) of Poast tended to be smaller than nontreated control plants but similar to or larger than growth indices of Fusilade-treated plants. Fusilade 2000 reduced growth of all grass species at the lower rate except dwarf fountain in 1991 and the higher rate resulted in lower growth indices with all grasses compared to the nontreated plants. Maiden grasses treated with Acclaim had similar growth compared to the nontreated plants in 1991 regardless of application rate.

Flower number in three of the four grasses, maiden grasses and dwarf fountain grass, was reduced by all postemergence herbicide treatments in 1991 (Table 3). The fourth grass, pampas grass, did not flower during the 1991 growing season. Purple maiden grass, which had the least injury when Acclaim was applied, had more flowers with the low Acclaim rate compared to the other postemergence herbicide treatments. Poast at the low rate, which had a limited effect on growth indices, reduced flowering of maiden grass and

Table 3. Effects of postemergence herbicides on inflorescence number of ornamental grasses in 1991.

Herbicide	Rate lb/ai/A	Inflorescence number: Pampas grass 120 DAT	Maiden grass 120 DAT	Purple Maiden grass 120 DAT	Dwarf Fountain grass 60 DAT
Poast + 0.25% COC	0.25	0.1	3.4	12.4	0.3
Poast + 0.25% COC	0.50	0.1	5.1	7.3	0.9
Fusilade 2000 + 0.25% X-77	0.25	0.0	0.1	7.6	1.1
Fusilade 2000 + 0.25% X-77	0.50	0.0	0.0	5.6	0.0
Acclaim + 0.25% X-77	0.25	0.0	8.3	24.0	0.1
Acclaim + 0.25% X-77	0.50	0.0	3.1	15.6	0.0
Nontreated		0.0	19.2	31.6	25.4
LSD 0.05[z]		0.2	9.6	6.3	3.9

[z]LSD = Least significant difference, P = 0.05.

purple maiden grass 82 and 61% respectively. Flowering data collection until November 1991, when no further flowering occurred, showed that flowering was reduced for the entire growing season and not just delayed until later in the year.

Use of postemergence herbicides will injure ornamental grasses. The extent of injury varies with species, postemergence applied herbicide and application rate. In extreme situations, weed pressure may dictate use of a postemergence applied herbicide. Application early in the year appears to allow ornamental grasses time to recover from the injury. Generally, Poast was the least injurious to pampas grass and dwarf fountain grass and Acclaim was least injurious to the maiden grasses.

(*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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Microclimates and Tree Growth in Three Urban Spaces[1]

Roger K. Kjelgren[2] and James R. Clark[3]

Department Plant, Soils, and Biometeorology
Utah State University
Logan, UT 84332

Abstract

Microclimates characteristic of urban park, plaza, and canyon spaces were related to physiology and growth of even-aged sweetgum (*Liquidambar styraciflua* L.) street trees. Microclimates, tree growth, and physiological responses were characterized diurnally and seasonally. Park and plaza sites received unobstructed sunlight while the canyon was limited to four hours of direct solar radiation in midsummer. Potential seasonal insolation was 44% of the potential maximum at the canyon and over 90% at the park. Afternoon air temperatures and vapor pressure deficits were somewhat greater at the plaza than the other two sites, and potential pan evaporation was nearly 50% greater over the season. Tree growth at the plaza and canyon acclimated physiologically and developmentally to the prevailing environmental conditions. Thinner leaves and less trunk growth when compared with the park were indications of shade acclimation in the canyon trees. This did not, however, appear to affect crown size or shoot growth of canyon trees. In contrast, plaza trees were sparse and stunted, exhibiting diminished crown size and diameter increment when compared with trees at the other sites. Less favorable water relations suggested that chronically higher evaporative demand and limited soil resources restricted growth of the plaza trees. Park, plaza, and canyon designations of urban spaces can provide a useful framework for predicting microclimatic factors that can affect tree growth for an urban site. Long-term growth and development, however, within any of these urban spaces will depend on interactions with existing soil conditions.

Key words: *Liquidambar styraciflua* L., urban microclimate, solar radiation, shade response, evaporative demand

Significance to the Nursery Industry

Soil conditions are often the primary consideration when urban sites are evaluated for tree planting. Results of this study show that microclimate conditions should also be considered. Establishing whether an urban site has park, plaza, or canyon characteristics can assist landscapers and nurserymen in better selecting suitable species for planting or diagnosing problems of established trees. Photosynthesis and growth can be light-limited in an urban canyon, so a shade-tolerant species may be more suitable for such conditions. Sites with extensive paving will have greater evaporative demand possibly requiring a more heat and drought tolerant plant. Species selection has to be evaluated in terms of existing soil conditions to avoid potential interactions with microclimatic conditions that can create greater stresses.

Introduction

While trees are used to improve aesthetics (11) and ameliorate climatic extremes (14) in cities, their growth and longevity are often less than desired (9). This is generally

[1]Received for publication January 27, 1992; in revised form April 20, 1992.

[2]Assistant Professor.

[3]Present address: Hortscience, Inc., 1257 Quarry Lane, Pleasanton, CA 94566.