Weed Management Research in Alfalfa Seed - 2011

Rick Boydston, USDA-ARS, Prosser, WA

Two field trials were conducted in alfalfa seed production in 2011 to determine crop safety, alfalfa seed yield, and weed control with various weed management treatments.

Alfalfa seed herbicide trial – Touchet, WA.

Thirteen herbicide treatments were tested in a 2-year old alfalfa seed field near Touchet, WA (Table 1). The soil was a Sagemore silt loam. The entire trial was tilled in early March 2011 and eight herbicide treatments were applied March 17, 2011 when alfalfa was 2 to 4 inches tall (early POST). A sparse population of prickly lettuce was present at the time of the first herbicide applications and ranged from 2 to 4 inch diameter. The field was sprinkler irrigated with a wheel line irrigation system within a week following the initial herbicide treatments. Postemergence (POST) treatments were applied April 12, 2011 when alfalfa was 5 to 6 inches tall and larger prickly lettuce plants were 4 to 6 inch diameter.

Herbicides were applied with a bicycle sprayer equipped with four, 8002 XR flan fan nozzles spaced 20 inches apart and calibrated to deliver 20 GPA. Plots measured 7.5 by 20 feet. Treatments were replicated four times in a RCB design. Weed control and alfalfa injury were rated on several dates following herbicide treatments. Prickly lettuce was the main weed present and was sparse in some plots.

Alfalfa was 30 inches tall by early June and beginning to bloom. Alfalfa seed was harvested August 30, 2011 by cutting plants from the middle row (20 in.) by 10 feet in each plot, drying the plants, and passing them twice through a belt thresher. Seed was further cleaned by sieving and blowing and finally weighed to determine yield.

Results.

Prickly lettuce control was greater than 90% with all herbicide treatments on May 4, 2011 except for SpartanCharge, sulfentrazone F9021-2, and pyroxasulfone applied early POST, and Authority Assist applied POST, which ranged from 15 to 70% control (Table 3). By late July, prickly lettuce numbers were lowest in plots treated with saflufenacil, indaziflam, Chateau, VelparAlfamax, Raptor (ten-fold rate), and Asulox (Table 3). Minor amounts of downy brome and mayweed chamomile were present in several plots, but not numerous enough throughout the trial to rate control (data not shown).

Alfalfa was emerged at the time of the initial herbicide applications and all treatments injured alfalfa ranging from 10 to 96% injury 2 weeks after treatment (WAT) (Table 1). SpartanCharge injured alfalfa the greatest (96%), followed by sulfentrazone F9021-2 (75%) and VelparAlfamax (24%). Injury from the remaining treatments was mainly due to the inclusion of Gramoxone Inteon in the tank mix. Injury from early POST treatments had mostly dissipated by May 4, 2011 and ranged from 0 to 13% (Table 1).

Authority Assist applied late POST injured alfalfa the greatest at 1 WAT, averaging 55% (Table 1). A ten-fold rate of Raptor was applied by mistake in two treatments and resulted in 71% injury in early May (approximately 3 WAT) causing stunted and chlorotic growth. Surprisingly, alfalfa had nearly totally recovered from Raptor injury by June 10, 2011 (Table 1). Asulox applied POST did not significantly injure alfalfa except when applied in combination with Raptor at the elevated rate. Firstrate applied late POST caused only minor injury to alfalfa for several weeks following treatment (Table 1). Alfalfa percent bloom on June 10 ranged from 5

to 13% and was not significantly different among treatments, but tended to be lower in plots treated with SpartanCharge, indaziflam, or Chateau applied early POST and with Authority Assist, or ten-fold rates of Raptor applied late POST (Table 2).

Alfalfa seed yield was variable and ranged from 627 to 1015 lb/acre. There were no statistically significant differences in seed yield among herbicide treatments (Table 2).

Table 1. Alfalfa injury following early and late postemergence applied herbicides near Touchet, WA in 2011.

Crop Name Rating Date Rating Type Rating Unit					Alfalfa Mar-30-2011 Injury Percent	Alfalfa Apr-19-2011 Injury Percent	Alfalfa May-4-2011 Injury Percent	Alfalfa Jun-10-2011 Injury Percent
Trt No.	Treatment Name	Rate	Rate Unit	Appl Code				
	Sulfentrazone (Spartan Charge)	0.137	lb ai/a	A	96.3 a	47.5 b	13.0 c	0.0 a
	COC	1	% v/v	A				
	Sulfentrazone (F9021-2)	0.125	lb ai/a	A	75.0 b	3.0 d	3.0 d	6.3 a
	COC	1	% v/v	A				
	Saflufenacil (BAS800)	0.066	lb ai/a	A	16.8 d	4.5 d	6.5 d	0.0 a
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Pyroxasulfone (KIH-485)	0.19	lb ai/a	A	12.3 d	0.0 d	2.0 d	0.0 a
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Indaziflam	0.0652	lb ai/a	A	13.0 d	3.8 d	3.8 d	2.5 a
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Flumioxazin (Chateau)	0.128	lb ai/a	A	11.0 d	1.8 d	5.0 d	3.8 a
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Hexazinone Diuron (Velpar AlfaMax)	1.16	lb ai/a	A	23.8 c	2.0 d	3.8 d	2.5 a
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Flumioxazin Pyroxasulfone (Fierce)	0.144	lb ai/a	A	11.0 d	0.0 d	0.0 d	5.0 a
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Sulfentrazone Imazethapyr (Authority Assist)	0.156	lb ai/a	B	0.0 e	55.0 a	22.5 b	0.0 a
	NIS (R-11)	0.25	% v/v	B				
	Gramoxone Inteon	0.5	lb ai/a	A	10.5 d	5.5 d	16.3 c	2.5 a
	NIS (R-11)	0.25	% v/v	A				
	Chloransulam (Firstrate)	0.0158	lb ai/a	B				
	NIS (R-11)	0.25	% v/v	B				
	Gramoxone Inteon	0.5	lb ai/a	A	11.0 d	13.8 c	71.3 a	1.3 a
	NIS (R-11)	0.25	% v/v	A				
	Imazamox (Raptor)	0.39	lb ai/a	B				
	NIS (R-11)	0.25	% v/v	B				
	Gramoxone Inteon	0.5	lb ai/a	A	11.0 d	0.0 d	3.8 d	2.5 a
	NIS (R-11)	0.25	% v/v	A				
	Asulam (Asulox)	1.5	lb ai/a	B				
	NIS (R-11)	0.25	% v/v	B				
	Gramoxone Inteon	0.5	lb ai/a	A	11.0 d	12.0 c	71.3 a	10.0 a
	NIS (R-11)	0.25	% v/v	A				
	Asulam (Asulox)	1.25	lb ai/a	B				
	Imazamox (Raptor)	0.39	lb ai/a	B				
	NIS (R-11)	0.25	% v/v	B				
	None				0.0 e	0.0 d	0.0 d	0.0 a
LSD (P=.05)					4.54	5.06	4.38	7.20

Means within a column followed by the same letter do not significantly differ (P=0.05, Student-Newman-Keuls test). Application codes: A=March 17, 2011; B=April 12, 2011.

Table 2. Alfalfa percent bloom June 10, 2011 and final seed yield following early and late postemergence applied herbicides near Touchet, WA in 2011.

Crop Name Rating Date Rating Type Rating Unit					Alfalfa Jun-10-2011 Bloom Percent	Alfalfa Aug-30-2011 Seed Yield Lb/acre
Trt No.	Treatment Name	Rate	Rate Unit	Appl Code		
	Sulfentrazone (Spartan Charge)	0.137	lb ai/a	A	6.5 a	627
	COC	1	% v/v	A		
	Sulfentrazone (F9021-2)	0.125	lb ai/a	A	8.3 a	784
	COC	1	% v/v	A		
	Saflufenacil (BAS800)	0.066	lb ai/a	A	10.5 a	825
	COC	1	% v/v	A		
	Gramoxone Inteon	0.5	lb ai/a	A		
	Pyroxasulfone (KIH-485)	0.19	lb ai/a	A	12.5 a	786
	COC	1	% v/v	A		
	Gramoxone Inteon	0.5	lb ai/a	A		
	Indaziflam	0.0652	lb ai/a	A	6.5 a	1015
	COC	1	% v/v	A		
	Gramoxone Inteon	0.5	lb ai/a	A		
	Flumioxazin (Chateau)	0.128	lb ai/a	A	6.5 a	719
	COC	1	% v/v	A		
	Gramoxone Inteon	0.5	lb ai/a	A		
	Hexazinone Diuron (Velpar AlfaMax)	1.16	lb ai/a	A	10.0 a	770
	COC	1	% v/v	A		
	Gramoxone Inteon	0.5	lb ai/a	A		
	Flumioxazin Pyroxasulfone (Fierce)	0.144	lb ai/a	A	8.3 a	888
	COC	1	% v/v	A		
	Gramoxone Inteon	0.5	lb ai/a	A		
	Sulfentrazone Imazethapyr (Authority Assist)	0.156	lb ai/a	B	7.0 a	784
	NIS (R-11)	0.25	% v/v	B		
	Gramoxone Inteon	0.5	lb ai/a	A	10.0 a	899
	NIS (R-11)	0.25	% v/v	A		
	Chloransulam (Firstrate)	0.0158	lb ai/a	B		
	NIS (R-11)	0.25	% v/v	B		
	Gramoxone Inteon	0.5	lb ai/a	A	5.3 a	940
	NIS (R-11)	0.25	% v/v	A		
	Imazamox (Raptor)	0.39	lb ai/a	B		
	NIS (R-11)	0.25	% v/v	B		
	Gramoxone Inteon	0.5	lb ai/a	A	11.8 a	990
	NIS (R-11)	0.25	% v/v	A		
	Asulam (Asulox)	1.5	lb ai/a	B		
	NIS (R-11)	0.25	% v/v	B		
	Gramoxone Inteon	0.5	lb ai/a	A	6.5 a	639
	NIS (R-11)	0.25	% v/v	A		
	Asulam (Asulox)	1.25	lb ai/a	B		
	Imazamox (Raptor)	0.39	lb ai/a	B		
	NIS (R-11)	0.25	% v/v	B		
	None				9.5 a	757
LSD (P=.05)					4.40	N.S.

Means within a column followed by the same letter do not significantly differ (P=0.05, Student-Newman-Keuls test). Application codes: A=March 17, 2011; B=April 12, 2011.

Table 3. Prickly lettuce control following early and late postemergence applied herbicides near Touchet, WA in 2011.

Pest Name Rating Date Rating Type Rating Unit					Prickly lettuce Apr-19-2011 Control Percent	Prickly lettuce May-4-2011 Control Percent	Prickly lettuce Jun-10-2011 Number/plot Counts	Prickly lettuce Jul-27-2011 Number/plot Counts
Trt No.	Treatment Name	Rate	Rate Unit	Appl Code				
	Sulfentrazone (Spartan Charge)	0.137	lb ai/a	A	78.8 b	15.0 c	7.3 ab	6.5 a
	COC	1	% v/v	A				
	Sulfentrazone (F9021-2)	0.125	lb ai/a	A	87.5 ab	67.5 b	9.8 a	6.8 a
	COC	1	% v/v	A				
	Saflufenacil (BAS800)	0.066	lb ai/a	A	95.0 ab	92.5 ab	1.5 b	1.5 ab
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Pyroxasulfone (KIH-485)	0.19	lb ai/a	A	95.8 ab	80.0 ab	1.8 b	3.0 ab
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Indaziflam	0.0652	lb ai/a	A	96.3 ab	92.5 ab	3.5 ab	1.5 ab
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Flumioxazin (Chateau)	0.128	lb ai/a	A	100.0 a	100.0 a	0.0 b	0.3 b
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Hexazinone Diuron (Velpar AlfaMax)	1.16	lb ai/a	A	100.0 a	100.0 a	0.0 b	0.5 b
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Flumioxazin Pyroxasulfone (Fierce)	0.144	lb ai/a	A	92.5 ab	90.0 ab	3.5 ab	4.5 ab
	COC	1	% v/v	A				
	Gramoxone Inteon	0.5	lb ai/a	A				
	Sulfentrazone Imazethapyr (Authority Assist)	0.156	lb ai/a	B	87.5 ab	70.0 ab	7.8 ab	6.3 a
	NIS (R-11)	0.25	% v/v	B				
	Gramoxone Inteon	0.5	lb ai/a	A	100.0 a	90.0 ab	2.0 b	2.5 ab
	NIS (R-11)	0.25	% v/v	A				
	Chloransulam (Firstrate)	0.0158	lb ai/a	B				
	NIS (R-11)	0.25	% v/v	B				
	Gramoxone Inteon	0.5	lb ai/a	A	100.0 a	100.0 a	0.5 b	0.8 b
	NIS (R-11)	0.25	% v/v	A				
	Imazamox (Raptor)	0.39	lb ai/a	B				
	NIS (R-11)	0.25	% v/v	B				
	Gramoxone Inteon	0.5	lb ai/a	A	97.5 a	100.0 a	1.0 b	1.8 ab
	NIS (R-11)	0.25	% v/v	A				
	Asulam (Asulox)	1.5	lb ai/a	B				
	NIS (R-11)	0.25	% v/v	B				
	Gramoxone Inteon	0.5	lb ai/a	A	91.3 ab	95.0 ab	1.8 b	2.8 ab
	NIS (R-11)	0.25	% v/v	A				
	Asulam (Asulox)	1.25	lb ai/a	B				
	Imazamox (Raptor)	0.39	lb ai/a	B				
	NIS (R-11)	0.25	% v/v	B				
	None				0.0 c	0.8 c	5.0 ab	5.3 ab
LSD (P=.05)					11.30	17.75	4.91	3.19

Means within a column followed by the same letter do not significantly differ (P=0.05, Student-Newman-Keuls test). Application codes: A=March 17, 2011; B=April 12, 2011.

Herbicide trial on alfalfa seed – Wapato, WA.

Fourteen herbicide treatments were tested in a 2-year old alfalfa seed field near Wapato, WA (Table 4). The soil was a Shano silt loam. The entire trial was tilled in late March 2011 and eight herbicide treatments were applied April 1, 2011 when alfalfa was 2 to 3 inches tall and still emerging (PRE to weeds). No weeds were present at the time of the first herbicide applications so Gramoxone Inteon was not included. The first rainfall (0.08 in.) occurred on April 15, 2011. The field was first irrigated with a wheel line irrigation system April 20, 2011 following the initial herbicide treatments. Six postemergence (POST) treatments were applied April 26, 2011 when alfalfa was 10 to 12 inches tall and weeds had begun to emerge and were up to 0.5 in. tall. The most prevalent weed was annual sowthistle followed by common lambsquarters and kochia. Some annual grass weeds, mainly barnyardgrass, emerged later in the spring.

Herbicides were applied with a bicycle sprayer equipped with four, 8002 XR flan fan nozzles spaced 20 inches apart and calibrated to deliver 20 GPA. Plots measured 7.5 by 20 feet. Treatments were replicated four times in a RCB design.

Weed control and alfalfa injury were rated on several dates following herbicide treatments. Alfalfa seed was harvested September 15, 2011 by cutting plants from the middle row (3 ft.) by 10 feet in each plot, drying the plants, and passing them twice through a belt thresher. Seed was further cleaned by sieving and blowing and finally weighed to determine yield.

Results.

Among the PRE treatments, annual sowthistle was controlled most completely by Chateau, Velpar AlfaMax, and Fierce (Table 5). SpartanCharge and Sulfentrazone F9021-2 controlled sowthistle fairly well in May, but control decreased by late July. Authority Assist, Firstrate, ET, Asulox, and Asulox plus Raptor applied POST controlled annual sowthistle well, ranging from 86 to 99% control on July 27, 2011. Raptor applied alone tended to be less effective on sowthistle, averaging 73% control in late July (Table 5).

Common lambsquarters control was excellent with most PRE herbicide treatments with the exception of indaziflam and saflufenacil, which resulted in less than 50% control (Table 6). POST applied Authority Assist and ET completely controlled common lambsquarters. Raptor or Raptor plus Asulox applied POST only partially suppressed lambsquarters.59 to 70% (Table 6). Firstrate and Asulox alone applied POST resulted in poor control of lambsquarters.

Kochia control May 27, 2011 was excellent with most treatments with the exception of indaziflam, applied PRE and Firstrate, Raptor, or Asulox applied POST (Table 7). The kochia biotype present in this trial was likely resistant to the two ALS inhibitor herbicides; Firstrate and Raptor. Plots treated with Asulox alone or tanked mixed with Raptor had no kochia present by late July even though earlier control ratings in May were not complete (Table 7).

Barnyardgrass control was excellent with most PRE applied treatments except those containing sulfentrazone or saflufenacil (Table 6). Firstrate, Authority Assist, and Asulox plus Raptor tended to control annual grass weeds better than other POST treatments, but by May 27, 2011 all POST treatments were controlling grass weeds less than 87%.

Alfalfa was emerged at the time of the initial herbicide applications and all treatments injured alfalfa ranging from 3 to 18% injury 2 weeks after treatment (WAT) (Table 4). Velpar AlfaMax injured alfalfa the greatest (18%) followed by sulfentrazone F9021-2 (14%) and SpartanCharge (13%). Injury from the remaining early treatments was less than 10% (Table 4).

ET, Authority Assist, and Firstrate injured alfalfa the greatest among the treatments applied POST averaging 15, 14, and 13%% injury at 2 WAT, respectively. Asulox applied alone injured

alfalfa the least among the POST applied treatments, resulting in only 2% injury 2WAT (Table 4). On May 27, 2011, no alfalfa injury was noticeable from all POST treatments except ET, which injury averaged only 5% due to some necrotic spots remaining on lower leaves.

Alfalfa seed yield ranged from 331 to 574 lbs/acre and was not significantly different among herbicide treatments (Table 8).

Table 4. Alfalfa injury following preemergence and postemergence applied herbicides near Wapato, WA in 2011.

Crop Name Rating Date Rating Type Rating Unit				Alfalfa Apr-15-2011 Injury Percent	Alfalfa Apr-26-2011 Injury Percent	Alfalfa May-4-2011 Injury Percent	Alfalfa May-27-2011 Injury Percent
Treatment	Rate	Unit	Timing				
Sulfentrazone (Spartan Charge)	0.137	lb ai/a	A	12.8 b	1.3 ab	0.0 d	0.0 b
Sulfentrazone (F9021-2)	0.125	lb ai/a	A	14.3 b	2.0 a	0.0 d	0.0 b
Saflufenacil (BAS800)	0.066	lb ai/a	A	8.3 c	0.0 b	0.0 d	0.0 b
Pyroxasulfone (KIH-485)	0.19	lb ai/a	A	3.3 ef	0.0 b	0.0 d	0.0 b
Indaziflam	0.0652	lb ai/a	A	7.0 cd	0.0 b	0.0 d	0.0 b
Flumioxazin (Chateau)	0.128	lb ai/a	A	5.5 de	0.0 b	1.3 d	0.0 b
Hexazinone Diuron (Velpar AlfaMax)	1.16	lb ai/a	A	17.5 a	1.5 ab	0.8 d	0.0 b
Flumioxazin Pyroxasulfone (Fierce)	0.144	lb ai/a	A	2.8 f	0.0 b	0.0 d	0.0 b
Sulfentrazone Imazethapyr (Authority Assist)	0.156	lb ai/a	B	0.0 f	0.0 b	14.3 a	0.0 b
Chloransulam (Firstrate)	0.0158	lb ai/a	B	0.0 f	0.0 b	12.5 a	0.0 b
NIS (R-11)	0.25	% v/v	B				
Imazamox (Raptor)	0.039	lb ai/a	B	0.0 f	0.0 b	5.8 c	0.0 b
NIS (R-11)	0.25	% v/v	B				
Asulam (Asulox)	1.5	lb ai/a	B	0.0 f	0.0 b	2.0 d	0.0 b
NIS (R-11)	0.25	% v/v	B				
Asulam (Asulox)	1.25	lb ai/a	B	0.0 f	0.0 b	8.5 b	0.0 b
Imazamox (Raptor)	0.039	lb ai/a	B				
NIS (R-11)	0.25	% v/v	B				
Pyraflufen ethyl	1	fl oz/a	B	0.0 f	0.0 b	14.8 a	5.0 a
NIS (R-11)	0.25	% v/v	B				
None				0.0 f	0.0 b	0.0 d	0.0 b
LSD (P=.05)				2.25	1.02	2.43	0.00

Means within a column followed by the same letter do not significantly differ (P=0.05, Least significant difference test).
Application timing: A=April 1, 2011; B=April 26, 2011.

Table 5. Annual sowthistle control following preemergence and postemergence applied herbicides near Wapato, WA in 2011.

Rating Date Rating Type Rating Unit Pest Name				May-4-2011 Control Percent An. Sowthistle		May-27-2011 Control Percent An. Sowthistle		Jul-27-2011 Control Percent An. Sowthistle	
Treatment	Rate	Unit	Appl	%		%		%	
Sulfentrazone (Spartan Charge)	0.137	lb ai/a	A	81.3	a	80.8	ab	37.5	b
Sulfentrazone (F9021-2)	0.125	lb ai/a	A	83.8	a	86.3	ab	67.0	ab
Saflufenacil (BAS800)	0.066	lb ai/a	A	53.8	b	38.8	c	0.0	c
Pyroxasulfone (KIH-485)	0.19	lb ai/a	A	60.0	b	85.0	ab	54.5	ab
Indaziflam	0.0652	lb ai/a	A	98.5	a	95.0	a	76.5	ab
Flumioxazin (Chateau)	0.128	lb ai/a	A	99.8	a	97.0	a	91.3	a
Hexazinone Diuron (Velpar AlfaMax)	1.16	lb ai/a	A	99.5	a	100.0	a	97.0	a
Flumioxazin Pyroxasulfone (Fierce)	0.144	lb ai/a	A	99.5	a	100.0	a	97.5	a
Sulfentrazone Imazethapyr (Authority Assist)	0.156	lb ai/a	B	100.0	a	95.0	a	90.3	a
Chloransulam (Firstrate)	0.0158	lb ai/a	B	95.8	a	97.5	a	98.8	a
NIS (R-11)	0.25	% v/v	B						
Imazamox (Raptor)	0.039	lb ai/a	B	93.0	a	57.5	bc	73.3	ab
NIS (R-11)	0.25	% v/v	B						
Asulam (Asulox)	1.5	lb ai/a	B	85.8	a	72.5	ab	94.5	a
NIS (R-11)	0.25	% v/v	B						
Asulam (Asulox)	1.25	lb ai/a	B	95.8	a	87.5	ab	86.3	a
Imazamox (Raptor)	0.039	lb ai/a	B						
NIS (R-11)	0.25	% v/v	B						
Pyraflufen ethyl	1	fl oz/a	B	98.8	a	95.0	a	98.8	a
NIS (R-11)	0.25	% v/v	B						
None				0.0	c	0.0	d	0.0	c
LSD (P=.05)				16.54		22.62		29.04	

Means within a column followed by the same letter do not significantly differ (P=0.05, Least significant difference test).
Application timing: A=April 1, 2011; B=April 26, 2011.

Table 6. Common lambsquarters control following preemergence and postemergence applied herbicides near Wapato, WA in 2011.

Rating Date Rating Type Rating Unit Pest Name				May-4-2011 Control Percent Common lambsquarters		May-27-2011 Control Percent Common lambsquarters		Jul-27-2011 Number no./plot Common lambsquarters	
Treatment	Rate		Timing	%		%		No.	
Sulfentrazone (Spartan Charge)	0.137	lb ai/a	A	97.5	a	100.0	a	0.0	b
Sulfentrazone (F9021-2)	0.125	lb ai/a	A	100.0	a	100.0	a	0.0	b
Saflufenacil (BAS800)	0.066	lb ai/a	A	18.7	c	41.3	b	3.0	ab
Pyroxasulfone (KIH-485)	0.19	lb ai/a	A	97.5	a	93.0	a	0.5	b
Indaziflam	0.0652	lb ai/a	A	89.5	a	45.0	b	5.5	a
Flumioxazin (Chateau)	0.128	lb ai/a	A	97.5	a	97.5	a	0.3	b
Hexazinone Diuron (Velpar AlfaMax)	1.16	lb ai/a	A	100.0	a	100.0	a	0.0	b
Flumioxazin Pyroxasulfone (Fierce)	0.144	lb ai/a	A	96.8	a	98.8	a	0.3	b
Sulfentrazone Imazethapyr (Authority Assist)	0.156	lb ai/a	B	98.7	a	100.0	a	0.0	b
Chloransulam (Firstrate)	0.0158	lb ai/a	B	83.9	a	6.3	c	3.0	ab
NIS (R-11)	0.25	% v/v	B						
Imazamox (Raptor)	0.039	lb ai/a	B	87.5	a	58.8	b	1.3	b
NIS (R-11)	0.25	% v/v	B						
Asulam (Asulox)	1.5	lb ai/a	B	49.9	b	41.1	b	2.8	ab
NIS (R-11)	0.25	% v/v	B						
Asulam (Asulox)	1.25	lb ai/a	B	91.3	a	69.5	ab	0.3	b
Imazamox (Raptor)	0.039	lb ai/a	B						
NIS (R-11)	0.25	% v/v	B						
Pyraflufen ethyl	1	fl oz/a	B	100.0	a	100.0	a	0.0	b
NIS (R-11)	0.25	% v/v	B						
None				0.0	c	0.0	c	2.3	b
LSD (P=.05)				21.53		24.34		2.25	

Means within a column followed by the same letter do not significantly differ (P=0.05, Least significant difference test).
Application timing: A=April 1, 2011; B=April 26, 2011.

Table 7. Kochia and annual grass control following preemergence and postemergence applied herbicides near Wapato, WA in 2011.

Rating Date Rating Type Rating Unit Pest Name				May-4-2011 Control Percent Kochia	May-27-2011 Control Percent Kochia	May-4-2011 Control Percent Grass	May-27-2011 Control Percent Barnyardgrass
Treatment	Rate	Unit	Timing	%	%	%	%
Sulfentrazone (Spartan Charge)	0.137	lb ai/a	A	96.3 a	100.0 a	6.9 c	25.0 de
Sulfentrazone (F9021-2)	0.125	lb ai/a	A	98.8 a	100.0 a	0.6 c	40.0 cd
Saflufenacil (BAS800)	0.066	lb ai/a	A	57.5 ab	90.0 a	0.0 c	0.0 e
Pyroxasulfone (KIH-485)	0.19	lb ai/a	A	61.3 ab	100.0 a	97.5 a	95.8 a
Indaziflam	0.0652	lb ai/a	A	52.5 ab	0.0 d	97.5 a	97.5 a
Flumioxazin (Chateau)	0.128	lb ai/a	A	99.3 a	100.0 a	93.8 a	77.0 abc
Hexazinone Diuron (Velpar AlfaMax)	1.16	lb ai/a	A	99.5 a	99.0 a	95.0 a	96.3 a
Flumioxazin Pyroxasulfone (Fierce)	0.144	lb ai/a	A	99.8 a	100.0 a	99.8 a	98.0 a
Sulfentrazone Imazethapyr (Authority Assist)	0.156	lb ai/a	B	95.0 a	100.0 a	96.3 a	62.5 a-d
Chloransulam (Firstrate)	0.0158	lb ai/a	B	2.5 c	0.0 d	92.5 a	86.3 ab
NIS (R-11)	0.25	% v/v	B				
Imazamox (Raptor)	0.039	lb ai/a	B	0.0 c	37.5 c	91.3 a	51.3 bcd
NIS (R-11)	0.25	% v/v	B				
Asulam (Asulox)	1.5	lb ai/a	B	38.8 bc	66.3 b	71.9 b	27.5 de
NIS (R-11)	0.25	% v/v	B				
Asulam (Asulox)	1.25	lb ai/a	B	87.5 a	80.0 ab	96.3 a	60.0 a-d
Imazamox (Raptor)	0.039	lb ai/a	B				
NIS (R-11)	0.25	% v/v	B				
Pyraflufen ethyl	1	fl oz/a	B	86.3 a	100.0 a	0.0 c	0.0 e
NIS (R-11)	0.25	% v/v	B				
None				0.5 c	0.0 d	0.0 c	0.0 e
LSD (P=.05)				30.18	18.71	8.41	26.65

Means within a column followed by the same letter do not significantly differ (P=0.05, Least significant difference test).
Application timing: A=April 1, 2011; B=April 26, 2011.

Table 8. Alfalfa seed yield following preemergence and postemergence applied herbicides near Wapato, WA in 2011.

Crop Date					Alfalfa Sep-15-2011 Seed yield lb/acre	
Trt	Treatment	Rate		Timing		
1	Sulfentrazone (Spartan Charge)	0.137	lb ai/a	A	444	a
2	Sulfentrazone (F9021-2)	0.125	lb ai/a	A	391	a
3	Saflufenacil (BAS800)	0.066	lb ai/a	A	331	a
4	Pyroxasulfone (KIH-485)	0.19	lb ai/a	A	389	a
5	Indaziflam	0.0652	lb ai/a	A	461	a
6	Sulfentrazone Imazethapyr (Authority Assist)	0.156	lb ai/a	B	415	a
7	Flumioxazin (Chateau)	0.128	lb ai/a	A	448	a
8	Hexazinone Diuron (Velpar AlfaMax)	1.16	lb ai/a	A	370	a
9	Flumioxazin Pyroxasulfone (Fierce)	0.144	lb ai/a	A	491	a
10	Chloransulam (Firstrate)	0.0158	lb ai/a	B	574	a
	NIS (R-11)	0.25	% v/v	B		
11	Imazamox (Raptor)	0.039	lb ai/a	B	348	a
	NIS (R-11)	0.25	% v/v	B		
12	Asulam (Asulox)	1.5	lb ai/a	B	334	a
	NIS (R-11)	0.25	% v/v	B		
13	Asulam (Asulox)	1.25	lb ai/a	B	433	a
	Imazamox (Raptor)	0.039	lb ai/a	B		
	NIS (R-11)	0.25	% v/v	B		
14	Pyraflufen ethyl	1	fl oz/a	B	553	a
	NIS (R-11)	0.25	% v/v	B		
15	None			A	372	a
LSD (P=.05)						N.S.

Means within a column followed by the same letter do not significantly differ (P=0.05, Least significant difference test).
Application timing: A=April 1, 2011; B=April 26, 2011.