

EVALUATION OF POSTEMERGENCE HERBICIDES ON EIGHT NATIVE GRASS SPECIES GROWN FOR SEED, 2000-2001

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Abstract

Herbicide screenings were conducted on eight native grass species: great basin wildrye, bluebunch wheatgrass, streambank wheatgrass, big bluegrass, Idaho fescue, Indian ricegrass, squirreltail, and prairie junegrass. Fall-applied treatments on October 18, 2000, included 1x and 2x rates of Axiom[®], Beacon[®], Clarity[®], Diuron[®], Frontier[®], Goal[®], Kerb[®], Maverick[®], Sencor[®], Sinbar[®], and Surflan[®]. Dormant application of Maverick, Milestone[®], Rely[®], and Roundup[®] were made November 3, 2000. Herbicides causing the most damage across grass species were Roundup applied during dormancy, and 2x fall-applied treatments of Sinbar and Kerb. Herbicides applied at a 2x rate that caused the least damage were Frontier, Goal, and Surflan. The greatest reduction on heading across the herbicide treatments was on Idaho fescue, prairie junegrass, and squirreltail. Grass species with the least effect on heading following herbicide treatments were bluebunch wheatgrass, great basin wildrye, and streambank wheatgrass.

Introduction

The demand for seed of native grasses used to reseed burned or otherwise disturbed rangelands continues to increase. Because agricultural production of native grasses is relatively new, management practices are still in the process of being determined. One of the major factors for successful production is adequate weed control. The objective of this project is to evaluate the crop safety of potential herbicides that may be used in native grass seed production.

Materials and Methods

On April 20, 2000 big bluegrass, bluebunch wheatgrass, squirreltail, great basin wildrye, streambank wheatgrass, and Idaho fescue were planted at a rate of 45 seeds/ft. Indian ricegrass was planted at a rate of 90 seeds/ft and prairie junegrass was planted at 135 seeds/ft. A four-row small-plot cone planter (Almaco, Inc.) was used, with a planting depth of 0.25 in. Plots were a single row, 80 ft long, with 2-ft row spacing. Plots were irrigated as needed to keep the seed zone moist for 2 weeks following planting. Weeds were controlled by hoeing and cultivation, with no herbicides applied prior to plot treatment.

Most herbicides were applied at both 1x and 2x rates. Application timing included fall-applied herbicides on October 18 and herbicides applied during dormancy on November 3, 2000. Treatments were applied with a CO₂-pressurized, hand-held, boom sprayer at 40 psi and 20 gal/acre water in 9-ft bands perpendicular to the grass rows. A non-ionic surfactant was added at 0.5 percent v/v to the November 3 application of Maverick only.

Evaluations were conducted using a rating scale from 0 (no negative effect) to 5 (maximum negative effect). Plots were evaluated for stunting, chlorosis, and mortality on March 27 and 28, 2001. Reduced heading was evaluated June 16-19, and stand reduction was evaluated November

2, 2001. Data were analyzed as a randomized complete block design, and no comparisons were made between grasses.

Results

Table 1 is a summary of the results for herbicide treatments across the eight native grass species for both stand reduction and reduced heading. Less than 10 percent damage is indicated by a +, more than 50 percent damage is shown with a -, while 10-50 percent damage received a 0. Separate numerical ratings for the effect of herbicide treatments on reducing heading and stand reduction are provided in tables 2 and 3.

Treatments that caused the most damage across grass species were Roundup at 1.5 pint/acre applied during dormancy, and 2x fall-applied treatments of Sinbar at 1.5 lb/acre and Kerb at 0.8 lb/acre. The safest herbicides at the 2x rate across grass species were Frontier at 64 fl oz/acre, Goal at 20 oz/acre and Surflan at 6 qt/acre. Other 2x herbicide treatments that were relatively safe include Axiom at 22 oz/acre, Beacon at 1.52 oz/acre, Maverick at 1.34 oz/acre and Milestone at 4 oz/acre.

Stand reduction following herbicide treatments was the greatest for Indian ricegrass and great basin wildrye, followed by squirreltail, prairie junegrass, and Idaho fescue. Stands were least affected by herbicide treatments for streambank wheatgrass and big bluegrass.

Grass species where heading was least affected following herbicide treatments were bluebunch wheatgrass, great basin wildrye, and streambank wheatgrass. Grass species with the greatest reduction in heading following herbicide treatments were Idaho fescue, prairie junegrass, and squirreltail. It is interesting to note that herbicide treatments on these three species generally had little effect on stand reduction but did cause a strong reduction in heading.

Table 4 through Table 11 provide results by grass species for stunting, chlorosis, mortality, stand reduction, and reduced heading following each of the herbicide treatments.

Table 1. Summary of herbicide effect on stand reduction (SR) evaluated on November 2 and reduced heading (RH) evaluated on June 16-19 across native grass species, 2001.

Treatment	Rate/acre	Timing	Gr basn wrye		Blbnch whtgr		Strmbk whtgr		Big blgr		Idaho fescue		Indianricegr		Squirreltail		Pr. junegr	
			SR	RH	SR	RH	SR	RH	SR	RH	SR	RH	SR	RH	SR	RH	SR	RH
Axiom	11 oz	fall	0 ¹	0	+	+	+	0	+	-	+	0	0	0	+	+	+	-
Axiom	22 oz	fall	+	+	+	0	+	0	+	-	+	-	+	0	0	+	0	-
Beacon	0.76 oz	fall	0	+	+	+	0	0	+	+	+	0	+	0	+	0	+	0
Beacon	1.52 oz	fall	+	0	0	+	+	0	+	+	+	0	+	0	+	-	0	-
Clarity	4 pt	fall	0	0	+	0	0	0	+	0	0	-	0	0	0	-	0	-
Clarity	8 pt	fall	0	-	0	-	+	-	+	0	0	-	0	-	0	-	+	-
Diuron	1.8 lb	fall	+	+	0	+	+	+	+	0	+	0	0	0	+	0	0	-
Diuron	3.6 lb	fall	0	0	0	-	0	0	+	-	0	-	0	0	-	-	0	-
Frontier	32 fl oz	fall	0	0	+	+	+	+	+	0	0	0	-	0	+	+	+	0
Frontier	64 fl oz	fall	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	0
Goal	10 fl oz	fall	+	+	+	+	+	+	+	+	+	0	0	+	+	0	0	+
Goal	20 fl oz	fall	0	+	+	+	+	+	+	+	+	0	0	0	+	-	+	0
Kerb	0.4 lb	fall	0	-	0	-	+	0	0	-	0	-	0	0	-	-	+	-
Kerb	0.8 lb	fall	-	-	-	-	+	-	-	-	-	-	0	0	-	-	-	-
Maverick	0.67 oz	fall	0	+	+	+	+	+	+	+	0	-	0	0	0	0	+	0
Maverick	1.34 oz	fall	0	0	+	+	+	0	+	0	0	-	0	0	+	+	+	-
Maverick	0.67 oz	dormant	0	0	+	+	+	0	+	0	0	-	0	0	+	-	0	-
Milestone	2 oz	dormant	+	+	0	+	+	+	+	+	+	0	0	0	+	-	+	+
Milestone	4 oz	dormant	0	+	+	+	+	+	+	0	0	0	0	0	+	+	0	0
Rely	3 pt	dormant	+	+	0	0	+	+	+	0	+	0	0	0	+	-	+	0
Roundup	1.5 pt	dormant	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-
Sencor	0.4 lb	fall	0	0	+	+	+	+	+	0	+	0	+	0	0	0	0	+
Sencor	0.8 lb	fall	0	+	+	+	0	0	-	-	0	-	0	0	0	0	0	-
Sinbar	0.75 lb	fall	+	0	+	0	+	0	0	0	+	0	+	0	-	-	0	0
Sinbar	1.5 lb	fall	-	-	-	-	-	-	-	-	-	-	+	0	-	-	-	-
Surflan	3 qt	fall	0	+	+	+	+	+	+	+	+	0	0	0	+	+	+	0
Surflan	6 qt	fall	+	+	0	+	+	+	+	+	0	0	0	+	0	+	+	0
Control	---	----	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

¹ Symbol key: + = <10% damage , 0 = 10-50% damage, - = >50% damage.

Table 2. Effect of herbicide treatments on reduced heading of native grass species evaluated on June 16-19, 2001.

Treatment	Rate	Timing	Gr basn wrye	Blbnch whtgr	Strmbk whtgr	Big blgr	Idaho fescue	Indianriceg	Squirreltail	Pr. junegr
Axiom	11 oz	fall	0.5 ¹ a ²	0.3 a	0.6 ab	2.7 c	1.7 cdef	1.1	0.0	2.5 bcd
Axiom	22 oz	fall	0.0 a	0.7 a	1.1 ab	4.0 d	2.7 fgh	1.3	0.3	4.0 de
Beacon	0.76 oz	fall	0.0 a	0.2 a	1.0 ab	0.2 a	1.2 bcde	0.8	0.9	1.7 abc
Beacon	1.52 oz	fall	0.8 ab	0.3 a	1.7 bc	0.2 a	2.0 def	1.7	5.0	4.0 de
Clarity	4 pt	fall	1.5 ab	2.0 b	2.4 cd	1.0 a	3.5 ghi	2.2	5.0	2.7 cde
Clarity	8 pt	fall	2.6 ab	3.0 c	2.6 cd	0.7 a	3.5 ghi	2.8	4.1	3.0 cde
Diuron	1.8 lb	fall	0.0 a	0.2 a	0.3 ab	0.5 a	1.0 abcd	0.6	1.9	4.3 e
Diuron	3.6 lb	fall	1.5 ab	3.0 c	1.0 ab	2.5 bc	2.5 efg	2.4	5.0	5.0 e
Frontier	32 fl oz	fall	0.8 ab	0.0 a	0.3 ab	0.5 a	1.7 cdef	1.9	0.0	2.0 abc
Frontier	64 fl oz	fall	0.3 a	0.3 a	0.2 a	0.2 a	3.5 ghi	0.2	0.0	2.0 abc
Goal	10 fl oz	fall	0.0 a	0.2 a	0.0 a	0.0 a	0.7 abcd	0.0	1.9	0.0 a
Goal	20 fl oz	fall	0.4 a	0.0 a	0.4 ab	0.0 a	1.0 abcd	0.6	3.4	0.5 ab
Kerb	0.4 lb	fall	2.7 ab	3.4 c	2.3 cd	4.5 d	3.7 hij	1.1	4.1	4.0 de
Kerb	0.8 lb	fall	4.1 b	4.6 de	3.0 d	5.0 d	5.0 k	1.7	4.1	5.0 e
Maverick	0.67 oz	fall	0.3 a	0.2 a	0.3 ab	0.2 a	2.7 fgh	1.3	0.9	1.0 abc
Maverick	1.34 oz	fall	0.8 ab	0.3 a	0.6 ab	1.0 a	4.2 ijk	2.4	0.3	2.5 bcd
Maverick	0.67 oz	dormant	1.2 ab	0.3 a	0.9 ab	1.5 ab	4.0 ijk	2.2	3.4	3.0 cde
Milestone	2 oz	dormant	0.0 a	0.2 a	0.3 ab	0.2 a	0.5 abc	1.1	2.8	0.0 a
Milestone	4 oz	dormant	0.0 a	0.2 a	0.0 a	0.5 a	2.0 def	1.1	0.0	2.0 abc
Rely	3 pt	dormant	0.3 a	1.3 ab	0.0 a	0.5 a	1.5 bcdef	0.8	3.4	1.3 abc
Roundup	1.5 pt	dormant	4.1 b	5.0 e	4.7 e	5.0 d	4.7 jk	2.8	4.1	5.0 e
Sencor	0.4 lb	fall	0.5 ab	0.4 a	0.0 a	0.5 a	1.0 abcd	1.1	1.3	0.3 abc
Sencor	0.8 lb	fall	0.0 a	0.0 a	0.7 ab	4.5 d	2.5 efg	0.6	0.9	3.0 cde
Sinbar	0.75 lb	fall	1.2 ab	1.3 ab	0.9 ab	2.2 bc	1.5 bcdef	0.6	5.0	1.3 abc
Sinbar	1.5 lb	fall	2.8 ab	4.1 d	5.0 e	5.0 d	4.5 ijk	1.9	3.4	5.0 e
Surflan	3 qt	fall	0.0 a	0.0 a	0.0 a	0.0 a	0.7 abcd	0.6	0.0	1.0 abc
Surflan	6 qt	fall	0.0 a	0.4 a	0.3 ab	0.2 a	0.7 abcd	0.2	0.3	1.3 abc
Control	---	---	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0	0.0	0.0 a
								NS	NS	

¹ Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

² Mean separation with Student-Newman-Kuels Test at $P \leq 0.05$.

Table 3. Effect of herbicide treatments on stand reduction of native grass species evaluated on November 2, 2001.

Treatment	Rate	Timing	Gr basn wrye	Blbnch whtgr	Strmbk whtgr	Big blgr	Idaho fescue	Indianriceg	Squirreltail	Pr. junegr
Axiom	11 oz	fall	0.5 ¹ ab ²	0.2 a	0.4	0.0 a	0.1 a	0.6	0.0 ab	0.1
Axiom	22 oz	fall	0.1 a	0.0 a	0.0	0.1 a	0.3 a	0.0	2.1 ab	2.2
Beacon	0.76 oz	fall	1.0 ab	0.0 a	0.6	0.0 a	0.3 a	0.0	0.4 ab	0.4
Beacon	1.52 oz	fall	0.2 a	0.6 a	0.3	0.3 a	0.0 a	0.0	0.0 ab	2.0
Clarity	4 pt	fall	0.5 ab	0.2 a	0.6	0.1 a	0.7 a	1.2	2.1 ab	1.3
Clarity	8 pt	fall	0.9 ab	1.4 a	0.1	0.0 a	1.4 a	1.7	0.8 ab	0.0
Diuron	1.8 lb	fall	0.0 a	0.0 a	0.0	0.0 a	0.1 a	0.9	0.0 ab	1.0
Diuron	3.6 lb	fall	1.3 ab	2.3 ab	0.5	0.1 a	1.7 a	2.1	3.8 ab	2.0
Frontier	32 fl oz	fall	1.8 ab	0.0 a	0.0	0.0 a	1.2 a	2.7	0.0 ab	0.0
Frontier	64 fl oz	fall	0.0 a	0.0 a	0.0	0.0 a	0.0 a	0.0	0.0 ab	0.4
Goal	10 fl oz	fall	0.0 a	0.0 a	0.0	0.0 a	0.3 a	0.9	0.0 ab	0.7
Goal	20 fl oz	fall	0.7 ab	0.2 a	0.0	0.0 a	0.1 a	0.9	0.0 ab	0.1
Kerb	0.4 lb	fall	1.8 ab	1.1 a	0.0	2.2 b	1.7 a	1.5	3.8 ab	0.1
Kerb	0.8 lb	fall	3.0 b	4.6 c	0.2	4.7 c	4.1 c	1.5	4.6 ab	2.9
Maverick	0.67 oz	fall	1.0 ab	0.2 a	0.0	0.3 a	1.2 a	0.9	1.3 ab	0.0
Maverick	1.34 oz	fall	0.9 ab	0.2 a	0.3	0.1 a	1.2 a	1.5	0.0 a	0.0
Maverick	0.67 oz	dormant	1.0 ab	0.0 a	0.0	0.0 a	0.7 a	0.9	0.0 ab	0.7
Milestone	2 oz	dormant	0.0 a	0.8 a	0.2	0.0 a	0.1 a	0.6	0.4 ab	0.1
Milestone	4 oz	dormant	0.5 ab	0.0 a	0.0	0.0 a	1.2 a	1.5	0.4 ab	0.5
Rely	3 pt	dormant	0.0 a	2.3 ab	0.0	0.0 a	0.3 a	0.6	0.0 ab	0.1
Roundup	1.5 pt	dormant	1.9 ab	5.0 c	3.0	4.9 c	3.0 b	1.5	5.0 ab	4.6
Sencor	0.4 lb	fall	1.0 ab	0.0 a	0.2	0.0 a	0.3 a	0.3	1.7 ab	0.7
Sencor	0.8 lb	fall	0.5 ab	0.0 a	0.6	3.9 c	1.2 a	0.6	0.8 ab	1.6
Sinbar	0.75 lb	fall	0.0 a	0.2 a	0.0	2.0 b	0.3 a	0.0	5.0 ab	1.0
Sinbar	1.5 lb	fall	3.0 b	3.5 bc	5.0	5.0 c	5.0 c	0.3	5.0 b	5.0
Surflan	3 qt	fall	0.8 ab	0.2 a	0.0	0.1 a	0.3 a	0.6	0.4 ab	0.0
Surflan	6 qt	fall	0.2 a	0.5 a	0.2	0.1 a	0.9 a	0.6	1.3 ab	0.1
Control	---	---	0.0 a	0.0 a	0.0	0.0 a	0.0 a	0.0	0.0 a	0.0
					NS			NS		NS

¹ Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

² Mean separation with Student-Newman-Kuels Test at $P \leq 0.05$.

Table 4. Effect of herbicide treatments on Idaho fescue, 2001.

Treatment	Rate/acre	Timing	Stunting	Chlorosis	Mortality	Stand reduction	Reduced heading
Axiom	11 oz	fall	0.6 ¹ abc ²	1.5 abcdefg	0.0 a	0.1 a	1.7 cdef
Axiom	22 oz	fall	0.6 abc	2.4 fgh	0.6 abcd	0.3 a	2.7 fgh
Beacon	0.76 oz	fall	0.0 a	0.9 abcde	0.0 a	0.3 a	1.2 bcde
Beacon	1.52 oz	fall	0.5 abc	1.3 abcdef	0.0 a	0.0 a	2.0 def
Clarity	4 pt	fall	0.9 abc	1.7 bcdefgh	0.0 a	0.7 a	3.5 ghi
Clarity	8 pt	fall	0.3 ab	2.0 defgh	0.4 abc	1.4 a	3.5 ghi
Diuron	1.8 lb	fall	0.1 a	0.3 ab	0.1 a	0.1 a	1.0 abcd
Diuron	3.6 lb	fall	0.9 abc	2.0 defgh	0.4 abc	1.7 a	2.5 efg
Frontier	32 fl oz	fall	0.5 abc	1.5 abcdefg	0.0 a	1.2 a	1.7 cdef
Frontier	64 fl oz	fall	0.0 a	2.3 efgh	0.4 abc	0.0 a	3.5 ghi
Goal	10 fl oz	fall	0.0 a	0.6 abcd	0.1 a	0.3 a	0.7 abcd
Goal	20 fl oz	fall	0.0 a	0.3 ab	0.0 a	0.1 a	1.0 abcd
Kerb	0.4 lb	fall	0.0 a	2.7 fghi	0.8 abcd	1.7 a	3.7 hij
Kerb	0.8 lb	fall	0.5 abc	3.8 i	1.1 cde	4.1 c	5.0 k
Maverick	0.67 oz	fall	0.1 a	1.7 bcdefgh	0.1 a	1.2 a	2.7 fgh
Maverick	1.34 oz	fall	1.6 c	3.8 i	1.2 de	1.2 a	4.2 ijk
Maverick	0.67 oz	dormant	0.1 a	3.2 hi	1.0 bcde	0.7 a	4.0 ijk
Milestone	2 oz	dormant	0.0 a	0.1 a	0.0 a	0.1 a	0.5 abc
Milestone	4 oz	dormant	0.3 ab	1.3 abcdef	0.2 ab	1.2 a	2.0 def
Rely	3 pt	dormant	0.5 abc	1.8 cdefgh	0.7 abcd	0.3 a	1.5 bcdef
Roundup	1.5 pt	dormant	0.3 ab	5.0 j	4.4 f	3.0 b	4.7 jk
Sencor	0.4 lb	fall	0.0 a	0.0 a	0.0 a	0.3 a	1.0 abcd
Sencor	0.8 lb	fall	0.5 abc	1.7 bcdefgh	0.1 a	1.2 a	2.5 efg
Sinbar	0.75 lb	fall	0.0 a	1.5 abcdefg	0.2 ab	0.3 a	1.5 bcdef
Sinbar	1.5 lb	fall	1.5 bc	2.8 ghi	1.6 e	5.0 c	4.5 ijk
Surflan	3 qt	fall	0.0 a	0.5 abc	0.0 a	0.3 a	0.7 abcd
Surflan	6 qt	fall	0.3 ab	1.3 abcdef	0.0 a	0.9 a	0.7 abcd
Control	---	---	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a

¹Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

²Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 5. Effect of herbicide treatments on great basin wildrye, 2001.

Treatment	Rate/acre	Timing	Stunting	Chlorosis	Mortality	Stand reduction	Reduced heading
Axiom	11 oz	fall	0.0 ¹	0.5 ab ²	0.0 a	0.5 ab	0.5 a
Axiom	22 oz	fall	0.1	0.0 a	0.0 a	0.1 a	0.0 a
Beacon	0.76 oz	fall	0.1	0.5 ab	0.0 a	1.0 ab	0.0 a
Beacon	1.52 oz	fall	0.7	2.5 cd	0.9 a	0.2 a	0.8 ab
Clarity	4 pt	fall	0.0	0.2 ab	0.0 a	0.5 ab	1.5 ab
Clarity	8 pt	fall	0.1	1.3 abc	0.2 a	0.9 ab	2.6 ab
Diuron	1.8 lb	fall	0.0	0.5 ab	0.0 a	0.0 a	0.0 a
Diuron	3.6 lb	fall	0.0	0.8 ab	0.2 a	1.3 ab	1.5 ab
Frontier	32 fl oz	fall	0.1	0.5 ab	0.0 a	1.8 ab	0.8 ab
Frontier	64 fl oz	fall	0.1	0.0 a	0.0 a	0.0 a	0.3 a
Goal	10 fl oz	fall	0.1	0.0 a	0.0 a	0.0 a	0.0 a
Goal	20 fl oz	fall	0.0	0.3 ab	0.0 a	0.7 ab	0.4 a
Kerb	0.4 lb	fall	0.1	3.3 de	1.9 ab	1.8 ab	2.7 ab
Kerb	0.8 lb	fall	0.5	4.1 ef	2.6 b	3.0 b	4.1 b
Maverick	0.67 oz	fall	0.7	1.9 bcd	0.8 a	1.0 ab	0.3 a
Maverick	1.34 oz	fall	0.3	2.3 cd	0.7 a	0.9 ab	0.8 ab
Maverick	0.67 oz	dormant	0.7	2.4 cd	1.9 ab	1.0 ab	1.2 ab
Milestone	2 oz	dormant	0.5	0.1 ab	0.0 a	0.0 a	0.0 a
Milestone	4 oz	dormant	0.1	0.1 a	0.0 a	0.5 ab	0.0 a
Rely	3 pt	dormant	0.1	0.0 a	0.0 a	0.0 a	0.3 a
Roundup	1.5 pt	dormant	1.0	5.0 f	4.8 c	1.9 ab	4.1 b
Sencor	0.4 lb	fall	0.0	0.0 a	0.0 a	1.0 ab	0.5 ab
Sencor	0.8 lb	fall	0.1	0.1 ab	0.2 a	0.5 ab	0.0 a
Sinbar	0.75 lb	fall	0.0	0.1 a	0.0 a	0.0 a	1.2 ab
Sinbar	1.5 lb	fall	0.5	0.7 ab	0.0 a	3.0 b	2.8 ab
Surflan	3 qt	fall	0.1	0.2 ab	0.0 a	0.8 ab	0.0 a
Surflan	6 qt	fall	0.1	0.1 a	0.0 a	0.2 a	0.0 a
Control	---	---	0.0	0.0 a	0.0 a	0.0 a	0.0 a

NS

¹Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

²Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 6. Effect of herbicide treatments on bluebunch wheatgrass, 2001.

Treatment	Rate/acre	Timing	Stunting	Chlorosis	Mortality	Stand reduction	Reduced heading
Axiom	11 oz	fall	0.3 ¹ abc ²	0.6 ab	0.0 a	0.2 a	0.3 a
Axiom	22 oz	fall	0.1 abc	0.0 a	0.0 a	0.0 a	0.7 a
Beacon	0.76 oz	fall	0.2 abc	0.3 a	0.0 a	0.0 a	0.2 a
Beacon	1.52 oz	fall	0.9 abc	0.9 ab	0.2 a	0.6 a	0.3 a
Clarity	4 pt	fall	0.7 abc	0.7 ab	0.0 a	0.2 a	2.0 b
Clarity	8 pt	fall	0.6 abc	1.3 abc	0.0 a	1.4 a	3.0 c
Diuron	1.8 lb	fall	0.5 abc	0.0 a	0.0 a	0.0 a	0.2 a
Diuron	3.6 lb	fall	1.3 abcd	2.4 c	0.8 a	2.3 ab	3.0 c
Frontier	32 fl oz	fall	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Frontier	64 fl oz	fall	0.0 a	0.1 a	0.0 a	0.0 a	0.3 a
Goal	10 fl oz	fall	0.0 a	0.0 a	0.0 a	0.0 a	0.2 a
Goal	20 fl oz	fall	0.0 a	0.0 a	0.0 a	0.2 a	0.0 a
Kerb	0.4 lb	fall	1.5 cde	3.7 d	1.6 a	1.1 a	3.4 c
Kerb	0.8 lb	fall	2.3 de	4.5 de	2.7 b	4.6 c	4.6 de
Maverick	0.67 oz	fall	0.0 a	0.0 a	0.0 a	0.2 a	0.2 a
Maverick	1.34 oz	fall	0.1 abc	0.0 a	0.0 a	0.2 a	0.3 a
Maverick	0.67 oz	dormant	0.1 abc	0.3 a	0.0 a	0.0 a	0.3 a
Milestone	2 oz	dormant	0.0 ab	0.2 a	0.0 a	0.8 a	0.2 a
Milestone	4 oz	dormant	0.0 a	0.0 a	0.0 a	0.0 a	0.2 a
Rely	3 pt	dormant	1.5 bcde	2.1 bc	0.3 a	2.3 ab	1.3 ab
Roundup	1.5 pt	dormant	2.6 e	5.0 e	5.0 c	5.0 c	5.0 e
Sencor	0.4 lb	fall	0.0 a	0.0 a	0.0 a	0.0 a	0.4 a
Sencor	0.8 lb	fall	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Sinbar	0.75 lb	fall	0.3 abc	0.6 ab	0.0 a	0.2 a	1.3 ab
Sinbar	1.5 lb	fall	0.9 abc	1.6 abc	0.6 a	3.5 bc	4.1 d
Surflan	3 qt	fall	0.0 a	0.3 a	0.0 a	0.2 a	0.0 a
Surflan	6 qt	fall	0.0 a	0.0 a	0.0 a	0.5 a	0.4 a
Control	---	---	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a

¹Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

²Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 7. Effect of herbicide treatments on Indian ricegrass, 2001.

Treatment	Rate/acre	Timing	Stunting	Chlorosis	Mortality	Stand reduction	Reduced heading
Axiom	11 oz	fall	0.0 ¹	0.5 ab ²	0.0	0.6	1.1
Axiom	22 oz	fall	0.0	0.0 a	0.0	0.0	1.3
Beacon	0.76 oz	fall	0.1	0.0 a	0.0	0.0	0.8
Beacon	1.52 oz	fall	0.1	0.3 ab	0.0	0.0	1.7
Clarity	4 pt	fall	0.0	0.9 ab	0.2	1.2	2.2
Clarity	8 pt	fall	0.6	1.1 ab	0.6	1.7	2.8
Diuron	1.8 lb	fall	0.2	0.5 ab	0.1	0.9	0.6
Diuron	3.6 lb	fall	0.1	0.6 ab	0.4	2.1	2.4
Frontier	32 fl oz	fall	0.1	0.5 ab	0.1	2.7	1.9
Frontier	64 fl oz	fall	0.0	0.0 a	0.0	0.0	0.2
Goal	10 fl oz	fall	0.0	0.0 a	0.0	0.9	0.0
Goal	20 fl oz	fall	0.1	0.1 a	0.0	0.9	0.6
Kerb	0.4 lb	fall	0.2	0.5 ab	0.1	1.5	1.1
Kerb	0.8 lb	fall	0.7	1.8 ab	1.2	1.5	1.7
Maverick	0.67 oz	fall	0.1	0.1 a	0.0	0.9	1.3
Maverick	1.34 oz	fall	0.2	1.5 ab	0.4	1.5	2.4
Maverick	0.67 oz	dormant	0.6	0.7 ab	0.2	0.9	2.2
Milestone	2 oz	dormant	0.0	0.0 a	0.0	0.6	1.1
Milestone	4 oz	dormant	0.7	1.1 ab	1.1	1.5	1.1
Rely	3 pt	dormant	0.2	0.3 ab	0.0	0.6	0.8
Roundup	1.5 pt	dormant	0.2	2.4 b	1.2	1.5	2.8
Sencor	0.4 lb	fall	0.0	0.1 a	0.0	0.3	1.1
Sencor	0.8 lb	fall	0.1	0.1 a	0.0	0.6	0.6
Sinbar	0.75 lb	fall	0.0	0.0 a	0.0	0.0	0.6
Sinbar	1.5 lb	fall	0.2	0.5 ab	0.0	0.3	1.9
Surflan	3 qt	fall	0.1	0.0 a	0.0	0.6	0.6
Surflan	6 qt	fall	0.0	0.3 ab	0.0	0.6	0.2
Control	---	---	0.0	0.0 a	0.0	0.0	0.0
			NS		NS	NS	NS

¹Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

²Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 8. Effect of herbicide treatments on streambank wheatgrass, 2001.

Treatment	Rate/acre	Timing	Stunting	Chlorosis	Mortality	Stand reduction	Reduced heading
Axiom	11 oz	fall	0.1 ¹	0.3 ab ²	0.0	0.4 a	0.6 ab
Axiom	22 oz	fall	0.1	0.3 ab	0.0	0.0 a	1.1 ab
Beacon	0.76 oz	fall	0.6	0.7 ab	0.0	0.6 a	1.0 ab
Beacon	1.52 oz	fall	0.7	1.7 cd	0.3	0.3 a	1.7 bc
Clarity	4 pt	fall	0.8	1.8 cd	0.0	0.6 a	2.4 cd
Clarity	8 pt	fall	1.1	1.7 cd	0.0	0.1 a	2.6 cd
Diuron	1.8 lb	fall	0.0	0.0 a	0.0	0.0 a	0.3 ab
Diuron	3.6 lb	fall	0.1	0.7 ab	0.0	0.5 a	1.0 ab
Frontier	32 fl oz	fall	0.9	0.1 ab	0.0	0.0 a	0.3 ab
Frontier	64 fl oz	fall	0.0	0.0 a	0.0	0.0 a	0.2 a
Goal	10 fl oz	fall	0.0	0.0 a	0.0	0.0 a	0.0 a
Goal	20 fl oz	fall	0.0	0.0 a	0.0	0.0 a	0.4 ab
Kerb	0.4 lb	fall	0.9	3.1 e	0.6	0.0 a	2.3 cd
Kerb	0.8 lb	fall	1.3	3.3 e	1.1	0.2 a	3.0 d
Maverick	0.67 oz	fall	0.3	0.2 ab	0.0	0.0 a	0.3 ab
Maverick	1.34 oz	fall	0.4	0.5 ab	0.0	0.3 a	0.6 ab
Maverick	0.67 oz	dormant	0.7	0.3 ab	0.0	0.0 a	0.9 ab
Milestone	2 oz	dormant	0.2	0.1 ab	0.0	0.2 a	0.3 ab
Milestone	4 oz	dormant	0.0	0.5 ab	0.0	0.0 a	0.0 a
Rely	3 pt	dormant	0.4	1.3 bc	0.0	0.0 a	0.0 a
Roundup	1.5 pt	dormant	1.1	4.7 f	3.6	3.0 b	4.7 e
Sencor	0.4 lb	fall	0.3	0.0 a	0.0	0.2 a	0.0 a
Sencor	0.8 lb	fall	0.2	0.5 ab	0.0	0.6 a	0.7 ab
Sinbar	0.75 lb	fall	0.0	1.3 bc	0.0	0.0 a	0.9 ab
Sinbar	1.5 lb	fall	0.9	2.5 de	0.2	5.0 c	5.0 e
Surflan	3 qt	fall	0.0	0.1 ab	0.0	0.0 a	0.0 a
Surflan	6 qt	fall	0.2	0.1 ab	0.0	0.2 a	0.3 ab
Control	---	---	0.0	0.0 a	0.0	0.0 a	0.0 a
			NS		NS		

¹Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

²Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 9. Effect of herbicide treatments on prairie junegrass, 2001.

Treatment	Rate/acre	Timing	Stunting	Chlorosis	Mortality	Stand reduction	Reduced heading
Axiom	11 oz	fall	0.0 ¹	1.3 abc ²	0.0 a	0.1	2.5 bcd
Axiom	22 oz	fall	0.8	2.2 cd	0.8 ab	2.2	4.0 de
Beacon	0.76 oz	fall	0.2	0.8 abc	0.2 a	0.4	1.7 abc
Beacon	1.52 oz	fall	0.1	1.2 abc	0.4 a	2.0	4.0 de
Clarity	4 pt	fall	0.8	0.6 ab	0.1 a	1.3	2.7 cde
Clarity	8 pt	fall	0.0	0.8 abc	0.0 a	0.0	3.0 cde
Diuron	1.8 lb	fall	1.4	3.8 ef	3.4 c	1.0	4.3 e
Diuron	3.6 lb	fall	0.5	4.3 fg	4.6 d	2.0	5.0 e
Frontier	32 fl oz	fall	0.0	0.9 abc	0.0 a	0.0	2.0 abc
Frontier	64 fl oz	fall	0.4	0.8 abc	0.1 a	0.4	2.0 abc
Goal	10 fl oz	fall	0.1	0.1 ab	0.1 a	0.7	0.0 a
Goal	20 fl oz	fall	0.0	0.3 ab	0.0 a	0.1	0.5 ab
Kerb	0.4 lb	fall	0.5	1.4 abc	0.0 a	0.1	4.0 de
Kerb	0.8 lb	fall	0.2	1.7 bcd	0.0 a	2.9	5.0 e
Maverick	0.67 oz	fall	0.0	1.1 abc	0.0 a	0.0	1.0 abc
Maverick	1.34 oz	fall	0.6	1.3 abc	0.0 a	0.0	2.5 bcd
Maverick	0.67 oz	dormant	0.4	1.6 bc	0.4 a	0.7	3.0 cde
Milestone	2 oz	dormant	0.2	0.6 ab	0.2 a	0.1	0.0 a
Milestone	4 oz	dormant	0.0	1.3 abc	0.0 a	0.5	2.0 abc
Rely	3 pt	dormant	0.7	2.3 cd	1.1 ab	0.1	1.3 abc
Roundup	1.5 pt	dormant	1.2	5.0 g	5.0 d	4.6	5.0 e
Sencor	0.4 lb	fall	0.5	0.8 abc	0.1 a	0.7	0.3 abc
Sencor	0.8 lb	fall	1.1	2.3 cd	1.8 b	1.6	3.0 cde
Sinbar	0.75 lb	fall	0.1	0.8 abc	0.0 a	1.0	1.3 abc
Sinbar	1.5 lb	fall	0.6	3.0 de	1.4 ab	5.0	5.0 e
Surflan	3 qt	fall	0.0	0.2 ab	0.0 a	0.0	1.0 abc
Surflan	6 qt	fall	0.4	0.8 abc	0.0 a	0.1	1.3 abc
Control	---	---	0.0	0.0 a	0.0 a	0.0	0.0 a
			NS			NS	

¹Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

²Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 10. Effect of herbicide treatments on squirreltail, 2001.

Treatment	Rate/acre	Timing	Stunting	Chlorosis	Mortality	Stand reduction	Reduced heading
Axiom	11 oz	fall	0.0 ¹	0.3 abc ²	0.0 a	0.0 ab	0.0
Axiom	22 oz	fall	0.7	1.6 abcd	1.2 abc	2.1 ab	0.3
Beacon	0.76 oz	fall	0.8	2.0 abcd	1.2 abc	0.4 ab	0.9
Beacon	1.52 oz	fall	0.9	4.0 abcd	3.3 abc	0.0 ab	5.0
Clarity	4 pt	fall	0.7	1.9 abcd	1.7 abc	2.1 ab	5.0
Clarity	8 pt	fall	0.9	3.1 abcd	2.1 abc	0.8 ab	4.1
Diuron	1.8 lb	fall	1.0	2.1 abcd	2.2 abc	0.0 ab	1.9
Diuron	3.6 lb	fall	0.9	4.8 cd	4.7 bc	3.8 ab	5.0
Frontier	32 fl oz	fall	0.0	0.0 a	0.0 a	0.0 ab	0.0
Frontier	64 fl oz	fall	0.3	1.0 abcd	1.2 abc	0.0 ab	0.0
Goal	10 fl oz	fall	0.5	1.9 abcd	2.1 abc	0.0 ab	1.9
Goal	20 fl oz	fall	1.7	2.9 abcd	3.0 abc	0.0 ab	3.4
Kerb	0.4 lb	fall	1.5	4.5 cd	3.8 abc	3.8 ab	4.1
Kerb	0.8 lb	fall	1.0	4.4 cd	4.0 abc	4.6 ab	4.1
Maverick	0.67 oz	fall	0.5	1.8 abcd	1.2 abc	1.3 ab	0.9
Maverick	1.34 oz	fall	0.3	1.6 abcd	1.5 abc	0.0 a	0.3
Maverick	0.67 oz	dormant	0.3	0.9 abcd	0.0 a	0.0 ab	3.4
Milestone	2 oz	dormant	0.3	1.5 abcd	1.2 abc	0.4 ab	2.8
Milestone	4 oz	dormant	0.0	0.1 ab	0.0 a	0.4 ab	0.0
Rely	3 pt	dormant	1.2	4.1 bcd	3.5 abc	0.0 ab	3.4
Roundup	1.5 pt	dormant	2.0	5.0 d	5.0 c	5.0 ab	4.1
Sencor	0.4 lb	fall	0.2	1.4 abcd	0.9 abc	1.7 ab	1.3
Sencor	0.8 lb	fall	1.4	2.4 abcd	1.6 abc	0.8 ab	0.9
Sinbar	0.75 lb	fall	1.3	3.1 abcd	3.0 abc	5.0 ab	5.0
Sinbar	1.5 lb	fall	2.2	4.7 cd	4.7 c	5.0 b	3.4
Surflan	3 qt	fall	0.2	0.5 abc	0.2 ab	0.4 ab	0.0
Surflan	6 qt	fall	0.0	0.9 abcd	1.0 abc	1.3 ab	0.3
Control	---	---	0.0	0.0 a	0.0 a	0.0 ab	0.0
			NS				NS

¹Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

²Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 11. Effect of herbicide treatments on big bluegrass, 2001.

Treatment	Rate/acre	Timing	Stunting	Chlorosis	Mortality	Stand reduction	Reduced heading
Axiom	11 oz	fall	1.1 ¹ abc ²	1.5 abc	0.0 a	0.0 a	2.7 c
Axiom	22 oz	fall	1.8 cd	2.8 d	1.3 a	0.1 a	4.0 d
Beacon	0.76 oz	fall	0.1 a	0.0 a	0.0 a	0.0 a	0.2 a
Beacon	1.52 oz	fall	0.2 ab	0.1 a	0.0 a	0.3 a	0.2 a
Clarity	4 pt	fall	0.6 ab	0.3 a	0.0 a	0.1 a	1.0 a
Clarity	8 pt	fall	0.6 ab	0.1 a	0.0 a	0.0 a	0.7 a
Diuron	1.8 lb	fall	0.2 ab	0.5 a	0.0 a	0.0 a	0.5 a
Diuron	3.6 lb	fall	1.3 bc	2.4 cd	0.4 a	0.1 a	2.5 bc
Frontier	32 fl oz	fall	0.2 ab	0.3 a	0.0 a	0.0 a	0.5 a
Frontier	64 fl oz	fall	0.8 abc	0.3 a	0.0 a	0.0 a	0.2 a
Goal	10 fl oz	fall	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Goal	20 fl oz	fall	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Kerb	0.4 lb	fall	1.1 abc	2.3 cd	0.1 a	2.2 b	4.5 d
Kerb	0.8 lb	fall	1.8 cd	2.8 d	0.8 a	4.7 c	5.0 d
Maverick	0.67 oz	fall	0.2 ab	0.3 a	0.0 a	0.3 a	0.2 a
Maverick	1.34 oz	fall	1.0 abc	1.0 ab	0.1 a	0.1 a	1.0 a
Maverick	0.67 oz	dormant	1.2 abc	2.0 bcd	0.1 a	0.0 a	1.5 ab
Milestone	2 oz	dormant	0.1 a	0.0 a	0.0 a	0.0 a	0.2 a
Milestone	4 oz	dormant	0.2 ab	0.5 a	0.1 a	0.0 a	0.5 a
Rely	3 pt	dormant	1.0 abc	0.9 ab	0.0 a	0.0 a	0.5 a
Roundup	1.5 pt	dormant	2.4 d	5.0 e	5.0 c	4.9 c	5.0 d
Sencor	0.4 lb	fall	0.1 a	0.3 a	0.0 a	0.0 a	0.5 a
Sencor	0.8 lb	fall	1.2 d	4.1 e	3.3 b	3.9 c	4.5 d
Sinbar	0.75 lb	fall	1.0 abc	1.8 bcd	1.3 a	2.0 b	2.2 bc
Sinbar	1.5 lb	fall	2.4 d	4.4 e	3.9 b	5.0 c	5.0 d
Surflan	3 qt	fall	0.0 a	0.0 a	0.0 a	0.1 a	0.0 a
Surflan	6 qt	fall	0.2 ab	0.0 a	0.0 a	0.1 a	0.2 a
Control	---	---	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a

¹Rating scale from 0 (no negative effect) to 5 (maximum negative effect).

²Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.0$