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Herbicide Tolerance of Buffalograss

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Abstract

Buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.) is a low-maintenance turfgrass alternative in many parts of the United States. When buffalograss is seeded, competition from weeds can significantly delay establishment. Additional research is needed on buffalograss seedling tolerance to herbicides, including newer herbicides such as the sulfonylurea family. Research was conducted in 2004 near Mead, NE and in Fayetteville, AR to evaluate both preemergence and postemergence herbicide tolerance of seedling buffalograss. Foramsulfuron, imazapic, metsulfuron, MSMA, oxadiazon, pendimethalin, prodiamine, quinclorac, rimsulfuron, simazine, and trifloxysulfuron-sodium were applied to seedling buffalograss as per warm-season grass label rates. All herbicides evaluated exhibited moderate to excellent safety for newly established buffalograss. Some initial, moderate injury may be expected with foramsulfuron and imazapic, but any injury observed 4 weeks after application was deemed acceptable for all herbicides evaluated. In general, buffalograss is tolerant to a majority of the herbicides used with other warm-season grasses. In addition, buffalograss exhibited adequate seedling tolerance to the sulfonylurea herbicide family.

Introduction

The turfgrass industry and the general public continue to seek low-maintenance turfgrasses that require less fertilizer and water inputs while still maintaining acceptable turfgrass quality (1). Buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.), a native grass to the plains region of the United States, has excellent drought tolerance and is used as a low-maintenance, turfgrass alternative for many parts of the U.S. (11). Although buffalograss requires minimal inputs once established, a higher level of maintenance is generally required during the first year of growth to ensure an adequate stand. Proper fertilization and weed control during the year of establishment is essential to ensure adequate establishment of buffalograss and other turfgrasses (8). High weed pressure during the first year can greatly reduce turfgrass quality and affect density for several years. Herbicide tolerance of bermudagrass (*Cynodon dactylon* (L.) Pers.) and zoysiagrass (*Zoysia japonica* Steud.) during establishment has been adequately documented (2,3,5,9,12). Many of the herbicides evaluated in these studies are commonly used in warm-season turfgrass and generally provided equal or better turfgrass cover than control treatments by the end of the growing season.

Fry et al. (6) evaluated several common pre-emergence herbicides applied at the same time buffalograss was seeded. Dithiopyr (0.6 kg/ha), DCPA (11.8 kg/ha), pendimethalin (2.2 kg/ha), siduron (13.4 kg/ha), oryzalin (1.7 kg/ha), and benefin (1.1 kg/ha) + oryzalin (1.1 kg/ha) applications reduced buffalograss seedling number at 4 weeks after application. At 12 weeks after application, imazethapyr (0.07 kg/ha), simazine (1.1 kg/ha), pronamide (1.1 kg/ha), prodiamine (0.8 kg/ha), benefin (1.7 kg/ha), bensulide (8.4 kg/ha), oxadiazon (2.2 kg/ha), and benefin + oryzalin caused least buffalograss injury. Throughout the experiment, imazethapyr provided acceptable control of annual grass and broadleaf weeds with little observed buffalograss seedling injury.

Dotray and McKenney (4) evaluated several herbicides on both newly seeded and established buffalograss stands. Established buffalograss had good tolerance of benefin (3.4 kg/ha), benefin (1.7 kg/ha) + oryzalin (1.7 kg/ha), benefin (2.3 kg/ha) + trifluralin (1.1 kg/ha), DCPA (16.8 kg/ha), dithiopyr (0.6 kg/ha), isoxaben (1.1 kg/ha), oryzalin (2.2 kg/ha), pendimethalin (3.4 kg/ha), and prodiamine (1.7 kg/ha). However, established buffalograss was injured by atrazine (2.2 kg/ha), diuron (2.8 kg/ha), metolachlor (4.5 kg/ha), and simazine (2.2 kg/ha) up to 15 weeks after application. When the herbicides were applied within 1 day of seeding, alachlor (3.4 kg/ha), atrazine (2.2 kg/ha), dicamba (0.3 kg/ha), linuron (1.1 kg/ha), metolachlor (3.4 kg/ha), metribuzin (1.1 kg/ha), oryzalin (1.7 kg/ha), pendimethalin (1.7 kg/ha), and quinclorac (0.6 kg/ha) all severely reduced buffalograss cover. Only cyanazine (1.7 kg/ha), metsulfuron (0.017 kg/ha), propazine (1.7 kg/ha), and pyrithiobac (0.07 kg/ha) did not reduce buffalograss cover compared to the control when applied within 1 day of seeding.

Tolerance to various postemergence herbicides has been evaluated on established buffalograss stands (4). Initial injury was observed when asulam (2.24 kg/ha), MSMA (2.24 kg/ha), and sethoxydim (0.56 kg/ha) were applied. Little injury was observed with metsulfuron (0.017 kg/ha), quinclorac (0.56 kg/ha), and diclofop (1.12 kg/ha). Fry and Upham (7) also evaluated buffalograss seedling tolerance (1-3 leaves or 2-4 tillers) to some postemergence herbicides. Dithiopyr (0.6 kg/ha), quinclorac (0.8 kg/ha), MSMA (2.2 kg/ha), and clopyralid (0.8 kg/ha) did not significantly injure the buffalograss seedlings. Fenoxaprop-ethyl (0.2 kg/ha), triclopyr (0.6 kg/ha), 2,4-D (0.8 kg/ha), triclopyr (1.1 kg/ha) + 2,4-D (2.8 kg/ha), 2,4-D (3.1 kg/ha) + triclopyr (0.3 kg/ha) + clorpyralid (0.2 kg/ha), and 2,4-D (2.0 kg/ha) + mecoprop (1.1 kg/ha) + dicamba (0.2 kg/ha) caused significant buffalograss seedling injury. All of these treatments, except fenoxaprop-ethyl, recovered to acceptable levels after 6 weeks. In the second year of the study, metsulfuron methyl (0.04 kg/ha) did not exhibit any buffalograss injury or reduction in establishment.

Although herbicides have been evaluated for buffalograss establishment, little research has focused on newly available herbicide chemistries, such as the sulfonylurea herbicides. Further research is needed on buffalograss seedling tolerance to these and other herbicides. The objective of this experiment was to evaluate the tolerance of newly seeded buffalograss to various pre- and post-emergence herbicides in two climatic regions of the United States.

Buffalograss Seedling Herbicide Tolerance in Arkansas and Nebraska

A field experiment was conducted in 2004 at the John Seaton Anderson Turf and Ornamental Research Center near Mead, NE (Tomek silty clay loam; fine, montmorillonitic, mesic Typic Argiudoll) and at the University of Arkansas Research and Extension Center in Fayetteville, AR (Captina silt loam; fine-silty, siliceous, active, mesic Typic Fragiudults) to evaluate both preemergence and postemergence herbicide tolerance of seedling buffalograss. Each location received phosphorous and potassium fertilizer prior to planting according to soil test recommendations for warm-season grasses. Experimental areas were prepared to provide optimal germination conditions. ‘Cody’ buffalograss was seeded at a rate of 0.9 kg (2 lbs) of pure live seed on 29 June 2004 in Nebraska and 7 July 2004 in Arkansas. After seeding, the areas were lightly raked with a garden rake. Each location was irrigated to provide optimum moisture conditions for germination and establishment of the seed and to prevent water stress. Nitrogen was applied, beginning 14 days after first emergence and every 4 weeks thereafter as urea (46-0-0) at a rate of 24 kg N per ha. Beginning at 28 days after emergence, each location was mowed three times a week to a height of 3.7 cm with clippings returned. Seedlings emergence was observed within 2 weeks and herbicide treatments were applied when seedling reached the 1-2 tiller stage. Herbicide treatments (Table 1) were applied on 17 August 2004 in

Nebraska and 6 August 2004 in Arkansas with a CO_2-driven backpack sprayer equipped with a single 8002VS flat-fan nozzle. The experimental design was a randomized complete block with four replicates of each herbicide treatment. Plots were evaluated for herbicide injury (1-9; 1 = no injury and 9 = complete death) weekly after treatment. Analysis of variance and LSD (P = 0.05) were computed for each rating date at each site.

Table 1 [see Erratum*]. Herbicide injury ratings on 'Cody' buffalograss, as affected by pre- and post-emergence herbicides applied on seedling buffalograss 4 weeks after seeding (Fayetteville, AR) and 6 weeks after seeding (Lincoln, NE).

Herbicide	kg a.i. /ha	Formu- lation	Product rate	AR 4-wk old seedlings			NE 6-wk old seedlings		
				WAT[x]					
				1	3	4	2	3	4
				herbicide injury[y]					
UTC	—	—	—	1.0	1.0	1.0	1.0	1.0	1.3
foramsulfuron	0.0145	0.19 SC	0.2 oz/1000 ft²	1.0	1.0	1.0	1.7	1.0	1.0
foramsulfuron	0.029	0.19 SC	0.4 oz/1000 ft²	2.0	1.0	1.0	2.0	3.0	2.0
imazapic	0.07	2 EC	4 oz/acre	1.0	1.0	1.0	2.7	1.3	1.7
imazapic	0.107	2 EC	6 oz/acre	3.3	1.0	1.0	2.0	1.3	1.3
metsulfuron	0.021	60 WG	0.5 oz/acre	1.0	1.0	1.0	1.3	1.0	1.3
metsulfuron	0.042	60 WG	1.0 oz/acre	1.0	1.0	1.0	1.7	1.0	1.0
MSMA	1.56	6.6 SC	0.83 fl oz/1000 ft²	1.0	1.0	1.0	1.0	1.0	1.0
MSMA	1.74	6.6 SC	0.92 fl oz/1000 ft²	1.0	1.0	1.0	1.3	1.0	1.0
oxadiazon	2.2	2 G	2.25 lb/1000 ft²	1.0	1.0	1.0	1.7	1.7	1.7
oxadiazon	4.4	2 G	4.5 lb/1000 ft²	1.0	1.0	1.0	1.3	1.0	1.0
pendimethalin	2.3	3.3 EC	1.8 fl oz/1000 ft²	1.0	1.0	1.0	1.0	1.0	1.0
pendimethalin	3.3	3.3 EC	3.6 fl oz/1000 ft²	1.0	1.0	1.0	1.0	1.0	1.0
prodiamine	0.29	65 WG	0.4 lb/acre	1.0	1.0	1.0	1.0	1.0	1.0
prodiamine	0.58	65 WG	0.8 lb/acre	1.0	1.0	1.0	1.0	1.0	1.0
quinclorac	0.56	75 DF	0.245 oz/1000 ft²	1.0	1.0	1.0	1.0	1.3	1.3
quinclorac	0.84	75 DF	0.55 oz/1000 ft²	1.0	1.0	1.0	1.0	1.0	1.0
rimsulfuron	0.0175	25 DF	1 oz/acre	1.0	1.0	1.0	1.0	1.0	1.0
rimsulfuron	0.0351	25 DF	2 oz/acre	1.3	1.0	1.0	1.7	1.7	1.7
simazine	0.57	4 L	0.5 qt/acre	1.0	1.0	1.0	1.0	1.3	1.0
simazine	1.15	4 L	1.0 qt/acre	1.0	1.0	1.0	1.0	1.0	1.0
trifloxysulfuron -sodium	0.017	75 WG	0.33 oz/acre	—	—	—	1.7	1.3	1.0
trifloxysulfuron -sodium	0.029	75 WG	0.56 oz/acre	—	—	—	1.0	1.0	1.0
LSD (0.05)				1.3	ns	ns	1.0	0.7	0.8

[x] Abbreviations: LSD = Fisher's least significant difference (P = 0.05); ns = not significant (P = 0.05); UTC = untreated control; WAT = weeks after treatment.

[y] Herbicide injury rated visually (1 to 9 scale, 1 = no injury, 9 = complete death).

Some treatments caused visible injury to the buffalograss seedlings (Table 1); however, none of the treatments exhibited injury ratings above 3 at any rating date. Visible injury symptoms were not observed at 1 WAT in NE (*data not shown*). Imazapic caused significantly greater injury to the buffalograss in AR compared to the untreated control (UTC). In NE, higher injury ratings at 2 WAT were observed with both rates of imazapic and foramsulfuron. At 4 WAT, the herbicide injury symptoms for both locations were not statistically different than UTC for any herbicide treatment.

The herbicides evaluated in the experiment had moderate to excellent safety on newly established buffalograss (Table 1). Although some initial injury was observed, minimal injury was observed with any treatment at 4 WAT. Injury symptoms would likely be more severe under unfavorable growth conditions for buffalograss.

Overview: Buffalograss Herbicide Tolerance

In general, buffalograss is tolerant to a majority of the herbicides used with other warm-season grasses (Table 2). Also, buffalograss exhibited adequate seedling tolerance to the sulfonylurea herbicide group in the present study (Table 1). Buffalograss appears to have adequate seedling and/or established-turfgrass tolerance for benefin, bensulide, clorpyralid, diclofop, imazethapyr, metsulfuron, oxadiazon, pendimethalin, prodiamine, pronamide, quinclorac, rimsulfuron, simazine, and trifloxysulfuron-sodium when the label use recommendations were followed (Table 2). Based on previous results, some injury could occur from applications of asulam, benefin + oryzalin, 2,4-D, DCPA, dithiopyr, fenoxaprop-ethyl, mecoprop + 2,4-D, MSMA, oryzalin, pendimethalin, sethoxydim, siduron, triclopyr, triclopyr + 2,4-D, and triclopyr + 2,4-D + clorpyralid applied within the recommended use rates (Table 2). However, based on the results of the present study and previous trials, initial injury did not greatly reduce buffalograss cover or quality 4 to 6 weeks after application. Buffalograss treated with fenoxaprop-ethyl were the slowest to recover of all herbicides discussed.

Although many of the herbicides evaluated have shown safety to buffalograss, some herbicides are not currently labeled for this application. Turfgrass managers must always consult product labels prior to any herbicide application.

Table 2 [see Erratum*]. Relative herbicide susceptibility of seeded buffalograss.

	Common name	**Rate** (kg/ha)	**Suscept-ibility**[x]	**Author**[y]
Application at seeding	alachlor	3.4	●	4
	atrazine	2.2	●	4
	benefin	1.7	○	6
	benefin + oryzalin	1.1 + 1.1	●	6
	bensulide	8.4	○	6
	cyanazine	1.7	○	4
	DCPA	11.8	●	6
	dicamba	0.3	●	4
	dithiopyr	0.6	●	6
	imazethapyr	0.07	○	6
	linuron	1.1	●	4
	metolachlor	3.4	●	4
	metribuzin	1.1	●	4
	metsulfuron	0.017	○	4
	oryzalin	1.7	●	4, 6
	oxadiazon	2.2 to 4.4	○	6
	pendimethalin	1.7 to 2.2	●	4, 6
	prodiamine	0.29 to 0.8	○	6
	pronamide	1.1	○	6
	propazine	1.7	○	4
	pyrithiobac	0.7	○	4
	quinclorac	0.6	●	4
	siduron	13.4	●	6
	simazine	1.1 to 2.5	○	6

(continued)

Table 2. (continued).

	Common name	**Rate** (kg/ha)	**Suscept-ibility**[x]	**Author**[y]
Application to seedlings	2,4-D	0.8	⦿	7
	2,4-D + mecoprop + dicamba	2.0 + 1.1 + 0.2	⦿	7
	2,4-D + triclopyr	3.1 + 0.3	⦿	7
	2,4-D + triclopyr + clopyralid	3.1 + 0.3 + 0.2	⦿	7
	clopyralid	0.8	○	7
	dithiopyr	0.6	○	7
	fenoxaprop-ethyl	0.2	●	7
	foramsulfuron	0.0145	○	Table 1
		0.029	⦿	Table 1
	imazapic	0.07	○	Table 1
		0.107	⦿	Table 1
	metsulfuron	0.021 to 0.042	○	Table 1
	MSMA	1.56 to 2.2	○	7, Table 1
	oxadiazon	2.2 to 4.4	○	Table 1
	pendimethalin	2.27 to 3.28	○	Table 1
	prodiamine	0.29 to 0.58	○	Table 1
	quinclorac	0.56 to 0.84	○	7, Table 1
	rimsulfuron	0.018 to 0.035	○	Table 1
	simazine	0.87 to 1.15	○	Table 1
	triclopyr	0.6	⦿	7
	triclopyr + 2,4-D	1.1 + 2.8	⦿	7
	trifloxysulfuron-sodium	0.017 to 0.029	○	Table 1

(continued)

Table 2. (continued).

	Common name	Rate (kg/ha)	Suscept-ibility[x]	Author[y]
Application to established stand	asulam	2.24	◉	10
	atrazine	2.2	●	4
	benefin	3.4	○	4
	benefin + oryzalin	1.7 + 1.7	○	4
	benefin + trifluralin	2.3 + 1.1	○	4
	DCPA	16.8	○	4
	diclofop	1.12	○	10
	dithiopyr	0.6	○	4
	diuron	2.8	●	4
	isoxaben	1.1	○	4
	metolachlor	4.5	●	4
	metsulfuron	0.017	○	10
	MSMA	2.24	◉	10
	oryzalin	2.2	○	4
	pendimethalin	3.4	○	4
	prodiamine	1.7	○	4
	quinclorac	0.56	○	10
	sethoxydim	0.56	◉	10
	simazine	2.2	○	4

[x] Susceptibility: ● = susceptible, ◉ = moderately susceptible, and ○ = tolerant.

[y] Number refers to reference number in Literature Cited; Table 1 = modified from Table 1.

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