EVALUATION OF POSTEMERGENCE HERBICIDES ON EIGHT NATIVE GRASS SPECIES GROWN FOR SEED, 2001-2002

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Abstract

Herbicide screenings were conducted over two seasons 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 applied October 18, 2000 and October 4, 2001 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 and November 27, 2001. Treatments were applied to the same plots 2 years in a row to increase confidence related to crop safety. During 2002, treatments causing the most negative effect were Roundup at 1.5 pt/acre applied during dormancy, fall-applied Sinbar at 1.5 lb/acre and Kerb at 0.8 lb/acre. Treatments with the least effect on both stand reduction and reduced heading across grass species were Diuron at 1.8 lb/acre, Goal at 20 fl oz/acre and Sencor at 0.4 lb/acre. Stand reduction across herbicide treatments was the least for Great Basin wildrye, and was the greatest for prairie junegrass and squirreltail. The least impact on heading was observed with Great Basin wildrye and streambank wheatgrass, while it was most severe for squirreltail and prairie junegrass.

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 was to evaluate the crop safety of potential herbicides that may be used in native grass seed production.

Materials and Methods

Big bluegrass, bluebunch wheatgrass, squirreltail, Great Basin wildrye, streambank wheatgrass, and Idaho fescue were planted at the Central Oregon Agricultural Research Center April 20, 2000 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 inches. 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 two weeks following planting. Weeds were controlled by hoeing and cultivation, with no herbicides applied prior to plot treatment.

Most herbicide treatments were applied at both 1x and 2x rates. Herbicides were fall-applied October 18, 2000 and October 4, 2001. Dormancy applications were made November 3, 2000 and November 27, 2001. Treatments were applied with a CO_2-pressurized, hand-held, boom sprayer at 40 psi and 20 gal/acre water in 9-ft bands perpendicular to the grass rows. In 2000, a non-ionic surfactant (NIS) was added at 0.5 percent v/v to the November 3 application of

Maverick only. However, in 2001, NIS was applied to all fall applications in addition to the Maverick dormancy application.

Evaluations were conducted using a rating scale from 0 (no negative effect) to 5 (mortality). Plots were evaluated for stunting, chlorosis, and mortality on March 27 and 28, 2001 and May 15, 2002; reduced heading on June 16-19, 2001 and June 10, 2002. Stand reduction was evaluated following first year applications on November 2, 2000 and following second year applications on May 15, 2002. Data were analyzed as a randomized complete block design, and no comparisons were made between grasses.

Results

A summary of the results for herbicide treatments across the eight native grass species for both stand reduction and reduced heading is provided in Table 1. Less than 10 percent damage is indicated by a +, over 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 reduced heading and stand reduction are provided in Tables 2 and 3.

Treatments that consistently caused the most damage across grass species were Roundup at 1.5 pt/acre applied during dormancy, fall-applied Sinbar at 1.5 lb/acre and Kerb at 0.8 lb/acre.

Treatments with the least effect on both stand reduction and reduced heading across grass species were Diuron at 1.8 lb/acre, Goal at 20 fl oz/acre and Sencor at 0.4 lb/acre. Other products with little effect on stand reduction were Milestone at 2 oz/acre and 4 oz/acre, Rely at 3 pt/acre and Surflan at 3 qt/acre. Additional products that had the least negative impact on heading across species were Axiom at 11 oz/acre, Clarity at 4 pt/acre, Frontier at 64 fl oz/acre and Maverick at 1.34 oz/acre. The safest herbicides at the 2x rate across grass species were Milestone at 4 oz/acre and Goal at 20 oz/acre.

Stand reduction was the least for great basin wildrye, and was the greatest for prairie junegrass and squirreltail. Treatments least affected heading on great basin wildrye and streambank wheatgrass. Both species were largely unaffected by the various herbicide treatments except Roundup at 1.5 pt/acre applied during dormancy or fall-applied Sinbar at 1.5 lb/acre and Kerb at 0.8 lb/acre. Herbicides reduced heading most in squirreltail and prairie junegrass.

Specific results by grass species for stunting, chlorosis, mortality, stand reduction and reduced heading following herbicide treatments are provided in Tables 4-11.

Table 1. Summary of herbicide effect on stand reduction (SR) evaluated on May 15 and reduced heading (RH) evaluated on June 10, 2002 across native grass species, Madras, OR.

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

[1] Symbol key: + = damage < 10 percent , 0 = damage 10-50 percent, – = >50 percent.

Table 2. Effect of herbicide treatments on reduced heading on native grass species evaluated on June 10, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Gr basn wrye	Blbnch whtgr	Strmbk whtgr	Big blgr	Idaho fescue	Indianricegr	Squirreltail	Pr. junegr
Axiom	11 oz	fall	0.8[1]	1.3 abc[2]	1.6	0.5 a	1.3 abc	2.0 ab	1.7	4.5 cd
Axiom	22 oz	fall	0.0	0.0 ab	1.3	0.5 a	1.0 abc	2.0 ab	3.3	4.2 cd
Beacon	0.76 oz	fall	0.0	1.0 abc	1.3	0.3 a	2.0 abc	1.0 ab	2.0	2.5 abcd
Beacon	1.52 oz	fall	0.5	0.0 ab	1.6	1.0 a	1.3 abc	1.5 ab	3.3	4.3 cd
Clarity	4 pt	fall	1.3	0.7 abc	0.9	1.0 a	2.3 abc	2.3 ab	5.0	2.2 abcd
Clarity	8 pt	fall	0.4	3.0 abcd	1.4	0.3 a	2.5 abc	3.0 ab	1.7	0.5 abc
Diuron	1.8 lb	fall	0.0	1.1 abc	2.0	0.8 a	1.0 abc	1.0 ab	0.6	2.0 abcd
Diuron	3.6 lb	fall	0.0	1.0 abc	0.9	0.8 a	2.0 abc	3.3 ab	5.0	5.0 d
Frontier	32 fl oz	fall	2.0	1.1 abc	1.7	0.8 a	3.0 abcd	3.5 b	0.0	3.3 abcd
Frontier	64 fl oz	fall	0.3	0.0 ab	2.6	0.8 a	4.0 cd	1.5 ab	1.7	4.5 cd
Goal	10 fl oz	fall	0.6	1.3 abc	1.5	0.5 a	0.8 ab	2.8 ab	3.3	2.0 abcd
Goal	20 fl oz	fall	0.0	1.3 abc	1.3	0.5 a	0.8 ab	0.8 ab	1.9	1.5 abcd
Kerb	0.4 lb	fall	0.3	1.3 abc	1.0	3.0 bc	0.8 ab	2.5 ab	4.4	1.3 abcd
Kerb	0.8 lb	fall	0.0	3.5 bcd	0.3	4.5 cd	4.0 cd	0.0 ab	5.0	2.7 abcd
Maverick	0.67 oz	fall	1.3	1.0 abc	0.0	0.8 a	1.5 abc	2.8 ab	2.4	2.7 abcd
Maverick	1.34 oz	fall	2.0	0.7 abc	0.8	0.0 a	3.3 bcd	3.5 b	1.7	4.0 bcd
Maverick	0.67 oz	dormant	0.2	0.3 ab	2.4	1.0 a	1.8 abc	3.0 ab	3.3	3.2 abcd
Milestone	2 oz	dormant	0.0	1.1 abc	1.7	0.5 a	1.0 abc	1.0 ab	1.9	1.1 abc
Milestone	4 oz	dormant	0.0	1.8 abc	1.0	0.5 a	1.5 abc	1.8 ab	2.5	2.0 abcd
Rely	3 pt	dormant	0.7	1.7 abc	1.1	0.0 a	0.3 ab	1.0 ab	0.0	0.8 abc
Roundup	1.5 pt	dormant	0.0	5.0 d	1.3	5.0 d	2.3 abc	0.0 ab	5.0	5.0 d
Sencor	0.4 lb	fall	0.0	1.9 abc	0.7	1.0 a	1.0 abc	1.0 ab	2.5	1.4 abcd
Sencor	0.8 lb	fall	0.0	0.4 ab	1.0	4.0 cd	1.0 abc	1.5 ab	1.3	1.4 abcd
Sinbar	0.75 lb	fall	1.2	2.0 abc	3.4	2.3 ab	1.0 abc	0.3 ab	5.0	3.8 bcd
Sinbar	1.5 lb	fall	3.2	4.1 cd	3.0	5.0 d	5.0 d	1.0 ab	5.0	5.0 d
Surflan	3 qt	fall	0.0	2.1 abc	1.0	1.0 a	1.3 abc	2.3 ab	1.3	0.0 ab
Surflan	6 qt	fall	0.0	2.3 abc	1.7	2.3 ab	3.3 bcd	1.0 ab	1.3	1.7 abcd
Control	---	----	0.0	0.0 a	0.0	0.0 a	0.0 a	0.0 a	0.0	0.0 a
			NS		NS				NS	

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 3. Effect of herbicide treatments on stand reduction on native grass species evaluated on May 15, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Gr basn wrye		Blbnch whtgr		Strmbk whtgr		Big blgr		Idaho fescue		Indianricegr		Squirreltail		Pr. junegr	
Axiom	11 oz	fall	0.4[1]	a[2]	1.3	a	1.25	b	0.3	a	0.5	bc	0.5	ab	3.3	ab	1.0	abc
Axiom	22 oz	fall	0.0	a	1.0	a	0.125	a	1.3	ab	1.3	bcd	1.0	ab	4.7	b	3.8	bcd
Beacon	0.76 oz	fall	0.5	a	2.0	ab	1	b	0.3	a	1.0	bcd	0.8	ab	3.4	ab	2.4	abcd
Beacon	1.52 oz	fall	0.0	a	2.0	ab	1	b	0.3	a	0.5	bc	1.0	ab	4.0	ab	3.0	abcd
Clarity	4 pt	fall	0.2	a	1.0	a	0.375	a	0.3	a	1.0	bcd	0.3	ab	4.0	ab	2.3	abcd
Clarity	8 pt	fall	0.5	a	1.3	a	0.25	a	0.3	a	2.3	bcde	1.3	ab	4.0	ab	2.3	abcd
Diuron	1.8 lb	fall	0.0	a	1.1	a	0	a	0.5	a	0.5	bc	1.3	ab	3.6	ab	3.9	cd
Diuron	3.6 lb	fall	0.5	a	3.0	abcd	0.875	b	1.8	ab	2.3	bcde	3.3	b	4.7	b	3.8	bcd
Frontier	32 fl oz	fall	0.0	a	0.6	a	0	a	0.0	a	1.0	bcd	2.3	ab	2.8	ab	1.0	abc
Frontier	64 fl oz	fall	0.0	a	0.0	a	0.25	a	0.3	a	1.8	bcd	0.5	ab	3.3	ab	1.3	abc
Goal	10 fl oz	fall	0.0	a	1.0	a	0	a	0.0	a	0.3	b	0.5	ab	3.7	ab	0.3	ab
Goal	20 fl oz	fall	0.0	a	0.6	a	0.33	a	0.3	a	1.3	bcd	0.5	ab	3.1	ab	1.3	abc
Kerb	0.4 lb	fall	1.3	a	2.5	abc	0	a	2.8	bc	2.5	cde	1.5	ab	4.9	b	2.7	abcd
Kerb	0.8 lb	fall	3.0	b	4.1	bcd	0	a	4.8	d	4.5	e	1.0	ab	5.0	b	3.7	bcd
Maverick	0.67 oz	fall	0.0	a	1.5	a	0.33	a	0.8	a	1.8	bcd	1.5	ab	4.5	b	1.7	abcd
Maverick	1.34 oz	fall	0.1	a	0.0	a	0.375	a	0.5	a	2.5	cde	2.0	ab	2.3	ab	2.7	abcd
Maverick	0.67 oz	dormant	0.0	a	0.3	a	0.5	a	0.8	a	1.8	bcd	2.5	ab	3.7	ab	1.0	abc
Milestone	2 oz	dormant	0.0	a	1.5	a	0.666	b	0.5	a	0.5	bc	0.8	ab	3.5	ab	0.8	abc
Milestone	4 oz	dormant	1.8	ab	0.6	a	0	a	0.8	a	1.5	bcd	1.8	ab	4.0	b	2.0	abcd
Rely	3 pt	dormant	0.0	a	1.0	a	0.25	a	0.3	a	0.3	b	0.8	ab	3.3	ab	1.0	abc
Roundup	1.5 pt	dormant	1.2	a	5.0	d	2.66	cd	5.0	d	3.0	de	1.5	ab	5.0	b	5.0	d
Sencor	0.4 lb	fall	0.5	a	1.1	a	0	a	0.5	a	0.5	bc	0.8	ab	2.9	ab	1.6	abc
Sencor	0.8 lb	fall	0.0	a	1.0	a	1	b	3.8	cd	1.5	bcd	0.3	ab	3.5	ab	2.4	abcd
Sinbar	0.75 lb	fall	0.0	a	2.7	abc	2.125	bc	2.0	ab	1.0	bcd	0.3	ab	5.0	b	3.8	bcd
Sinbar	1.5 lb	fall	2.8	b	4.3	cd	5	d	5.0	d	5.0	e	1.3	ab	5.0	b	5.0	d
Surflan	3 qt	fall	0.0	a	1.6	a	0	a	0.3	a	1.0	bcd	1.3	ab	4.1	b	1.7	abcd
Surflan	6 qt	fall	0.0	a	2.0	ab	0	a	0.8	a	2.0	bcde	1.3	ab	3.4	ab	3.3	abcd
Control	---	----	0.0	a	0.0	a	0	a	0.3	a	0.0	a	0.0	a	0.0	a	0.0	a

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 4. Effect of herbicide treatments on bluebunch wheatgrass, evaluated May 16 and June 10, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Stunting		Chlorosis		Mortality		Reduced heading	
Axiom	11 oz	fall	1.0[1]	a[2]	0.0	a	1.3	a	1.3	abc
Axiom	22 oz	fall	1.0	a	0.8	a	1.0	a	0.0	ab
Beacon	0.76 oz	fall	2.5	abc	0.2	a	2.0	ab	1.0	abc
Beacon	1.52 oz	fall	1.3	ab	0.0	a	2.0	ab	0.0	ab
Clarity	4 pt	fall	1.3	ab	0.0	a	1.0	a	0.7	abc
Clarity	8 pt	fall	2.0	abc	0.3	a	1.3	a	3.0	abcd
Diuron	1.8 lb	fall	0.8	a	0.2	a	1.1	a	1.1	abc
Diuron	3.6 lb	fall	3.0	abcd	1.0	a	3.0	abcd	1.0	abc
Frontier	32 fl oz	fall	0.8	a	0.0	a	0.6	a	1.1	abc
Frontier	64 fl oz	fall	0.3	a	0.0	a	0.0	a	0.0	ab
Goal	10 fl oz	fall	1.3	ab	0.3	a	1.0	a	1.3	abc
Goal	20 fl oz	fall	1.1	a	0.0	a	0.6	a	1.3	abc
Kerb	0.4 lb	fall	2.1	abc	0.1	a	2.5	abc	1.3	abc
Kerb	0.8 lb	fall	4.1	bcd	3.3	b	4.1	bcd	3.5	bcd
Maverick	0.67 oz	fall	1.5	ab	0.4	a	1.5	a	1.0	abc
Maverick	1.34 oz	fall	2.0	abc	0.5	a	0.0	a	0.7	abc
Maverick	0.67 oz	dormant	0.7	a	0.0	a	0.3	a	0.3	ab
Milestone	2 oz	dormant	2.1	abc	0.0	a	1.5	a	1.1	abc
Milestone	4 oz	dormant	0.8	a	0.0	a	0.6	a	1.8	abc
Rely	3 pt	dormant	1.7	abc	0.3	a	1.0	a	1.7	abc
Roundup	1.5 pt	dormant	5.0	d	5.0	c	5.0	d	5.0	d
Sencor	0.4 lb	fall	2.3	abc	0.0	a	1.1	a	1.9	abc
Sencor	0.8 lb	fall	1.3	a	0.3	a	1.0	a	0.4	ab
Sinbar	0.75 lb	fall	2.7	abc	1.7	a	2.7	abc	2.0	abc
Sinbar	1.5 lb	fall	4.3	cd	3.6	b	4.3	cd	4.1	cd
Surflan	3 qt	fall	1.5	ab	0.0	a	1.6	a	2.1	abc
Surflan	6 qt	fall	1.4	ab	0.3	a	2.0	ab	2.3	abc
Control	---	---	0.0	a	0.0	a	0.0	a	0.0	a

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 5. Effect of herbicide treatments on big bluegrass, evaluated May 16 and June 10, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Stunting		Chlorosis		Mortality		Reduced heading	
Axiom	11 oz	fall	0.5[1]	a[2]	0.0	a	0.3	a	0.5	a
Axiom	22 oz	fall	1.3	a	0.0	a	1.3	ab	0.5	a
Beacon	0.76 oz	fall	0.8	a	0.0	a	0.3	a	0.3	a
Beacon	1.52 oz	fall	1.5	a	0.3	a	0.3	a	1.0	a
Clarity	4 pt	fall	1.3	a	0.0	a	0.3	a	1.0	a
Clarity	8 pt	fall	0.3	a	0.0	a	0.3	a	0.3	a
Diuron	1.8 lb	fall	0.5	a	0.0	a	0.5	a	0.8	a
Diuron	3.6 lb	fall	2.0	ab	0.0	a	1.8	ab	0.8	a
Frontier	32 fl oz	fall	0.8	a	0.0	a	0.0	a	0.8	a
Frontier	64 fl oz	fall	0.8	a	0.0	a	0.3	a	0.8	a
Goal	10 fl oz	fall	0.0	a	0.0	a	0.0	a	0.5	a
Goal	20 fl oz	fall	0.3	a	0.0	a	0.3	a	0.5	a
Kerb	0.4 lb	fall	2.0	ab	0.0	a	2.8	bc	3.0	bc
Kerb	0.8 lb	fall	4.5	c	3.3	b	4.8	d	4.5	cd
Maverick	0.67 oz	fall	1.8	ab	0.0	a	0.8	a	0.8	a
Maverick	1.34 oz	fall	2.5	ab	0.0	a	0.5	a	0.0	a
Maverick	0.67 oz	dormant	1.0	a	0.0	a	0.8	a	1.0	a
Milestone	2 oz	dormant	1.0	a	0.0	a	0.5	a	0.5	a
Milestone	4 oz	dormant	0.3	a	0.0	a	0.8	a	0.5	a
Rely	3 pt	dormant	0.5	a	0.0	a	0.3	a	0.0	a
Roundup	1.5 pt	dormant	5.0	c	5.0	c	5.0	d	5.0	d
Sencor	0.4 lb	fall	0.5	a	0.0	a	0.5	a	1.0	a
Sencor	0.8 lb	fall	3.8	bc	1.6	a	3.8	cd	4.0	cd
Sinbar	0.75 lb	fall	1.8	ab	1.3	a	2.0	ab	2.3	ab
Sinbar	1.5 lb	fall	5.0	c	5.0	c	5.0	d	5.0	d
Surflan	3 qt	fall	0.5	a	0.0	a	0.3	a	1.0	a
Surflan	6 qt	fall	1.8	ab	0.0	a	0.8	a	2.3	ab
Control	---	---	0.0	a	0.0	a	0.3	a	0.0	a

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 6. Effect of herbicide treatments on great basin wildrye, evaluated May 16 and June 10, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Stunting	Chlorosis	Mortality	Reduced heading
Axiom	11 oz	fall	0.5[1]	0.3 a[2]	0.4 a	0.8
Axiom	22 oz	fall	0.0	0.5 a	0.0 a	0.0
Beacon	0.76 oz	fall	1.5	0.0 a	0.5 a	0.0
Beacon	1.52 oz	fall	1.5	0.0 a	0.0 a	0.5
Clarity	4 pt	fall	0.7	0.3 a	0.2 a	1.3
Clarity	8 pt	fall	0.6	0.4 a	0.5 a	0.4
Diuron	1.8 lb	fall	0.0	0.0 a	0.0 a	0.0
Diuron	3.6 lb	fall	1.0	0.0 a	0.5 a	0.0
Frontier	32 fl oz	fall	1.8	0.7 a	0.0 a	2.0
Frontier	64 fl oz	fall	0.7	0.0 a	0.0 a	0.3
Goal	10 fl oz	fall	0.3	0.3 a	0.0 a	0.6
Goal	20 fl oz	fall	2.0	0.0 a	0.0 a	0.0
Kerb	0.4 lb	fall	1.7	0.3 a	1.3 a	0.3
Kerb	0.8 lb	fall	1.7	1.0 a	3.0 b	0.0
Maverick	0.67 oz	fall	1.0	0.3 a	0.0 a	1.3
Maverick	1.34 oz	fall	2.6	0.3 a	0.1 a	2.0
Maverick	0.67 oz	dormant	1.3	0.3 a	0.0 a	0.2
Milestone	2 oz	dormant	0.0	0.0 a	0.0 a	0.0
Milestone	4 oz	dormant	1.8	0.0 a	1.8 ab	0.0
Rely	3 pt	dormant	0.0	0.0 a	0.0 a	0.7
Roundup	1.5 pt	dormant	2.0	0.0 a	1.2 a	0.0
Sencor	0.4 lb	fall	1.0	0.0 a	0.5 a	0.0
Sencor	0.8 lb	fall	0.5	2.0 ab	0.0 a	0.0
Sinbar	0.75 lb	fall	0.8	1.8 a	0.0 a	1.2
Sinbar	1.5 lb	fall	3.3	3.0 b	2.8 b	3.2
Surflan	3 qt	fall	0.0	0.0 a	0.0 a	0.0
Surflan	6 qt	fall	0.7	0.5 a	0.0 a	0.0
Control	---	---	0.0	0.0 a	0.0 a	0.0
			NS			NS

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 7. Effect of herbicide treatments on Idaho fescue, evaluated May 16 and June 10, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Stunting		Chlorosis		Mortality		Reduced heading	
Axiom	11 oz	fall	0.8[1]	ab[2]	0.0	a	0.5	bc	1.3	abc
Axiom	22 oz	fall	1.3	bcd	0.0	a	1.3	bcd	1.0	abc
Beacon	0.76 oz	fall	2.0	bcd	0.7	a	1.0	bcd	2.0	abc
Beacon	1.52 oz	fall	1.8	bcd	0.7	a	0.5	bc	1.3	abc
Clarity	4 pt	fall	1.3	bcd	0.0	a	1.0	bcd	2.3	abc
Clarity	8 pt	fall	3.0	cde	0.3	a	2.3	bcde	2.5	abc
Diuron	1.8 lb	fall	0.8	ab	0.0	a	0.5	bc	1.0	abc
Diuron	3.6 lb	fall	2.5	cde	1.0	a	2.3	bcde	2.0	abc
Frontier	32 fl oz	fall	2.3	bcde	0.5	a	1.0	bcd	3.0	abcd
Frontier	64 fl oz	fall	3.5	def	0.0	a	1.8	bcd	4.0	cd
Goal	10 fl oz	fall	0.8	ab	0.0	a	0.3	b	0.8	ab
Goal	20 fl oz	fall	1.3	bcd	0.0	a	1.3	bcd	0.8	ab
Kerb	0.4 lb	fall	1.3	bcd	0.0	a	2.5	cde	0.8	ab
Kerb	0.8 lb	fall	4.5	ef	1.7	a	4.5	e	4.0	cd
Maverick	0.67 oz	fall	2.5	cde	0.3	a	1.8	bcd	1.5	abc
Maverick	1.34 oz	fall	3.3	cdef	0.7	a	2.5	cde	3.3	bcd
Maverick	0.67 oz	dormant	3.0	cde	0.0	a	1.8	bcd	1.8	abc
Milestone	2 oz	dormant	1.0	abc	0.0	a	0.5	bc	1.0	abc
Milestone	4 oz	dormant	1.3	bcd	0.0	a	1.5	bcd	1.5	abc
Rely	3 pt	dormant	1.0	abc	0.0	a	0.3	b	0.3	ab
Roundup	1.5 pt	dormant	2.5	cde	0.3	a	3.0	de	2.3	abc
Sencor	0.4 lb	fall	0.8	ab	0.0	a	0.5	bc	1.0	abc
Sencor	0.8 lb	fall	1.5	bcd	0.0	a	1.5	bcd	1.0	abc
Sinbar	0.75 lb	fall	1.8	bcd	0.3	a	1.0	bcd	1.0	abc
Sinbar	1.5 lb	fall	5.0	f	3.3	b	5.0	e	5.0	d
Surflan	3 qt	fall	2.0	bcd	0.0	a	1.0	bcd	1.3	abc
Surflan	6 qt	fall	2.8	cde	0.0	a	2.0	bcde	3.3	bcd
Control	---	---	0.0	a	0.0	a	0.0	a	0.0	a

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 8. Effect of herbicide treatments on Indian ricegrass, evaluated May 16 and June 10, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Stunting		Chlorosis		Mortality		Reduced heading	
Axiom	11 oz	fall	1.0[1]	abc[2]	1.0	ab	0.5	ab	2.0	ab
Axiom	22 oz	fall	0.8	abc	1.0	ab	1.0	ab	2.0	ab
Beacon	0.76 oz	fall	0.5	abc	1.0	ab	0.8	ab	1.0	ab
Beacon	1.52 oz	fall	1.0	abc	1.0	ab	1.0	ab	1.5	ab
Clarity	4 pt	fall	1.0	abc	0.3	a	0.3	ab	2.3	ab
Clarity	8 pt	fall	2.0	abc	1.5	ab	1.3	ab	3.0	ab
Diuron	1.8 lb	fall	1.0	abc	0.3	a	1.3	ab	1.0	ab
Diuron	3.6 lb	fall	2.5	bc	1.7	ab	3.3	b	3.3	ab
Frontier	32 fl oz	fall	2.5	bc	1.3	ab	2.3	ab	3.5	b
Frontier	64 fl oz	fall	0.0	ab	0.0	a	0.5	ab	1.5	ab
Goal	10 fl oz	fall	0.5	abc	1.8	ab	0.5	ab	2.8	ab
Goal	20 fl oz	fall	0.3	ab	0.0	a	0.5	ab	0.8	ab
Kerb	0.4 lb	fall	0.5	abc	0.5	a	1.5	ab	2.5	ab
Kerb	0.8 lb	fall	1.0	abc	1.7	ab	1.0	ab	0.0	ab
Maverick	0.67 oz	fall	1.0	abc	2.0	ab	1.5	ab	2.8	ab
Maverick	1.34 oz	fall	3.0	c	3.6	b	2.0	ab	3.5	b
Maverick	0.67 oz	dormant	3.0	c	2.5	ab	2.5	ab	3.0	ab
Milestone	2 oz	dormant	0.5	abc	0.0	a	0.8	ab	1.0	ab
Milestone	4 oz	dormant	1.8	abc	1.0	ab	1.8	ab	1.8	ab
Rely	3 pt	dormant	0.0	ab	0.3	a	0.8	ab	1.0	ab
Roundup	1.5 pt	dormant	0.8	abc	0.8	a	1.5	ab	0.0	ab
Sencor	0.4 lb	fall	0.5	abc	0.3	a	0.8	ab	1.0	ab
Sencor	0.8 lb	fall	0.3	ab	0.5	a	0.3	ab	1.5	ab
Sinbar	0.75 lb	fall	0.3	ab	0.5	a	0.3	ab	0.3	ab
Sinbar	1.5 lb	fall	0.8	abc	1.8	ab	1.3	ab	1.0	ab
Surflan	3 qt	fall	0.8	abc	0.5	a	1.3	ab	2.3	ab
Surflan	6 qt	fall	1.3	abc	1.0	ab	1.3	ab	1.0	ab
Control	---	---	0.0	a	0.0	a	0.0	a	0.0	a

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 9. Effect of herbicide treatments on prairie junegrass, evaluated May 16 and June 10, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Stunting		Chlorosis	Mortality		Reduced heading	
Axiom	11 oz	fall	0.7[1]	ab[2]	0.0	1.0	abc	4.5	cd
Axiom	22 oz	fall	3.1	abc	3.0	3.8	bcd	4.2	cd
Beacon	0.76 oz	fall	2.5	abc	1.7	2.4	abcd	2.5	abcd
Beacon	1.52 oz	fall	2.9	abc	2.3	3.0	abcd	4.3	Cd
Clarity	4 pt	fall	2.1	abc	1.0	2.3	abcd	2.2	abcd
Clarity	8 pt	fall	2.0	abc	0.0	2.3	abcd	0.5	abc
Diuron	1.8 lb	fall	3.4	abc	1.8	3.9	cd	2.0	abcd
Diuron	3.6 lb	fall	3.8	bc	5.0	3.8	bcd	5.0	D
Frontier	32 fl oz	fall	1.7	abc	1.0	1.0	abc	3.3	abcd
Frontier	64 fl oz	fall	1.8	abc	0.0	1.3	abc	4.5	Cd
Goal	10 fl oz	fall	0.0	a	0.0	0.3	ab	2.0	abcd
Goal	20 fl oz	fall	0.8	ab	0.0	1.3	abc	1.5	abcd
Kerb	0.4 lb	fall	2.3	abc	0.0	2.7	abcd	1.3	abcd
Kerb	0.8 lb	fall	3.3	abc	0.5	3.7	bcd	2.7	abcd
Maverick	0.67 oz	fall	2.0	abc	1.3	1.7	abcd	2.7	abcd
Maverick	1.34 oz	fall	3.7	abc	3.0	2.7	abcd	4.0	bcd
Maverick	0.67 oz	dormant	1.8	abc	0.7	1.0	abc	3.2	abcd
Milestone	2 oz	dormant	0.8	ab	0.3	0.8	abc	1.1	abc
Milestone	4 oz	dormant	1.7	abc	0.5	2.0	abcd	2.0	abcd
Rely	3 pt	dormant	1.0	ab	0.0	1.0	abc	0.8	abc
Roundup	1.5 pt	dormant	5.0	c	3.3	5.0	d	5.0	d
Sencor	0.4 lb	fall	1.5	abc	0.6	1.6	abc	1.4	abcd
Sencor	0.8 lb	fall	1.8	abc	0.5	2.4	abcd	1.4	abcd
Sinbar	0.75 lb	fall	3.5	abc	1.7	3.8	bcd	3.8	bcd
Sinbar	1.5 lb	fall	5.0	c	5.0	5.0	d	5.0	d
Surflan	3 qt	fall	1.7	abc	0.0	1.7	abcd	0.0	ab
Surflan	6 qt	fall	2.7	abc	0.5	3.3	abcd	1.7	abcd
Control	---	---	0.0	a	0.0	0.0	a	0.0	a
					NS				

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 10. Effect of herbicide treatments on squirreltail, evaluated May 16 and June 10, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Stunting		Chlorosis	Mortality		Reduced heading
Axiom	11 oz	fall	3.3[1]	ab[2]	0.0	3.3	ab	1.7
Axiom	22 oz	fall	4.0	ab	4.0	4.7	b	3.3
Beacon	0.76 oz	fall	3.4	ab	1.2	3.4	ab	2.0
Beacon	1.52 oz	fall	4.0	ab	0.0	4.0	ab	3.3
Clarity	4 pt	fall	4.0	ab	2.5	4.0	ab	5.0
Clarity	8 pt	fall	3.3	ab	2.0	4.0	ab	1.7
Diuron	1.8 lb	fall	2.0	ab	1.7	3.6	ab	0.6
Diuron	3.6 lb	fall	3.7	ab	2.5	4.7	b	5.0
Frontier	32 fl oz	fall	2.9	ab	1.5	2.8	ab	0.0
Frontier	64 fl oz	fall	3.3	ab	0.0	3.3	ab	1.7
Goal	10 fl oz	fall	3.3	ab	1.7	3.7	ab	3.3
Goal	20 fl oz	fall	3.1	ab	1.7	3.1	ab	1.9
Kerb	0.4 lb	fall	4.5	b	3.8	4.9	b	4.4
Kerb	0.8 lb	fall	5.0	b	5.0	5.0	b	5.0
Maverick	0.67 oz	fall	4.5	b	2.5	4.5	b	2.4
Maverick	1.34 oz	fall	4.0	ab	2.5	2.3	ab	1.7
Maverick	0.67 oz	dormant	3.7	ab	1.7	3.7	ab	3.3
Milestone	2 oz	dormant	3.8	ab	2.5	3.5	ab	1.9
Milestone	4 oz	dormant	3.8	ab	0.8	4.0	b	2.5
Rely	3 pt	dormant	3.3	ab	1.7	3.3	ab	0.0
Roundup	1.5 pt	dormant	5.0	b	5.0	5.0	b	5.0
Sencor	0.4 lb	fall	3.5	ab	2.5	2.9	ab	2.5
Sencor	0.8 lb	fall	2.9	ab	2.1	3.5	ab	1.3
Sinbar	0.75 lb	fall	5.0	b	5.0	5.0	b	5.0
Sinbar	1.5 lb	fall	5.0	b	5.0	5.0	b	5.0
Surflan	3 qt	fall	3.4	ab	2.5	4.1	b	1.3
Surflan	6 qt	fall	2.9	ab	0.8	3.4	ab	1.3
Control	---	---	0.0	ab	0.0	0.0	a	0.0
					NS			NS

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.

Table 11. Effect of herbicide treatments on streambank wheatgrass, evaluated May 16 and June 10, 2002, Madras, OR.

Treatment	Rate/acre	Timing	Stunting		Chlorosis		Mortality		Reduced heading
Axiom	11 oz	fall	1.25[1]	b[2]	0	a	1.25	b	1.62
Axiom	22 oz	fall	1.25	b	1.666	a	0.125	a	1.25
Beacon	0.76 oz	fall	0.666	b	0	a	1	b	1.33
Beacon	1.52 oz	fall	1.75	b	0.5	a	1	b	1.62
Clarity	4 pt	fall	0.5	b	0	a	0.375	a	0.875
Clarity	8 pt	fall	0.875	b	0	a	0.25	a	1.375
Diuron	1.8 lb	fall	0	a	0	a	0	a	2
Diuron	3.6 lb	fall	1.875	b	0.33	a	0.875	b	0.875
Frontier	32 fl oz	fall	1	b	0	a	0	a	1.67
Frontier	64 fl oz	fall	0.625	b	0	a	0.25	a	2.625
Goal	10 fl oz	fall	0	a	0	a	0	a	1.5
Goal	20 fl oz	fall	0.666	b	0	a	0.33	a	1.33
Kerb	0.4 lb	fall	0.33	b	0	a	0	a	1
Kerb	0.8 lb	fall	0.666	b	0	a	0	a	0.333
Maverick	0.67 oz	fall	0.33	b	0.33	a	0.33	a	0
Maverick	1.34 oz	fall	2.25	b	0.33	a	0.375	a	0.75
Maverick	0.67 oz	dormant	1.625	b	0.625	a	0.5	a	2.375
Milestone	2 oz	dormant	1.33	b	0	a	0.666	b	1.67
Milestone	4 oz	dormant	0	a	0	a	0	a	1
Rely	3 pt	dormant	0.5	b	0	a	0.25	a	1.125
Roundup	1.5 pt	dormant	2.666	bc	1.666	a	2.66	cd	1.33
Sencor	0.4 lb	fall	1	b	0	a	0	a	0.666
Sencor	0.8 lb	fall	0.666	b	0	a	1	b	1
Sinbar	0.75 lb	fall	2.625	bc	1.125	a	2.125	bc	3.375
Sinbar	1.5 lb	fall	5	c	3.666	b	5	d	3
Surflan	3 qt	fall	0.666	b	0	a	0	a	1
Surflan	6 qt	fall	0.33	b	0	a	0	a	1.67
Control	---	---	0	a	0	a	0	a	0

[1]Rating scale from 0 (no negative effect) to 5 (maximum negative effect).
[2]Mean separation with Student-Newman-Kuels (SNK) Test at $P \leq 0.05$.