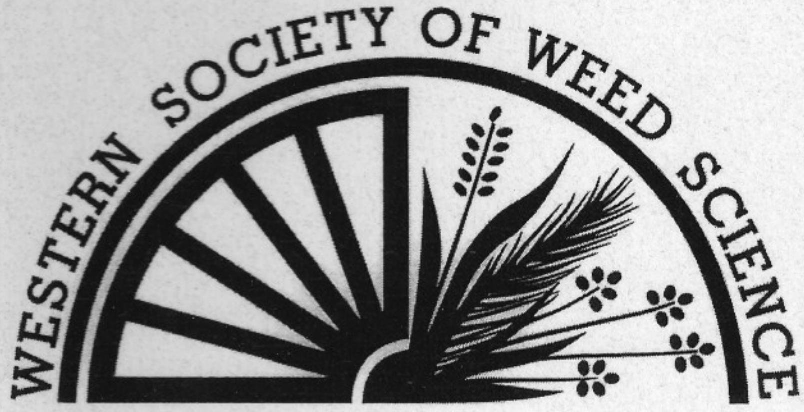

2009 RESEARCH PROGRESS REPORT

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FOREWORD

The 2009 Research Progress Report of the Western Society of Weed Science (WSWS) is a compilation of research investigations contributed by weed scientists in the western United States of America. The objective of the Research Progress Report is to provide an avenue for presentation and exchange of on-going research to the weed science community. The information in this report is preliminary; therefore, it is not for the development of endorsements or recommendations.

The reports contained herein and their respective content, format, and style are the responsibility of the author(s) who submitted them. Reports are printed as received from the authors.

WSWS appreciates the time and effort of the authors who shared their research results with the members of WSWS.

Traci Rauch and Joan Campbell
Co-editors, Research Progress Report
Western Society of Weed Science
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Control of downy brome in dryland intermediate wheatgrass. Richard N. Arnold, Michael K. O'Neill, and Kevin A. Lombard. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on April 29, 2008 in southern Colorado to evaluate the response of dryland intermediate wheatgrass and downy brome (BROTE) to postemergence herbicides. Soil type was a Ramper loam with a pH of 7.8 and an organic matter content less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 12 by 25 feet. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on April 29 with crop oil concentrate and Uran 32 at 0.5 and 1% v/v. Treatments were evaluated on June 4.

Nicosulfuron in combination with metsulfuron at 0.623 plus 0.1 oz ai/A and nicosulfuron in combination with metsulfuron and diuron at 0.782 plus 0.123 plus 12.8 oz ai/A gave 92 percent control of downy brome.

Table. Control of downy brome with postemergence herbicides in great basin wildrye.

Treatment[1]	Rate	BROTE control[2]
	oz ai/A	------%-------
Nicosulfuron + metsulfuron	0.469+0.75	75
Nicosulfuron + metsulfuron	0.623+0.1	92
Nicosulfuron + metsulfuron	0.782+0.125	72
Nicosulfuron + metsulfuron	0.938+0.15	88
Nicosulfuron + metsulfuron + diuron	0.623+0.1+12.8	88
Nicosulfuron + metsulfuron + diuron	0.782+0.125+12.8	92
Sulfosulfuron	1.0	80
Aminocyclopyrachlor	1.25	73
Aminocyclopyrachlor	2.5	85
Weedy check	0	0

[1] Treatments were applied with a crop oil concentrate and Uran 32 at 0.5 and 1.0% v/v.

[2] Rated on a scale from 0 to 100 with 0 being no control and 100 being dead plants.

Buffelgrass control with glyphosate and fluazifop-P-butyl. Francis E. Northam and Kai Umeda (University of Arizona, Maricopa County Cooperative Extension, Phoenix, AZ 85040) An efficacy demonstration experiment was conducted on an urban vacant lot adjacent to Maricopa County Cooperative Extension office property in Phoenix, AZ. Herbicides were applied as spray-to-wet individual plant spot treatments using a backpack CO_2 sprayer equipped with a hand-held wand sprayer with a 8003 flat-fan nozzle. Spray mixes were delivered in water pressurized to 32 psi. Site conditions when treatments were applied on 31 August 2006 included: air temperature ranged from 99° to 101° F during mid-afternoon, soil temperature was 130° F at 0.5 inch depth and 100° F at four inches depth, and wind speed varied from 1 to 5 mph. Treatment mixtures included: glyphosate at 1.2% and 2.5% v/v in water (no surfactant added) and fluazifop at 0.73% or 1.47% v/v plus 0.05% v/v methylated seed oil in water. Replication was attained by rating or measuring 7 to 9 plants within each treatment. When buffelgrass response was evaluated September 2006, both glyphosate concentrations and the high fluazifop rate had greater than 90% visually estimated leaf mortality (Table). By November 2006, above ground buffelgrass biomass was greater than 90% dead in all herbicide treatments, and the few remaining live stems inside multi-stem clumps were less than >2 in. tall. Spring 2007 recovery began with January rains. In February 2007, foliage height was about 4 in. in both fluazifop treatments and non-sprayed plants. No regrowth was detected from any plants treated with glyphosate through early October 2007. At that time a common urban vegetation inhibitor was applied to the site (concrete and asphalt parking lot mulch).

Table. Buffelgrass control with glyphosate and fluazifop

	Buffelgrass control			
Treatment	Dead Foliage 21 September 2006	Dead Biomass 23 November 2006	Live Biomass Hgt. 23 November 2006	Hgt. of Foliage 15 February 2007
	%	%	inches	inches
Untreated check	17	58	14.1	4.3
Fluazifop 0.73%	60	91	0.8	4.3
Fluazifop 1.47%	53	97	0.8	3.9
Glyphosate 1.2%	96	98	1.2	0
Glyphosate 2.5%	95	98	0.4	0

Wild caraway control in a Colorado hay meadow. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Wild caraway (CARCA) was introduced into the United States as a cultivated species but escaped to become a weed in mountain meadows, hayfields, and along irrigation ditches and roadways in the western half of Colorado. Wild caraway is a biennial that has one or more shoots emerging from a single taproot. CARCA produces unpalatable, hollow, woody stems that detract from the value of grass hay.

An experiment was established near Yampa, CO on June 16, 2008 to evaluate chemical control of CARCA with metsulfuron, aminopyralid, and 2,4-D . The experiment was designed as randomized complete block and treatments were replicated four times. Herbicides were applied in spring or fall 2008 when CARCA was in rosette to early bolt growth stage (June 16,2008) or rosette (October 7, 2008; Table 1). The entire site had been cut for hay and there was 2 to 3" tall stubble at the October 7, 2008 application. All treatments were applied with a CO_2-pressurized backpack sprayer using 11002LP flat fan nozzles at 20 gal/a and 30 psi. Plot size was 10 by 30 feet. Visual evaluations and biomass compared to non-treated plots were collected on August 14, 2008 (Table2).

Only the June 16, 2008 treatments were evaluated (on August 14, 2008) for this report. The remaining treatments were sprayed on October 16, 2008 and will be evaluated in spring 2009. Aminopyralid sprayed alone was the only treatment in this study that controlled CARCA inadequately (58%), approximately 5 months after treatment (MAT). All other treatments controlled 93 to 96% of CARCA. Biomass was collected on August 14, 2008 from a randomly placed 1 m^2 quadrat/plot (Table 3).

Each biomass sample was dried, separated into CARCA, grass hay, clover, and miscellaneous species, and weighed. CARCA was subdivided into green or dead stand. Green CARCA was healthy live plants that recovered or emerged after the June 6, 2008 application. CARCA dead stand was woody stems and leaves that were present in the grass hay at harvest. Both green and dead stand CARCA would be unpalatable to livestock.

There was 215 lbs/a of green CARCA in untreated plots. Aminopyralid sprayed alone was the only treatment in the experiment with significant (76 lb/a) quantities of green CARCA biomass. Aminopyralid or 2,4-D sprayed alone increased grass hay biomass (2054 or 2529 lb/a) to approximately twice that produced in the untreated check (961 lb/A). Aminopyralid plus 2,4-D increased grass biomass by almost four-fold (3784 lb/A). The increase in grass biomass was likely due to the lack of competition from clover and CARCA that were decreased or almost eliminated with this treatment. All metsulfuron treatments had grass biomass similar to untreated checks even though the clover and CARCA were nearly eliminated. Grass in metsulfuron treatments was severely stunted (58 to 67% height reduction) compared to untreated checks. Red clover was almost eliminated in all treatments except 2,4-D. There was 172, 1628, and 0 to 6 lb/a of clover in 2,4-D, untreated, and all remaining treatments, respectively.

All metsulfuron treatments decreased desirable biomass (grass plus clover, 607 to 1255 lb/A) compared to untreated checks (2530 lb/a). Similar desirable biomass was produced in plots treated with aminopyralid or 2,4-D sprayed alone (2054 or 2529 lb/a) and aminopyralid plus 2,4-D treated plots produced 1.67-fold more desirable biomass (3784 lb/A) than untreated checks. Visual evaluations for residual control and biomass will be conducted in 2009 to determine long-term CARCA control and possible recovery of clover.

Table 1. Application data for wild caraway control in a Colorado hay meadow.

Environmental data		
Application date	June 16, 2008	October 7, 2008
Application time	9:30 am	3:00 pm
Air temperature, F	67°	62
Relative humidity, %	47	33
Wind speed, mph	5 to 7	0 to 4

Application date	Species	Common Name	Growth stage	Height
June 16, 2008	CARCA	Wild caraway	Early bolt	4 to 6
	TAROF	Common dandelion	Flower	5 to 8
	TRIPR	Red Clover	Vegetative	2 to 3
	BROMA	Mountain Brome	3 to 4 leaf	4 to 7
	PHLPR	Timothy	3 to 4 leaf	4 to 8
	POASP	Bluegrass	Vegetative	2 to 3
October 7, 2008	CARCA	Wild caraway	Rosette	2 to 3
	GRASS	All grass species	Vegetative	2 to 3

Table 2. Wild caraway control in a Colorado hay meadow.

		Wild caraway control		
Herbicide	Rate	Rosettes	Bolted	Grass height reduction
	oz/a	(%)		
2,4-D amine	37	93	99	10
Aminopyralid	4	58	64	5
Aminopyralid + 2,4-D	4 + 37	96	99	0
Aminopyralid + metsulfuron	2	94	100	66
Aminopyralid + metsulfuron	2.5	95	100	68
Aminopyralid + metsulfuron	3	93	98	70
Metsulfuron + 2,4-D	0.3 + 18.5	90	98	50
Metsulfuron + 2,4-D	0.5 + 18.5	93	99	65
LSD (0.05)		11	13	18

[1] Non-ionic surfactant added to all treatments at 0.25% v/v.

[2] Pre-mix formulation of aminopyralid plus metsulfuron.

Table 3. Wild caraway and forage biomass in a Colorado hay meadow.

		Wild caraway biomass		Forage biomass			
Herbicide[1]	Rate	Green	Dead stand	Clover	Grass	Misc.	Desirable
	oz/a	lb/a					
2,4-D Amine	37	1	14	172	2054	2	2226
Aminopyralid	4	76	0	0	2529	6	2530
Aminopyralid + 2,4-D	4 + 37	0	0	0	3784	0	3784
Aminopyralid[2] + metsulfuron	2	0	11	0	607	1	607
Aminopyralid + metsulfuron	2.5	0	9	0	961	0	961
Aminopyralid + metsulfuron	3	0	13	0	880	2	880
Metsulfuron + 2,4-D	0.3 + 18.5	1	14	6	1255	15	1261
Metsulfuron + 2,4-D	0.5 + 18.5	5	9	1	1083	10	1084
Untreated check		216	0	1628	961	20	2530
LSD (0.05)		52	13	180	472	12	501

[1] Non-ionic surfactant added to all treatments at 0.25% v/v.
[2] Pre-mix formulation of aminopyralid plus metsulfuron.

Oriental clematis control in Colorado. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Oriental clematis (CLEOR) has extensive climbing vines that smother grass, shrubs, and trees. In recent times, CLEOR has rapidly expanded its range along the steep slopes and canyons of the Front Range in Colorado. CLEOR often grows on trees and along ditches near water where many herbicides cannot be used and is often found in steep rugged terrain making herbicide application very difficult.

An experiment was established near Georgetown, CO on August 3, 2006 to evaluate chemical control of CLEOR. The experiments were designed as randomized complete blocks and treatments were replicated four times. Herbicides were applied when CLEOR was in full bloom to late flower growth stage (Table 1). All treatments were applied with a CO_2-pressurized backpack sprayer using 11002LP flat fan nozzles at 20 gal/A and 30 psi. Plot size was 10 by 30 feet. Visual evaluations for control were compared to non-treated plots and these data were collected in October 2006, July 2007, and October 2008 (Table2).

Metsulfuron controlled CLEOR slowly and was not as effective as in previously reported CSU research. In this experiment metsulfuron controlled 29% of CLEOR 2 months after treatment (MAT), 80% at 12 MAT, and 49% at 26 MAT. In our previous research, metsulfuron controlled 93 and 86% of CLEOR 12 and 24 MAT, but application timing was at the bud to very early flower growth stages whereas, application timing in this experiment was at flowering. All other treatments controlled 79 to 100% of CLEOR 2 and 12 MAT. CLEOR appears to be highly sensitive to aminopyralid (100% control with all rates 12 MAT and 99 to 100% control 26 MAT). Applications of 2,4-D in this and other CLEOR studies have provided excellent long term CLEOR control, but often cause unacceptable collateral damage to desirable native brush species. In this experiment, 2,4-D (16 or 32 oz ai/a) controlled 85 or 100% of CLEOR approximately 12 MAT, respectively. CLEOR control with 16 oz ai/a of 2,4-D dropped to 70% at 26 MAT; however, 2,4-D at 32 oz ai/a remained at 100% CLEOR control 26 MAT

Table 1. Application data for oriental clematis control in Colorado.

Environmental data	
Application date	August 3, 2006
Application time	9:30 am
Air temperature, F	67
Relative humidity, %	47
Wind speed, mph	5 to 7

Application date	Species	Common Name	Growth stage	Height
				--(in.)--
August 3, 2006	CLEOR	Oriental clematis	Flower	24 to 36
	PASSM	Western wheatgrass	Flower	10 to 14

Table 2. Oriental clematis control in Colorado.

Herbicide[1]	Rate	Oriental clematis control October 2006	July 2007	October 2008
	oz ai/a	(%)		
Metsulfuron	0.6	29	80	49
2,4-D Amine	16	79	85	70
2,4-D Amine	32	90	100	100
Aminopyralid	0.8	97	100	100
Aminopyralid	1.3	97	100	99
Aminopyralid	1.8	93	100	100
Aminopyralid + 2,4-D amine	0.8 + 16	98	100	100
Control		0	0	0
LSD (0.05)		10	8	10

[1] Non-ionic surfactant added to all treatments at 0.25% v/v.

Control of hoary cress with chlorsulfuron, metsulfuron, or 2,4-D amine prior to seeding non-irrigated pasture. Ralph Whitesides, Matthew Palmer, and Corey Ransom. (Utah State University, Department of Plants, Soils, and Climate, Logan, UT 84322, Sanpete County Extension Agent, Ephraim, UT 84627, Utah State University, Department of Plants, Soils, and Climate, Logan, UT 84322) The west bench of the North Sanpete Valley in Utah has become heavily infested with hoary cress (*Cardaria draba*). In 2007 the Sanpitch Cooperative Weed Management Area (CWMA) used grant funding to map hoary cress and establish a research and education plot near the community of Wales. The objective was to demonstrate effective hoary cress control and re-vegetation practices for the area. Individual plots measuring 40 x 200 feet were arranged in a randomized block design with three replications. Herbicide treatments were applied on May 14, 2007, using an ATV-mounted boomless sprayer calibrated to deliver 15 gallon per acre. A non-ionic surfactant was added to all treatments at the reate of 0.25% v/v. Hoary cress was in the bud stage of growth at treatment time, however some plants had been grazed by cattle prior to treatment and the location was very dry having experienced drought throughout the winter. Visual control ratings were zero during the treatment year. No treatment appeared any different from the control. On October 16, 2007 Crested Wheatgrass (CD II), Russian Wildrye (Bozoisky), Siberian Wheatgrass (Vavilov), and Pubescent Wheatgrass (Luna) where planted as a fall-dormant seeding with a range drill at 10 lb/acre. Twelve months after herbicide application and 7 months after grass seeding, chlorsulfuron treated plots had the best hoary cress control and only crested wheatgrass had germinated and become established in any of the treated plots or the check. At the time of the 12-month visual evaluation grasshoppers had migrated from the nearby rangelands in tremendous numbers and were eating all vegetation in the area. Extremely dry winter conditions and defoliation by grasshoppers resulted in no successful grass establishment in any plots, including the non-treated control plots.

Table. Control of hoary cress 12 months following 2007 herbicide treatment.

Treatment	Rate[1]	Control
	oz ai / A	--------------% ----------------
Chlorsulfuron	1.33	98
Metsulfuron	2.00	75
2,4-D amine	32.0	0
Non-Treated	--	--
LSD (0.05)		9

[1] 2,4-D amine is in lb ae/A.

<u>Evaluation of DPX KJM44-062 for weed control in pasture and rangeland.</u> Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). DPX KJM44-062 is a new and currently non-classified herbicide from E. I. DuPont company with a proposed common name of aminocyclopyrachlor. Little is known about the efficacy of this herbicide or if the new compound could be useful in general or invasive weed control programs. The purpose of this research was to evaluate DPX KJM44-062 for control of invasive and troublesome weeds in pasture and rangeland.

For all studies, herbicides were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 30 feet and replicated three or four times in a randomized complete block design. Control of each species was evaluated visually using percent stand reduction compared to the untreated control. Results were compared to other commonly used herbicides applied at the general use rate for each weed species.

The first and second studies evaluated the control of leafy spurge with DPX KJM44-062 applied alone from 1 to 3 oz ai/A in the spring or fall. The first experiment was established near Walcott, ND in an ungrazed area of pasture with a dense stand of leafy spurge (92 stems/m^2). Treatments were applied June 5, 2007 when leafy spurge was in the true-flower growth stage. The second experiment was established on abandoned cropland near Fargo, ND on September 19, 2007 when leafy spurge was in the fall regrowth stage with a stand density of 30 stems/m^2.

DPX KJM44-062 applied at 2 oz/A or higher provided better long-term leafy control than the standard treatments of picloram at 8 oz/A or picloram plus imazapic plus 2,4-D at 4 + 1 + 16 oz/A (Table 1). For instance, DPX KJM44-062 applied at 2 oz/A provided 90 and 88% leafy spurge control in June and August 2008, respectively, compared to 58 and 45% control respectively, with picloram at 8 oz/A. The major grass species present were Kentucky bluegrass and smooth brome and less than 5% grass injury was observed 2 MAT (months after treatment) with DPX KJM44-062 compared to an average of 12% when the treatment included picloram.

Leafy spurge control 11 MAT with DPX KJM44-062 applied in the fall increased from 89 to 99% as the application rate increased from 1 to 3 oz/A (Table 2). Control was similar to picloram at 16 oz/A and no grass injury was observed with either herbicide.

The third study was established near Fargo, ND on June 5, 2007 to evaluate control of Canada thistle, perennial sowthistle, curly dock, and common dandelion with DPX KJM44-062. Dandelion was in the flowering growth stage, while the other three species were vegetative to beginning to bolt.

Initial Canada thistle and perennial sowthistle control with DPX KJM44-062 tended to be lower than the commonly used treatments of picloram at 8 oz/A or aminopyralid at 1.5 oz/A (Table 3). For instance, DPX KJM44-062 at 2 oz/A provided 79 and 75% Canada thistle and perennial sowthistle control, respectively, approximately 3 weeks after application compared to 96 and 88%, respectively, with picloram. DPX KJM44-062 provided complete control of dandelion but did not control curly dock regardless of application rate.

Canada thistle control with DPX KJM44-062 at 1.5 oz/A or higher provided an average of 96% Canada thistle control in September 2007 (3 MAT) compared to 88 and 92% with picloram and aminopyralid, respectively. Canada thistle control with DPX KJM44-062 remained high the year after treatment. Control in June and September 2008 with DPX KJM44-062 at 1.5 oz/A or more averaged 97 and 95%, respectively, compared to 58% or less with picloram and aminopyralid. DPX KJM44-062 provided excellent control of perennial sowthistle in the year of treatment, but control averaged less than 50% by 12 MAT regardless of application rate.

The fourth experiment was established to evaluate yellow toadflax control with DPX KJM44-062. The experiment was located on a wildlife production area near Valley City, ND which contained a dense stand of yellow toadflax and smooth bromegrass. Treatments were applied as previously described on July 20, 2007 when yellow toadflax was in the vegetative to flowering growth stage.

DPX KJM44-062 applied at 1 to 3 oz/A averaged less than 30% yellow toadflax the year of treatment (Table 4). Controlled increased to 82% in July 2008 (12 MAT) the year after treatment with DPX KJM44-062 at 3 oz/A but declined rapidly and only averaged 54% by September 2008. Picloram at 32 oz/A provided 90% yellow toadflax control in August 2008.

In summary, DPX KJM44-062 provided similar or better control of leafy spurge, Canada thistle, and perennial sowthistle than commonly used herbicides. DPX KJM44-062 did not provide adequate control of curly dock or yellow toadflax. This herbicide shows promise for broadleaf weed control including several invasive species and should be further evaluated. The soil residual potential of DPX KJM44-062 to move off site or into groundwater is not yet known.

Table 1. Evaluation of DPX KJM44-062 for leafy spurge control applied in June 2007 near Walcott, ND.

		Control/evaluation date				
		2007		2008		
		6 Aug.		9 June	17 July	19 Aug.
Treatment	Rate	Leafy spurge	Grass injury	Leafy spurge	Leafy spurge	Leafy spurge
	oz/A	%				
DPX KJM44-062 + MSO[1]	1 + 1%	92	1	79	66	55
DPX KJM44-062 + MSO	1.5 + 1%	98	2	87	75	71
DPX KJM44-062 + MSO	2 + 1%	99	4	90	90	88
DPX KJM44-062 + MSO	2.5 + 1%	99	4	97	97	92
DPX KJM44-062 + MSO	3 + 1%	99	4	96	96	92
Picloram + MSO	8 + 1%	86	12	58	40	45
Picloram + imazapic + 2,4-D + MSO	4 + 1 + 16 + 1 qt	97	13	45	62	56
LSD(0.05)		7	5	31	32	23

[1]MSO was Scoil, by AGSCO, 1168 12th St NE: Grand Forks ND 58201.

Table 2. Evaluation of DPX KJM44-062 for leafy spurge control applied in September 2007 at Fargo, ND.

		Control/2008 evaluation	
Treatment	Rate	20 June	20 Aug .
	oz/A	%	
DPX KJM44-062 + MSO[1]	1 + 1%	93	89
DPX KJM44-062 + MSO	2 + 1%	99	97
DPX KJM44-062 + MSO	3 + 1%	100	99
Picloram + MSO	16 + 1%	99	97
LSD(0.05)		NS	7

[1]MSO was Scoil, by AGSCO, 1168 12th St NE: Grand Forks ND 58201.

Table 3. Evaluation of DPX KJM44-062 for Canada thistle, and perennial sowthistle, curly dock, and dandelion control at Fargo, ND.

		Control./evaluation date									
		2007							2008		
		29 June				5 September			20 June		26 Sept.
Treatment	Rate	CT[1]	PEST	Curly dock	Dande lion	CT	PEST	Curly dock	CT	PEST	CT
	— oz/A —	%									
DPX KJM44-062 + MSO[2]	1 + 1 %	43	35	0	100	54	100	25	56	0	43
DPX KJM44-062 + MSO	1.5 + 1 %	75	71	0	100	93	99	0	95	6	88
DPX KJM44-062 + MSO	2 + 1 %	79	75	0	100	100	100	0	97	45	95
DPX KJM44-062 + MSO	2.5 + 1 %	82	77	0	100	99	100	0	98	47	99
DPX KJM44-062 + MSO	3 + 1 %	84	77	5	100	93	100	38	97	39	97
Picloram + MSO	8 + 1 %	96	88	41	100	88	98	100	5	86	0
Aminopyralid + Act 90[3]	1.5 + 0.25 %	92	80	16	96	92	92	100	30	58	58
LSD(0.05)		12	15	8	NS	17	5	35	29	43	39

[1] Abbreviations: CT = Canada thistle, PEST = perennial sowthistle.
[2] MSO was Scoil, by AGSCO, 1168 12th St NE: Grand Forks ND 58201.
[3] Activator 90 surfactant by Loveland Products, Inc. P.O. Box 1286 Greeley, CO 80632.

Table 4. Evaluation of DPX KJM44-062 applied in July 2007 at flowering for yellow toadflax control near Valley City, ND.

		Control/evaluation date			
		2007		2008	
Treatment	Rate	15 Aug	14 Sept	14 July	13 Aug
	— oz/A —	%			
DPX KJM44-062 + MSO[1]	1 + 1 %	5	29	10	0
DPX KJM44-062 + MSO	1.5 + 1 %	9	32	23	22
DPX KJM44-062 + MSO	2 + 1 %	7	23	37	8
DPX KJM44-062 + MSO	2.5 + 1 %	13	26	48	31
DPX KJM44-062 + MSO	3 + 1 %	14	24	82	54
Picloram + MSO	8 + 1 %	8	31	36	33
Picloram + MSO	32 + 1 %	29	46	91	90
LSD(0.05)		6	NS	31	35

[1] MSO was Scoil, by AGSCO, 1168 12th St NE: Grand Forks ND 58201.

Halogeton control on Colorado rangeland. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Halogeton (HALGL) is an annual weed that has rapidly invaded millions of acres in the western United States. It is adapted to alkaline soils and semi-arid environments. HALGL produces toxic oxalates that are especially poisonous to sheep. An experiment was established near Craig, CO to evaluate HALGL control. Previous research conducted by CSU demonstrated that HALGL is relatively easy to control with herbicides; however, Nuttaill's saltbush that is prevalent in the same areas was severely injured by herbicides. The purpose of this study was to determine if there may be additional herbicides that control HALGL effectively without injuring Nuttaill's saltbush.

The experiments were designed as a randomized complete block with four replications. Herbicides (Table 2) were applied on June 12, 2007 when HALGL 1 to 2" tall. All treatments were applied with a CO_2-pressurized backpack sprayer using 11003LP flat fan nozzles at 21 gal/A and 14 psi. Other application information is presented in Table 1. Plot size was 10 by 30 feet.

Visual evaluations for control compared to non-treated plots were collected on August 8, 2007 and July 10, 2008 (Table 1), approximately 3 and 13 months after treatment (MAT). Imazamox, fluroxypyr, 2,4-D, and dicamba are known to selectively control other annuals weeds and were used in this study.

2,4-D (LV) or 2,4-D (amine) controlled 97 or 71% of HALGL approximately 2 MAT; however, HALGL control dropped to 0 or 8% approximately 13 MAT. Dicamba controlled 71 and 68% HALGL 2 and 13 MAT. Fluroxypyr controlled 9 to 33% HALGL 2 to 13 MAT. Imazamox (15 or 20 oz/a) controlled 89 or 99% HALGL 13 MAT. Although there was 0 to 29% saltbush injury with imazamox 2 MAT the saltbush injury disappeared by 13 MAT.

Our data indicates that Imazamox is an excellent choice for controlling HALGL (89 to 99%) with little injury or stand loss to Nuttaill's saltbush. This study will be evaluated in 2009 for long term HALGL control.

Table 1. Application data for halogeton control on Colorado rangeland.

Environmental data	
Application date	June 12, 2007
Application time	10:30 am
Air temperature, F	62
Relative humidity, %	29
Wind speed, mph	0 to 3

Application date	Species	Common name	Growth stage	Height (in.)
June 12, 2007	HALGL	Halogeton	Vegetative	1 to 2

Table 2. Halogeton control on Colorado rangeland.

Herbicide[1]	Rate	Halogeton August 2007	Halogeton July 2008	Saltbush August 2007	Saltbush July 2008
	(oz/a)	(Control %)		(Injury %)	
Imazamox	15	25	89	0	0
Imazamox	20	24	99	0	0
Fluroxypyr	16	33	9	6	0
Fluroxypyr	24	29	19	0	0
2,4-D amine	48	70	8	21	0
2,4-D ester	48	97	0	29	0
Dicamba	32	71	68	26	0
LSD (0.05)		9	19	9	1

[1] Non-ionic surfactant added to all treatments at 0.25% v/v.

Halogeton control and Nuttall's saltbush injury on Colorado rangeland. James R. Sebastian and K.G. Beck. (Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523 Halogeton (HALGL) is a toxic annual weed that has been an historic problem for livestock producers in several western U.S. locations. It is well adapted to alkaline soils and semi-arid environments. HALGL produces toxic oxalates that are especially poisonous to sheep but are also toxic to cattle. An experiment was established near Craig, CO to evaluate HALGL control. Previous research conducted by CSU demonstrated that HALGL is relatively easy to control with herbicides; however, Nuttall's saltbush that is prevalent in the same areas and a desirable forage, was severely injured by herbicides. The purpose of this study was to determine if it is possible to decrease herbicide rates and still control HALGL while not injuring Nuttall's saltbush.

The experiment was designed as a randomized complete block and treatments were replicated four times. Herbicides (Table 2) were applied on June 12, 2007 when HALGL 1 to 2" tall. All treatments were applied with a CO_2-pressurized backpack sprayer using 11003LP flat fan nozzles at 21 gal/A and 14 psi. Other application information is presented in Table 1. Plot size was 10 by 30 feet.

Baseline stand counts of Nuttall's saltbush were conducted in each 10'x30' plot before the June, 12, 2007 application. Visual evaluations for control compared to non-treated plots were conducted on July 7, 2008 (Table 1) approximately 13 months after treatment (MAT). Ultra-low to standard rates of metsulfuron, chlorsulfuron, and metsulfuron plus chlorsulfuron tank mixes were used in this study.

Metsulfuron or chlorsulfuron treatments controlled 29 to 86% or 66 to 100% HALGL, respectively (Table 2). There does not appear to be any advantage to tank mixing metsulfuron with chlorsulfuron since there was similar HALGL control with the same rates of chlorsulfuron sprayed alone. For example, metsulfuron plus chlorsulfuron at 0.019 + 0.023 oz/a controlled 59% HALGL, which was similar to 66% HALGL control with 0.023 oz/a of chlorsulfuron sprayed alone. HALGL appears to be extremely susceptible to control with ultra-low rates of chlorsulfuron. Metsulfuron at 0.5 oz/a controlled 86% HALGL compared to 89% HALGL control with only 0.047 oz/a of chlorsulfuron.

Chlorsulfuron at 0.5 oz/a was the only treatment in this study that decreased saltbush stand counts. The change in saltbush density from baseline saltbush stand counts from chlorsulfuron (0.5 oz/a) was -17 compared to 4% change in untreated checks. Zero percent change would be similar densities to baseline counts and negative change would be a loss of HALGL. All other treatments in this experiment provided -3 to 43% change with no loss of saltbush from herbicide treatments. We have conducted several experiments in northwest Colorado to control halogeton and droughty conditions typically exist. In 2007, however, precipitation and growing conditions were improved over previous years when injury to Nuttall's saltbush was very high (76 to 94%) from all chlorsulfuron rates (lowest at 0.3 oz ai/a) and halogeton control was 100% from all rates. Large scale commercial applications subsequent to the experiment reported here have since been made at 0.25 oz/a of chlorsulfuron with zero to minor injury to Nuttall's saltbush and 95 to 100% HALGL control.

Our data indicates that low rates of chlorsulfuron (< 0.5 oz/a) is the best choice for controlling HALGL (66 to 100% control) with no injury or stand loss to Nuttall's saltbush. This study will be evaluated in 2009 for long term HALGL control. Caution should be used when spraying HALGL with chlorsulfuron (≥0.5 oz/a) if Nuttall's saltbush is present or when drought conditions exist as injury may be enhanced.

Table 1. Application data for halogeton control and Nuttall's saltbush injury on Colorado rangeland.

Environmental data	
Application date	June 12, 2007
Application time	10:30 am
Air temperature, F	62
Relative humidity, %	29

Application date	Species	Common name	Growth stage	Height (in.)
June 12, 2007	HALGL	Halogeton	Vegetative	1 to 2

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Baseline stand counts of Nuttall's saltbush were conducted in each 10'x30' plot before the June, 12, 2007 application. Visual evaluations for control compared to non-treated plots were conducted on July 7, 2008 (Table 1) approximately 13 months after treatment (MAT). Ultra-low to standard rates of metsulfuron, chlorsulfuron, and metsulfuron plus chlorsulfuron tank mixes were used in this study.

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Our data indicates that low rates of chlorsulfuron (< 0.5 oz/a) is the best choice for controlling HALGL (66 to 100% control) with no injury or stand loss to Nuttall's saltbush. This study will be evaluated in 2009 for long term HALGL control. Caution should be used when spraying HALGL with chlorsulfuron (≥0.5 oz/a) if Nuttall's saltbush is present or when drought conditions exist as injury may be enhanced.

Table 1. Application data for halogeton control and Nuttall's saltbush injury on Colorado rangeland.

Environmental data	
Application date	June 12, 2007
Application time	10:30 am
Air temperature, F	62
Relative humidity, %	29

Application date	Species	Common name	Growth stage	Height (in.)
June 12, 2007	HALGL	Halogeton	Vegetative	1 to 2

Houndstongue control in Colorado. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Houndstongue (CYWOF) is an aggressive biennial that reproduces from seed. In recent times CYWOF has rapidly expanded its range along the steep slopes and canyons in the foothills and mid elevations in Colorado. Due to growth patterns and locations where CYWOF is found it is difficult to control. CYWOF often grows under trees, in brush, along riparian areas, and in steep rough terrain making herbicide application very difficult. CYWOF is a prolific seed producer and the velcro-like fruits attach to clothing, animal fur, and many other surfaces greatly aiding dispersal and rapid spread.

An experiment was established near Steamboat Springs, CO on June 13, 2008 to evaluate chemical control of CYWOF. The experiment was designed as a randomized complete block and treatments were replicated four times. Herbicides were applied when CYWOF was in early bud growth stage (Table 1). A second set of similar treatments was sprayed on October 8, 2008 to fall-emerged rosettes. All treatments were applied with a CO_2-pressurized backpack sprayer using 11002LP flat fan nozzles at 20 gal/a and 30 psi. Plot size was 10 by 30 feet. Visual evaluations for control compared to non-treated plots were conducted on August 15, 2008 (Table2).

Only the June 13, 2008 applied treatments will be discussed in this progress report as recently sprayed fall plots will not be evaulauted until spring 2009. All spring-applied treatments controlled 92 to 100% of bolted CYWOF plants in this study, approximately 4 months after treatment (MAT). Aminopyralid sprayed alone controlled 23% of CYWOF rosettes and aminopyralid tank mixes or metsulfuron sprayed alone or tank mixed with chlorsulfuron controlled 79 to 100% of CYWOF rosettes 4 MAT. CYWOF seedlings emerged in fall 2008 with fall precipitation.

Although there didn't appear to be any perennial grass stand loss from any treatment in this study, there was stunting of smooth brome (*Bromus inermis*), intermediate wheatgrass (*Thinopyrum intermedium,)* and timothy (*Phleum pratense*) with all metsulfuron tank mixes. Evaluations for residual control will be conducted in 2009 to determine long-term CYWOF control.

Table 1. Application data for houndstongue control in Colorado.

Environmental data		
Application date	June 13, 2008	October 8, 2008
Application time	8:00 am	10:00 am
Air temperature, F	42	53
Relative humidity, %	66	48
Wind speed, mph	0	0 to 2

Application date	Species	Common Name	Growth stage	Height --(in.)--
June 13, 2008	CYWOF	Houndstongue	Early bud	9 to 14
	CYWOF	Houndstongue	Rosette	5 to 9
	PHLPR	Timothy	Vegetative	10 to 14
	BROIN	Smooth brome	Vegetative	14 to 18
	POAPR	Kentucky bluegrass	Vegetative	3 to 5
October 8, 2008	CYWOF	Houndstongue	Rosette	3 to 6
	PHLPR	Timothy	Vegetative	18 to 26
	BROIN	Smooth brome	Vegetative	22 to 28
	POAPR	Kentucky bluegrass	Vegetative	3 to 10

Table 2. Houndstongue control in Colorado[1].

Herbicide[2,3]	Rate	Houndstongue control (10/8/08)	
		Bolted	Rosettes
	oz/a	(%)	
Aminopyralid	7	92	23
Metsulfuron	0.52	100	100
Aminopyralid + metsulfuron	2	100	79
Aminopyralid + metsulfuron	2.5	100	100
Aminopyralid + metsulfuron	3.3	100	100
Aminopyralid + metsulfuron + 2,4-D	2.5 + 16	100	100
Aminopyralid + 2,4-D	7 + 16	100	96
Metsulfuron + chlorsulfuron	0.3 + 0.3	100	100
LSD (0.05)		5	14

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[1] Table is for June 13 applied herbicides. No evaluation has been conducted for October 8, 2008 treatments.
[2] Nonionic surfactant added to all treatments at 0.25% v/v.
[3] Pre-mix formulation of aminopyralid plus metsulfuron.

Control of Russian knapweed using GF2050 -- a WG formulation of aminopyralid + metsulfuron. Steve Dewey, Bill Mace, and Kim Edvarchuk. (Utah State University, Logan, UT 84322) The objective of this field research project was to determine the effectiveness of a WG formulation of aminopyralid + metsulfuron (GF-2050) in controlling Russian knapweed on a semi-arid industrial site in northern Utah. Individual plots measuring 10 x 30 feet were arranged in a randomized block design with four replications. Herbicide treatments were applied once to each plot on November 8, 2006, May 9, 2007, or September 25, 2007, using a CO2 backpack sprayer calibrated to deliver 19 gallons per acre. Non-ionic surfactant was added to all treatments at the rate of 0.25% v/v. The majority of knapweed plants were in the late-bud to early-bloom stage of growth at the time of May treatments. Most knapweed plants were mature but still green on the September application date, whereas on the November application date all plants were fully senesced. Plots were evaluated visually on May 22 and September 23 in 2008. The WG formulation of aminopyralid + metsulfuron was effective in controlling Russian knapweed for one to two growing seasons, depending on the rate applied. Cimarron was more effective when applied in September than in May, but was generally less effective than GF-2050 applied at comparable timings.

Table. Control of Russian knapweed following single applications of herbicide.

Treatment	Rate	Application date	Control May 2008	Control Sep 2008
	oz product/A		%	%
GF-389 + Cimarron	5.2 + 1.0	Nov 06	99	92
GF-389 + Telar	5.2 + 1.0	Nov 06	98	86
GF-2050	2.5	May 07	93	77
GF-2050	3.3	May 07	100	78
GF-2050	5.0	May 07	100	93
Cimarron	0.53	May 07	15	0
Cimarron	1.0	May 07	8	0
GF-389	5.3	May 07	95	78
GF-2050 + Cimarron	3.3 + 0.47	May 07	98	79
GF-2050	2.5	Sep 07	100	93
GF-2050	3.3	Sep 07	100	97
GF-2050	5.0	Sep 07	100	97
Cimarron	0.53	Sep 07	65	25
Cimarron	1.0	Sep 07	98	51
GF-389	5.3	Sep 07	100	94
GF-2050 + Cimarron	3.3 + 0.47	Sep 07	100	97
Non-treated	--		--	--
LSD (0.05)			14	11

Second year Russian knapweed control with summer and fall herbicide applications. Corey V. Ransom and Steven A. Dewey. (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) Trials were established in 2006 to evaluate Russian knapweed control. In one trial herbicide treatments were applied on July 20, 2006, when Russian knapweed was in full bloom. In the second trial, treatments were applied on October 24, 2006, when Russian knapweed was dormant. Herbicide treatments were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 20 gpa at 30 psi. Research plots measured 10 by 30 feet and were arranged in a randomized complete block design with four replications. Russian knapweed control was evaluated on June 26, 2008; two seasons after treatments were applied (Table). Imazapyr applied in the summer provided very little Russian knapweed control at any rate. Imazapyr applied in the fall provided 78 and 87% control at rates of 0.375 and 0.5 lb ai/A, respectively. Clopyralid provided 51 and 61% control and picloram provided 76 and 85% control with fall and summer applications. Aminopyralid controlled Russian knapweed 94% or greater regardless of application timing.

Table. Russian knapweed control two years after herbicide treatment at full bloom or in late fall.

		Control[2]	
Herbicide[1]	Rate	Summer application	Fall application
	lb ai/A	-------------------------%---------------------	
Untreated	--	--	--
Imazapyr	0.063	1 d	0 g
Imazapyr	0.094	1 d	1 g
Imazapyr	0.125	0 d	0 g
Imazapyr	0.187	2 d	17 f
Imazapyr	0.25	1 d	38 de
Imazapyr	0.375	5 d	78 bc
Imazapyr	0.5	35 c	86 ab
Imazapic	0.125	3 d	0 g
Imazapic	0.187	0 d	0 g
Picloram	0.5	85 a	76 bc
Clopyralid	0.375	61 bc	51 d
Aminopyralid	0.094	94 a	95 a

[1] All herbicide treatments included methylated seed oil at 1.25% v/v. Picloram, clopyralid, and aminopyralid rates are in lb ae/A.

[2] Mean separations for control ratings were performed on arcsine square root transformed data. Untransformed means are presented. Numbers followed by the same letter are not significantly different at the P=0.05 significance level.

Control of squarrose knapweed using aminopyralid applied in the fall. Steven Dewey, Bill Mace, Kim Edvarchuk, and Jeff Banks. (Utah State University, Logan, UT 84322) The goal of this field research project was to compare the effectiveness of aminopyralid and aminopyralid + 2,4-D with other standard fall-applied herbicide treatments for the control of well-established squarrose knapweed on semi-arid rangeland in west-central Utah. Individual plots measuring 10 x 30 feet were arranged in a randomized block design with four replications. Herbicide treatments were applied on October 18, 2006, using a CO_2 backpack sprayer calibrated to deliver 19 gallons per acre. Non-ionic surfactant was added to all treatments at the rate of 0.25% v/v. Mature knapweed plants were senesced and appeared dormant at the time of treatment. The few seedlings and rosettes, which were present in most plots, were generally still green. Plots were evaluated visually on June 14, 2007, and again on June 23, 2008. All herbicides resulted in excellent control on both evaluation dates. No seedlings or rosettes were found in any of the treated plots in 2007 or 2008, but were sparsely present in all non-treated plots. The majority of treated plots were moderately to heavily infested with downy brome by the second evaluation date.

Table. Control of squarrose knapweed 8 and 20 months following a single herbicide application in October, 2006.

Treatment	Rate	Control[1] 8 MAT	Control[1] 20 MAT
	oz ae/A	%	%
Aminopyralid	1.25	100	97
Aminopyralid	1.75	100	100
Picloram / fluroxypyr	2.68 / 2.68	100	100
Picloram / fluroxypyr	4.02 / 4.02	100	100
Picloram	8.0	100	100
Picloram + 2,4-D amine	6.0 + 15.2	100	100
Aminopyralid / 2,4-D	1.73 / 14.02	100	100
Picloram / 2,4-D	6.48 / 24.0	100	100
Picloram / 2,4-D + picloram	4.32 / 16.0 + 8.0	100	100
Non-treated	--	--	--
LSD (0.05)		NS	1

[1] MAT = Months After Treatment

Squarrose knapweed control on rangeland with herbicides applied at the rosette and bolting stage. Rob G. Wilson. (University of California Cooperative Extension, 707 Nevada St., Susanville, CA 96130) Squarrose knapweed is a persistent, perennial rangeland weed found in the Big Valley region of Northeast California. An experiment was established in 2007 near Nubieber, CA to evaluate herbicides applied at the rosette and late bolting stage for squarrose knapweed control. The experiment was arranged in a randomized complete block with three replications. Plot size was 10 by 30 ft. Herbicides were applied with a CO_2-pressurized backpack sprayer using 11002 LP flat fan nozzles at 20 gal/A. Application and site information are presented in Table 1. Squarrose knapweed control was visually estimated based on percent density reduction compared to the untreated control. Control ratings were taken on July 11, 2007, August 14, 2007, and May 20, 2008.

Aminopyralid at rates ≥ 1.25 oz ae/A applied at the rosette stage provided over 90% control of squarrose knapweed one year after treatment (YAT)(Table 2). Aminopyralid applications at the bolting stage required the high 1.75 oz ae/A rate to achieve > 90% control 1 YAT (Table 2). When applied at the bolting stage, aminopyralid and clopyralid were slow-acting and several bolting plants retained green leaves and stems at the August 2007 evaluation. Adding 2,4-D to aminopyralid and clopyralid at the bolting stage gave quicker burn-down compared to applying aminopyralid or clopyralid alone, but the addition of 2,4-D did not influence control 1 YAT. Aminopyralid and clopyralid's slow burn-down activity on bolting squarrose knapweed maybe a reason land managers have reported inconsistent control with these herbicides when they were not tank-mixed with 2,4-D.

Table 1. Herbicide application information.

Rosette application		Bolting application	
Date	04/23/2007	Date	06/06/2007
Time	11:00 am	Time	9:00 am
Air temperature (F)	62	Air temperature (F)	50
Relative humidity (%)	41	Relative humidity (%)	53
Wind speed (mph)	0 to 3	Wind speed (mph)	0
Soil moisture (0-2 in)	wet	Soil moisture (0-2 in)	dry
Rosette diameter	3 to 7 inch	Bolting height	1 to 2.5 feet

Table 2. Squarrose knapweed control from herbicides applied at the rosette or bolting stage in 2007.

		Squarrose knapweed control			
		Rosette application		Bolting application	
Herbicide treatment	Rate	August 07	May 08	August 07	May 08
	oz ae/A	--------------------------% control	-------------------------		
Untreated control	----	0	0	0	0
Aminopyralid + NIS[1]	0.75	73	88	52	47
Aminopyralid + NIS	1.25	82	95	72	75
Aminopyralid + NIS	1.75	97	95	72	98
Aminopyralid + 2,4-D ester + NIS	1.75 + 12	97	98	100	100
Clopyralid + NIS	4.0	95	93	57	97
Clopyralid + 2,4-D ester + NIS	4.0 + 12	100	100	100	98
LSD $_{(0.05)}$		15	13	15	13

[1] NIS = non-ionic surfactant (R-11) added at 0.25% v/v

Control of squarrose knapweed using aminopyralid applied at bloom. Steven Dewey, Bill Mace, Kim Edvarchuk, and Jeff Banks. (Utah State University, Logan, UT 84322) The goal of this field research project was to compare the effectiveness of aminopyralid and aminopyralid + 2,4-D with other standard herbicide treatments for the control of well-established squarrose knapweed on semi-arid rangeland in west-central Utah. Individual plots measuring 10 x 30 feet were arranged in a randomized block design with four replications. Herbicide treatments were applied on July 21, 2006, using a CO2 backpack sprayer calibrated to deliver 19 gallons per acre. Non-ionic surfactant was added to all treatments at the rate of 0.25% v/v. The majority of knapweed plants were in full bloom at the time of treatment, although a few seedlings and small rosettes were present. Plots were evaluated visually on June 14, 2007, and again on June 23, 2008. All herbicides resulted in excellent control 11 and 23 months after treatment. No seedlings or rosettes were found in any of the treated plots, but were present in all non-treated plots. All treated plots had become moderately to heavily infested with downy brome by the second evaluation date, but there was little to no downy brome in the non-treated checks.

Table. Control of squarrose knapweed 11 and 23 months following 2006 herbicide treatment.

Treatment	Rate	Control[1] 11 MAT	Control[1] 23 MAT
	oz ae/A	%	%
Aminopyralid	0.75	99	95
Aminopyralid	1.25	100	98
Aminopyralid	1.75	100	99
Aminopyralid / 2,4-D	1.0 / 8.01	100	97
Aminopyralid / 2,4-D	1.32 / 10.68	100	98
Aminopyralid / 2,4-D	1.73 / 14.02	100	100
Picloram	6.0	100	100
Picloram	8.0	100	100
Picloram / 2,4-D	4.32 / 16.0	100	100
Picloram / 2,4-D	6.48 / 24.0	100	100
Non-Treated	--	--	--
LSD (0.05)		1	3

[1] MAT = Months After Treatment

Medusahead control on Great Basin rangeland with various herbicides. Rob G. Wilson. (University of California Cooperative Extension, 707 Nevada St., Susanville, CA 96130) The invasion of non-native annual grasses is considered by many private and public range managers to be the most serious and threatening pest problem in the Great Basin. Experiments were established between fall 2006 and spring 2008 near Likely, CA to evaluate herbicide efficacy for medusahead control in big sagebrush rangeland. Herbicides were applied with a CO_2-pressurized backpack sprayer using 11002 LP flat fan nozzles at 20 gal/A. Each experiment was arranged in a randomized complete block with three replications. Plot size was 10 by 30 ft.

The first experiment was established in 2006-2007. Herbicides were applied in fall 2006 or early spring 2007, and weed control and injury ratings were taken on June 4, 2007 and June 30, 2008. The second experiment was established in 2007-2008. Herbicides were applied in fall 2007, early spring 2008, or late spring 2008 and weed control ratings were taken on June 30, 2008. Weed control was visually estimated based on percent density reduction compared to the untreated control. Application and site information are presented in Table 1.

Fall application of rimsulfuron at rates $\geq$ 1.0 oz ai/A gave 100% control of medusahead seven months after treatment (MAT) (Tables 2 and 3). Fall application of sulfometuron or sulfometuron + chlorsulfuron also gave 100% medusahead control 7 MAT (Tables 2 and 3). Spring application of rimsulfuron or sulfometuron + chlorsulfuron was not as effective as the fall application for medusahead control. Rimsulfuron applied in fall or spring caused minimal injury to California brome (Table 2).

Rimsulfuron gave < 30% medusahead control in June 2008 one year after treatment (YAT) suggesting rimsulfuron soil activity was minimal after the first growing season (Table 2). Imazapic and sulfometuron gave 68% to 83% control 1 YAT, but medusahead plants that survived in these plots were robust and produced a lot of seed (personal observation) due to low competition. The high density of medusahead plants in fall rimsulfuron plots 1 YAT suggests that a significant amount of medusahead seed remains in the seedbank after one season of control.

Government land managers have interest in using glyphosate to control annual grasses on Great Basin rangeland. Spring-applied glyphosate at the tillering and late boot stage gave 100% medusahead control except for the low 4 oz ai/A rate (Table 3). Perennial grass injury for all spring glyphosate treatments was not evaluated due to a sparse perennial grass population.

Table 1. Herbicide application information.

Treatment application	Date	Medusahead stage/ height
2006-2007 experiment		
Fall application 2006	11/01/2006	pre-emergence
Spring application 2007	03/22/2007	2 to 3 leaf/ 1 to 2 inch
2007-2008 experiment		
Fall application 2007	10/25/2007	1 leaf/ 1 inch
Early spring application 2008	04/28/2008	tillering/ 2 to 3 inch
Late spring application 2008	05/30/2008	late boot/ 9 to 12 inch

Table 2. Medusahead control and visual grass injury from herbicides applied near Likely, CA in 2006-2007.

Herbicide treatment[1]	Rate	Application time	Medusahead control June 07	Medusahead control June 08	California brome injury[2] June 07
	oz ai/A		%	%	%
Untreated			0	0	0
Rimsulfuron + NIS	0.5	fall	91	7	0
Rimsulfuron + NIS	0.75	fall	92	0	0
Rimsulfuron + NIS	1.0	fall	100	0	0
Rimsulfuron + NIS	1.25	fall	100	13	1
Rimsulfuron + NIS	1.5	fall	100	13	1
Rimsulfuron+chlorsulfuron+NIS	1.0+0.38	fall	100	27	1
Sulfometuron + NIS	0.75	fall	100	83	10
Sulfometuron+chlorsulfuron+NIS	0.5+0.25	fall	100	80	9
Imazapic + MSO	1.5	fall	98	68	1
Metribuzin + NIS	0.75	fall	88	0	0
Rimsulfuron + NIS	0.75	spring	50	10	0
Rimsulfuron + NIS	1.0	spring	82	20	1
Rimsulfuron + NIS	1.5	spring	88	13	1
Rimsulfuron + glyphosate + NIS	0.75+0.25	spring	90	0	4
$LSD_{(0.05)}$			8	19	3

[1] Sulfometuron + chlorsulfuron applied as the premix Landmark XP. NIS = non-ionic surfactant (R-11) added at 0.25% v/v. MSO = ethylated seed oil and non-ionic surfactant blend (Hasten) added at 1.0 pt/A

[2] Percent injury was based on visual herbicide stunting and chlorosis compared to the untreated plot. 0 = no injury; 10 = plant death

Table 3. Medusahead control from herbicides applied near Likely, CA in 2007-2008.

Herbicide treatment[1]	Rate	Application time	Medusahead control June 08
	oz ai/A		%
Untreated			0
Rimsulfuron + NIS	1.0	fall	100
Rimsulfuron+chlorsulfuron+NIS	1.0+0.38	fall	100
Sulfometuron+chlorsulfuron+ NIS	0.25+0.13	fall	100
Sulfometuron+chlorsulfuron+ NIS	0.5+0.25	fall	100
Sulfometuron+chlorsulfuron+ NIS	0.25+0.13	early spring	0
Glyphosate + NIS + AMS	4	early spring	75
Glyphosate + NIS + AMS	8	early spring	100
Glyphosate + NIS + AMS	12	early spring	100
Glyphosate + NIS + AMS	16	early spring	100
Glyphosate + NIS + AMS	4	late spring	70
Glyphosate + NIS + AMS	8	late spring	100
Glyphosate + NIS + AMS	12	late spring	100
Glyphosate + NIS + AMS	16	late spring	100
$LSD_{(0.05)}$			3

[1] Sulfometuron + chlorsulfuron applied as the premix Landmark XP. NIS = non-ionic surfactant (R-11) added at 0.25% v/v. AMS = ammonium sulfate added at 10 lb per 100 gallons of spray solution

Perennial pepperweed control two seasons after treatment with summer and fall herbicide applications. Corey V. Ransom and Steven A. Dewey. (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) Summer and fall herbicide applications were evaluated for long-term perennial pepperweed control at locations near Vernal, Utah. Treatments were applied to perennial pepperweed in full bloom on June 21, 2006 or in the fall on November 1, 2006, at Site 1 on the Ouray National Wildlife Refuge. Fall treatments were also applied at Site 2 near Jensen, Utah. Herbicide treatments were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 20 gpa at 30 psi. Research plots measured 10 by 30 feet and were arranged in a randomized complete block design with four replications. Perennial pepperweed control was evaluated on July 8, 2008, two seasons after treatments were applied. Imazapyr at rates above 0.125 lb ai/A applied at full bloom controlled perennial pepperweed 95% or greater. Fall applications required 0.375 to 0.5 lb ai/A of imazapyr to exceed 90% control. Imazapic provided from 69 to 91% control depending on rate and application timing. Metsulfuron did not provide effective control from either summer or fall applications. Chlorsulfuron was more effective than metsulfuron providing 86% control when applied at full bloom, but 95% or greater control when applied in the fall. Less response to imazapyr rate was observed with summer applications compared to fall applications. This research demonstrates that long term control of perennial pepperweed is affected by the herbicide, herbicide rate, and the application timing.

Table. Perennial pepperweed control two seasons after herbicide treatment at full bloom or in late fall.

		Control[2]		
		Summer application	Fall application	
Herbicide[1]	Rate	Site 1	Site 1	Site 2
	lb ai/A	---------------------------	%	---------------------
Untreated	--	--	--	--
Imazapyr	0.063	85 cde	15 d	14 f
Imazapyr	0.094	90 bc	33 c	60 d
Imazapyr	0.125	95 ab	45 c	63 d
Imazapyr	0.187	95 ab	74 b	86 bc
Imazapyr	0.25	95 ab	71 b	84 c
Imazapyr	0.375	96 ab	92 a	95 ab
Imazapyr	0.5	99 a	96 a	98 a
Imazapic	0.125	83 de	69 b	86 bc
Imazapic	0.187	90 bc	90 a	91 abc
Metsulfuron	0.038	80 e	13 d	25 e
Chlorsulfuron	0.047	86 cd	96 a	95 ab

[1] All herbicide treatments included methylated seed oil at 1.25% v/v.

[2] Mean separations for control ratings were performed on arcsine square root transformed data. Untransformed means are presented. Numbers followed by the same letter are not significantly different at the P=0.05 significance level.

Wild oat control in irrigated spring wheat with pyroxsulam compared to other herbicides. Don W. Morishita, J. Daniel Henningsen, and Donald L. Shouse. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare pyroxsulam with other herbicides for wild oat and broadleaf weed control in irrigated spring wheat. 'Westbred 936' was planted April 8, 2008 at 100 lb/A. Experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Soil type was a Portneuf silt loam (29.4% sand, 65% silt, and 5.6% clay) with a pH of 8.1, 1.55% organic matter, and CEC of 14-meq/100 g soil. Herbicides were applied on May 29 with a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 22 psi. Environmental conditions at application were as follows: air temperature 57 F, soil temperature 58 F, relative humidity 30%, wind speed 3 mph, and 65% cloud cover. Wild oat, common lambsquarters, and kochia densities averaged 10, 10, and <1 plants/ft^2, respectively. Application began at 9:30 am. Crop injury (chlorosis and growth inhibition) was evaluated visually 5, 14, 28, and 46 days after application (DAA) on June 6, June 12, June 26, and July 14, respectively. Weed control was evaluated visually 28 and 46 DAA. Grain was harvested August 13 with a small-plot combine.

Chlorosis was visible on all herbicide treatments 5 DAA ranging from 5 to 19% (Table) and became less at subsequent evaluations (data not shown) for all herbicide treatments. By 46 DAA, no chlorosis was observed. Growth inhibition ranged from 5 to 19% at 5 DAA and became less obvious at subsequent evaluations (data not shown), but was still visible, though variable, between replications in most of the treatments. Kochia control and common lambsquarters control ranged from 97 to 100% over both evaluation dates and was consistent between replications within a treatment. For example, common lambsquarters control with GF 1848 alone averaged 97%, but was statistically lower than GF 1848 + nonionic surfactant (99%) at the same herbicide rate. Wild oat control was very similar to broadleaf weed control and ranged from 96 to 100% for all herbicide treatments. Pinoxaden + clopyralid/fluroxypyr + MCPA at 0.054 + 0.187 + 0.375 lb/A; clodinafop + thifensulfuron/tribenuron + 2,4-D LVE at 0.05 + 0.019 + 0.375 lb/A; and flucarbazone + 2,4-D LVE all controlled wild oat 96%, but this was statistically lower than all other herbicide treatments that controlled wild oat 99 to 100%. Wheat yields ranged from 60 to 90 bu/A. The untreated check grain yield, which averaged 60 bu/A, was statistically lower than all herbicide treatments with yields greater than 73 bu/A. Pyroxsulam with the chemical safener cloquintocet appears to be a good alternative mode of action for controlling wild oats in spring wheat.

Gray rabbitbrush control using an experimental one-pass mower/dripwiper implement. Chad R. Reid, Dean L. Winward, and Steven A. Dewey. (Iron County Extension Office, Cedar City, UT 84721) *Chrysothamnus* is a genus of native shrubs that are common in many plant communities throughout the western United States. The genus contains 16 species and 41 subspecies. The three most abundant in terms of distribution are Douglas rabbitbrush (C. *viscidiflorus*), Parry rabbitbrush (C. *parryi*); and gray rabbitbrush (C. *nauseosus*). All species of rabbitbrush are very prolific seed producers and can be extremely invasive, particularly in disturbed areas such as abandoned homesteads or rangeland seedings. Management of rabbitbrush is difficult because it is deep rooted and sprouts vigorously after disturbance such as fire or mechanical treatments. Many treatments and combinations of treatments have been tried with little success or with highly variable results. Multiple treatments combining fire, mechanical removal, or herbicides have shown the greatest promise for control. In October of 2006 a field study was established at the Southern Utah University farm in Cedar Valley to determine the effectiveness of an experimental one-pass mower/spraywiper implement (a modified Brown Brush Monitor®) for the control of rubber rabbitbrush. The study was repeated at a second location in 2007. Plots were arranged in a randomized complete block design with 3 replications. The treatment implement mowed the established rabbitbrush plants to a height of approximately 4 inches above the ground, depositing the woody debris in a windrow to the side. Herbicide was applied immediately to the cut stems (stubble) by contact with a herbicide-soaked flexible fabric brush (dripwiper) mounted directly behind the mower housing. Herbicide solution was applied constantly to the fabric brush by a series of permanently mounted spray nozzles. Herbicide that was not wiped directly onto cut stems dripped from the brush onto the ground. This results in a constant application rate to treated areas, regardless of the ratio of cut stems to bare ground. Plots were visually evaluated once in July of the year following their treatment.

Table. Control of gray rabbitbrush 9 months following a one-pass dripwiper treatment of mowing + herbicide.

		Control	
Treatment	Rate	Site 1	Site 2
	oz ae/A	%	
Aminopyralid	1.75	69	52
Aminopyralid	0.875	16	15
Aminopyralid	0.45	12	15
Picloram	4.0	93	90
Picloram	8.0	98	93
Picloram	16.0	100	97
Dicamba	8.0	53	53
Dicamba	16.0	88	69
Dicamba	32.0	93	92
Mowing alone	---	2	5
LSD (0.05)		26	22

Gray rabbitbrush control using an experimental one-pass mower/dripwiper implement. Chad R. Reid, Dean L. Winward, and Steven A. Dewey. (Iron County Extension Office, Cedar City, UT 84721) *Chrysothamnus* is a genus of native shrubs that are common in many plant communities throughout the western United States. The genus contains 16 species and 41 subspecies. The three most abundant in terms of distribution are Douglas rabbitbrush (C. *viscidiflorus*), Parry rabbitbrush (C. *parryi*); and gray rabbitbrush (C. *nauseosus*). All species of rabbitbrush are very prolific seed producers and can be extremely invasive, particularly in disturbed areas such as abandoned homesteads or rangeland seedings. Management of rabbitbrush is difficult because it is deep rooted and sprouts vigorously after disturbance such as fire or mechanical treatments. Many treatments and combinations of treatments have been tried with little success or with highly variable results. Multiple treatments combining fire, mechanical removal, or herbicides have shown the greatest promise for control. In October of 2006 a field study was established at the Southern Utah University farm in Cedar Valley to determine the effectiveness of an experimental one-pass mower/spraywiper implement (a modified Brown Brush Monitor®) for the control of rubber rabbitbrush. The study was repeated at a second location in 2007. Plots were arranged in a randomized complete block design with 3 replications. The treatment implement mowed the established rabbitbrush plants to a height of approximately 4 inches above the ground, depositing the woody debris in a windrow to the side. Herbicide was applied immediately to the cut stems (stubble) by contact with a herbicide-soaked flexible fabric brush (dripwiper) mounted directly behind the mower housing. Herbicide solution was applied constantly to the fabric brush by a series of permanently mounted spray nozzles. Herbicide that was not wiped directly onto cut stems dripped from the brush onto the ground. This results in a constant application rate to treated areas, regardless of the ratio of cut stems to bare ground. Plots were visually evaluated once in July of the year following their treatment.

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Picloram	4.0	93	90
Picloram	8.0	98	93
Picloram	16.0	100	97
Dicamba	8.0	53	53
Dicamba	16.0	88	69
Dicamba	32.0	93	92
Mowing alone	---	2	5
LSD (0.05)		26	22

Control of sweetbriar rose using triclopyr and imazapyr. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established in Fall 2006 and 2007 near Moscow, Idaho to evaluate the effect of triclopyr and imazapyr on sweetbriar rose (*Rosa eglanteria* L.). Imazapyr was evaluated as a foliar application targeting the post-flower phenological stage and was applied at a 2.5% v/v concentration using a deposition aid (Thinvert RTU) comprised of paraffinic oil and emulsifier blends as a carrier. Treatments were applied using a Birchmeir backpack sprayer and a Thinvert Brush Gun SS calibrated to deliver 5 gal/A. Triclopyr was evaluated as a thinline basal bark application targeting dormant rose stems and was applied at a 25% v/v concentration using a mineral oil (WEB Oil) as a carrier. Triclopyr applications were made using a backpack sprayer calibrated to deliver 10.5 mL/s of spray solution with a 5002 flat fan nozzle.

Table 1. Application and soil data.

Application date	10/3/06	11/08/06	9/21/07	12/4/07
Weed growth stage	post flower	dormant	post flower	dormant
Air temp (F)	64	44	70	55
Relative humidity (%)	42	85	10	55
Wind (mph, direction)	2 to 4, E	3 to 7, SW	n/a	3 to 7, W
Cloud cover (%)	80	80	n/a	60
Soil temp at 2 inches (F)	58	44	65	38

Treatments were evaluated on September 16, 2008 to determine percent control of stems of the targeted shrubs approximately 1 and 2 years after treatment (YAT). Control was based on the percent mortality of remnant-stems that were treated compared to the untreated check. New stems sprouting from root buds within the treated shrub or its periphery were observed. The number of new stems emerging within the canopy of the remnant shrub was recorded and expressed as the percentage of the number of remnant stems of the target shrub to determine the amount of re-growth in proportion to shrub size. Additionally, percent vegetation cover was estimated below the drip line of the remnant shrub to determine the non-target effects of treatments on other vegetation.

Triclopyr and imazapyr resulted in greater than 90% control of remnant shrubs following applications in 2006-2007 (Table 2). However, significantly greater number of new stems had emerged following triclopyr treatments in comparison to imazapyr. Mean stem-regrowth ranged from 14 to 17 stems per plant following triclopyr treatments, whereas stem-regrowth was negligible following imazapyr applications approximately 2 YAT. Vegetation cover below the remnant shrub canopy was significantly greater following triclopyr treatments. Imazapyr treatments resulted in large areas of exposed soil below the drip line. Approximately 2 YAT, vegetation below imazapyr treated shrubs was dominated by weed species.

Table 2. Evaluation of sweetbriar rose control near Moscow, ID on September 16, 2008 following applications in 2006 and 2007, approximately 1 and 2 years after treatment.

Treatment	Application	Control[1]		Re-growth[2]		Vegetation cover[3]	
		2006	2007	2006	2007	2006	2007
		----------	----------	---------- %	----------	----------	----------
Triclopyr + WEB Oil	basal bark	100	100	17	14	87	65
Imazapyr + Thinvert RTU	foliar	100	94	0	1	46	10
Untreated check		0	0	0	0	87	91
Tukey's Studentized Range HSD (0.05)		0	6	8	7	29	28

[1] Percent control of remnant shrub growth.

[2] The number of new stems expressed as a percentage of remnant stems.

[3] Percent vegetation-cover below the drip line.

Photo analysis of feral rye (*Secale cereale* L.) invasion of non-crop hillsides in northern Utah. Kyle C. Roerig and Corey V. Ransom. (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) In fall of 2008 feral rye was observed to have expanded across large areas of the upland hillsides near Logan, Utah. The dominant native grass on these hillsides is bluebunch wheatgrass. In photos taken in 1990 a few small patches of feral rye low on the foot hills were noticeable. By 2008 those patches have expanded and gained elevation at an alarming rate. Now much of the hillside above Cache Valley is covered in bright yellow patches of the expanding feral rye population. Images were analyzed using image analysis software (VegMeasurement), which can be used to single out the distinctive, bright color of feral rye. By adjusting the software image analysis threshold, the software can estimate the area of the image that is comprised of feral rye compared to the total area of the image. A photo taken in 1990, compared to a photo taken from the same location in 2008 showed that the area with dense feral rye increased 304% over 18 years (1990-2008), or an average of approximately 17% per year (Figure).

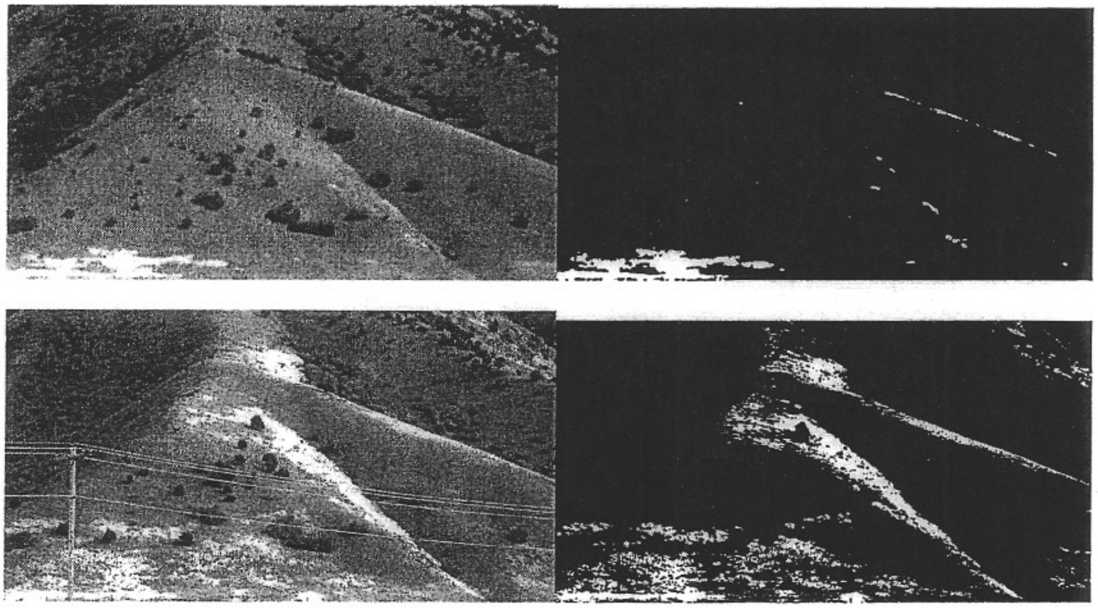

Figure. Photo from 1990 (top left) feral rye hue isolated, 2.4% (top right). Photo from 2008 (bottom left) feral rye hue isolated, 9.7% (bottom right). It is noteworthy that a telephone pole and lines were added since the 1990 photo was taken. The pole and power lines in the 2008 image were digitally removed from the black and white image prior to calculating the infested area.

Rush skeletonweed control with DPX-MAT28 on Idaho rangeland. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Cambridge, ID in sagebrush-steppe to evaluate rush skeletonweed (*Chondrilla juncea* L.) control with DPX-MAT28, DPX-KJM44, and aminopyralid at the rosette stage in the spring and late fall, and at the floral bud stage in mid-summer. The experiment was blocked by timing with four replications. A control treatment was added in each timing block due to the irregularity of the plot layout. Plot size was 10 by 20 feet. All treatments were applied with a CO_2-pressurized backpack sprayer at 15 gpa (Table 1).

Table 1. Application and soil data.

Application date	May 19, 2008	July 22, 2008	November 17, 2008
Weed growth stage	rosette - spring	floral bud-summer	rosette-fall
Air temp (F)	86	89	53
Relative humidity (%)	16	22	50
Wind (mph, direction)	0 to 2, SW	2 to 6, S	0 to 1, W
Cloud cover (%)	35	80	70
Soil temp at 2 inches (F)	94	90	48
Soil type	sandy loam	sandy loam	sandy loam

A visual evaluation was conducted on October 6, 2008 to determine rush skeletonweed control in treatments timed to the spring-rosette stage (135 DAT) and floral bud stage (65 DAT). No data were available for the rosette-fall treatment at time of publication. Percent control was calculated using the formula:

% CTL = [1 – (Number of living CHJU per treatment plot / Number of CHJU per control plot)]*100

The number of rush skeletonweed plants ranged from 1 to 2 per ft^2 in the control plots. A significant timing effect was detected. Rush skeletonweed control was greater than 90% at the spring-rosette application timing. No differences occurred between treatments. A previous evaluation at 60 DAT for the rosette timing indicated that the 2 and 3 oz ai/A treatment of DPX-MAT28 provided greater control than the 1 oz ai/A rate. These differences were not detected at 135 DAT, though the 3 oz ai/A rate provided the greatest control. Rush skeletonweed control was 10% or less across all treatments at the floral bud application timing. No differences occurred between treatments at this timing. Non-target injury to big sagebrush, rabbitbrush and bitterbrush was assessed. Herbicide injury was observed on all species across treatments. Symptoms included decreased vigor and leaf production but did not result in mortality. Generally, greater shrub injury was observed at the high rate of DPX-MAT28 compared to the low rate.

Table 2. Rush skeletonweed control near Cambridge, ID in 2008.

Treatment [1]	Rate	Spring-rosette timing	Floral bud timing
	oz ai / A	%	
DPX-MAT28	1	92	0
DPX-MAT28	2	92	3
DPX-MAT28	3	99	10
Aminopyralid	1.75	96	8
DPX-KJM44	2.88	94	3
Untreated check		0	0
Tukeys Studentized Range HSD (0.05)		21	21

[1] 90% non-ionic surfactant (R-11) at 0.5% v/v was applied with all treatments

Myrtle spurge control in Colorado. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Myrtle spurge (EPHMY) is an invasive ornamental that has escaped into sensitive ecosystems, displaced native vegetation, and is considered a noxious weed in Colorado. EPHMY is a tap-rooted perennial that produces a toxic, milky latex that causes blister-like burns if contacted by the skin and is very toxic to eyes.

An experiment was established in 2005 near Golden, CO to evaluate EPHMY control. The experiment was designed as a randomized complete block and treatments were replicated three times. Herbicides (Table 2) were applied in the fall on October 18, 2005 when EPHMY was in vegetative growth stage or in the spring on April 20, 2006 when EPHMY was in vegetative to late flower growth stages. All treatments were applied with a CO_2-pressurized backpack sprayer using 11003LP flat fan nozzles at 21 gal/A and 14 psi. Other application information is presented in Table 1. Plot size was 10 by 20 feet. Methylated seed oil was added at 32 fl oz/a to all treatments.

Visual evaluations for control compared to non-treated plots were conducted in May 2006 and 2007 and early fall 2006, 2007, and 2008 (Table 2). Picloram or quinclorac sprayed alone (at either application timing) controlled EPHMY slowly in May 2006 (30 to 53% control). Both treatments sprayed alone controlled 89 to 96% EPHMY by September 2006. All treatments in this study controlled 88 to 100% of EPHMY in September 2006. Quinclorac, quinclorac plus 2,4-D acid, or dicamba plus 2,4-D amine controlled EPHMY similarly (91 to 100%) to picloram or picloram plus 2,4-D acid (89 to 100%).

All herbicides when combined with 2,4-D acid controlled 98 to 100% EPHMY in September, 2006 compared to 86 to 96% EPHMY control when the same herbicides were sprayed alone. The differences between treatments sprayed alone or 2,4-D tank mixed was again evident at the September 2007 and 2008 evaluations. All herbicides when combined with 2,4-D acid controlled 95 to 100% EPHMY compared to 73 to 92% EPHMY control when the same herbicides were sprayed alone. Fall applications of 2,4-D acid controlled 78% of EPHMY compared to 97% EPHMY control with spring-applied 2,4-D acid (Fall 2008). EPHMY appears to be very sensitive to 2,4-D acid as it applied alone was one of the most effective treatments.

A similar study was established on an adjacent site in spring of 2005. Spring treatments (data not included in this report) did not control EPHMY as well as similar fall treatments in that study. In this study, treatment rates were increased and EPHMY plants were smaller at application.

Handpulling may be an alternative option to herbicides if entire root systems are pulled. Handpulling controlled 78 or 100% and 78 or 96% of EPHMY when done in fall or spring, respectively, at the September 2007 and 2008 evaluation. Soil moisture in the fall was dry and some of the EPHMY plants were dried out and broke off at the crown when pulled. Entire EPHMY plants were easier to pull when soil moisture was high and EPHMY was green (spring timing in this study). EPHMY seedling plants emerged from seed and some seedings broke off at the crown so, it may be necessary to handpull more than once. Gloves and protective eye wear should be used while handpulling to prevent getting toxic latex on skin or in eyes. Digging EPHMY plants would also work but it was too rocky at this particular site to dig.

Table 1. Application data for myrtle spurge control in Colorado.

Environmental data		
Application date	October 18, 2005	April 20, 2006
Application time	1:00 AM	9:00 AM
Air temperature, F	68	55
Relative humidity, %	35	20
Wind speed, mph	0	0 to 2

Application date	Species	Common name	Growth stage	Height
				---(in.)---
October 18, 2005	EPHMY	myrtle spurge	vegetative	4 to 7
April 20, 2006	EPHMY	myrtle spurge	late flower	2 to 10

Table 2. Myrtle spurge control in Colorado.

Herbicide[1,2,3]	Rate	Application timing	Myrtle spurge control				
			May 2006	September 2006	May 2007	September 2007	August 2008
	oz/A		(%)				
Picloram	20	Fall 05	53	89	88	82	78
Picloram + 2,4-D acid	20 + 134	Fall 05	100	100	100	100	96
Quinclorac	16	Fall 05	50	91	85	80	73
Quinclorac + 2,4-D acid	16 + 134	Fall 05	100	100	100	100	98
2,4-D acid	134	Fall 05	90	90	91	81	78
Dicamba + 2,4-D amine	17 + 47	Fall 05	100	100	96	95	95
Dicamba + 2,4-D amine	34 + 94	Fall 05	100	100	97	95	90
Handpull		Fall 05	90	88	88	78	78
Picloram	20	Spring 06	30	86	89	79	75
Picloram + 2,4-D acid	2 + 134	Spring 06	82	100	100	100	99
Quinclorac	16	Spring 06	35	96	91	90	92
Quinclorac + 2,4-D acid	16 + 134	Spring 06	80	100	100	100	100
2,4-D acid	134	Spring 06	90	100	98	97	97
Dicamba + 2,4-D amine	17 + 47	Spring 06	85	100	100	100	100
Dicamba + 2,4-D amine	34 + 94	Spring 06	68	98	96	96	95
Handpull		Spring 06	100	99	100	100	96
LSD (P=.05)			11	8	9	13	14

[1] Methylated seed oil added to all imazapic treatments at 32 oz/A.

[2] Unison is the trade name for the 1.74 lb/ae formulation of 2,4-D acid.

[3] 1 lb ae + 2.87 ae formulation of dicamba plus 2,4-D amine (Weedmaster premix).

Yellow starthistle control with aminopyralid on Idaho rangeland. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Lewiston, ID in degraded annual grassland to evaluate yellow starthistle (*Centaurea solstitialis* L.) control with aminopyralid, clopyralid, and picloram at the rosette stage in late fall and spring, and the bolting stage in late spring. The experiment was designed as a randomized complete block with four replications. Plot size was 10 by 30 feet. All treatments were applied with a CO_2-pressurized backpack sprayer at 15 gpa (Table 1).

Table 1. Application and soil data.

Application date	November 10, 2006	April 27, 2007	May 25, 2007
Weed growth stage	rosette - fall	rosette – spring	bolting
Air temp (F)	43	63	68
Relative humidity (%)	87	25	33
Wind (mph, direction)	2 to 3, NW	3 to 4, NW	2 to 4, NW
Cloud cover (%)	85	15	15
Soil temp at 2 inches (F)	40	64	62
Soil type	stony silt loam	stony silt loam	stony silt loam

A visual evaluation was conducted on June 26, 2008 to determine yellow starthistle control one growing season after treatments (Table 2). Control was based on the percent canopy cover of yellow starthistle in comparison to the untreated check which was 41% at the evaluation date. Canopy cover of bur chervil, field bindweed, winter vetch, and annual grasses including downy brome and ventenata was estimated to determine changes in plant community composition across different timings of treatments.

Yellow starthistle control was high across all treated plots and each treatment resulted in significantly less yellow starthistle cover in comparison to the control (Table 2). The timing of treatment had a significant effect on the level of yellow starthistle control. Treatments at the bolting stage timing resulted in greater levels of control in comparison to treatments at the fall rosette stage timing. A high level of control occurred following treatments at the rosette stage in the spring, which did not differ from bolting-timed treatments. No differences were detected between pair-wise comparisons of treatment rates and products.

Few trends were detected in analysis of plant community response to herbicide treatment timings. Canopy cover of bur chervil, field bindweed, winter vetch, and annual grasses were statistically similar across treatments (Table 2). The timing of treatments did not affect canopy cover of bur chervil and field bindweed. Treatments targeting the fall-rosette stage resulted in significantly greater winter vetch in comparison to other timings. Treatments targeting the bolting stage resulted in annual grass dominated plots.

Table 2. Yellow starthistle control with various herbicides near Lewiston, ID in 2006-2008.

				Canopy cover			
Treatment[1]	Rate	Growth Stage	[2]CESO control	ANCA	COAR	VIVI	Annual grass
	oz ae / A		%	------------------------ % ------------------------			
Aminopyralid	0.75	spring-rosette	91	10	18	1	59
Aminopyralid	1	spring-rosette	98	6	11	1	79
Aminopyralid	1.25	spring-rosette	99	5	15	0	70
Aminopyralid	1.5	spring-rosette	100	11	12	0	75
Clopyralid	3.75	spring-rosette	100	1	17	1	71
Picloram	6	spring-rosette	100	0	4	1	96
Aminopyralid	1	bolting	99	5	8	0	75
Aminopyralid	1.5	bolting	100	0.0	8	0	91
Aminopyralid	1.75	bolting	100	11	6	0	66
Aminopyralid +2,4-D(A)	1 + 16	bolting	100	1	3	3	83
Aminopyralid +2,4-D(A)	1.5 + 16	bolting	100	8	3	0	84
Clopyralid	3.75	bolting	100	2	13	0	79
Picloram	6	bolting	100	0	1	0	99
Aminopyralid	0.75	fall-rosette	85	22	10	7	60
Aminopyralid	1.0	fall-rosette	91	25	13	9	53
Aminopyralid	1.25	fall-rosette	92	16	11	17	55
Aminopyralid	1.75	fall-rosette	96	9	10	7	73
Clopyralid	3.75	fall-rosette	81	33	8	5	48
Picloram	6	fall-rosette	98	9	16	5	73
Check			0	6	5	2	62
Tukeys Studentized Range HSD (0.05)			20	37	18	14	43

[1] 90% non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments

[2] CESO = yellow starthistle, ANCA = bur chervil, COAR = field bindweed, VIVI = winter vetch

Control of Canada thistle with aminocyclopyrachlor in irrigated intermediate wheatgrass. Richard N. Arnold, Michael K. O'Neill, and Kevin A. Lombard. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on October 10, 2007 in southern Colorado to evaluate the response of irrigated intermediate wheatgrass and Canada thistle (CIRAR) to aminocyclopyrachlor. Soil type was a Ramper loam with a pH of 7.8 and organic matter content less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 12 by 25 feet. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on October 10, 2007 with methylated seed oil at 1% v/v. Treatments were evaluated on June 3, 2008.

All treatments except the weedy check gave excellent control of Canada thistle eight months after treatment.

Table. Control of Canada thistle with aminocyclopyrachlor in irrigated intermediate wheatgrass.

Treatments	Rate	CIRAR control
	oz ai/A	------%-------
Aminocyclopyrachlor	0.5	100
Aminocyclopyrachlor	1.0	100
Aminocyclopyrachlor	2.0	100
Aminocyclopyrachlor	2.5	100
Aminocyclopyrachlor	3.0	100
Aminocyclopyrachlor	4.0	100
Aminopyralid	1.25	100
Aminopyralid	1.75	100
Chlorosulfuron	0.75	100
Weedy check	0	0

[1] Rated on a scale from 0 to 100 with 0 being no control and 100 being dead plants.

The effect of mowing and time of treatment for Canada thistle control with aminopyralid. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminopyralid is a member of the pyridinecarboxylic acid family of herbicides and controls Canada thistle at lower use rates than other commonly used herbicides. Previous research has found that aminopyralid will control Canada thistle when applied in the spring prior to flowering or in the fall. Canada thistle is often found along roadsides and waste areas that are mowed during the summer, but the effect of mowing prior to aminopyralid application is unknown. The purpose of this research was to evaluate aminopyralid applied in the spring or fall for Canada thistle control on plants that were mowed in mid-summer.

Aminopyralid at 1.25 or 1.75 oz ae/A was applied to Canada thistle at two locations in North Dakota. Picloram at 6 oz ae/A was included as a standard comparison. Treatments were applied June 5, Sept. 19, Oct.1, or Oct. 29, 2007, near Fargo, ND on former crop-land. The same treatments were applied on June 20, Sept. 14, Oct. 1, or Oct. 29, 2007, near Eckelson, ND along a wind-break with a dense stand of perennial grasses. Herbicides were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Whole plots were 10 by 30 feet and were subdivided by mowing the front or back half of each plot (10 by 15) in July 2007. There were four replicates in a randomized split-block design. Canada thistle was in the bolt to early bud growth stage when treated in June. Plants were in the rosette stage in the mowed plots at all fall treatment dates and varied from post seed-set in mid-September to plants with brown top growth and stems following several hard frosts by the late October application date in the non-mowed plots. Canada thistle stem density averaged 15 and 12 stems/m^2 at the Fargo and Eckelson locations, respectively. Control was visually evaluated using percent stand reduction compared to the untreated control.

In general, long-term Canada thistle control was higher at the Eckelson compared to the Fargo location and the data could not be combined (Tables 1 and 2). Canada thistle control in June 2008 averaged over all treatments applied in June 2007 (12 months after treatment) was 46% at Fargo compared to 97% at Eckelson. The dense grass stand at Eckelson likely competed with Canada thistle and reduced regrowth compared to the generally bare ground following treatment at Fargo. Mowing did not effect Canada thistle control regardless of treatment or application date at either location. For instance, control in August 2008 at Eckelson was 89 and 92% averaged over all non-mow and mow treatments, respectively.

Aminopyralid provided excellent Canada thistle control even when applied after several killing frosts in late-October. All plants in the mowed treatment were green and in the rosette growth stage compared to plants in the non-mowed areas which had brown stems and little or no green tissue remaining. Control from all aminopyralid treatments applied in late-October averaged 93 and 96% at Fargo and Eckelson, respectively, 10 months after treatment. Canada thistle control in August 2008 with picloram at the Fargo location declined from an average of 92 to 44% when applied in September compared to late October. However, control was similar regardless of fall application date at Eckelson and averaged 93% in August 2008.

In summary, aminopyralid provided excellent Canada thistle control when applied in the fall, even after several killing frosts. Long-term control was enhanced when there was good grass cover to compete with Canada thistle regrowth compared to little or no cover. Mowing did not affect control regardless of application date or treatment.

Table 1. Effect of time of treatment and mowing on Canada thistle control with aminopyralid applied at four application dates near Fargo, ND.

		Evaluation date/mowing treatment[1]					
		6 Aug. 2007		17 June 2008		20 Aug. 2008	
Treatment[2] / date	Rate	Mow	No mow	Mow	No mow	Mow	No-mow
	— oz/A —	%					
Applied 5 June 2007							
Aminopyralid	1.25	99	97	41	39	42	31
Aminopyralid	1.75	99	99	72	58	57	56
Picloram	6	92	92	38	28	31	35
Applied 19 Sept. 2007							
Aminopyralid	1.25			92	99	98	96
Aminopyralid	1.75			99	100	95	96
Picloram	6			100	99	92	92
Applied 1 Oct. 2007							
Aminopyralid	1.25			99	99	98	97
Aminopyralid	1.75			100	100	96	99
Picloram	6			96	99	82	77
Applied 29 Oct. 2007							
Aminopyralid	1.25			99	100	93	89
Aminopyralid	1.75			99	99	93	95
Picloram	6			84	80	45	44
LSD(0.05)		NS		19		22	

[1] Front or back half of each plot mowed on 9 July 2007.

[2] Surfactant Activator 90 at 0.25% v/v was applied with all treatments, Loveland Products Greeley, CO 80632.

Table 2. Effect of time of treatment and mowing on Canada thistle control with aminopyralid applied at four application dates near Eckelson, ND.

		Evaluation date/mowing treatment[1]					
		17 Aug. 2007		24 June 2008		13 Aug. 2008	
Treatment[2] / date	Rate	Mow	No mow	Mow	No mow	Mow	No mow
	oz/A	%					
Applied 20 June 2007							
Aminopyralid	1.25	91	91	99	97	69	90
Aminopyralid	1.75	94	94	95	99	90	84
Picloram	6	93	93	96	95	75	65
Applied 14 Sept. 2007							
Aminopyralid	1.25			100	100	98	94
Aminopyralid	1.75			99	99	97	90
Picloram	6			99	99	92	93
Applied 1 Oct. 2007							
Aminopyralid	1.25			99	100	93	81
Aminopyralid	1.75			100	100	99	97
Picloram	6			100	100	98	97
Applied 29 Oct. 2007							
Aminopyralid	1.25			98	100	95	96
Aminopyralid	1.75			100	99	99	94
Picloram	6			100	100	97	82
LSD(0.05)		NS		3		15	

[1] Front or back half of each plot was mowed on 11 July 2007.

[2] Surfactant Activator 90 at 0.25% v/v was applied with all treatments, Loveland Products Greeley, CO 80632.

Aminopyralid applied at the maximum use rate for Canada thistle control. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58108-6050). Aminopyralid has become widely used for Canada thistle control and is generally applied at 0.75 to 1.75 oz ae/A. Aminopyralid is labeled for spot treatments at 3.5 oz/A which may provide better long-term control than when applied at lower rates and reduce or eliminate the cost of repeat applications. Diflufenzopyr is a semicarbazone herbicide which inhibits auxin transport in susceptible plants. The addition of diflufenzopyr has improved weed control of some species with certain herbicides. The purpose of this research was to evaluate aminopyralid at the maximum use rate alone or with diflufenzopyr for Canada thistle control.

The experiment was established near Eckelson, ND, on a dense stand of Canada thistle with relatively thick under story of smooth brome and Kentucky bluegrass. Treatments were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi on June 19 or September 20, 2006. Spring treatments were applied to actively growing Canada thistle in the bolt to bud stage and fall treatments were applied to Canada thistle rosettes. Experimental plots were 10 by 30 feet and replicated four times in a randomized complete block design. Canada thistle control was evaluated visually using percent stand reduction compared to the untreated control.

Canada thistle control the year after treatment with aminopyralid was similar regardless of application rate and averaged 94 and 99% in September 2007 when spring or fall applied, respectively (Table). No grass injury was observed from any treatment. Canada thistle control with aminopyralid applied alone or with diflufenzopyr was similar.

Canada thistle control was better with aminopyralid applied in the spring at 3.5 compared to 1.75 oz/A in June 2008, 24 months after treatment (MAT) and averaged 96 and 76% control, respectively (Table). However, the same treatments applied in the fall provided similar control and averaged 89% in August 2008, 23 MAT. Control was similar with aminopyralid applied alone or with diflufenzopyr regardless of application or evaluation date.

In summary, Canada thistle control 24 MAT with aminopyralid applied at 3.5 compared to 1.75 oz/A was better when applied in June but not September. Land managers would need to consider herbicide cost (2X) compared to application costs of repeat treatments to determine if using aminopyralid at the maximum spot treatment use rate would be cost-effective for their weed control program.

Table. Aminopyralid applied at the maximum use rate in the spring or fall for spot treatment of Canada thistle in North Dakota.

		Control/ evaluation date				
		2006	2007		2008	
Treatment[1]	Rate	Aug.	June	Sept.	June	Aug.
Applied June 2006	-- oz/A --			%		
Aminopyralid	1.75	99	96	96	76	74
Aminopyralid	3.5	99	96	92	96	92
Picloram	8	98	96	93	72	73
Aminopyralid + diflufenzopyr	1.75 + 0.7	99	96	93	87	89
Applied September 2006						
Aminopyralid	1.75		99	99	87	85
Aminopyralid	3.5		100	99	93	93
Picloram	8		99	91	73	67
Aminopyralid + diflufenzopyr	1.75 + 0.7		100	99	88	87
LSD (0.05)		NS	2.5	4.5	14	15

[1] Activator 90 was applied at 0.25% with all treatments, Loveland Products, Inc., Greeley CO 80632-1286.

Musk thistle control with postemergence aminocyclopyrachlor. Corey V. Ransom and Steven A. Dewey. (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) Aminocyclopyrachlor is a new growth regulator herbicide being investigated for weed control in range and pastures. It is formulated differently in two experimental herbicides; MAT 28 and KJM 44. Aminocyclopyrachlor at different rates and in combination with other herbicides was tested for control of musk thistle. Herbicide treatments were applied to musk thistle patches prior to bolting on June 12, 2008 near Croydon, Utah and June 19 near Fairview, Utah. Treatments were applied with a CO_2-pressurized backpack sprayer delivering 15 gpa at Croydon and 25 gpa at Fairview. Plots measured 10 by 30 feet and were arranged in a randomized complete block design with three and four replications at Fairview and Croydon, respectively. Musk thistle control was evaluated approximately 9 weeks after treatment (Table). MAT 28 rates above 1.0 oz ai/A provided greater than 90% musk thistle control which was similar to control provided by aminopyralid, 2,4-D ester, and combinations of MAT 28 with metsulfuron. At Fairview, chlorsulfuron added to MAT 28 also increased musk thistle control compared to MAT 28 at 0.5 oz ai/A alone. KJM 44 was as effective as MAT 28 at Croydon but was less effective at Fairview. The use of MSO in place of NIS did not significantly influence MAT 28 activity on musk thistle.

Table. Musk thistle control approximately 9 weeks after treatment.

		Control	
Treatment[1]	Rate	Croydon	Fariview
	oz ai/A	-------------------------%--------------------	
Untreated	--	--	--
MAT 28 + NIS	0.25	68	53
MAT 28 + NIS	0.5	85	72
MAT 28 + NIS	1.0	100	91
MAT 28 + MSO	1.0	100	98
KJM 44 + NIS	1.0	100	82
MAT 28 + NIS	1.5	100	99
MAT 28 + NIS	2.0	100	99
Aminopyralid + NIS	1.25	100	93
2,4-D ester + NIS	16.0	100	96
MAT 28 + metsulfuron + NIS	0.5 + 0.10	93	99
MAT 28 + chlorsulfuron + NIS	0.5 + 0.19	86	99
LSD (0.05)		7	12

[1] NIS was applied at 0.25% v/v and MSO at 1.0% v/v.

Topographic factors influencing spot-treatment of musk thistle in a montane environment. Ralph Whitesides and Clayton Whitesides. (Utah State University, Department of Plants, Soils, and Climate, Logan, UT 84322 and Texas State University, Department of Geography, San Marcos, TX 78666) Musk thistle populations in a high mountain ecosystem were monitored and spot-treated annually from 1991 to 2007. Spot-treatments were made with a back-pack or hand-held sprayer annually in July when thistle plants were easily identified from the dense understory vegetation. Picloram was used each year until 2005 at a 2% solution v/v. Beginning in 2005 aminopyralid was substituted for picloram at the same concentration. It was hypothesized that steep slopes, southern aspects and the presence of marshland could greatly reduce the effectiveness of thistle treatment because they reduce human ability to control musk thistle through herbicidal spot treatment. It was assumed that steep slopes limit applicator mobility and subsequent thistle control. Marshland was also assumed to limit applicator mobility and required altered search patterns based on the level on inundation by water. Thistles on south aspects in cold montane regions benefit from addition sunlight on south-facing slopes and are likely to have higher thistle populations that may be difficult to spot-treat. Fourteen study sites were selected based on visual analysis of dense thistle populations. The perimeter of each site was recorded with a handheld global positioning system. A 10 meter digital elevation model was used to calculate slope and aspect for the region. Zonal statistics were employed to obtain mean slope and aspect for individual study sites. The average slope, aspect, presence of marshland and thistles per acre in 2007 were compiled and a correlation matrix was created to identify relationships between variables. All variables were log transformed to achieve normal distributions. Slope, aspect, and presence of marshland were regressed against the number of thistles per acre in 2007. A correlation matrix indicted a significant relationship between 2007 thistles and slope. Areas with a slope of 18 degrees or higher experienced a 300+% increase in thistle population from 1991 to 2007. Although the area designated as the "road area" had a slope greater than 18 degrees excellent thistle control was achieved due to ease of mobility along the graded surface. The increase in thistle population was attributed to the fact that steep slopes are difficult to navigate while searching for thistles and carrying a full backpack or handheld sprayer. Aspect was expected to influence thistle density because thistles in cold montane regions have an extended growing season and benefit from additional sunlight on south aspects. However, there was no apparent pattern between aspect and thistle population. Variation in annual precipitation over the duration of the study period resulted in interesting spot-treatment dynamics. Years of lower than average precipitation resulted in less marshland and required inspection of areas that were normally inundated. Areas with varying water levels were considered more difficult to treat due to reduced applicator mobility and a dynamic study site. However, musk thistles in marshland were slow to advance into areas that experienced periodic inundation and the study site with the best control (99%) contained substantial marshland. Slope is a significant factor determining musk thistle control via spot-treatment. Steep slopes hinder herbicide applicator mobility and allow musk thistle to proliferate. Aspect and the presence of marshland were insignificant in determining control of musk thistle.

Dalmation toadflax control using low rates of chlorsulfuron and two surfactants. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Whitebird, ID to evaluate Dalmation toadflax (*Linaria dalmatica* (L.) P.Mill) control using low rates of chlorsulfuron with a methylated seed oil (MSO) or a non-ionic surfactant (NIS). The experiment was designed as a randomized complete block with four replications. Plot size was 10 by 20 feet. All treatments were applied with a CO_2-pressurized backpack sprayer at 15 gpa (Table 1).

Table 1. Application and soil data.

Location	Whitebird, ID
Target weed	Dalmation toadflax
Weed growth stage	flower
Application date	May 15, 2007
Air temp (F)	87
Relative humidity (%)	17
Wind (mph, direction)	2 to 4, NE
Cloud cover (%)	0
Soil temp at 2 inches (F)	92
Soil type	cobble loam

A visual evaluation was conducted 14 months after treatment (MAT). Dalmation toadflax control was based on the percent cover of treated plots in comparison to the untreated check (Table 2). A significant rate effect was detected 14 MAT. Chlorsulfuron at 0.50 and 0.75 oz ai/A did not differ in pairwise comparisons, but both rates resulted in greater toadflax control than 0.38 oz ai/A. Chlorsulfuron at 0.50 and 0.75 oz ai/A resulted in greater than 98% control. Trends indicate that applications with a methylated seed oil may increase levels of control, but no surfactant effect was detected 14 MAT.

Table 2. Dalmation toadflax control following chlorsulfuron treatments and two surfactants near Whitebird, ID.

Treatment	Rate	Dalmation toadflax control 14 MAT
	oz ai/A	------------ % ------------
Chlorsulfuron + NIS[1]	0.38	62
Chlorsulfuron + NIS	0.50	98
Chlorsulfuron + NIS	0.75	100
Chlorsulfuron + MSO[2]	0.38	100
Chlorsulfuron + MSO	0.50	100
Chlorsulfuron + MSO	0.75	100
Untreated check [3]		0
Tukey's Studentized Range HSD (0.05)		25

[1] 90% non-ionic surfactant (R-11) applied at 0.25% v/v

[2] 100% methylated seed oil (Superspread MSO) applied at 1.0% v/v

[3] Untreated check had 40% Dalmation toadflax cover on evaluation date.

Yellow toadflax control in Colorado. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Yellow toadflax (LINVU) is an aggressive escaped ornamental that reproduces from seed and creeping roots. In recent times LINVU has rapidly expanded its range along the steep slopes and canyons in the foothills and higher elevations in Colorado. LINVU often grows in steep rough terrain making herbicide application difficult. LINVU has proven to be difficult to control with herbicides and often requires high herbicide rates and even then providing unacceptable long term LINVU control.

An experiment was established near Crested Butte, CO on August 29, 2007 to evaluate chemical control of LINVU. The experiment was designed as a randomized complete block and treatments were replicated four times. Herbicides were applied when LINVU was in vegetative to late flower growth stage (Table 1). Root buds (1 to 2 cm long) had formed on 70% of LINVU shoots. All treatments were applied with a CO_2-pressurized backpack sprayer using 11002LP flat fan nozzles at 20 gal/a and 30 psi. Plot size was 10 by 30 feet. Visual evaluations for control compared to non-treated plots were collected on October 7, 2008 (Table 2), approximately 13 months after treatment (MAT).

Dicamba or diflufenzopyr plus dicamba controlled 30 or 29% LINVU approximately 13 MAT. Picloram (32 or 64 oz/a) sprayed alone controlled 63 or 70% LINVU; however, when the same rates of picloram were tank mixed with diflufenzopyr plus dicamba, LINVU controlled increased to 97 or 94%. There was a significant advantage to the picloram plus diflufenzopyr plus dicamba tank mixed compared to these same herbicides sprayed alone. There was 70 or 73% LINVU control with picloram sprayed alone or picloram plus dicamba, respectively and no benefit to adding dicamba (without diflufenzopyr) to the picloram tank mix. Although there didn't appear to be any perennial grass stand loss with any treatment in this study, there was slight stunting of grass species (0 to 28%).

There are currently few herbicides available for effective long term yellow toadflax control in rangeland. This experiment has shown that picloram plus diflufenzopyr plus dicamba provides excellent LINVU control with minor stunting to perennial grass species 13 MAT. It is possible to lower picloram rates and increase long term LINVU control by tank mixing picloram plus diflufenzopyr plus dicamba. Visual evaluations for residual long-term LINVU control and grass injury will be conducted in 2009.

Table 1. Application data for yellow toadflax control in Colorado.

Environmental data	
Application date	August 29, 2007
Application time	8:00 am
Air temperature, F	58
Relative humidity, %	41
Wind speed, mph	0

Application date	Species	Common Name	Growth stage	Height
				--(in.)--
August 29, 2007	LINVU	Yellow toadflax	Late flower	5 to 28
	PHLPR	Timothy	Seedset	30 to 45
	BROMA	Mountain brome	Seedset	30 to 48
	NASVI	Green needlegrass	Seedset	30 to 45

Table 2. Yellow toadflax control in Colorado.

Herbicide[1,2]	Rate	Yellow toadflax control	Grass injury
		October 7, 2008	
	oz/a	(%)	
Dicamba	8	29	8
Diflufenzopyr + dicamba	1.6 + 4	30	0
Picloram	32	63	0
Picloram	64	70	8
Picloram + diflufenzopyr + dicamba	32 + 1.6 + 4	97	28
Picloram + diflufenzopyr + dicamba	64 + 1.6 + 4	94	13
Picloram + dicamba	64 + 8	73	10
LSD (0.05)		14	19

[1] Methylated seed oil added to all treatments at 1% v/v.

[2] Diflufenzopyr + dicamba is the premix formulation of Overdrive.

Yellow toadflax control in Colorado with DPX-KJM44. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Yellow toadflax (LINVU) is an aggressive escaped ornamental that reproduces from seed and creeping roots. In recent times LINVU has rapidly expanded its range along the steep slopes and canyons in the foothills and higher elevations in Colorado. LINVU often grows in steep rough terrain making herbicide application difficult. LINVU has proven to be difficult to control with herbicides and often requires high herbicide rates and even then providing unacceptable long term LINVU control.

An experiment was established near Crested Butte, CO on August 29, 2007 to evaluate chemical control of LINVU with a new herbicide (DPX-KJM44) from DuPont Crop Protection. The proposed common name for DPX-KJM44 is aminocyclopyrachlor-methyl ester. The experiment was designed as a randomized complete block and treatments were replicated four times. Herbicides were applied when LINVU was in vegetative to late flower growth stage (Table 1). Root buds (1 to 2 cm long) had formed on 70% of LINVU shoots at the time of application. All treatments were applied with a CO_2-pressurized backpack sprayer using 11002LP flat fan nozzles at 20 gal/a and 30 psi. Plot size was 10 by 30 feet. Visual evaluations for control compared to non-treated plots were conducted on August 29, 2007 (Table 2), approximately 13 months after treatment (MAT).

LINVU control increased with increasing rates of DPX-KJM44. There was 30% LINVU control from 0.3 oz ai/a of DPX-KJM44 and 100% LINVU control from 12 oz ai/a of DPX-KJM44 approximately 13 MAT. Although there didn't appear to be perennial grass stand loss from DPX-KJM44, there was significant stunting of grass species (especially at the higher rates). There was 8 to 19% grass height reduction with 0.25 to 1 oz ai/a and 33 to 51 grass height reduction with 2 to 12 oz ai/a of DPX-KJM44.

There are currently few herbicides available for effective long term yellow toadflax control in rangeland. This experiment has shown that DPX-KJM44 provides good to excellent LINVU control with minor stunting to perennial grass species 13 MAT. Visual evaluations for residual long-term LINVU control and grass injury will be conducted in 2009.

Table 1. Application data for yellow toadflax control in Colorado with DPX-KJM44.

Environmental data	
Application date	August 29, 2007
Application time	8:00 am
Air temperature, F	58
Relative humidity, %	41
Wind speed, mph	0

Application date	Species	Common Name	Growth stage	Height
				--(in.)--
August 29, 2007	LINVU	Yellow toadflax	Late flower	5 to 28
	PHLPR	Timothy	Seedset	30 to 45
	BROMA	Mountain brome	Seedset	30 to 48
	NASVI	Green needlegrass	Seedset	30 to 45

Table 2. Yellow toadflax control in Colorado with DPX-KJM44.

Herbicide[1]	Rate	Yellow toadflax control	Grass injury
		October 7, 2008	
	oz ai/a	(%)	
DPX-KJM44[2]	0.3	30	10
DPX-KJM44[2]	0.5	40	8
DPX-KJM44[2]	1	51	19
DPX-KJM44[2]	2	67	36
DPX-KJM44[2]	4	91	33
DPX-KJM44[2]	8	98	51
DPX-KJM44[2]	12	100	45
LSD (0.05)		9	16

[1] Methylated seed oil added to all treatments at 1% v/v.

[2] Aminocyclopyrachlor-methyl ester.

Control of *Ventenata dubia* using various selective herbicides. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Moscow, Idaho on a Palouse Prairie restoration site to evaluate the efficacy of various herbicides for the control of ventenata (*Ventenata dubia* [Leers] Coss.). Herbicide injury symptoms on native perennial grasses (Idaho fescue, bluebunch wheatgrass) were also evaluated. Early-post emergent applications, 1-2 leaf stage, were investigated for six herbicide treatments; imazapic, glyphosate, two rates of imazapic + glyphosate, sulfosulfuron, and terbacil. The amount of active ingredient of imazapic and glyphosate in the low rate of imazapic + glyphosate was equal to imazapic and glyphosate applied alone in this study. The experiment was designed as a randomized complete block with five replications. Plot size was 10 by 30 feet. All treatments were applied with a CO_2-pressurized backpack sprayer at 15 gpa (Table 1).

Table 1. Application and soil data.

Location	Moscow, ID
Target weed	ventenata (VEDU)
Weed growth stage	early-post (1-2 leaf)
Application date	December 4, 2007
Air temp (F)	55
Relative humidity (%)	55
Wind (mph, direction)	3 to 7, W
Cloud cover (%)	60
Soil temp at 2 inches (F)	38
Soil type	silt loam

Treatments were visually evaluated for percent control of ventenata (VEDU) in comparison to the untreated check approximately seven and nine months after treatment (MAT). Treatments were also visually evaluated for perennial grass injury in comparison to the untreated control. Perennial grass was rated on a scale of zero to four: 0 = no injury, 1 = <50% growth suppression, 2 = >50% growth suppression, 3 = >50% growth suppression + <50% injury symptoms, 4 = >50% growth suppression + >50% injury symptoms.

Each treatment resulted in greater than 80% control of ventenata (Table 2). Application of glyphosate resulted in less ventenata control in comparison with other treatments 9 MAT. The high rate of imazapic + glyphosate resulted in significantly greater injury to perennial grasses than other treatments (Table 3). Greater than 50% growth suppression and visible injury symptoms were observed in this treatment. Less than 50% growth suppression was observed across other imazapic treatments. Perennial grasses were generally tolerant to sulfosulfuron, terbacil and glyphosate alone.

Table 2. Ventenata control with various herbicides near Moscow, Idaho in 2007-2008.

		VEDU control	
Treatment	Rate	7 MAT	9 MAT
	oz ae/A	---------- % ----------	
Imazapic [1]	0.08	98	99
Glyphosate	0.16	83	81
Imazapic + glyphosate	0.08 + 0.16	99	99
Imazapic + glyphosate	0.12 + 0.25	100	100
Sulfosulfuron [2]	0.75 [3]	100	100
Terbacil	12.8	98	97
Control		0	0
Tukey's Studentized Range HSD (0.05)		20	12

[1] 100% methylated seed oil (Superspread MSO) applied at 1.0% v/v with imazapic and glyphosate

[2] 90% non-ionic surfactant (R-11) applied at 0.25% v/v with sulfosulfuron and terbacil

[3] sulfosulfuron and terbacil are expressed in oz ai/A

Table 3. Perennial grass injury following herbicide treatments near Moscow, Idaho in 2007-2008. Injury was rated on a scale of zero to four: 0 = no injury, 1 = <50% growth suppression, 2 = >50% growth suppression, 3 = >50% growth suppression + <50% injury symptoms, 4 = >50% growth suppression + >50% injury symptoms.

		7 MAT					9 MAT				
		Injury scale (0-4)					Injury scale (0-4)				
Treatment	Rate	0	1	2	3	4	0	1	2	3	4
	oz ae/A	% Frequency									
Imazapic [1]	0.08	16	33	50	0	0	50	50	0	0	0
Glyphosate	0.16	33	66	0	0	0	83	16	0	0	0
Imazapic + glyphosate	0.08 + 0.16	0	50	33	16	0	33	33	16	16	0
Imazapic + glyphosate	0.12 + 0.25	0	0	16	66	16	0	0	50	50	0
Sulfosulfuron [2]	0.75 [3]	33	66	0	0	0	83	16	0	0	0
Terbacil	12.8	66	33	0	0	0	83	16	0	0	0
Control		100	0	0	0	0	100	0	0	0	0

[1] 100% methylated seed oil (Superspread MSO) applied at 1.0% v/v with imazapic and glyphosate

[2] 90% non-ionic surfactant (R-11) applied at 0.25% v/v with sulfosulfuron and terbacil

[3] sulfosulfuron and terbacil are expressed in oz ai/A

Development of restoration tools for *Ventenata dubia* infested pastures. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Sanders, Idaho in the fall of 2006 to determine the effect of herbicide and fertilizer treatment combinations on ventenata (*Ventenata dubia* [Leers] Coss.) infested pastures. Ventenata density varied within the study site. The pasture was delineated into three levels of ventenata infestation using ocular cover estimates of ventenata within a gridded frame: LOW (<25% cover), MED (40-60% cover), and HIGH (>75% cover). The primary perennial grasses present at the site included bearded wheatgrass (*Elymus trachycaulus subsecundas* (Link) Gould), Sandberg bluegrass (*Poa secunda* J. Presl), meadow foxtail (*Alopecurus pratensis* L.), smooth brome (*Bromus inermis* Leyss.), and timothy (*Phleum pratense* L.). Soil type was a Taney silt loam.

The experiment was designed as a split-plot arranged in a randomized complete block with four blocks in each pre-treatment ventenata cover class. Each block consisted of two whole plot factors (herbicide, control) and two sub-plot factors (fertilizer, control). Triasulfuron was applied at 0.42 oz ai/A as a pre-emergent to whole plots (10 by 40 ft) at a rate of 0.56 oz/A on October 16, 2006 with a CO_2-pressurized backpack sprayer at 15 gpa (Table 1). This treatment provided no control of ventenata six months after treatment (MAT). Though an earlier study indicated triasulfuron may be effective, it has failed to provide ventenata control in subsequent studies. Consequently, imazapic was applied at 0.08 oz ae/A as a post-emergent to whole plots at a rate of on April 15, 2007. Fertilizer was applied to sub-plots (10 by 20 ft) with a hand-held broad cast spreader. A split application of fertilzer (27-8-8) was applied at 80 lb N/A on 7-May and 21-September in 2007. A standard soil fertility test was analyzed pre-treatment and applied to target-rate recommendations from the North Idaho Fertilizer Guide[1].

Table 1. Application data.

Treatment	Rate	Timing
Herbicide		
Triasulfuron	0.42 oz ai/A	October 18, 2006
Imazapic	0.08 oz ae/A	April 16, 2007
Fertilizer		
NPK (27-8-8)	80 lb N/A	May 7, 2007
NPK (27-8-8)	80 lb N/A	September 21, 2007

The post-emergent application of imazapic resulted in nearly complete control (< 0.1 ton/A biomass 3 MAT) of ventenata across treatments but significantly injured perennial grasses. Perennial grass biomass declined by 50% across treatments in herbicide-only treatments in comparison to the control 3 MAT (data not shown). An evaluation conducted in the following growing season, July 2008, detected significant treatment differences approximately 15 MAT. These results are summarized in Tables 2 and 3.

In the LOW (<25%) pre-treatment ventenata-cover class, ventenata cover increased in the control, but declined similarly across herbicide and fertilizer treatments (Table 2). No differences occurred between fertilizer alone and herbicide treatments. Herbicide and fertilizer treatments did not affect the change in cover of perennial grasses, which increased 15 to 22% across treatments. However, fertilizer treatments had a significant effect on biomass production of perennial grasses (Table 3). The addition of fertilizer treatments increased biomass production in herbicide plots, as well as in herbicide control plots.

In the MED (40-60%) pre-treatment ventenata-cover class, treatments significantly decreased ventenata cover and increased perennial grasses in comparison to the control (Table 2). Herbicide treatments significantly decreased ventenata biomass in comparison to the controls. Fertilizer-only treatments resulted in a significantly greater increase in perennial grass cover and aboveground biomass in comparison to the control and the herbicide-only plots and did not differ in comparison to the herbicide + fertilizer treatment (Table 2-3). Forb cover, primarily *Lotus unifoliolatus*, increased in herbicide-only plots, in the absence of fertilizer.

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[1] North Idaho Fertilizer Guide: Grass Pastures. 2005. University of Idaho Extension. Idaho Agricultural Experiment Station. CIS853.

In the HIGH (>75%) pre-treatment ventenata-cover class, ventenata cover significantly decreased, but above-ground biomass increased, following the fertilizer-only treatment in comparison to the control (Table 2-3). The application of herbicide resulted in a greater decrease in ventenata cover and biomass in comparison to the control and fertilizer-only treatment. Fertilizer significantly increased perennial grass cover and biomass in comparison to fertilizer controls. Herbicide + fertilizer treatments resulted in a greater increase in perennial grass cover in comparison to the fertilizer only treatment, but did not differ in biomass production.

In summary, a spring application of imazapic at 0.08 oz ae/A provided greater than 90% control of ventenata but resulted in significant injury to perennial grasses. Subsequent studies of imazapic and imazapic + glyphosate applied in the fall as an early post-emergent have resulted in high levels of control and negligible injury to perennial grasses. Due to the perennial grass injury incurred in this study, inferences drawn from comparisons between fertilizer effects and herbicide effects are limited. In herbicide control plots, fertilizer treatments resulted in decreased ventenata cover and significantly increased perennial grass biomass across all levels of ventenata infestations, including ventenata-dominated (>75%) sites.

Table 2. Percent change in canopy cover of ventenata, perennial grass, and forbs in July 2008, approximately 15 months after imazapic treatment.

Pre-Treatment Ventenata Cover Class	Treatment		Canopy Cover Change 15 MAT Ventenata	 Perennial Grass	 Forbs
			----------	%	----------
LOW (< 25%)	No Treatment		13	15	-2
	Fertilizer Only		-1	21	1
	Herbicide Only		-1	22	4
	Herbicide + Fertilizer		-1	19	4
		SE	*4*	*9*	*2*
MED (40 to 60%)	No Treatment		3	-2	-3
	Fertilizer Only		-39	52	-9
	Herbicide Only		-50	31	27
	Herbicide + Fertilizer		-35	59	2
		SE	*10*	*9*	*9*
HIGH (>75%)	No Treatment		-3	6	-2
	Fertilizer Only		-35	47	-2
	Herbicide Only		-66	40	8
	Herbicide + Fertilizer		-70	75	-1
		SE	*10*	*10*	*3*

Table 3. Aboveground biomass (ton/A) of ventenata, perennial grass, and forbs in July 2008, approximately 15 months after imazapic treatment.

Pre-Treatment Ventenata Cover	Treatment		Aboveground Biomass 15 MAT Ventenata	Perennial Grass	Forbs
			---------------------------- ton/A	------------------------------	
LOW (< 25%)	No Treatment		0.1	1.7	0.0
	Fertilizer Only		0.0	3.0	0.0
	Herbicide Only		0.1	2.3	0.0
	Herbicide + Fertilizer		0.1	2.8	0.1
		SE	*0.1*	*0.2*	*0.1*
MED (40 to 60%)	No Treatment		0.4	0.7	0.1
	Fertilizer Only		0.3	2.6	0.0
	Herbicide Only		0.1	0.9	0.1
	Herbicide + Fertilizer		0.2	2.7	0.1
		SE	*0.1*	*0.3*	*0.1*
HIGH (>75%)	No Treatment		0.5	0.7	0.1
	Fertilizer Only		0.7	2.0	0.1
	Herbicide Only		0.1	0.9	0.1
	Herbicide + Fertilizer		0.2	2.0	0.2
		SE	*0.1*	*0.2*	*0.1*

Absinth wormwood control in Colorado. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Absinth wormwood (ARTAB) is any escaped ornamental that has spread into pastures and rangeland in Colorado. It is an herbaceous perennial that is a prolific seed producer and also spreads by short roots. It is easily recognized by its strong odor. ARTAB is an ingredient in the banned liquor absinthe and and has been used medicinally.

This experiment was established near Gunnison, CO to evaluate chemical control of ARTAB. The experiment was designed as a randomized complete block and treatments were replicated four times. Herbicides were sprayed on July 12, 2006 at late bud to early flower growth stages. All treatments were applied with a CO_2-pressurized backpack sprayer using 11002LP flat fan nozzles at 20 gal/A and 30 psi. Plot size was 10 by 20 feet. Application information is presented in Table 1. Visual evaluations for control compared to non-treated plots were conducted in August 2006 and in fall 2006, 2007, and 2008, approximately 1, 2, 14, and 27 months after treatment (MAT; Table 2).

All treatments controlled 46 to 71% of ARTAB approximately 1 MAT. At 2 MAT, metsulfuron plus chlorsulfuron tank mixed with clopyralid, aminopyralid, or 2,4-D controlled 70 to 88% of ARTAB while metsulfuron plus chlorsulfuron mixed with picloram controlled 54 o 55% of ARTAB. Clopyralid plus 2,4-D controlled 94% of ARTAB, 2 MAT and provided the best control in 2006.

ARTAB control decreased from all treatments at the 14 MAT evaluation; however, treatments with 2,4-D in the tank mix tended to control ARTAB better 27 MAT. Tank mixes of metsulfuron plus chlorsulfuron when applied at 0.2 + 0.2 oz ai/a controlled 28 to 46% of ARTAB while tank mixes with metsulfuron plus chlorsulfuron when applied at 0.6 + 0.8 oz ai/a controlled 24 to 74% of ARTAB. Metsulfuron plus chlorsulfuron tank mixed with picloram controlled 24 to 28% of ARTAB compared to 46 to 74% ARTAB control when metsulfuron plus chlorsulfuron was tank mixed with other herbicides.

The best treatments in this study (metsulfuron plus chlorsufluron plus 2,4-D or clopyralid plus 2,4-D) controlled 81 or 85% ARTAB 27 MAT, had 2,4-D in the tank mix, and these tended to provide better control. Higher herbicides rates than those used in this experiment may be necessary to provide long term ARTAB control. There was no perennial grass injury observed with any of these treatments.

Table 1. Application data for absinth wormwood control in Colorado.

Environmental data	
Application date	July 12, 2006
Application time	11:30 am
Air temperature, F	68
Relative humidity, %	46
Wind speed, mph	0 to 2

Application date	Species	Common Name	Growth stage	Height --(in.)--
July 12, 2006	ARTAB	Absinth wormwood	Late bud to early flower	14 to 36

Table 2. Absinth wormwood control in Colorado.

Herbicide[1,2,3]	Rate	Absinth wormwood control August 2006	 September 2006	 September 2007	 October 2008
	oz ai/a	(%)			
Metsulfuron + chlorsulfuron + picloram	0.2 + 0.2 + 2	46	54	28	30
Metsulfuron + chlorsulfuron + picloram	0.6 + 0.8 + 2	43	55	24	26
Metsulfuron + chlorsulfuron + clopyralid	0.2 + 0.2 + 3	49	70	51	63
Metsulfuron + chlorsulfuron + clopyralid	0.6 + 0.8 + 3	51	82	63	59
Metsulfuron + chlorsulfuron + aminopyralid	0.2 + 0.2 + 1.5	40	58	46	61
Metsulfuron + chlorsulfuron + aminopyralid	0.6 + 0.8 + 1.5	65	80	70	64
Metsulfuron + chlorsulfuron + 2,4-D	0.2 + 0.2 + 16	66	83	40	69
Metsulfuron + chlorsulfuron + 2,4-D	0.6 + 0.8 + 16	71	88	74	81
Clopyralid + 2,4-D	13 + 48	63	94	68	85
LSD (0.05)		13	10	22	22

[1] Crop oil concentrate added to all treatments at 2% v/v.

[2] 2,4-D amine 4 lb ai/gal formulation.

[3] Clopyralid plus 2,4-D is the premix formulation of Curtail.

Short-term effect of six herbicides on established Sandberg's bluegrass on a recently burned sagebrush site. Brad W. Schultz and Earl Creech. (University of Nevada Cooperative Extension, Winnemucca, NV 89445). On many degraded sagebrush rangelands, cheatgrass is usually abundant, and Sandberg's bluegrass (*Poa secunda*) is often the only perennial grass in the herbaceous understory. Following wildfire, Sandberg's bluegrass is often widespread but at a density too low to prevent cheatgrass from assuming ecological dominance. Chemical control of cheatgrass is possible, but the effect of many herbicides on Sandberg's bluegrass, a desired non-target species, is largely unknown. Six herbicides (glyphosate, imazapic, metribuzin, propoxycarbazone, sulfometuron, and sulfosulfuron) (Table 2) were applied to a sagebrush rangeland site the first growing season after it had burned (July 2007). Ammonium sulfate (AMS) was mixed with the glyphosate treatment and the non-ionic surfactant (NIS), Activator 90, was mixed with the other herbicide treatments. Sandberg's bluegrass was at the 1-3 leaf growth stage at the March 4 application and the 8-10 leaf stage at the April 17 application. Each herbicide treatment was applied with a CO_2 press urized back-pack sprayer to individual plots measuring 10 x 30 ft. Treatments were arranged in a randomized complete block with four replications. Table 1 describes weather and soil conditions at the time of application and the post-application precipitation pattern. Also, the March through June period had six wind events that exceeded 50 mph, resulting in substantial movement of soil surface particles.

Table 1. Growing conditions at the time of herbicide application and subsequent precipitation patterns.

Parameter	1-3 leaf stage (March 4, 2008)	8-10 leaf stage (April 17, 2008)
Time of application	10:30 A	4:00 P
Air temperature	42°F	67°F
Relative humidity	25%	20%
Wind speed and direction	10 mph from NW	1 mph from SW
Soil temperature	35°F	64°F
Soil moisture	Moist below surface	Dry throughout profile
Cloud cover	None	None
Soil type	Silt loam	Silt loam
Bluegrass height	< 1 inch	3 inches
Precipitation[1]	0.21 inches on March 14	0.20 inches on April 20

[1] March 1- May 20th precipitation was less than 0.63 inches (33% of average). May 20th to June 4th precipitation was 1.44 inches.

In each treatment plot, we established a 3 x 30 ft belt transect down the middle of the plot. We assessed the short-term effect of each treatment on Sandberg's bluegrass by measuring the percentage of plants with seed stalks and percent stunting. Field data were collected in early July 2008. Means were calculated for each treatment and transformed (arc sin) to equalize variances. A one-way analysis of variance was used to compare means for each application date, respectively. LSD mean separation was applied and is reported at two levels, $P \leq 0.05$ and 0.10. A two sample t-test was used to compare treatments between growth stages. Actual p-values are reported.

There were large differences among treatments for the percent of Sandberg's bluegrass plants with seed stalks and between the treatments and the control, for treatments applied at the 1-3 leaf stage (Table 2). Imazapic, sulfometuron, sulfosulfuron and glyphosate treatments each had a significantly smaller percentage of plants with seed stalks, compared to the control. Differences between these four treatments were small. Propoxycarbazone treatments generally had significantly fewer bluegrass plants with seed stalks, than did the control, but propoxycarbazone effect was not as severe as treatments with imazapic, sulfometuron, sulfosulfuron or glyphosate.

When herbicide treatments were applied at the 8-10 leaf stage of Sandberg's bluegrass, only the split application of propoxycarbazone had significantly fewer bluegrass plants with seed stalks than did the control (Table 3). Differences among most treatments were small and not significant (Table 3). The lone exception was the split application of propoxycarbazone, which had substantially fewer Sandbeg's bluegrass plants with seed stalks.

The same treatment applied at different leaf growth stages often resulted in a significantly different response (Table 4). Statistically significant differences occurred for propoxycarbazone treatments at the 0.63 and 0.85 oz/a treatments, and for treatments with imazapic, sulfometuron, sulfosulfuron, and glyphosate. There were large differences in the means for the low rate of propoxycarbazone treatment and the propoxycarbazone and nitrogen treatments, respectively; but large variability among plots probably affected the statistical results. Means were nearly identical for treatments with metribuzin or propoxycarbazone + metribuzin.

Table 2. Percent of Sandberg's bluegrass with seed stalks after herbicide treatments were applied at the 1-3 leaf stage in early March 2008.

Treatment	**Rate**	**With Seed Stalks**	**$P \leq 0.05$**	**$P \leq 0.10$**
	oz ai/a	%		
Propoxycarbazone + NIS	0.42 + 0.25% v/v	50.3	abc	abc
Propoxycarbazone + NIS	0.63 + 0.25% v/v	33.8	cd	d
Propoxycarbazone + NIS	0.85 + 0.25% v/v	37.5	bcd	cd
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	30.0	de	d
Metribuzin + NIS	3.0 + 0.25% v/v	54.8	ab	ab
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	61.0	a	a
Imazapic + NIS	1.4 + 0.25% v/v	13.0	fg	e
Sulfometuron +NIS	1.125 + 0.25% v/v	4.5	g	f
Sulfosulfuron +NIS	1.125 + 0.25% v/v	15.3	ef	e
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	12.0	fg	ef
Propoxycarbazone and propoxycarbazone +NIS[1]	0.42 + 0.42 + 0.25% v/v	41.3	bcd	bcd
Control		63.5	a	a

[1] This was a split application of propoxycarbazone, with 0.42 oz ai/a applied at the 1-3 leaf stage and 0.42 oz ai/a applied at the 8-10 leaf stage.

Table 3. Percent of Sandberg's bluegrass with seed stalks after application of herbicide treatments at the 8-10 leaf stage with reproductive tillers emerging to fully elongated (mid-April 2008).

Treatment	**Rate**	**With Seed Stalks**	**$P \leq 0.05$**	**$P \leq 0.10$**
	oz ai/a	%		
Propoxycarbazone and propoxycarbazone +NIS[1]	0.42 + 0.42 + 0.25% v/v	41.3	b	b
Propoxycarbazone + NIS	0.42 + 0.25% v/v	67.5	a	a
Propoxycarbazone + NIS	0.63 + 0.25% v/v	60.8	ab	a
Propoxycarbazone + NIS	0.85 + 0.25% v/v	68.3	a	a
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	53.5	ab	ab
Metribuzin + NIS	3.0 + 0.25% v/v	55.0	ab	ab
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	59.3	ab	ab
Imazapic + NIS	1.4 + 0.25% v/v	65.5	a	a
Sulfometuron +NIS	1.125 + 0.25% v/v	54.0	ab	ab
Sulfosulfuron +NIS	1.125 + 0.25% v/v	55.0	ab	ab
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	53.0	ab	ab
Control		63.5	a	a

[1] This was a split application of propoxycarbazone, with 0.42 oz ai/a applied at the <1 leaf stage and 0.42 oz ai/a applied at the 3-5 leaf stage.

Table 4. Percent stunting of Sandberg's bluegrass with herbicide treatments applied at the 1-3 leaf stage and 8-10 leaf stage.

Treatment	Rate	Leaf Stage	With Seed Stalks	P-Value
	oz ai/a		%	
Propoxycarbazone + NIS	0.42 + 0.25% v/v	1-3	50.3	0.16
Propoxycarbazone + NIS	0.642+ 0.25% v/v	8-10	67.5	
Propoxycarbazone + NIS	0.63 + 0.25% v/v	1-3	33.8	0.03
Propoxycarbazone + NIS	0.63+ 0.25% v/v	8-10	60.8	
Propoxycarbazone + NIS	0.85 + 0.25% v/v	1-3	37.5	0.01
Propoxycarbazone + NIS	0.85 + 0.25% v/v	8-10	68.3	
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	1-3	30.0	0.18
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	8-10	53.5	
Metribuzin + NIS	3.0 + 0.25% v/v	1-3	54.8	0.98
Metribuzin + NIS	3.0 + 0.25% v/v	8-10	55.0	
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	1.3	61.0	0.80
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	8-10	59.3	
Imazapic + NIS	1.4 + 0.25% v/v	1-3	13.0	0.00
Imazapic + NIS	1.4 + 0.25% v/v	8-10	65.5	
Sulfometuron +NIS	1.125 + 0.25% v/v	1-3	4.5	0.02
Sulfometuron +NIS	1.125 + 0.25% v/v	8-10	54.0	
Sulfosulfuron +NIS	1.125 + 0.25% v/v	1-3	15.3	0.02
Sulfosulfuron +NIS	1.125 + 0.25% v/v	8-10	55.0	
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	1-3	12.0	0.01
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	8-10	53.0	

Compared to the control, all treatments at the 1-3 leaf stage had more stunting of the Sandberg's bluegrass (Table 5). The differences were significant for the following treatments: 0.63 oz/a of propoxycarbazone, propoxycarbazone + nitrogen, imazapic, sulfometuron, sulfosulfuron, glyphosate, and the split application of propoxycarbazone. Stunting was greater than 83% for the following treatments: imazapic, sulfometuron, sulfosulfuron, and glyphosate. Stunting probably occurred in the control because the strong southwest spring winds moved particles of soil among the treatments. The only control plot without any stunting was located on the extreme southwest corner of the treatment block.

Table 5. Percent stunting of Sandberg's bluegrass from herbicide treatments applied at the 1-3 leaf stage in early March 2008.

Treatment	Rate	Stunting	$P\leq0.05$	$P\leq0.10$
	oz ai/a	%		
Propoxycarbazone + NIS	0.42 + 0.25% v/v	52.5	cde	efg
Propoxycarbazone + NIS	0.63 + 0.25% v/v	66.3	bcd	bcde
Propoxycarbazone + NIS	0.85 + 0.25% v/v	56.3	cde	def
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	77.5	abc	abcd
Metribuzin + NIS	3.0 + 0.25% v/v	52.5	cde	efg
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	42.5	de	fg
Imazapic + NIS	1.4 + 0.25% v/v	83.8	ab	abc
Sulfometuron +NIS	1.125 + 0.25% v/v	92.0	a	a
Sulfosulfuron +NIS	1.125 + 0.25% v/v	86.3	ab	abc
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	86.3	ab	ab
Propoxycarbazone and propoxycarbazone +NIS[1]	0.42 + 0.42 + 0.25% v/v	63.8	bcd	cdef
Control		35.0	e	g

[1] This was a split application of propoxycarbazone, with 0.42 oz ai/a applied at the <1 leaf stage and 0.42 oz ai/a applied at the 3-5 leaf stage.

All treatments applied at the 8-10 leaf stage resulted in stunting of the Sandberg's bluegrass (Table 6). Compared to the control, most treatments had stunting within 20 percentage points of that shown by the control plots, and often the difference was much less. The lone exception was the split application of the propoxycarbazone, but the difference was significant only at the $P\leq0.10$ level. The split application of propoxycarbazone also had significantly more stunting than the propoxycarbazone + metribuzin treatment. Among the other treatments, the percent of stunting was not significantly different at either probability level (Table 6).

Table 6. Percent stunting of Sandberg's bluegrass from herbicide treatments applied at the 8-10 leaf stage (mid-April 2008).

Treatment	Rate	Stunting	$P\leq0.05$	$P\leq0.10$
	oz ai/a	%		
Propoxycarbazone and propoxycarbazone +NIS[1]	0.42 + 0.42 + 0.25% v/v	63.8	a	a
Propoxycarbazone + NIS	0.42 + 0.25% v/v	50.0	a	ab
Propoxycarbazone + NIS	0.63 + 0.25% v/v	40.0	a	ab
Propoxycarbazone + NIS	0.85 + 0.25% v/v	37.5	a	ab
Propoxycarbazone + nitrogen (32%)	0.85 + 0.25% v/v	41.3	a	ab
Metribuzin + NIS	3.0 + 0.25% v/v	38.8	a	ab
Propoxycarbazone + metribuzin	0.85 + 3.0 + 0.25% v/v	28.8	a	b
Imazapic + NIS	1.4 + 0.25% v/v	46.3	a	ab
Sulfometuron +NIS	1.125 + 0.25% v/v	53.8	a	ab
Sulfosulfuron +NIS	1.125 + 0.25% v/v	52.5	a	ab
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	45.0	a	ab
Control		35.0	a	b

[1] This was a split application of propoxycarbazone, with 0.42 oz ai/a applied at the <1 leaf stage and 0.42 oz ai/a applied at the 3-5 leaf stage.

The same treatment applied at different leaf growth stages often resulted in large and significantly different amounts of stunting (Table 7). At P≤0.10, there was significantly more stunting for treatments applied at the 1-3 leaf stage, compared to the 8-10 leaf stage, for the following applications: 0.63 or 0.85 oz ai/a of propoxycarbazone, propoxycarbazone and nitrogen, imazapic, sulfometuron, sulfosulfuron, and glyphosate. The difference in the amount of stunting between the two growth stages was often as high 30 to 40%. There was almost no difference in the amount of stunting for the 0.42 oz/a rate of propoxycarbazone, regardless of the growth stage of Sandberg's bluegrass. For the metribuzin and the propoxycarbazone + metribuzin treatments, there was more stunting numerically at the 1-3 leaf stage, but the difference was not statistically significant (Table 7).

Table 7. Percent stunting of Sandberg's bluegrass with herbicide treatments applied at the 1-3 leaf stage and 8-10 leaf stage.

Treatment	Rate	Leaf Stage	Stunting	P-Value
	oz ai/a		%	
Propoxycarbazone + NIS	0.42 + 0.25% v/v	1-3	52.5	0.91
Propoxycarbazone + NIS	0.642+ 0.25% v/v	8-10	50.0	
Propoxycarbazone + NIS	0.63 + 0.25% v/v	1-3	66.3	0.08
Propoxycarbazone + NIS	0.63+ 0.25% v/v	8-10	40.0	
Propoxycarbazone + NIS	0.85 + 0.25% v/v	1-3	56.3	0.03
Propoxycarbazone + NIS	0.85 + 0.25% v/v	8-10	37.5	
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	1-3	77.5	0.05
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	8-10	41.3	
Metribuzin + NIS	3.0 + 0.25% v/v	1-3	52.5	0.38
Metribuzin + NIS	3.0 + 0.25% v/v	8-10	38.8	
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	1.3	42.5	0.17
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	8-10	28.8	
Imazapic + NIS	1.4 + 0.25% v/v	1-3	83.8	0.08
Imazapic + NIS	1.4 + 0.25% v/v	8-10	46.3	
Sulfometuron +NIS	1.125 + 0.25% v/v	1-3	92.0	0.05
Sulfometuron +NIS	1.125 + 0.25% v/v	8-10	53.8	
Sulfosulfuron +NIS	1.125 + 0.25% v/v	1-3	86.3	0.05
Sulfosulfuron +NIS	1.125 + 0.25% v/v	8-10	52.5	
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	1-3	86.3	0.06
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	8-10	45.0	

Different herbicide treatments that may control cheatgrass are likely to have differential effects on residual populations of Sandberg's bluegrass, with respect to the number of plants with seed stalks and percent stunting. Also, applications that occur at the 1-3 leaf stage are likely to have a larger effect than applications at the 8-10 leaf stage. The herbicides most likely to have the largest adverse effect are imazapic, sulfometuron, sulfosulfuron and glyphosate. Adverse impacts decline substantially or are eliminated when applications occur at the 8-10 leaf stage, and presumably at later stages of maturity.

Seeded perennial grass tolerance to various herbicides used for annual grass control. Rob G. Wilson. (University of California Cooperative Extension, 707 Nevada St., Susanville, CA 96130) A plant-back trial evaluated seeded perennial grass tolerance to rimsulfuron, sulfometuron + chlorsulfuron, and imazapic applied in winter 2007. The study was conducted on fallow ground at the Intermountain Research and Extension Center in Tulelake, CA. The experiment was arranged in a split plot with four replications. Sub-plot size was 5 by 20 ft. Herbicides were applied with a CO_2-pressurized backpack sprayer using 11002 XR flat fan nozzles at 20 gal/A on January 20, 2007.

Perennial grasses were seeded using a drill on April 20, 2007 (spring seeding 3 months after herbicide treatment) or August 16, 2007 (fall seeding 7 months after herbicide treatment). The trial was irrigated during grass establishment to assure uniform grass emergence and seedling growth. Irrigation was cut-off after grasses reached the four leaf stage. All plots were hand-weeded to prevent weed competition. The soil was a mucky silty clay loam. Visual perennial grass cover and injury were measured two months after grass seeding. Dry matter yield and average plant height were measured on September 25, 2007 for spring-seeded grasses and on June 11, 2008 for fall-seeded and spring-seeded grasses. Yield was collected using a Carter harvester by harvesting forage from a 3 by 15 ft swath in each plot.

All herbicides reduced spring-seeded perennial grass cover two months after seeding (MAS) compared to the untreated control (Table 1). Herbicides also reduced fall 2007 and spring 2008 grass forage yields for most spring-seeded grass species compared to the untreated control (Table 1). Crested wheatgrass, intermediate wheatgrass, and squirreltail showed the greatest tolerance to imazapic. Intermediate wheatgrass and squirreltail showed the best tolerance to rimsulfuron. Sulfometuron + chlorsulfuron caused unacceptable injury to all spring-seeded grass species.

Delaying seeding until fall increased grass tolerance to all herbicides compared to the spring seeding (Table 1 and Table 2). All fall-seeded grasses showed excellent tolerance to rimsulfuron (Table 2). Given that rimsulfuron injured all spring-seeded grasses, the majority of rimsulfuron soil activity was likely lost during the 4 month period between the spring and fall seeding. Most fall-seeded grasses showed excellent tolerance to imazapic, but imazapic decreased beardless wildrye and smooth brome cover and yield compared to the untreated control (Table 2). Sulfometuron + chlorsulfuron caused a large reduction in fall-seeded grass cover, yield, and height for most species compared to the untreated control.

Table 1. The influence of herbicides[1] on spring-seeded perennial grasses' visual cover, yield, and average plant height.

	Untreated			Rimsulfuron 1.0 oz			Rimsulfuron 2.0 oz			Imazapic			Sulfometuron + chlorsulfuron		
	Cover	Yield[2]		Cover	Yield		Cover	Yield		Cover	Yield		Cover	Yield	
Perennial grasses	2 MAS[3]	F[4]	S[5]	2 MAS	F	S	2 MAS	F	S	2 MAS	F	S	2 MAS	F	S
	-% -	-lb/A -		-% -	-lb/A -		-% -	-lb/A -		-% -	-lb/A -		-% -	-lb/A -	
Crested wheatgrass	38	4902	8706	7	767	2190	2	100	1882	22	2427	6486	2	51	246
Intermediate wheatgrass	80	6247	15366	33	4093	13442	10	1689	7312	30	3786	13176	3	394	1492
Bluebunch wheatgrass	20	1392	5144	6	328	2758	5	124	1114	12	378	3494	0	0	0
Squirreltail	50	4437	7716	37	2644	8362	25	1556	6364	27	1232	6150	1	0	0
Beardless (creeping) wildrye	23	2229	8508	3	364	2400	0	0	0	9	132	2648	0	0	0
Big bluegrass	--[6]	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Idaho fescue	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Smooth brome	72	7183	11368	9	2217	9850	4	558	4094	7	197	4458	0	0	0
LSD $_{(0.05)}$	14	1364	2472	14	1364	2472	14	1364	2472	14	1364	2472	14	1364	2472

[1] Herbicide treatments were applied at the following rates: rimsulfuron at 1.0 oz ai/A, rimsulfuron at 2.0 oz ai/A, imazapic at 1.5 oz ai/A, and sulfometuron at 0.75 oz ai/A + chlorsulfuron at 0.375 oz ai/A. Sulfometuron + chlorsulfuron was applied as the premix (Landmark XP). All treatments included a non-ionic surfactant added at 0.25% v/v.

[2] Yield = 100% dry matter yield

[3] 2 MAS = two months after seeding

[4] F = fall harvest on September 25, 2007

[5] S = spring harvest on June 11, 2008

[6] -- = Big bluegrass and Idaho fescue establishment was poor in all plots. The seed source was replaced for the fall planting.

Table 2. The influence of herbicides[1] on fall-seeded perennial grasses' visual cover, yield, and average plant height.

	Untreated			Rimsulfuron 1.0 oz			Rimsulfuron 2.0 oz			Imazapic			Sulfometuron + chlorsulfuron		
Perennial grasses	Cover 2MAS[3]	Yield[2] 6/30/08	Height 6/30/08	Cover 2MAS	Yield 6/30/08	Height 6/30/08	Cover 2 MAS	Yield 6/30/08	Height 6/30/08	Cover 2 MAS	Yield 6/30/08	Height 6/30/08	Cover 2 MAS	Yield 6/30/08	Height 6/30/08
	-% -	-lb/A -	inches	-% -	-lb/A -	inches	-% -	-lb/A -	inches	-% -	-lb/A -	inches	-% -	-lb/A -	inches
Crested wheatgrass	28	9488	14	30	11014	15	22	10619	14	28	10822	15	6	2844	9
Intermediate wheatgrass	65	18199	17	67	18108	16	65	19876	17	48	16813	17	20	8888	14
Bluebunch wheatgrass	30	6629	12	32	7022	13	27	7279	13	28	5239	12	7	1274	6
Squirreltail	30	4592	7	27	5557	7	25	6084	6	27	4552	6	6	1572	4
Beardless (creeping) wildrye	38	6222	9	38	7255	10	30	5873	11	25	3053	6	5	108	3
Big bluegrass	5	4230	11	3	4183	11	5	4339	11	5	3880	10	2	1939	11
Idaho fescue	2	759	4	1	328	3	1	512	3	2	864	4	0	0	--
Smooth brome	55	12131	15	50	12155	15	38	12513	17	33	7729	16	4	377	4
LSD $_{(0.05)}$	11	2815	3	11	2815	3	11	2815	3	11	2815	3	11	2815	3

[1] Herbicide treatments were applied at the following rates: rimsulfuron at 1.0 oz ai/A, rimsulfuron at 2.0 oz ai/A, imazapic at 1.5 oz ai/A, and sulfometuron at 0.75 oz ai/A + chlorsulfuron at 0.375 oz ai/A. Sulfometuron + chlorsulfuron was applied as the premix (Landmark XP). All treatments included a non-ionic surfactant added at 0.25% v/v.

[2] Yield = 100% dry matter yield

[3] 2 MAS = two months after seeding

Established perennial grass tolerance and downy brome control with rimsulfuron and sulfometuron. Rob G. Wilson. (University of California Cooperative Extension, 707 Nevada St., Susanville, CA 96130) This study examined established perennial grass and shrub tolerance to rimsulfuron and sulfometuron + chlorsulfuron applied in the fall one month after a killing frost. Perennial grasses were established for at least three years prior to herbicide application. The study was conducted within an abandoned dryland perennial grass variety trial infested with downy brome located near Likely, CA. The experiment was arranged in a split plot with three replications. Sub-plot size was 5 by 20 ft.

Herbicides were applied with a CO_2 pressurized backpack sprayer using 11002 XR flat fan nozzles at 20 gal/A. Herbicides were applied on October 25, 2007 when annual grasses were at the one-leaf stage and one inch tall. Perennial grasses and shrubs were going dormant, but many plants still had green tissue. The soil was a cobbly loam. Weed control and injury data were collected on June 30, 2008 when the majority of grasses were flowering. Visual injury ratings were made on a scale of 0 to 100 with 0 equal to no chlorosis or stunting compared to the untreated control and 100 equal to plant death.

Rimsulfuron and sulfometuron + chlorsulfuron gave 98% or better control of downy brome (Table 1). Perennial grasses and shrubs showed greater tolerance to rimsulfuron compared to sulfometuron + chlorsulfuron (Table 2). Rimsulfuron caused ≤ 5% injury to most wheatgrass species, sagebrush, and rabbitbrush and ≤ 20% injury to smooth brome and squirreltail. Rimsulfuron caused the greatest injury (32 to 40%) to Russian and beardless wildrye. Sulfometuron + chlorsulfuron caused > 30% injury to most grasses, but was safe (0% injury) on sagebrush and rabbitbrush. Crested wheatgrass, squirreltail, tall wheatgrass, western wheatgrass, and bluebunch wheatgrass showed the greatest tolerance to sulfometuron + chlorsulfuron. Grass tolerance was not influenced by the rate of sulfometuron + chlorsulfuron.

Table 1. Downy brome control from herbicides on June 30, 2008.

Herbicide treatment[1]	Rate	Downy brome control
	oz ai/A	---------------------------% control---------------------------
Untreated control	----	0
Rimsulfuron + NIS	1.0	99
Sulfometuron + chlorsulfuron + NIS	0.25 + 0.13	98
Sulfometuron + chlorsulfuron + NIS	0.5 + 0.25	100
LSD $_{(0.05)}$		4

[1] Sulfometuron + chlorsulfuron applied as the premix (Landmark XP). NIS = non-ionic surfactant (R-11) added at 0.25% v/v.

Table 2. Injury from herbicides on June 30, 2008.

	Herbicide injury		
	Rimsulfuron + NIS[1]	Sulfometuron + chlorsulfuron + NIS[1]	
Species	1.0 oz ai/A	0.25 + 0.13 oz ai/A	0.5 + 0.25 oz ai/A
	----------------	----% injury----	----------------
'Rosana' western wheatgrass	3	33	42
'Lincoln' smooth brome	13	65	60
'Secar' bluebunch wheatgrass	0	42	45
'Bannock' thickspike wheatgrass	5	55	60
'Hycrest' crested wheatgrass	0	35	25
'Oahe' intermediate wheatgrass	0	62	72
'Luna' pubescent wheatgrass	5	58	48
'Newhy' hybrid wheatgrass	13	67	68
'Alkar' tall wheatgrass	2	35	40
'Shoshone' beardless wildrye	40	72	67
'Sand hollow' squirreltail	20	33	32
'Bozoisky-Sel.' Russian wildrye	32	53	42
Wyoming big sagebrush	0	0	0
Gray rabbitbrush	0	0	0
LSD $_{(0.05)}$	----------------	16	----------------

[1] Sulfometuron + chlorsulfuron applied as the premix (Landmark XP). NIS = non-ionic surfactant (R-11) added at 0.25% v/v

Tolerance of ponderosa pine to aminopyralid applications. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). Experiments were conducted over consecutive years (2007-2008) near Santa, ID to evaluate the tolerance of ponderosa pine to aminopyralid, aminopyralid + clopyralid, and picloram treatments beneath the canopy. In 2007, the study was conducted in an abandoned pasture undergoing ponderosa pine (*Pinus ponderosa* Dougl.) encroachment. Targeted trees ranged between 5 and 12 years of age. A second experiment was conducted in 2008 on seven year old ponderosa pine trees which were planted following harvest in a ponderosa pine/common snowberry community type. In both studies, ten trees were tagged and treated per treatment. Tagged trees were blocked by approximate tree height for the 2007 study and the trees in the 2008 study were similar. All treatments were applied with a single off-center nozzle (OC-06) delivered by a backpack sprayer calibrated to 8.4 gpa in 2007 and 12 gpa in 2008 (Table 1). A 12 by 8 ft swath was sprayed away from the trunk on the north and south side of each tree.

Table 1. Application data.

Application date	May 24, 2007	June 2, 2008
Plant growth stage	5 to 12 years old	7 years old
Air temp (F)	73	54
Relative humidity (%)	35	51
Wind (mph, direction)	3 to 5, NE	1 to 2, SE
Cloud cover (%)	65	80
Soil temp at 2 inches (F)	78	56
Soil type	Helmer silt loam	Helmer silt loam

Injury symptoms were evaluated by observing the development of new candle and needle growth approximately 1, 2 and 12 month after treatment (MAT). Orientation of new terminal and lateral candle growth was ranked according to severity of herbicide injury symptoms: 0 = no symptoms, 1 = twisting of candle is observable, 2 = twisting has resulted in candle oriented horizontally to ground, 3 = twisting has resulted in candle oriented towards ground, 4 = mortality of terminal or lateral bud (Table 2, 4-5). Injury symptoms were evaluated for new needle growth by quantifying the percentage of total branches in which delayed elongation or twisting of new needle growth was observed. In ranking the order of injury symptoms, terminal candle injury was considered the most serious and then lateral injury followed by delayed elongation and finally twisting of needles.

In the 2007 study, tree-age (block) was not significant in analyses of injury symptoms. Injury to terminal and lateral candles was highly variable across treatments and blocks 12 MAT (Table 2). The application of picloram resulted in greater injury to lateral candles than the low rate of aminopyralid and aminopyralid + clopyralid but did not differ in comparison to the high rate of aminopyralid. This trend was similar in the evaluation of terminal buds, but did not statistically differ. No differences were detected in analysis of needle twisting data (Table 3). Delayed elongation was minimal following applications of the low rate of aminopyralid. Delayed elongation following application of picloram and the high rate of aminopyralid was significantly greater than the low rate of aminopyralid. Aminopyralid + clopyralid did not differ in comparison to other treatments.

Table 2. Terminal and lateral candle injury following herbicide treatments beneath ponderosa pine canopies approximately 12 MAT near Santa, ID - Zenner. See 2007 WSWS progress reports for 1 and 2 MAT evaluations.

		Candle injury (Scale 0-4)									
		Terminal					Lateral				
Treatment[1]	Rate	0	1	2	3	4	0	1	2	3	4
	oz ae/A	% frequency									
Aminopyralid	0.75	50	40	0	0	10	60	30	10	0	0
Aminopyralid	1.75	40	30	0	0	30	20	80	0	0	0
Aminopyralid + clopyralid	0.75 + 1.5	60	30	0	0	10	60	40	0	0	0
Picloram	4	10	60	10	0	20	30	30	20	0	20
Untreated check		70	30	0	0	0	100	0	0	0	0

[1] 90% non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments

Table 3. Ponderosa pine injury following herbicide treatments beneath the tree canopy approximately 12 MAT near Santa, ID - Zenner. See 2007 WSWS progress reports for 1 and 2 MAT evaluations.

		Needle injury	
Treatment[1]	Rate	Twisting	Delayed elongation
	oz ae/A	-------- % of total branches --------	
Aminopyralid	0.75	3	2
Aminopyralid	1.75	26	57
Aminopyralid + clopyralid	0.75 + 1.5	15	33
Picloram	4	17	64
Untreated check		0	0
Tukey's Studentized Range HSD (0.05)		32	40

[1] 90% non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments

In the 2008 study, the application of picloram resulted in significantly greater injury to terminal candles 1 and 2 MAT in comparison to other treatments (Table 4). Low and high aminopyralid rates and aminopyralid + clopyralid resulted in minimal terminal candle injury. Lateral candle trends were similar. Picloram treatments resulted in significantly greater injury than other treatments (Table 5). The high rate of aminopyralid resulted in greater lateral injury 2 MAT in comparison to the low rate and aminopyralid + clopyralid. Differences were not detected in analysis of needle twisting after each evaluation (Table 6). At each evaluation, delayed elongation injury was significantly greater following picloram applications in comparison to other treatments. Application of the high rate of aminopyralid resulted in greater delayed elongation in comparison with the low rate and aminopyralid + clopyralid 1 MAT, but did not differ at the 2 MAT evaluation. Compared between 2007 and 2008 studies, treatment results were similar 2 MAT. Picloram treatments resulted in greater injury than the untreated check, aminopyralid at 0.75 oz ae/A, and aminopyralid + clopyralid, but did not differ in comparison to aminopyralid at 1.75 oz ae/A.

Table 4. Terminal candle injury following herbicide treatments beneath ponderosa pine canopies approximately 1 and 2 MAT near Santa, ID - Danielson.

		Terminal candle injury (Scale 0-4)									
		1 MAT					2 MAT				
Treatment[1]	Rate	0	1	2	3	4	0	1	2	3	4
	oz ae/A	----------------------------- % frequency -----------------------------									
Aminopyralid	0.75	90	10	0	0	0	90	10	0	0	0
Aminopyralid	1.75	55	44	0	0	0	70	30	0	0	0
Aminopyralid + clopyralid	0.75 + 1.5	60	40	0	0	0	90	10	0	0	0
Picloram	4	10	80	10	0	0	0	80	20	0	0
Untreated check		100	0	0	0	0	90	10	0	0	0

[1] Month after treatment

[2] 90% non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments

Table 5. Lateral candle injury following herbicide treatments beneath ponderosa pine canopies approximately 1 and 2 MAT near Santa, ID - Danielson.

		Lateral candle injury (Scale 0-4)									
		1 MAT					2 MAT				
Treatment[1]	Rate	0	1	2	3	4	0	1	2	3	4
	oz ae/A	----------------------------- % frequency -----------------------------									
Aminopyralid	0.75	60	40	0	0	0	70	30	0	0	0
Aminopyralid	1.75	33	55	11	0	0	10	90	0	0	0
Aminopyralid + clopyralid	0.75 + 1.5	80	20	0	0	0	80	20	0	0	0
Picloram	4	0	20	80	0	0	0	10	60	30	0
Untreated check		100	0	0	0	0	90	10	0	0	0

[1] Month after treatment

[2] 90% non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments

Table 6. Ponderosa pine injury following herbicide treatments beneath the tree canopy approximately 1 and 2 MAT near Santa, ID – Danielson.

		Needle injury			
		1 MAT		2 MAT	
Treatment[1]	Rate	Twisting	Delayed elongation	Twisting	Delayed elongation
	oz ae/A	---------------------% of total branches---------------------			
Aminopyralid	0.75	32	13	20	4
Aminopyralid	1.75	61	61	41	21
Aminopyralid + clopyralid	0.75 + 1.5	35	16	27	12
Picloram	4	38	100	25	100
Untreated check		0	0	0	0
Tukey's Studentized Range HSD(0.05)		42	28	41	25

[1] Month after treatment

[2] 90% non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments

Response of crested wheatgrass seedlings to six herbicides applied in the spring. Brad W. Schultz and Earl Creech. (University of Nevada Cooperative Extension, Winnemucca, NV 89445). On many low-elevation sagebrush rangelands cheatgrass becomes abundant following wildfires. Crested wheatgrass (*Agropyron* sp.) is often seeded on sites without a perennial herbaceous understory, but competition from cheatgrass can limit its establishment. Chemical control of cheatgrass is possible, but the effect of many herbicides on emerging or recently emerged seedlings of crested wheatgrass is largely unknown. Following a large wildfire in July 2007, three varieties of crested wheatgrass (Kirk, Hycrest and Nordan) were mixed and seeded in early December 2007. Six herbicides (glyphosate, imazapic, metribuzin, propoxycarbazone, sulfometuron, and sulfosulfuron) were applied to the seeded area on either March 4, 2008 (pre-emergent to one leaf stage) or on April 17, 2008 (3-5 leaf stage). Ammonium sulfate (AMS) was mixed with the glyphosate treatment and the non-ionic surfactant (NIS), Activator 90, was mixed with the other herbicide treatments. Each herbicide treatment was applied with a CO_2 pressurized back-pack sprayer to individual plots measuring 10 x 30 ft. Treatments were arranged in a randomized complete block with four replications. Table 1 describes weather and soil conditions at the time of application and the post-application precipitation pattern. Also, the March through June period had six wind events that exceeded 50 mph, resulting in substantial movement of soil surface particles.

Table 1. Growing conditions at the time of herbicide application and subsequent precipitation patterns.

Parameter	**Pre-emergent to one leaf stage (March 4, 2008)**	**3-5 leaf stage (April 17, 2008)**
Time of application	10:30 A	4:00 P
Air temperature	42°F	67°F
Relative humidity	25%	20%
Wind speed and direction	10 mph from NW	1 mph from SW
Soil temperature	35°F	64°F
Soil moisture	Moist below surface	Dry throughout profile
Cloud cover	None	None
Soil type	Silt loam	Silt loam
Bluegrass height	< 1 inch	3 inches
Precipitation[1]	0.21 inches on March 14	0.20 inches on April 20

[1] March 1- May 20th precipitation was less than 0.63 inches (33% of average). May 20th to June 4th precipitation was 1.44 inches.

In each treatment plot, we established a 3 x 30 ft belt transect down the middle of the plot. We assessed the short-term effect of each treatment on crested wheatgrass seedlings by counting the total number of seedlings in each belt transect and measuring seedling height on up to ten seedlings. For seedling height, we selected the seedlings closest to the center of the belt transect. Field data were collected in early July 2008. Means were calculated for each treatment and transformed (square root) to equalize variances. A one-way analysis of variance was used to compare means for each application date, respectively. LSD mean separation was applied and is reported at two levels, $P \leq 0.05$ and 0.10. A two sample t-test was used to compare treatments between growth stages. Actual p-values are reported.

When applied on March 4, 2008, glyphosate did not eliminate most crested wheatgrass seedlings (Table 2). This suggests the early March application was largely at the pre-emergent growth phase. There were large differences among many treatments for seedling density, and between numerous treatments and the control, for applications on March 4th (Table 2). Compared to the control, treatment with metribuzin (alone or with propoxycarbazone), imazapic, and sulfometuron resulted in significantly fewer seedlings. Propoxycarbazone by itself did not result in significantly fewer seedlings than the control when applied on March 4th, regardless of the rate used. A split application of propoxycarbazone across both application dates, however, resulted in substantially fewer seedlings than the control or the highest rate applied only on March 4th. The difference between the means was significant (Table 2).

Treatments applied when seedlings were largely in the 3-5 leaf stage (April 17, 2008) resulted in a wide range of seedling densities, compared to the control (Table 3). The following treatments all resulted in at least 60 percent fewer seedlings: propoxycarbazone + nitrogen, metribuzin, propoxycarbazone + metribuzin, imazapic and sulfometuron. Differences for all treatments, except metribuzin, were significant at $P \leq 0.10$ (Table 3). Propoxycarbazone alone, regardless of rate did not result in substantially fewer crested wheatgrass seedlings. Adding nitrogen to the high rate of propoxycarbazone appears to dramatically increase the mortality of crested wheatgrass seedlings. The difference was significant ($P \leq 0.05$) compared to the low rate of propoxycarbazone. The glyphosate treatment averaged over eight seedlings per plot, which suggests additional germination occurred after the treatments were applied.

Table 2. Mean crested wheatgrass seedling density by herbicide treatment in plots after treatment at the pre-emergent to single leaf growth stage (March 4, 2008).

Treatment	**Rate**	**Seedling density**	**$P \leq 0.05$**	**$P \leq 0.10$**
	oz ai/a	#/90 ft^2		
Propoxycarbazone + NIS	0.42 + 0.25% v/v	16.0	bc	bcd
Propoxycarbazone + NIS	0.63 + 0.25% v/v	18.5	abc	bc
Propoxycarbazone + NIS	0.85 + 0.25% v/v	24.5	ab	ab
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	15.5	bc	bcd
Metribuzin + NIS	3.0 + 0.25% v/v	5.8	c	d
Propoxycarbazone +metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	5.8	c	d
Imazapic + NIS	1.4 + 0.25% v/v	0.5	d	e
Sulfometuron +NIS	1.125 + 0.25% v/v	0.3	d	e
Sulfosulfuron +NIS	1.125 + 0.25% v/v	34.5	a	a
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	16.8	abc	bc
Propoxycarbazone and propoxycarbazone +NIS[1]	0.42 + 0.42 + 0.25% v/v	11.0	c	cd
Control		24.8	ab	ab

[1] This was a split application of propoxycarbazone, with 0.42 oz ai/a applied at the <1 leaf stage and 0.42 oz ai/a applied at the 3-5 leaf stage.

Table 3. Mean crested wheatgrass seedling density by herbicide treatment in plots after treatment at the 3-5 leaf growth stage (April 17, 2008).

Treatment	**Rate**	**Seedling density**	**$P \leq 0.05$**	**$P \leq 0.10$**
	oz ai/a	#/90 ft^2		
Propoxycarbazone and propoxycarbazone +NIS[1]	0.42 + 0.42 + 0.25% v/v	11.0	abcd	bcd
Propoxycarbazone + NIS	0.42 + 0.25% v/v	32.3	a	a
Propoxycarbazone + NIS	0.63 + 0.25% v/v	21.5	abc	abc
Propoxycarbazone + NIS	0.85 + 0.25% v/v	19.3	abc	abc
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	6.8	bcd	cde
Metribuzin + NIS	3.0 + 0.25% v/v	9.3	abcd	bcd
Propoxycarbazone + metribuzin +NIS	0.85 + 3.0 + 0.25% v/v	9.0	cd	cde
Imazapic + NIS	1.4 + 0.25% v/v	1.0	d	e
Sulfometuron +NIS	1.125 + 0.25% v/v	2.5	d	de
Sulfosulfuron +NIS	1.125 + 0.25% v/v	28.5	ab	ab
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	8.5	abcd	bcd
Control		24.8	abc	ab

[1] This was a split application of propoxycarbazone, with 0.42 oz ai/a applied at the <1 leaf stage and 0.42 oz ai/a applied at the 3-5 leaf stage. This treatment is the same in all of the following tables.

The respective herbicide treatments generally had similar results at both growth stages (Table 4). There were no statistical differences ($P \leq 0.10$) based on growth stage. The large relative difference in the propoxycarbazone + nitrogen treatment, however, suggests that the addition of nitrogen in the 3-5 leaf stage will further reduce crested wheatgrass seedling density.

Table 4. Comparison of mean crested wheatgrass seedling density by herbicide treatment at two different growth stages.

Treatment	**Rate**	**Seedling leaf stage**	**Seedling density**	**P-Value**
	oz ai/a		#/90 ft^2	
Propoxycarbazone + NIS	0.42 + 0.25% v/v	<1 leaf	16.0	0.38
Propoxycarbazone + NIS	0.42 + 0.25% v/v	3-5	32.3	
Propoxycarbazone + NIS	0.63 + 0.25% v/v	<1 leaf	18.5	0.99
Propoxycarbazone + NIS	0.63 + 0.25% v/v	3-5	21.5	
Propoxycarbazone + NIS	0.85 + 0.25% v/v	<1 leaf	24.5	0.51
Propoxycarbazone + NIS	0.85 + 0.25% v/v	3-5	19.3	
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	<1 leaf	15.5	0.19
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	3-5	6.8	
Metribuzin + NIS	3.0 + 0.25% v/v	<1 leaf	5.8	0.27
Metribuzin + NIS	3.0 + 0.25% v/v	3-5	9.3	
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	1.3	5.8	0.97
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	3-5	9.0	
Imazapic + NIS	1.4 + 0.25% v/v	<1 leaf	0.5	0.57
Imazapic + NIS	1.4 + 0.25% v/v	3-5	1.0	
Sulfometuron +NIS	1.125 + 0.25% v/v	<1 leaf	0.3	0.38
Sulfometuron +NIS	1.125 + 0.25% v/v	3-5	2.5	
Sulfosulfuron +NIS	1.125 + 0.25% v/v	<1 leaf	34.5	0.55
Sulfosulfuron +NIS	1.125 + 0.25% v/v	3-5	28.5	
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	<1 leaf	16.8	0.12
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	3-5	8.5	

Mean seedling height was shorter than the control for all treatments applied at the pre-emergent to one-leaf growth stage (Table 5). The difference between the treatments and the control was significant ($P<0.05$) for all rates of propoxycarbazone, propoxycarbazone + nitrogen, imazapic, sulfometuron, and the split application of propoxycarbazone. Treatments with imazapic and especially sulfometuron resulted in exceptionally large reductions in height. The similar height between the glyphosate treatment and the control reflects a pre-emergence application. Metribuzin and sulfosulfuron appear to have little if any effect on crested wheatgrass seedlings when applied at the pre-emergent to one-leaf stage.

Table 5. Mean height of crested wheatgrass seedlings by herbicide treatment applied at the pre-emergent to one leaf leaf growth stage (March 4, 2008).

Treatment	**Rate**	**Mean height**	**$P\leq0.05$**	**$P\leq0.10$**
	oz ai/a	inches		
Propoxycarbazone + NIS	0.42 + 0.25% v/v	3.0	bc	bc
Propoxycarbazone + NIS	0.63 + 0.25% v/v	2.8	bc	c
Propoxycarbazone + NIS	0.85 + 0.25% v/v	3.1	bc	bc
Propoxycarbazone +NIS + nitrogen (32%)	0.85 + 0.25% v/v	3.1	bc	bc
Metribuzin + NIS	3.0 + 0.25% v/v	4.0	abc	abc
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	3.4	abc	bc
Imazapic + NIS	1.4 + 0.25% v/v	1.1	d	d
Sulfometuron +NIS	1.125 + 0.25% v/v	0.3	e	e
Sulfosulfuron +NIS	1.125 + 0.25% v/v	4.3	abc	ab
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	4.5	ab	ab
Propoxycarbazone and propoxycarbazone +NIS[1]	0.42 + 0.42 + 0.25% v/v	2.7	c	c
Control		5.1	a	a

[1] This was a split application of propoxycarbazone, with 0.42 oz ai/a applied at the <1 leaf stage and 0.42 oz ai/a applied at the 3-5 leaf stage. This treatment is the same in all of the following tables.

Most of the treatments resulted in shorter seedlings than the control when applied at the 3-5 leaf stage (Table 6). The lone exception was metribuzin, which had a mean height almost one-half inch taller than the control. Differences between the means for the treatment and control were significant ($P<0.10$) for the split application of propoxycarbazone, the high rate of propoxycarbazone, propoxycarbazone + nitrogen, propoxycarbazone + metribuzin, imazapic and sulfometuron (Table 6). Sulfometuron had substantially shorter seedlings than all treatments.

Table 6. Mean height of crested wheatgrass seedlings by herbicide treatment applied at the 3-5 leaf growth stage (April 17, 2008).

Treatment	**Rate**	**Mean height**	**$P\leq0.05$**	**$P\leq0.10$**
	oz ai/a	inches		
Propoxycarbazone and propoxycarbazone +NIS[1]	0.42 + 0.42 + 0.25% v/v	2.7	bcd	bcd
Propoxycarbazone + NIS	0.42 + 0.25% v/v	4.0	abc	abc
Propoxycarbazone + NIS	0.63 + 0.25% v/v	3.8	abc	abc
Propoxycarbazone + NIS	0.85 + 0.25% v/v	2.5	cd	cd
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	2.9	bcd	bcd
Metribuzin + NIS	3.0 + 0.25% v/v	5.5	a	a
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	2.3	de	de
Imazapic + NIS	1.4 + 0.25% v/v	2.3	cde	cd
Sulfometuron +NIS	1.125 + 0.25% v/v	1.6	e	e
Sulfosulfuron +NIS	1.125 + 0.25% v/v	3.9	abc	abc
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	4.6	abc	ab
Control		5.1	ab	a

[1] This was a split application of propoxycarbazone, with 0.42 oz ai/a applied at the <1 leaf stage and 0.42 oz ai/a applied at the 3-5 leaf stage. This treatment is the same in all of the following tables.

There majority of treatments (6 of 10) applied at the 3-5 leaf stage resulted in taller seedlings, compared to treatment at the pre-emergent to single leaf stage (Table 7). The late applications of imazapic and sulfometuron resulted in seedlings over twice as tall as their early applications, but their heights were still shorter than any other treatment.

Table 7. Comparison of the mean height of crested wheatgrass seedlings following application of the same herbicide treatment at two growth stages (pre-emergent to one leaf and 3-5 leaf) in 2008.

Treatment	Rate	Leaf Growth Stage	Height	P-Value
	oz ai/a		inches	
Propoxycarbazone + NIS	0.42 + 0.25% v/v	<1 leaf	3.0	0.21
Propoxycarbazone + NIS	0.42+ 0.25% v/v	3-5	4.0	
Propoxycarbazone + NIS	0.63 + 0.25% v/v	<1 leaf	2.8	0.21
Propoxycarbazone + NIS	0.63 + 0.25% v/v	3-5	3.8	
Propoxycarbazone + NIS	0.85 + 0.25% v/v	<1 leaf	3.1	0.19
Propoxycarbazone + NIS	0.85 + 0.25% v/v	3-5	2.5	
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	<1 leaf	3.1	0.64
Propoxycarbazone + NIS + nitrogen (32%)	0.85 + 0.25% v/v	3-5	2.9	
Metribuzin + NIS	3.0 + 0.25% v/v	<1 leaf	4.0	0.07
Metribuzin + NIS	3.0 + 0.25% v/v	3-5	5.5	
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	1.3	3.4	0.27
Propoxycarbazone + metribuzin + NIS	0.85 + 3.0 + 0.25% v/v	3-5	2.3	
Imazapic + NIS	1.4 + 0.25% v/v	<1 leaf	1.1	0.17
Imazapic + NIS	1.4 + 0.25% v/v	3-5	2.3	
Sulfometuron +NIS	1.125 + 0.25% v/v	<1 leaf	0.3	0.31
Sulfometuron +NIS	1.125 + 0.25% v/v	3-5	1.6	
Sulfosulfuron +NIS	1.125 + 0.25% v/v	<1 leaf	4.3	0.52
Sulfosulfuron +NIS	1.125 + 0.25% v/v	3-5	3.9	
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	<1 leaf	4.5	0.94
Glyphosate + AMS	6 oz ae/a + 1.25% v/v	3-5	4.6	

Sulfosulfuron generally had has less effect on crested wheatgrass seedling density or height than the other treatments, when treated from the pre-emergent to 3-5 leaf stage. Compared to the control, crested wheatgrass seedling density was dramatically lower for treatments with metribuzin, imazapic or sulfometuron, regardless of the growth stage. The later treatment appeared to have a slightly less adverse effect. Propoxycarbazone treatments generally affected seedling height more than seedling density. Imazapic and sulfometuron result in the fewest and shortest seedlings for treatments applied at the 3-5 leaf stage or earlier. Metribuzin's small effect on height with a pre-emergent application is meaningless because of the significant ($P<0.05$) reduction in density.

Stand establishment of one non-native and four native grasses from the application of soil applied herbicides.

Richard N. Arnold, Michael K. O'Neill and Kevin A. Lombard. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on April 8, 2008 at the Agricultural Science Center, Farmington, New Mexico to evaluate the establishment of one non-native and four native grasses to soil applied herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a split plot with rangeland grasses as whole plots and herbicide treatments as sub-plots. Individual plots were 10 by 30 ft in size. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on April 14 and immediately incorporated with 0.75 in of sprinkler applied water. Plots were evaluated for percent stand establishment on July 21.

Clopyralid applied at 0.5 lb ai/A had 93 percent or better stand establishment of Arriba Western Wheatgrass, San Luis Slender Wheatgrass, Bottle Brush Squirreltail HyCrest Crested Wheatgrass and Rimrock Indian Ricegrass. Aminopyralid applied at 0.079 lb ai/A showed 90 percent or better stand establishment of Arriba Western Wheatgrass and Rimrock Indian Ricegrass. Picloram and aminocyclopyrachlor applied at 0.5 and 0.125 lb ai/A gave 25 percent of less stand establishment of Arriba Western Wheatgrass, San Luis Slender Wheatgrass, Bottlebrush Squirreltail and HyCrest Crested Wheatgrass.

Table. Percent stand establishment of one non-native and four native grasses from the application of soil applied herbicides.

		Stand establishment[2]				
Treatments	Rate	AWW[1]	SLSW[1]	BBST[1]	HCCW[1]	RRIR[1]
	lb ai/A	%				
Aminopyralid	0.079	90	55	40	13	93
Aminopyralid	0.11	80	12	18	5	15
Clopyralid	0.5	100	93	95	97	97
Picloram	0.5	25	8	8	12	67
Aminocyclopyrachlor	0.125	10	4	4	4	67
Untreated		100	100	100	100	100

[1] AWW, SLSW, BBST, HCCW, and RRIR equal Arriba Western Wheatgrass, San Luis Slender Wheatgrass, Bottlebrush Squirreltail, HyCrest Crested Wheatgrass, and Rimrock Indian Ricegrass.

[2] Stand establishment based on a scale from 0 to 100 with 0 being no grass and 100 being fully established.

Evaluation of bispyribac-sodium for *Poa annua* control in turf. Kai Umeda. (University of Arizona, Maricopa County Cooperative Extension, Phoenix, AZ 85040) Two small plot experiments were conducted at Paradise Valley Country Club in Paradise Valley, AZ and Arizona Biltmore Country Club in Phoenix, AZ. Both sites were in rough areas on the golf courses on perennial ryegrass overseeded into bermudagrass. At Paradise Valley CC (Table 1), the individual plots measured 5 ft by 8 ft and were replicated three times in a randomized complete block design. At the Biltmore CC (Table 2), in a similar design, individual plots measured 5 ft by 15 ft. All treatments were applied using a backpack CO_2 sprayer equipped with a hand-held boom with three 8003LP flat-fan nozzles spaced 20 inches apart. Sprays were made in approximately 50 gpa water pressurized to 25 psi. At Paradise Valley CC, initial applications were made on 29 January 2008 when the air temperature was 56°F, clear sky, and no wind with *P. annua* initiating seedhead formation. Repeat applications of the same treatments were made on 12 February at 2 weeks after the first application when the temperature was 68°F with a very slight breeze. At Biltmore CC, the single application of treatments was made on 12 February with temperature at 76°F, clear sky, and very slight breeze with *P. annua* flowering. Bispyribac-sodium at 0.044 lb a.i./A provided *P. annua* control better than at 0.022 lb a.i./A. Bispyribac-sodium at 0.044 or 0.066 lb a.i./A offered similar *P. annua* control with a single application. Bispyribac-sodium at 0.044 lb a.i./A with the addition of non-ionic surfactant Latron CS-7 or trinexapac-ethyl, *P. annua* control was almost similar to that of ethofumesate at 80%. Bispyribac-sodium at 0.022 lb a.i./A combinations or at 0.044 lb a.i./A without additives gave less than 75% control.

Table 1. Bispyribac-sodium herbicide combinations for *Poa annua* control, Paradise Valley CC, AZ

Treatment	Rate	POANN control		
		06 Mar	20 Mar	10 Apr
	lb a.i./A	%		
Untreated check		0	0	0
Bispyribac-sodium[1]	0.044	63	65	38
Bispyribac-sodium + NIS[1]	0.022 + 0.25% v/v	57	55	60
Bispyribac-sodium + NIS	0.044 + 0.25% v/v	77	82	75
Trinexapac-ethyl	0.04	0	0	0
Bispyribac-sodium + Trinexapac-ethyl	0.022 + 0.02	72	68	55
Bispyribac-sodium + Trinexapac-ethyl	0.022 + 0.04	75	70	70
Bispyribac-sodium + Trinexapac-ethyl	0.044 + 0.04	78	83	80
Ethofumesate	1.0	80	83	63
LSD (p=0.05)		12.9	22.0	38.1

[1] NIS = non-ionic surfactant (Latron CS-7). Applications made on 29 January and 12 February 2008.

Table 2. Comparison of bispyribac-sodium rates for *Poa annua* control in turf, Biltmore GC, AZ

Treatment[1]	Rate	POANN control			
		26 Feb	06 Mar	20 Mar	10 Apr
	lb a.i./A	%			
Untreated check		0	0	0	0
Paclobutrazol	0.16	0	30	10	0
Trinexapac-ethyl	0.04	17	0	0	0
Bispyribac-sodium	0.022	47	50	35	35
Bispyribac-sodium	0.044	57	85	80	73
Bispyribac-sodium	0.066	57	88	85	80
LSD (p=0.05)		22.9	19.6	17.0	13.5

[1] Single application made on 12 February 2008. All treatments included Latron CS-7 @ 0.25% v/v.

Evaluation of rimsulfuron for pre-emergence weed control in Marion blackberries. Diane Kaufman and Jason Harpole. (North Willamette Research and Extension Center, Oregon State University, 15210 NE Miley Rd, Aurora, OR 97002) A field trial was established at the North Willamette Research and Extension Center (NWREC) in a five-year old planting of 'Marion' blackberry to evaluate the effects of timing of rimsulfuron application on plant growth, vigor, and yield. Pre-emergence herbicides were applied using a CO_2 backpack sprayer equipped with a 3-nozzle boom (TeeJet 8002 flat fan nozzles) at 40 psi and a rate of 50 gallons of water per acre. Primocane burn-back sprays were applied with a single nozzle boom (TeeJet 8002 flat fan, 40 psi, at a rate of 100 gallons of water per acre) directed at emerging primocanes.

Plots six feet wide by 30 feet long (5 plants/plot) were arranged in a randomized complete block design with four replications. Treatments were applied on March 21, 2007 and March 18, 2008 (early = prior to primocane emergence) and April 10, 2007 and May 10, 2008 (late = after primocanes had begun to emerge). The 2008 rimsulfuron late treatment was delayed until May due to abnormally cold temperatures in spring, 2008. Treatments consisted of a single rate of rimsulfuron compared to an industry standard application of diuron plus napropamide. In 2007, an additional treatment of diuron plus napropamide followed by two applications of carfentrazone-ethyl for the purpose of burning back the first two flushes of primocanes was included. Plants were monitored for primocane growth during the summers of 2007 and 2008, with final cane measurements recorded prior to training in mid-August, 2007 and in early October, 2008, prior to removing the planting. Although there were no signs of phytotoxicity from the early application of rimsulfuron in 2007 or 2008, or the late rimsulfuron application in 2007, the unusually late application of rimuslfuron in 2008 resulted in a yellowing of leaf margins on sprayed primocanes, which continued to be visible until mid-June, 2008.

Table 1 Primocane growth measured in August, 2007 and October, 2008.

Treatment	Rate	Number of primocanes/palnt	Number of primocanes/plant	Ave primocane height	Ave primocane height
	lb ai/A	8/20/07	10/1/08	feet 8/20/07	feet 10/1/08
Rimsulfuron 3/21/07; 3/18/08	0.0312	7.15	7.73	17.70	17.77
Rimsulfuron 4/10/07; 5/10/08	0.0312	6.89	10.13	17.31	15.02
Diuron+ naprop 3/21/07	2.0 + 2.0	9.60	_____	10.31	_____
carfentrazone-ethyl 4/10/07 and 4/26/07	0.1				
Diuron + naprop 3/21/07; 3/18/08	2.0 + 2.0	7.02	9.47	16.71	18.36
LSD (0.05)		1.79	1.45	3.38	2.63

There were no differences in number of primocanes per plant as a result of pre-emergence herbicide or timing of rimsulfuron application in 2007. However, an early pre-emergence application of diuron plus napropamide, followed by chemical burn-back of the first two flushes of primocanes in 2007, resulted in more primocanes per plant. Number of primocanes per plant remained fairly consistent in 2007 and 2008 in plots treated with an early application of rimsulfuron. However, the number of primocanes per plant increased in 2008 in the rimsulfuron late and diuron plus napropamide treatments, resulting in more primocanes per plant in 2008 than the rimsulfuron early treatment. Average primocane height was not affected by pre-emergence herbicide or rimsulfuron timing in 2007. However, chemical burn-back of the first two flushes of primocanes in 2007 resulted in shorter primocanes. The much delayed pre-emergence application of rimsulfuron in 2008 resulted in shorter primocanes than the rimsulfuron early or diuron plus napropamide treatments. Cane growth data from 2008 marked the fourth year of rimsulfuron application to Marion blackberry plants with no deleterious effect on subsequent primocane growth.

Yield data was collected over three picks in July, 2008. Fruit was hand-harvested from a 6-foot length of row per plot. Yields tended to be lower than usual due to abnormally cold spring temperatures resulting in poorer pollination than usual.

Table 2. Yield data from plants treated the previous spring (2007)

Treatment	Rate	Total yield	Average fruit size
	lb ai/A	grams	grams
Rimsulfuron early	0.0312	5,830	4.95
Rimsulfuron late	0.0312	5,853	4.85
Diuron + napropamide	2.0 + 2.0	6,413	4.96
followed by carfentrazone-ethyl	0.1		
Diuron + napropamide	2.0 + 2.0	5,150	4.96
Significance		ns	ns

Total yield and average fruit size were similar across treatments. Even though chemical primocane suppression resulted in more and shorter primocanes than other treatments in 2007, it did not result in significantly more yield in 2008. Spring, 2007 marked the third year of experimental application of rimsulfuron to Marion blackberry plots with no harmful effect on yield.

Weed control was excellent (90 – 100%) in all treatments through mid-August in 2007 and 2008 (data not shown).

A survey of weeds in Utah tart cherry orchards. Corey V. Ransom, Brent L. Black, and Ralph E. Whitesides (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) During the summer of 2007, surveys were conducted in three tart cherry orchards. The surveys were conducted in orchards located in Utah County. Within each orchard, three tart cherry blocks of varying ages were sampled. The blocks were newly established (4 years old), moderate in age (12-15 years old), or old (>25 years old). Within each block transects were run between and within tree rows. A total of twelve transects were established in each block. The transects were 160 feet long and every 20 feet a yardstick was placed perpendicular to the transect and used to determine the relative abundance of plant species. Marks were placed on the yardstick at 3 inch intervals, and the vegetation intersected by each point on the yardstick was recorded by species. This technique documents the relative abundance of each species as a percent of ground cover. Additionally, all the weed species observed to be present within the sample areas were recorded. Many of the weeds recorded as present within the sampled area were not present in high enough numbers to be sampled in the actual transect. Forty-six weed species were present in the orchards that were sampled (Table 1). Two of the perennial broadleaf weeds identified in the survey, field bindweed and hoary cress are on the State of Utah noxious weed list. In general, field bindweed and dandelion were among the most abundant weeds in the orchards surveyed (Table 2). Tree rows were relatively weed-free with soil comprising 55 to 97% of the sampled area. Other than field bindweed accounting for 22% of the cover in the newly established block at Orchard 2, and grass weeds comprising 33% of the cover in the old block at Orchard 3, abundance of any particular weed within the tree row was less than 10%. The relatively low abundance of weeds and the varied species present within the tree row where herbicides are applied would suggest that weed populations have not developed resistance to the herbicides that are used, but are the result of incomplete herbicide coverage or infrequent herbicide application. An interesting observation is that a number of weeds appeared to be growing in the interface between the herbicide treated tree row and the untreated grass alleyway. This area may be susceptible to weed invasion because it receives some herbicide application, which controls the desirable grasses, but is not treated consistently enough to prevent weed growth. This area was not sampled and may warrant further investigation.

Table 1. Weeds present in a survey of Utah tart cherry orchards, 2007.

Weed species detected in abundance

Alfalfa
Annual sowthistle
Barnyardgrass
Field bindweed
Black medic
Prostrate vervain
Broadleaf dock
Buckhorn plantain
Bulbous bluegrass
Common mallow
Common dandelion
Downy brome
Redstem filaree
Foxtail barley
Green foxtail
Hare barley
Hoary cress
Jointed goatgrass
Kochia
Lambsquarters
Panicle willowweed
Prickly lettuce
Prostrate knotweed
Puncturevine
Redroot pigweed
Shepherdspurse
Smooth groundcherry
Western salsify
Wild buckwheat
Wild oats
Yellow foxtail

Weed species present but densities too low to detect in transects

Annual bluegrass
Annual sunflower
Asparagus
Bull thistle
Burdock
Curly dock
Dodder
Field horsetail
Houndstongue
Musk thistle
Poverty sumpweed
Russian thistle
Showy milkweed

Table 2. Relative abundance of desirable and weedy plants within and between tree rows in Utah tart cherry orchard blocks established for approximately 4, 12, or 25 years, 2007.

	Relative species abundance								
	Orchard 1			Orchard 2			Orchard 3		
Species or soil	4 yr	12 yr	25 yr	4 yr	12 yr	25 yr	4 yr	12 yr	25 yr
	---% cover---								
	Between tree row sampling								
Desirable grasses	47	72	8	20	49	72	1	7	27
Field bindweed	37	4	41	20	9	3	44	68	60
Dandelion	1	11	2	48	41	24	0	9	6
Soil	10	1	4	0	0	0	21	11	3
Grass weeds	2	12	40	6	0.3	0	1	1	1
Broadleaf weed	1	1	5	5	1	2	33	5	4
	Within tree row sampling								
Soil	86	87	90	64	92	97	92	96	55
Field bindweed	9	1	7	22	2	0	5	2	4
Dandelion	0	2	0	5	2	3	0	1	3
Grass weeds	2	9	2	3	3	0	2	0	33
Broadleaf weeds	3	2	1	6	1	1	2	2	6

Cucurbit tolerance to fomesafen and other herbicides. Ed Peachey and Doug Doohan. (Horticulture Department, Oregon State University, Corvallis; Department of Horticulture & Crop Science, and Ohio State University, OARDC, Wooster) This study determined the tolerance of cucurbits to fomesafen herbicide and potential tankmix combinations. The experimental design was a split plot with main effects of cucurbit crop and herbicide treatment with 4 replications in each block. Processing squash (var. golden delicious) was planted with a John Deere max emerge on May 14, 2008 in 2 paired rows on a 2.5 ft row spacing in 30 foot long plots. Zucchini and cucumber were planted on May 15 with belt planters. Zucchini (var. Tigress) had one row per plot. The cucumber varieties Speedway and Muncher were planted in two adjacent 5 ft rows in each plot. Preemergence herbicides were applied in a 6.6 foot band over the 30 foot long plots on May 16 using a backpack CO_2 sprayer set at 25 PSI and delivering 20 GPA through 4-XR8003 nozzles. Plots were 30 ft long and separated by a 15' fallow strip. Crop injury was evaluated at 4 and 7 weeks after planting (WAP), and weed control at 5 WAP and at harvest.

Cucumber emergence was extremely low, probably because of the 4 weeks of unseasonably cool and wet weather after planting. Cucumbers were not harvested because of the very weak stand. Crop growth at 4 WAP was reduced 18 and 24% by fomesafen herbicide at the 1 and 2.5 pts/A rates, respectively (Table 1). Cucumbers were more tolerant to s-metolachlor than fomesafen. Weed control was good to exceptional with fomesafen, and far surpassed the control provided by s-metolachlor or halosulfuron (Tables 3 and 4).

Zucchini emergence, growth and yield were reduced by fomesafen at 2.5 pts/A (Table 2). Yield was greatest with s-metolachlor and fomesafen at 1 pt/A. Halosulfuron did not control hairy nightshade adequately and yield was low in halosulfuron plots because of weed competition (Table 3).

Processing squash was the most tolerant of the 3 cucurbit crops to fomesafen (Table 3). Very little crop injury was noted with fomesafen alone (at both rates) or when tankmixed with s-metolachlor and dimethenamid-P. Yield was greatest with fomesafen plus dimethenamid-P and weed control exceptional (Table 4). Weed control explained 90% of the squash yield variability.

Weed control. Hairy nightshade control with fomesafen herbicide was very good compared to s-metolachlor and halosulfuron. Fomesafen at 1 pt/A did not adequately control lambsquarters in plots with extremely high densities.

Table 1. Cucumber tolerance to herbicides.

	Treatment	Form	Rates	Product rates	Timing	Emergence	Phyto 4 WAT	Stunting 4 WAT	Stunting 7 WAT
			lbs ai/A			*no./plot*	*0-10*	%	%
1	Weedy control	- -	-	- -	-	7	0	0	8
2	Clomazone +	3 ME	0.21	0.56 PT/A	PRE	8	1	3	1
	Ethalfluralin	3 EC	0.70	1.87 PT/A	PRE				
3	S-Metolachlor	7.64 L	0.955	1 PT/A	PRE	8	0	3	1
4	S-Metolachlor	7.64 L	1.91	2 PT/A	PRE	6	1	6	5
5	Fomesafen	2 L	0.25	1 PT/A	PRE	6	3	18	6
6	Fomesafen	2 L	0.63	2.5 PT/A	PRE	2	4	24	59
7	Fomesafen +	2 L	0.31	1.25 PT/A	PRE	5	2	21	29
	S-Metolachlor	7.64 L	0.72	0.75 PT/A	PRE				
8	Halosulfuron	75% DF	0.031	0.66 OZ/A	PRE	9	0	0	1
9	Halosulfuron +	75% DF	0.031	0.66 OZ/A	PRE	7	0	0	0
	Strategy[1]	2.1 L	0.92	3.5 PT/A	PRE				
10	Halosulfuron +	75% DF	0.031	0.66 OZ/A	PRE	8	0	0	4
	Strategy	2.1 L	0.92	3.5 PT/A	POST				
11	Hand-weeded	-	-	-	-	7	0	0	0
12	Fomesafen +	2	0.25	1 PT/A	PRE	4	1	11	16
	Dimethenamid-P	6	0.66	14 OZ/A	PRE				
13	Fomesafen +	2	0.5	1 PT/A	PRE	2	1	11	29
	Dimethenamid-P	6	0.66	14 OZ/A	PRE				
	FPLSD (0.05)					3	1	8	18

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[1] Strategy herbicide: ethalfluralin and clomazone premix at 1.6 and 0.5 lbs ai/gal, respectively.

Table 2. Zucchini tolerance to herbicides.

	Treatment	Rates	Product rates		Timing	Emergence	Phyto 4 WAT	Stunting 4 WAT	Stunting 7 WAT	Harvest	
										Fruit	Wt.
		lbs ai/A				*no./plot*	*0-10*	*%*	*%*	*no./plot*	*tons/A*
1	Weedy control	-	-	-	-	13	0	1	0	14.3	3.4
2	Clomazone+	0.21	0.56	PT/A	PRE	11	0	3	1	21.8	6.8
	Ethalfluralin	0.70	1.87	PT/A	PRE						
3	S-Metolachlor	0.955	1	PT/A	PRE	12	0.3	0	0	24.3	7.9
4	S-Metolachlor	1.91	2	PT/A	PRE	13	0	0	0	26.8	9.2
5	Fomesafen	0.25	1	PT/A	PRE	11	0	0	0	25.3	8.8
6	Fomesafen	0.63	2.5	PT/A	PRE	3	0	10	12	8.7	2.9
7	Fomesafen +	0.31	1.25	PT/A	PRE	6	0	9	5	16.3	7.0
	S-Metolachlor	0.72	0.75	PT/A	PRE						
8	Halosulfuron	0.031	0.66	OZ/A	PRE	13	0	10	7	17.3	4.4
9	Halosulfuron +	0.031	0.66	OZ/A	PRE	14	0	8	3	24.8	7.6
	Strategy [1]	0.92	3.5	PT/A	PRE						
10	Halosulfuron +	0.031	0.66	OZ/A	PRE	15	0	1	4	20.3	5.9
	Strategy [1]	0.92	3.5	PT/A	POST						
11	Hand-Weeded	-	-	-	-	13	0	0	4	20.0	5.1
12	Fomesafen +	0.25	1	PT/A	PRE	13	0	4	0	23.5	8.3
	Dimethenamid-P	0.66	14	OZ/A	PRE						
13	Fomesafen +	0.5	1	PT/A	PRE	9	0.5	8	6	14.8	4.6
	Dimethenamid-P	0.66	14	OZ/A	PRE						
	FPLSD (0.05)					4	0.5	8	5	10.1	3.3

Table 3. Processing squash (*Cucurbita maxima* var. Golden Delicious) tolerance to herbicides.

	Treatment	Rates	Timing	Plant stand	Phyto 4 WAT	Stunting 4 WAT	Stunting 7 WAT	Weed control (5 WAP)			
								Hairy nightshade	Powell amaranth	Common purslane	Composite rating
		lbs ai/A		*no./plot*	*0-10*	*%*	*%*	%			
1	Weedy control	-	-	22	0	0	9	-	-	-	-
2	Clomazone+	0.21	PRE	20	0	0	1	100	99	78	99
	Ethalfluralin	0.70	PRE								
3	S-Metolachlor	0.955	PRE	18	0	1	3	79	100	100	90
4	S-Metolachlor	1.91	PRE	22	0	3	1	97	100	100	92
5	Fomesafen	0.25	PRE	21	0	3	0	95	100	100	95
6	Fomesafen	0.63	PRE	20	0	3	0	100	100	70	100
7	Fomesafen +	0.31	PRE	23	0	4	0	99	100	78	99
	S-Metolachlor	0.72	PRE								
8	Halosulfuron	0.031	PRE	20	1	5	8	28	75	75	50
9	Halosulfuron+	0.031	PRE	21	0	5	1	100	100	78	100
	Strategy [1]	0.92	PRE								
10	Halosulfuron+	0.031	PRE	21	0	1	6	45	75	75	60
	Strategy [1]	0.92	POST								
11	Hand-weeded	-	-	22	0	0	3	5	25	25	18
12	Fomesafen +	0.25	PRE	21	0	5	1	100	100	100	100
	Dimethenamid-P	0.66	PRE								
13	Fomesafen +	0.5	PRE	22	0	3	3	100	100	100	100
	Dimethenamid-P	0.66	PRE								
	FPLSD (0.05)			ns	ns	ns	6	22	39	49	23

Table 4. Treatment effects on processing squash (Cucurbita maxima, var. Golden delicious) yield and weed control at harvest.

				Harvest			Weed control at harvest			
	Treatment	Rates	Timing	Fruit	Yield	Avg. fruit wt.	Hairy nightshade	Powell amaranth	Lambs-quarters	Composite rating
		lbs ai/A		*fruit/plot*	*tons/A*	*lbs*	--------------------%----------------------			
1	Weedy control	-	-	8.0	7.1	11.7	0	0	0	0
2	Clomazone+	0.21	PRE	21.0	23.4	15.4	94	73	98	85
	Ethalfluralin	0.70	PRE							
3	S-Metolachlor	0.955	PRE	17.8	16.6	12.3	38	99	70	58
4	S-Metolachlor	1.91	PRE	21.5	21.2	13.0	88	98	73	73
5	Fomesafen	0.25	PRE	24.0	25.0	14.1	97	100	71	89
6	Fomesafen	0.63	PRE	23.0	27.3	16.3	99	100	98	99
7	Fomesafen +	0.31	PRE	27.3	30.6	15.6	99	100	98	97
	S-Metolachlor	0.72	PRE							
8	Halosulfuron	0.031	PRE	10.5	9.5	11.2	23	98	87	48
9	Halosulfuron+	0.031	PRE	25.3	25.2	13.9	85	100	100	81
	Strategy	0.92	PRE							
10	Halosulfuron+	0.031	PRE	14.0	12.0	11.2	35	100	98	35
	Strategy	0.92	POST							
11	Hand-weeded	-	-	25.8	27.6	15.0	97	100	100	97
12	Fomesafen +	0.25	PRE	27.5	30.0	15.0	83	95	99	95
	Dimethenamid-P	0.66	PRE							
13	Fomesafen +	0.5	PRE	27.3	31.6	16.3	100	100	100	98
	Dimethenamid-P	0.66	PRE							
	FPLSD (0.05)			6.1	6.4	2.6	31	20	32	14

Spinach, cilantro, and parsley tolerance to preemergence herbicides. Ed Peachey and Robert McReynolds (Horticulture Department, OSU, Corvallis, OR 97730). Plots were 8 ft by 20 ft with one row each of spinach, cilantro, and parsley planted with 26 inches between rows on May 21, 2008. The soil type was a silt loam with pH of 5.9, % OM of 2.8, and CEC of 20.7 meq/100 g soil. Herbicides were applied PPS (post-plant-surface) on May 22 with a CO_2 backpack sprayer delivering 20 GPA at 25 PSI. Plots were irrigated with ½ inch of water on May 23 to incorporate the herbicides. Plots were cultivated to reduce weed competition after the first evaluation. A composite weed control rating was made on July 1 and reported in Table 1 (low rate of herbicide only) and Table 2. Significant species at this site were pigweed, lambsquarters, hairy nightshade and common purslane. Crops were harvested as they matured; spinach, cilantro, and parsley at 41, 51, and 77 DAP, respectively.

There were large differences in crop tolerance to these herbicides (summarized in Table 1). All three crops were tolerant to S-metolachlor. Ethofumesate and pronamide were the other two herbicides with good to moderate crop safety on all three crops. Both cilantro and parsley were tolerant to linuron at 0.5 lbs ai/A (Tables 2-4). Tembotrione killed most weeds, spinach, and parsley, but cilantro was moderately tolerant at the rate tested.

Table 1. Summary of spinach, cilantro, and parsley tolerance to herbicides.

Common name	Product	Spinach	Cilantro	Parsley	Percent weed control at lowest herbicide rate
Pendimethalin	Prowl H_20	-	T	T	76
S-metolachlor	Dual Magnum	T	T	M	73
Ethofumesate	Nortron	T	M	M	66
Prometryn	Caparol	-	M	M	70
Pronamide	Kerb	M	T	M	60
Dimethenamid-P	Outlook	R	R	-	85
Linuron	Lorox	-	T	T	68
Flumioxazin	Valor	-	R	-	93
BAS 800	Kixor	-	-	-	71
Tembotrione	Laudis	-	R	-	56
Penoxsulam	Grasp	-	-	-	88
V10142	-	-	-	-	73
Fomesafen	Reflex	-	-	-	86
Lactofen	Cobra	-	-	-	75

T, tolerant; M, moderate tolerance at these rates; R, researchable- possible tolerance at lower rates; (-), no potential, sensitive to this herbicide.

Table 2. Spinach tolerance to PPS herbicides.

	Herbicide	Timing	Rate	Emergence	Phyto *(12-Jun-08)*	Stunting *(26-Jun-08)*	Yield	Weed Control *(1-Jul-08)*
			lbs ai/A	*no./ft of row*	*0-10*	*%*	*lbs/ft of row*	*%*
1	Pendimethalin H_20	PPS	0.500	9.8	29	65	0.1	76
2	Pendimethalin H_20	PPS	1.000	12.2	37	40	0	84
3	S-metolachlor	PPS	0.67	11.6	35	0	2.5	73
4	S-metolachlor	PPS	1.337	12.5	37	8	2.0	59
5	Ethofumesate	PPS	0.375	10.4	31	30	1.9	66
6	Ethofumesate	PPS	0.750	13.7	41	5	2.1	76
7	Prometryn	PPS	1.600	5.2	15	66	1.1	70
8	Prometryn	PPS	3.200	0.6	2	48	0.1	81
9	Pronamide	PPS	0.500	9.1	27	29	2.1	60
10	Pronamide	PPS	1.000	8.2	25	45	1.5	75
11	Dimethenamid-P	PPS	0.500	8.2	24	38	1.5	85
12	Dimethenamid-P	PPS	1.000	9.5	28	63	0.9	84
13	Linuron	PPS	0.250	10.7	32	40	1.8	68
14	Linuron	PPS	0.500	6.4	19	56	0.9	63
15	Flumioxazin	PPS	0.032	0.3	1	99	0	93
16	Flumioxazin	PPS	0.064	0.0	0	78	0	95
17	BAS 800	PPS	0.045	1.2	4	100	0	71
18	Tembotrione	PPS	0.410	4.6	14	90	0.1	56
19	Penoxsulam	PPS	0.100	0.9	3	100	0	88
20	V10142	PPS	0.050	6.4	20	91	0.1	73
21	Fomesafen	PPS	0.250	0.6	2	98	0.0	86
22	Lactofen	PPS	0.13	8.2	25	58	1.3	75
23	Check			12.8	38	0	2.2	0
	FPLSD (0.05)			4.9	15	40	0.7	28

Table 3. Cilantro tolerance to PPS herbicides.

	Herbicide	Timing	Rate	Emergence	Phyto *(12-Jun-08)*	Stunting *(26-Jun-08)*	Yield
			lbs ai/A	*no./ft of row*	*0-10*	*%*	*lbs/ ft of row*
1	Pendimethalin H_20	PPS	0.500	22.3	0.3	0	0.36
2	Pendimethalin H_20	PPS	1.000	22.9	0.0	18	0.39
3	S-metolachlor	PPS	0.669	23.8	0.0	0	0.42
4	S-metolachlor	PPS	1.337	22.9	0.0	5	0.38
5	Ethofumesate	PPS	0.375	23.2	0.0	0	0.15
6	Ethofumesate	PPS	0.750	22.0	0.0	0	0.28
7	Prometryn	PPS	1.600	22.0	0.8	3	0.32
8	Prometryn	PPS	3.200	19.5	0.3	25	0.26
9	Pronamide	PPS	0.500	23.5	0.0	0	0.45
10	Pronamide	PPS	1.000	22.0	0.5	3	0.28
11	Dimethenamid-P	PPS	0.500	21.3	1.0	23	0.16
12	Dimethenamid-P	PPS	1.000	10.7	3.5	65	0.08
13	Linuron	PPS	0.250	22.6	0.3	0	0.34
14	Linuron	PPS	0.500	24.4	0.0	0	0.35
15	Flumioxazin	PPS	0.032	14.6	3.8	18	0.25
16	Flumioxazin	PPS	0.064	13.4	5.5	28	0.21
17	BAS 800	PPS	0.045	10.7	3.3	48	0.08
18	Tembotrione	PPS	0.410	18.6	0.5	8	0.25
19	Penoxsulam	PPS	0.100	20.1	7.3	95	0.00
20	V10142	PPS	0.050	20.4	1.8	18	0.15
21	Fomesafen	PPS	0.250	0.6	9.0	78	0.00
22	Lactofen	PPS	0.125	12.8	6.0	30	0.09
23	Check			22.0	0.0	0	0.35
	FPLSD (0.05)			4.3	1.8	28	0.17

Table 4. Parsley tolerance to PPS herbicides.

	Herbicide	Timing	Rate	Emergence	Phyto *(12-Jun-08)*	Stunting *(1-Jul-08)*	Yield
			lbs ai/A	*no/ft of row*	*0-10*	*%*	*lbs/ft of row*
1	Pendimethalin H_20	PPS	0.500	7.6	0.8	20	0.15
2	Pendimethalin H_20	PPS	1.000	7.9	0.0	18	0.25
3	S-metolachlor	PPS	0.67	9.1	0.3	33	0.17
4	S-metolachlor	PPS	1.337	8.8	0.0	50	0.11
5	Ethofumesate	PPS	0.375	11.9	0.5	15	0.16
6	Ethofumesate	PPS	0.750	10.4	0.0	5	0.21
7	Prometryn	PPS	1.600	7.9	0.5	10	0.19
8	Prometryn	PPS	3.200	10.1	0.8	13	0.17
9	Pronamide	PPS	0.500	7.9	0.8	25	0.21
10	Pronamide	PPS	1.000	7.9	0.0	28	0.17
11	Dimethenamid-P	PPS	0.500	1.8	1.0	100	0
12	Dimethenamid-P	PPS	1.000	0.9	5.5	100	0
13	Linuron	PPS	0.250	11.0	0.8	10	0.18
14	Linuron	PPS	0.500	8.8	0.3	23	0.19
15	Flumioxazin	PPS	0.032	1.5	4.3	94	0.04
16	Flumioxazin	PPS	0.064	1.5	6.8	99	0.01
17	BAS 800	PPS	0.045	4.9	5.8	100	0.01
18	Tembotrione	PPS	0.410	7.3	0.8	60	0.05
19	Penoxsulam	PPS	0.100	2.4	4.8	100	0
20	V10142	PPS	0.050	6.7	2.8	93	0.01
21	Fomesafen	PPS	0.250	2.1	9.0	100	0
22	Lactofen	PPS	0.13	4.6	5.8	85	0.02
23	Check			11.9	0.0	0	0.21
	FPLSD (0.05)			4.0	2.6	22.0	0.13

Yellow mustard meal effects on common lambsquarters and spring barley. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Mustard meal effects on weeds and spring barley were evaluated at the University of Idaho research farm near Moscow, Idaho. Yellow mustard (*Sinapis alba*) meal was applied by hand at 0.5, 1, 2, and 4 tons/ acre 18, 12, and 6 days before planting 'Criton' spring barley at 100 lb/acre with a double disk drill. A control treatment was included for each application time. Plots were 11 ft^2 and the experimental design was a split-block with four replications. Common lambsquarters control and barley injury were evaluated visually as a percentage of the untreated plot, and barley grain was harvested by hand at maturity. Grain was threshed with a stationary head thresher.

Barley and common lambsquarters were not affected by the time of meal application (Table). Likely this was due to rainfall occurring after the last application, which activated the ionic isothiocyanates at the same time. Common lambsquarters was controlled at 1, 2 and 4 tons/acre, but not at 0.5 tons/acre; however weed populations were as low as 1 plant per plot so populations may have biased the results. Barley stand and vigor was reduced proportionately (23, 45, 79, and 91%) with an increase in mustard meal dose (0.5, 1, 2, and 4 tons/acre, respectively). Barley grain yield followed the same trend.

Table. Common lambsquarters control and barley injury with yellow mustard meal at Moscow, Idaho, 2008.

Application time	Mustard meal dose	Common lambsquarters control	Barley Injury	Barley Grain yield
days before planting	tons/acre	------------ %	------------	lb/acre
6	0	--	--	2506
12	0	--	--	3389
18	0	--	--	2492
Mean				*2796*
6	0.5	21	23	2316
12	0.5	24	23	2883
18	0.5	26	24	2141
Mean		*24*	*23*	*2447*
6	1	96	48	1894
12	1	96	50	1871
18	1	94	38	2278
Mean		*95*	*45*	*2015*
6	2	94	79	1974
12	2	94	79	1533
18	2	96	79	2187
Mean		*95*	*79*	*1898*
6	4	99	91	774
12	4	99	93	448
18	4	99	89	654
Mean		*99*	*91*	*626*
LSD $_{(0.05)}$		6	10	535

Broadleaf weed and green foxtail control with pyrasulfotole/bromoxynil in comparison with other herbicides. Don W. Morishita, J. Daniel Henningsen, and Donald L. Shouse. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare a pyrasulfotole and bromoxynil premixture to other broadleaf herbicides in weed control in spring wheat. 'Westbred 936' was planted April 8, 2008 at 100 lb/A. Experimental design was a randomized complete block with four replications. Individual plots were 8 by 30 ft. Soil type was a Portneuf silt loam (29.4% sand, 65% silt, and 5.6% clay) with a pH of 8.1, 1.55% organic matter, and CEC of 14-meq/100 g soil. Herbicides were applied with a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 22 psi. Additional environmental and application information is given in Table 1. Kochia, common lambsquarters, annual sowthistle, redroot pigweed, averaged 5, 9, 9, and 9 plants/ft^2 respectively. Weed control was evaluated visually 13 and 31 days after the last application (DALA) on June 12 and June 30. Grain was harvested August 11 with a small-plot combine.

Table 1. Environmental conditions at application.

Application date	May 20	May 30
Application timing	3 leaf	5 leaf
Air temperature (F)	74	66
Soil temperature (F)	64	58
Relative humidity (%)	82	38
Wind velocity (mph)	5	2
Cloud cover (%)	80	5
Time of day	1000	0800

Fifteen percent crop injury was observed with the 0.219 lb ai/A rate of pyrasulfotole/bromoxynil on the 13 DALA evaluation (Table 2). No other treatments injured the crop more than 3%. By 31 DALA, there were no differences in crop injury among herbicide treatments. Kochia control 13 DALA ranged from 61 to 98%. Thifensulfuron/tribenuron + pyrasulfotole/bromoxynil at 0.0156 + 0.129 lb ai/A + nonionic surfactant (NIS) at 0.25% v/v applied May 20 and 30 controlled kochia the poorest at 61 and 69%, respectively. However, by 31 DALA kochia control with these same two treatments average 100% and was not different from any other herbicide treatment. Common lambsquarters control 13 DALA was poorest with both fluroxypyr formulations averaging only 9%. Thifensulfuron/tribenuron + fluroxypyr also only controlled common lambsquarters 74% 13 DALA. At 31 DALA, all herbicide treatments controlled common lambsquarters 96 to 100%, with the exception of the two fluroxypyr formulations, which averaged 64% control. Annual sowthistle and redroot pigweed were effectively controlled with all herbicide treatments that ranged from 90 to 100%. Green foxtail was not anticipated in this study and ranged from 8 to 80%. Control was also quite variable and there was no difference between 55 and 80% control. Grain yields ranged from 95 (untreated check) to 112 bu/A, but there was no significant difference in yield among the treatments. This was due to variability in weed population throughout the study site.

Table 2. Crop injury, broadleaf weed control and spring wheat yield, near Kimberly, Idaho[1]

					Weed control[2]							
	Application		Crop injury		KCHSC		CHEAL		SONOL	AMARE	SETVI	Grain
Treatment[3]	rate	date	6/12	6/30	6/12	6/30	6/12	6/30	6/30	6/30	6/30	yield
	lb ai/A		%									bu/A
Check			-	-	-	-	-	-	-	-	-	95 a
Pyrslftl/brmxynl +	0.219 +	5/30	15 a	3 a	74 bcd	87 a	85 de	96 a	91 c	90 e	80 a	106 a
NIS+	0.25 % v/v											
AMS	0.5											
Pyrslftl/brmxynl +	0.241+	5/30	0 b	1 a	97 ab	98 a	100 a	100 a	98 ab	98 cd	8 d	97 a
NIS +	0.25 % v/v											
AMS	0.5											
Fluroxypyr 2.8 EC	0.14 +	5/30	1 b	1 a	96 ab	99 a	8 f	64 b	97 b	95 d	56 ab	106 a
Fluroxypyr 1.5 EC	0.124 +	5/30	3 b	1 a	96 ab	100 a	9 f	63 b	99 a	95 d	60 ab	104 a
Bromoxynil/MCPA	0.75 +	5/30	1 b	1 a	98 a	100 a	100 a	99 a	97 b	99 bc	19 cd	101 a
Pyrslftl/brmxynl +	0.241+	5/30	1 b	4 a	98 a	100 a	99 ab	100 a	99 a	100 a	43 bc	111 a
trflxystrbn /prpcnzl +	0.131 +											
NIS+	0.25 % v/v											
AMS	0.5											
Thfnslfrn/trbnm +	0.0156 +	5/20	0 b	3 a	80 a-d	100 a	100 a	100 a	98 ab	100 a	55 ab	110 a
fluroxypyr+	0.094 +											
NIS	0.25 % v/v											
Thfnslfrn/trbnm +	0.0156 +	5/30	1 b	3 a	84 a-d	100 a	74 e	100 a	98 ab	100 a	73 a	101 a
fluroxypyr +	0.094 +											
NIS	0.25 % v/v											
Thfnslfrn/trbnm +	0.0156 +	5/20	1 b	3 a	61 d	100 a	93 bcd	99 a	99 a	100 a	79 a	105 a
pyrslftl/brmxynl +	0.129 +											
NIS	0.25 % v/v											
Thfnslfrn/trbnm +	0.0156 +	5/30	1 b	1 a	69 cd	99 a	90 cd	100 a	99 a	100 a	75 a	109 a
pyrslftl/brmxynl +	0.129 +											
NIS	0.25 % v/v											
Thfnslfrn/trbnm +	0.0156 +	5/20	0 b	3 a	97 ab	75 a	98 abc	100 a	99 a	100 a	74 a	112 a
pyrslftl/brmxynl +	0.177 +											
NIS	0.25 % v/v											
Thfnslfrn/trbnm +	0.0156 +	5/30	1 b	1 a	95 abc	100 a	100 a	100 a	99 a	100 a	34 bcd	112 a
pyrslftl/brmxynl +	0.177+											
NIS	0.25 % v/v											

[1] Means followed by the same letter are not significantly different at $P = 0.05$.

[2] Weeds evaluated for control were kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), annual sowthistle (SONOL) and green foxtail (SETVI).

[3] Pyrslftl/brmxynl is a 1:8 mixture of bromoxynil and pyrasulfotole sold as Huskie. NIS is a nonionic surfactant. AMS is ammonium sulfate. Flrxypyr 2.8 EC is a 46% active ingredient formulation of fluroxypyr sold as Starane Ultra. Flrxypyr 1.5 EC is a 26% active ingredient formulation of fluroxypyr sold as Starane. Bromoxynil/MCPA is a 1:1 mixture sold as Bronate. Trflxystrbn/prpcnzl is a 1:1 mixture of trifloxystrobin and propiconazole sold as Stratego fungicide. Thfnslfrn/trbnm is a 1:1 mixture of thifensulfuron and tribenuron sold as Affinity BroadSpec.

<u>Broadleaf weed control in dry beans with preemergence herbicides followed by sequential postemergence herbicides</u>. Richard N. Arnold, Michael K. O'Neill and Kevin A. Lombard. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 27, 2008 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of dry beans (var. Bill Z) and annual broadleaf weeds to preemergence followed by sequential postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with four replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Dry beans were planted with flexi-planters equipped with disk openers on May 27. Preemergence treatments were applied on May 29 and immediately incorporated with 0.75 in of sprinkler-applied water. Postemergence treatments were applied on July 1 when dry beans were in the 3rd to 4th trifoliate leaf stage and weeds were small. All postemergence treatments had a crop oil concentrate (Clean Crop) and urea ammonium nitrate added at 0.5 and 1.0 percent v/v. Black nightshade, prostrate and redroot pigweed infestations were heavy and common lambsquarters and Russian thistle infestations were moderate and light throughout the experimental area. Treatments were evaluated on July 31.

Imazamox plus bentazon applied as a sequential postemergence treatment at 0.032 plus 0.25 lbs ai/A injured dry beans approximately two and three percent. Common lambsquarters, black nightshade, redroot and prostrate pigweed control were good to excellent with all treatments except the check. Dimethenamid-p alone at 0.56 lb ai/A or in combination with pendimethalin at 0.56 plus 0.8 lb ai/A gave poor control of Russian thistle. Flumioxazin alone at 0.05 lb ai/A gave excellent control of all weeds. Yields were 2651 to 3804 lb/A higher in the herbicide treated plots as compared to the check.

Table. Broadleaf weed control in dry beans with preemergence followed by sequential postemergence herbicides.

Treatments[1]	Rate	Crop injury[2]	Weed control[2]					Yield
			CHEAL	SOLNI	AMARE	AMABL	SASKR	
	lb ai/A	—%—			%—			lb/A
Flumioxazin	0.05	0	98	96	96	97	97	3996
Dimethenamid-p	0.56	0	98	85	90	90	33	3112
Flumioxazin + pendimethalin	0.05 0.8	0	99	96	97	96	97	4265
Dimethenamid-p + pendimethalin	0.56 0.8	0	99	93	95	94	45	3266
Flumioxazin/imazamox + bentazon	0.05/0.032+ 0.25	3	100	98	97	98	95	4034
Dimethenamid-p /imazamox + bentazon	0.56/ 0.032 0.25	2	99	96	97	98	95	4111
Dimethenamid-p + pendimethalin/imazamox + bentazon	0.56+ 0.8/0.032 0.25	3	99	97	97	97	95	3919
Flumioxazin + pendimethalin/imazamox + bentazon	0.05+ 0.8/0.032 0.25	2	99	97	99	98	98	4111
Weedy check		0	0	0	0	0	0	461
LSD (0.05)			2	3	2	4	6	607

[1] First treatment applied preemergence then a slash, followed by a sequential postemergence treatment.

[2] Rated on a scale from 0 to 100 with 0 being no control or crop injury and 100 being dead plants.

Weed control and Roundup Ready sugar beet tolerance to glyphosate/*s*-metolachlor. Don W. Morishita, Donald L. Shouse and J. Daniel Henningsen. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare glyphosate/*s*-metolachlor, a soil-active and foliar herbicide combination, with glyphosate alone and in combination with *s*-metolachlor for weed control in sugar beet. Experimental design was a randomized complete block with four replications. Soil type was a Portneuf silt loam (20.4% sand, 71.0% silt, and 8.6% clay) with a pH of 8.1, 1.50% organic matter, and CEC of 17-meq/100 g soil. 'CT02RR08' sugar beet was planted April 16, 2008 in 22-inch rows at a rate of 57,024 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), green foxtail (SETVI), and barnyardgrass (ECHCG) were the major weed species present. Herbicides were applied broadcast with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 4, 22, 44 and 121 days after the last herbicide application (DALA) on June 6, June 24, July 16, and October 1. Only the crop injury data from 4 and 44 DALA and weed control data from 22 and 121 DALA are shown. The two center rows of each plot were harvested mechanically October 15.

Table 1. Environmental conditions at application.

Application date	May 22	June 2
Application timing	2 leaf	6 leaf
Air temperature (F)	48	76
Soil temperature (F)	56	70
Relative humidity (%)	59	32
Wind velocity (mph)	6	6
Cloud cover (%)	100	90
Time of day	1015	1420
Weed species/ft2		
lambsquarters, common	3	6
kochia	1	1
pigweed, redroot	3	5
grass weeds[1]	11	14

[1] Grass weeds were green foxtail (SETVI) and barnyardgrass (ECHCG).

There was no crop injury in any of the treatments at either evaluation (Table 2), which indicates excellent crop tolerance to these herbicide treatments. Common lambsquarters, redroot pigweed, kochia and grass weed control was excellent, ranging from 96 to 100% with all herbicide treatments 22 DALA. At 121 DALA, common lambsquarters and kochia control were 73 and 75%, respectively with the lowest glyphosate/s-metolachlor +ammonium sulfate (AMS) application rate (1.31 + 2.5 lb ai/A). This was significantly lower than glyphosate/*s*-metolachlor + AMS rates from 1.96 to 5.25 + 2.5 lb ai/A. Also at the last evaluation grass weed control averaged 83% with glyphosate-T + AMS applied two times and was lower than all other herbicide treatments. Root yields ranged from 39 to 45 ton/A and sucrose yields ranged from 11,045 to 12,556 lb/A. There was no significant difference in root or sucrose yield among any herbicide treatments and all had higher yields than the untreated check.

Table 2. Sugar beet tolerance, weed control, and yield with *s*-metolachlor and glyphosate, near Kimberly, ID[1].

					Weed Control[2]									
	Application		Crop injury		CHEAL		AMARE		KCHSC		Grasses		Root	
Treatment[3]	rate	dates	6/06	7/16	6/24	10/01	6/24	10/01	6/24	10/01	6/24	10/01	yield	ERS[4]
	lb ai/A		%										ton/A	lb/A
Check			-	-	-	-	-	-	-	-	-	-	3 b	913 b
Glyphosate/*s*-metolachlor + AMS	1.31 + 2.5 lb/A	5/22	0 a	0 a	96 b	73 b	99 a	90 ab	98 a	75 c	99 a	95 a	39 a	11,035 a
Glyphosate/*s*-metolachlor + AMS	1.96 + 2.5 lb/A	5/22	0 a	0 a	99 a	86 abc	100 a	91 ab	99 a	95 ab	99 a	95 a	45 a	12,556 a
Glyphosate/*s*-metolachlor + AMS	2.63 + 2.5 lb/A	5/22	0 a	0 a	98 a	86 abc	100 a	95 a	100 a	95 ab	99 a	95 a	43 a	12,268 a
Glyphosate/*s*-metolachlor + AMS	3.94 + 2.5 lb/A	5/22	0 a	0 a	99 a	94 a	99 a	95 a	99 a	97 ab	99 a	98 a	42 a	11,977 a
Glyphosate/*s*-metolachlor + AMS	5.25 + 2.5 lb/A	5/22	0 a	0 a	99 a	89 ab	100 a	95 a	99 a	98 a	99 a	99 a	44 a	12,339 a
S-metolachlor + glyphosate-T + AMS	1.13 + 0.785 lb ae/A + 2.5 lb/A	5/22	0 a	0 a	99 a	79 cd	99 a	88 abc	98 a	84 bc	99 a	95 a	40 a	11,248 a
Glyphosate/*s*-metolachlor + AMS	1.96 + 2.5 lb/A	5/22 & 6/02	0 a	0 a	99 a	93 a	100 a	89 abc	100 a	97 ab	99 a	98 a	42 a	11,831 a
Glyphosate/*s*-metolachlor + AMS Glyphosate-T + AMS	1.96 + 2.5 lb/A 0.785 lb ae/A + 2.5 lb/A	5/22 & 6/02	0 a	0 a	99 a	86 abc	100 a	86 bc	100 a	98 a	99 a	96 a	45 a	12,562 a
Glyphosate-T + AMS Glyphosate/*s*-metolachlor + AMS	0.785 lb ae/A + 2.5 lb/A 1.96 + 2.5 lb/A	5/22 & 6/02	0 a	0 a	99 a	91 a	99 a	88 abc	99 a	98 a	99 a	90 b	44 a	12,386 a
Glyphosate-T + AMS	0.785 lb ae/A + 2.5 lb/A	5/22 & 6/02	0 a	0 a	99 a	83 bc	99 a	81 c	100 a	97 ab	99 a	83 c	42 a	11,763 a

[1] Means followed by the same letter are not significantly different (P=0.05).

[2] Weeds evaluated for control were common lambsquarters (CHEAL), kochia (KCHSC), redroot pigweed (AMARE), and two grass species, green foxtail (SETVI) and barnyardgrass (ECHCG).

[3] Glyphosate/*s*-metolachlor is a 1:1.33 premixture sold as Sequence; AMS is ammonium sulfate; glyphosate-T is Touchdown Total; *S*-metolachlor is Dual Magnum.

[4] ERS is estimated recoverable sugar.

Glyphosate tank mixture compatibility with other pesticides. J. Daniel Henningsen, Don W. Morishita, and Donald L. Shouse. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare glyphosate tank mixes with five insecticides and three fungicides currently registered for use in sugar beets. Experimental design was a randomized complete block with four replications. Soil type was a Portneuf silt loam (20.4% sand, 71.0% silt, and 8.6% clay) with a pH of 8.1, 1.50% organic matter, and CEC of 17-meq/100 g soil. 'CT02RR08' sugar beet was planted April 16, 2008 in 22-inch rows at a rate of 57,024 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), and green foxtail (SETVI), and barnyardgrass (ECHCG) were the major weed species present. The two grass species were evaluated together as grasses. Herbicides were applied broadcast with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 35, 42 and 94 days after the first herbicide (DAFA) application on June 24, July 1 and September 26. The two center rows of each plot were harvested mechanically October 15, 2007.

Table 1. Environmental conditions at application.

Application date	May 20	June 2	June 13	June 25
Application timing	2 leaf	6 leaf	10 leaf	15" ht.
Air temperature (F)	76	64	63	72
Soil temperature (F)	63	63	50	69
Relative humidity (%)	32	54	40	45
Wind velocity (mph)	6	4	0	3
Cloud cover (%)	50	30	0	5
Time of day	1015	1000	0700	0930
Weed species/ft2				
lambsquarters, common	-	7	-	8
kochia	-	1	-	1
pigweed, redroot	-	5	-	3
grass weeds	-	9	-	10
barnyardgrass	-	6	-	

There was less than 6% crop injury from all treatments except glyphosate + trifloxystrobin, which injured the crop 10% (Table 2). No injury was observed in subsequent evaluations (data not shown). All of the insecticides and fungicides tank-mixed with glyphosate controlled all weed species 94% or better 35 and 42 DAFA, and were equal to glyphosate applied alone. In the late season evaluation taken 94 DAFA, common lambsquarters, kochia, redroot pigweed, and grass control with esfenvalerate, chlorpyrifos, zeta-cypermethrin, methomyl, and oxamyl tank mixed with glyphosate were equal to glyphosate alone. Common lambsquarters control with glyphosate plus azoxystrobin at 0.25 lb ai/A or prothioconazole, as well as glyphosate/s-metolachlor plus azoxystrobin (applied one time) was reduced to 84, 83, and 78% control, respectively. A similar response was observed with these glyphosate and fungicide tank mixtures for redroot pigweed and grass control. In 2007, a reduction in weed control was observed with the strobilurin fungicides at an early weed control evaluation. In 2008, the reduction in weed control was observed later in the season with these two fungicide tank mixtures and no effect on early season weed control was observed. Root yields of the herbicide treatments ranged from 39 to 43 ton/A, while sucrose yields ranged from 10,996 to 12,112 lb/A. The untreated check yielded 1 ton/A root yield and only 390 lb/A sucrose. There was no significant difference in root or sucrose yield among the herbicide treatments. Although a reduction in late season weed control was observed with the glyphosate plus fungicide tank mix treatments, sugar beet yield and quality was not affected. After two years of testing the compatibility of selected insecticides and fungicides with glyphosate, it does not appear that yield is affected by these tank mixtures. It is unclear however, if weed control is slightly reduced with strobilurin tank mixtures and if these tank mixtures have any negative effect on insect or disease control.

Table 2. Crop injury, weed control, and yield with glyphosate tank mixtures with other pesticides, near Kimberly, Idaho.[1]

	Application		Crop injury	Weed control[2]												Root yield	ERS[4]
				CHEAL			KCHSC			AMARE			Grasses				
Treatment[3]	rate	dates	6/24	6/24	7/01	9/26	6/24	7/01	9/26	6/24	7/01	9/26	6/24	7/01	9/26		
			%													ton/A	lb/A
Check	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 b	390 b
Glyphosate + AMS	0.75 lb ae/A + 2.5 lb ai/A	5/20, 6/02 & 6/13	4 bc	98 a	99 a	93 ab	99 a	99 ab	96 a	99 a	100 a	94 ab	98 a	99 a	90 ab	42 a	11,724 a
Glyphosate + AMS + esfenvalerate Glyphosate + AMS	0.75 lb ae/A + 2.5 lb ai/A + 0.05 lb ai/A 0.75 lb ae/A + 2.5 lb ai/A	5/20 & 6/02 & 6/13	3 bc	98 a	98 ab	93 ab	99 a	99 ab	96 a	99 a	100 a	92 abc	98 a	99 a	89 abc	40 a	11,311 a
Glyphosate + AMS + chlorpyrifos Glyphosate + AMS	0.75 lb ae/A + 2.5 lb ai/A + 0.5 lb ai/A 0.75 lb ae/A + 2.5 lb ai/A	5/20 & 6/02 & 6/13	5 bc	98 a	99 a	90 abc	100 a	100 ab	98 a	98 a	100 a	93 abc	97 a	99 a	89 abc	43 a	12,064 a
Glyphosate + AMS + zeta-cypermethrin Glyphosate + AMS	0.75 lb ae/A + 2.5 lb ai/A + 0.047 lb ai/A 0.75 lb ae/A + 2.5 lb ai/A	5/20 & 6/02 & 6/13	1 c	99 a	99 a	93 ab	99 a	99 a	95 a	99 a	100 a	93 abc	98 a	99 a	91 ab	40 a	11,186 a
Glyphosate + AMS Glyphosate + AMS + methomyl Glyphosate + AMS	0.75 lb ae/A + 2.5 lb ai/A 0.75 lb ae/A + 2.5 lb ai/A + 0.9 lb ai/A 0.75 lb ae/A + 2.5 lb ai/A	5/20 & 6/02 & 6/13	3 bc	98 a	99 a	93 ab	99 a	99 a	100 a	99 a	100 a	94 ab	99 a	99 a	89 abc	39 a	11,092 a
Glyphosate + AMS + oxamyl Glyphosate + AMS	0.75 lb ae/A + 2.5 lb ai/A + 1.0 lb ai/A 0.75 lb ae/A + 2.5 lb ai/A	5/20 & 6/02 & 6/13	3 bc	98 a	98 ab	89 abc	99 a	100 a	99 a	99 a	99 abc	91 a-d	98 a	98 a	88 abc	43 a	11,983 a
Glyphosate + AMS Glyphosate + AMS + trifloxystrobin	0.75 lb ae/A + 2.5 lb ai/A 0.75 lb ae/A + 2.5 lb ai/A + 0.109 lb ai/A	5/20 & 6/02 & 6/13	10 a	99 a	99 a	86 bc	100 a	100 a	100 a	99 a	95 d	81 e	99 a	98 a	75 d	39 a	10,996 a

Table. continued.[1]

Treatment[3]	Application rate	Application dates	Crop injury 6/24	Weed control[2] CHEAL 6/24	CHEAL 7/01	CHEAL 9/26	KCHSC 6/24	KCHSC 7/01	KCHSC 9/26	AMARE 6/24	AMARE 7/01	AMARE 9/26	Grasses 6/24	Grasses 7/01	Grasses 9/26	Root yield	ERS[4]
			-----	-----	-----	-----	-----	-----	%	-----	-----	-----	-----	-----	-----	ton/A	lb/A
Glyphosate +	0.75 lb ae/A +	5/20 &	6 ab	98 a	99 a	84cd	99 a	98 abc	94 a	99 a	94 d	84 de	99 a	97 a	78 d	39 a	11,084 a
AMS	2.5 lb ai/A																
Glyphosate +	0.75 lb ae/A +	6/02 &															
AMS +	2.5 lb ai/A +	6/13															
azoxystrobin	0.25 lb ai/A																
Glyphosate +	0.75 lb ae/A +	5/20 &	4 bc	99 a	99 a	83 cd	99 a	98 abc	97 a	99 a	96 cd	84 de	99 a	97 a	80 cd	43 a	12,112 a
AMS	2.5 ai/A																
Glyphosate +	0.75 lb ae/A +	6/02 &															
AMS +	2.5 lb ai/A +	6/13															
prothioconazole	0.178 lb ai/A																
Glyphosate +	0.75 lb ae/A +	5/20 &	3 bc	99 a	96 bc	89 abc	99 a	96 c	99 a	99 a	95 d	85 cde	99 a	98 a	83 bcd	43 a	12,071 a
AMS	2.5 lb ai/A																
Glyphosate +	0.75 lb ae/A +	6/02 &															
AMS +	2.5 lb ai/A +																
prothioconazole +	0.178 lb ai/A +																
ethofumesate	1.0 lb ai/A																
Glyphosate +	0.75 lb ae/A +	6/13															
AMS +	2.5 lb ai/A +																
prothioconazole	0.178 lb ai/A																
Glyphosate/s-metolachlor +	1.97 lb ai/A +	5/20	5 bc	96 a	95 c	78 d	99 a	97 bc	90 a	99 a	97 bcd	88 b-e	98 a	98 a	93 a	40 a	11,378 a
azoxystrobin +	0 .211 lb ai/A +																
AMS	2.5 lb ai/A																
Glyphosate-T +	0.75 lb ae/A +	5/20 &	3 bc	98 a	99 a	96 a	100 a	100 a	99 a	98 a	100 a	98 a	98 a	99 a	93 a	43 a	12,035 a
azoxystrobin +	0.211 lb ai/A +	6/02 &															
AMS	2.5 lb ai/A																
Glyphosate-T +	0.75 lb ae/A +	6/13															
AMS	2.5 lb ai/A																

[1] Means followed by the same letter are not significantly different (P=0.05).

[2] Weeds evaluated for control were common lambsquarters (CHEAL), kochia (KCHSC), redroot pigweed (AMARE), and two grass species, green foxtail (SETVI) and barnyardgrass (ECHCG).

[3] AMS is ammonium sulfate, glyphosate is Roundup Power Max, glyphosate-T is Touchdown Total, and glyphosate/s-metolachlor is Sequence.

[4] ERS is estimated recoverable sugar.

Effect of glyphosate application rate and timing on weed control in sugar beet. Donald L. Shouse, Don W. Morishita and J. Daniel Henningsen. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). The current glyphosate label for sugar beets recommends making the first application when the weeds are about two inches tall. In some instances, a grower may be delayed in initiating applications until the weeds are larger. A field experiment was conducted at the University of Idaho Research and Extension Center near Aberdeen, Idaho to compare glyphosate application timing and rate for weed control in sugar beet. Experimental design was a randomized complete block with four replications. Soil type was a Declo sandy loam (55.9% sand, 32.0% silt, and 12.1% clay) with a pH of 8.0, 1.61% organic matter, and CEC of 14.3-meq/100 g soil. 'CT02RR08' sugar beet was planted April 25, 2008 in 22-inch rows at a rate of 57,024 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), common mallow (MALNE), and green foxtail (SETVI) were the major weed species present at densities of 1, 11, 3, 4, and 11 plants/ft^2, respectively. Herbicides were applied broadcast with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 29 and 128 days after the last herbicide application (DALA) on July 11, and October 20. The two center rows of each plot were harvested mechanically October 20.

Table 1. Environmental conditions at application.

Application date	May 23	May 30	June 12	June 28	July 08
Application timing	2 leaf	4 leaf	6 leaf	18 inch	22 inch
Air temperature (F)	56	63	57	80	53
Soil temperature (F)	62	63	61	84	60
Relative humidity (%)	40	50	58	40	74
Wind velocity (mph)	8	4	1	2	1
Cloud cover (%)	100	50	70	10	0
Time of day	1400	1100	1300	1300	0645

None of the treatments injured the crop at either evaluation (Table 2). Common lambsquarters, kochia, redroot pigweed, common mallow, and green foxtail control were all equal across all herbicides treatments for each species and ranged from 86 to 100% 29 DALA. However, weed control with the two treatments not started until June 28 had very poor common lambsquarters and kochia control at 51 and 74%, respectively. Sugar beet root yields ranged from 27 to 35 ton/A with the exception of the check, which yielded only 5 ton/A. Sucrose yields ranged from 6,631 to 8,478 lb/A with the exception of the check, which yielded 260 lb/A. The two treatments started June 28 had lower root and sucrose yield compared to the other herbicide treatments.

Table 2. Crop injury, weed control and sugar beet yield response to glyphosate rate and application timing, near Aberdeen, Idaho.[1]

			Weed control[2]											
	Application		Crop injury		CHEAL		KCHSC		AMARE		MALNE	SETVI	Root	
Treatment[3]	rate	dates	7/11	10/20	7/11	10/20	7/11	10/20	7/11	10/20	7/11	7/11	yield	ERS[4]
	lb ae/A		%										ton/A	lb/A
Glyphosate + AMS	0.75 + 2.5 lb/A	5/23 & 5/30	0 a	0 a	91 a	88 bc	100 a	100 a	98 a	100 a	89 a	99 a	34 a	8,249 a
Glyphosate + AMS	0.75 + 2.5 lb/A	5/30 & 6/12	0 a	0 a	92 a	98 a	100 a	100 a	99 a	100 a	86 a	100 a	34 a	8,299 a
Glyphosate + AMS	0.75 + 2.5 lb/A	6/12 & 6/28	0 a	0 a	95 a	98 ab	100 a	96 a	100 a	100 a	91 a	100 a	34 a	8,165 a
Glyphosate + AMS	0.75 + 2.5 lb/A	6/28 & 7/8	0 a	0 a	98 a	51 d	100 a	71 b	99 a	100 a	96 a	100 a	27 b	6,631 b
Glyphosate + AMS Glyphosate + AMS	1.125 + 2.5 lb/A 0.75 + 2.5 lb/A	5/23 & 5/30	0 a	0 a	96 a	86 c	100 a	100 a	98 a	94 b	95 a	99 a	35 a	8,416 a
Glyphosate + AMS Glyphosate + AMS	1.125 + 2.5 lb/A 0.75 + 2.5 lb/A	5/30 & 6/12	0 a	0 a	89 a	99 a	100 a	100 a	100 a	100 a	94 a	96 a	35 a	8,481 a
Glyphosate + AMS Glyphosate + AMS	1.125 + 2.5 lb/A 0.75 + 2.5 lb/A	6/12 & 6/28	0 a	0 a	95 a	100 a	100 a	100 a	99 a	100 a	90 a	100 a	35 a	8,478 a
Glyphosate + AMS Glyphosate + AMS	1.125 + 2.5 lb/A 0.75 + 2.5 lb/A	6/28 & 7/8	0 a	0 a	92 a	58 d	100 a	74 b	99 a	100 a	89 a	100 a	28 b	6,792 b
Check			-	-	-	-	-	-	-	-	-	-	5 c	260 c

[1] Means followed by the same letter are not significantly different (P=0.05).

[2] Weeds evaluated for control were common lambsquarters (CHEAL), kochia (KCHSC), redroot pigweed (AMARE), common mallow (MALNE), and green foxtail (SETVI).

[3] AMS is ammonium sulfate.

[4] ERS is estimated recoverable sugar.

Glyphosate application timing and tank mix partners for weed control in sugar beet. J. Daniel Henningsen, Don W. Morishita and Donald L. Shouse. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A field experiment was conducted at the University of Idaho Research and Extension Center near Aberdeen, Idaho to compare glyphosate tank mixtures applied for weed control in sugar beet. Experimental design was a randomized complete block with four replications. Soil type was a Declo sandy loam (55.9% sand, 32.0% silt, and 12.1% clay) with a pH of 8.0, 1.61% organic matter, and CEC of 14.3-meq/100 g soil. 'CT02RR08' sugar beet was planted April 25, 2008 in 22-inch rows at a rate of 57,024 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), common mallow (MALNE) and green foxtail (SETVI) were the major weed species present at densities of 1, 11, 3, 4, and 11 plants/ft^2, respectively. Herbicides were applied broadcast with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 29 days after the last herbicide application (DALA) on July 11. The two center rows of each plot were harvested mechanically October 20.

Table 1. Environmental conditions at application.

Application date	May 23	June 12
Application timing	2 leaf	6 leaf
Air temperature (F)	61	57
Soil temperature (F)	62	61
Relative humidity (%)	40	58
Wind velocity (mph)	6	1
Cloud cover (%)	100	70
Time of day	1345	1300

None of the treatments injured the crop (Table 2). Kochia control 29 DALA was ≥99% with all herbicide treatments except glyphosate applied at the two leaf stage (May 23) only. Common lambsquarters control ranged from 58 to 99%. Glyphosate applied at two leaf followed by glyphosate + *s*-metolachlor or dimethenamid-P were the only treatments that controlled common lambsquarters >90%. Redroot pigweed control ranged from 61 to 100% and was somewhat variable. However, glyphosate + AMS applied one time at the two leaf stage had the poorest control at 61%. Common mallow control mirrored common lambsquarters control, where glyphosate applied at two leaf followed by glyphosate + *s*-metolachlor or dimethenamid-P were the only treatments the controlled common mallow >90%. Green foxtail control ranged from 56 to 100%. Glyphosate + *s*-metolachlor or dimethenamid-P applied sequential to glyphosate alone controlled green foxtail 100%. All herbicide treatments had sugar beet yields greater than the untreated check. Glyphosate applied one time yielded 28 ton/A and was the only herbicide treatment that differed from the others.

Table 2. Crop injury, weed control and sugar beet yield with glyphosate applications, near Aberdeen, Idaho[1].

	Application		Crop	Weed Control[2]					Root
Treatment[3]	rate	date	injury	KCHSC	CHEAL	AMARE	MALNE	SETVI	yield
	lb ae/A		%						ton/A
Check			-	-	-	-	-	-	2 d
Glyphosate +	0.75 +	5/23 &	0 a	100 a	84 c	89 a	64 bc	93 ab	36 ab
triflusulfuron +	0.0156 lb ai/A								
AMS	2.5 lb/A +								
Glyphosate +	0.75 +	6/12							
AMS	2.5 lb/A								
Glyphosate +	0.75 +	5/23 &	0 a	100 a	81 c	91 a	61 c	90 b	35 ab
triflusulfuron +	0.0156 lb ai/A +								
AMS +	2.5 lb/A +								
COC	1% v/v								
Glyphosate +	0.75 +	6/12							
AMS	2.5 lb/A								
Glyphosate +	0.75 +	5/23 &	0 a	100 a	83 c	88 a	72 bc	93 ab	39 a
AMS	2.5 lb/A								
Glyphosate +	0.75 +	6/12							
clopyralid +	0.094 lb ai/A								
AMS	2.5 lb/A +								
Glyphosate +	0.75 +	5/23 &	0 a	100 a	86 bc	92 a	81 b	89 b	36 ab
AMS	2.5 lb/A								
Glyphosate +	0.75 +	6/12							
clethodim +	0.068 lb ai/A								
AMS	2.5 lb/A +								
Glyphosate +	0.75 +	5/23 &	0 a	100 a	80 c	85 a	69 bc	83 b	36 ab
ethofumesate +	0.09 lb ai/A								
AMS	2.5 lb/A +								
Glyphosate +	0.75 +	6/12							
AMS	2.5 lb/A								
Glyphosate +	0.75 +	5/23 &	0 a	99 a	75 c	91 a	73 bc	88 b	32 bc
efs/dmp/pmp +	0.46 lb ai/A								
AMS	2.5 lb/A +								
Glyphosate +	0.75 +	6/12							
AMS	2.5 lb/A								
Glyphosate +	0.75 +	5/23 &	0 a	100 a	96 ab	100 a	95 a	100 a	37 ab
AMS	2.5 lb/A								
Glyphosate +	0.75 +	6/12							
s-metolachlor +	1.25 lb ai/A								
AMS	2.5 lb/A +								
Glyphosate +	0.75 +	5/23 &	0 a	100 a	77 c	85 a	77 bc	80 bc	36 ab
AMS	2.5 lb/A	6/12							
Glyphosate +	0.75 +	5/23 &	0 a	100 a	99 a	100 a	99 a	100 a	38 ab
AMS	2.5 lb/A								
Glyphosate +	0.75 +	6/12							
dimethenamid-P +	0.98 lb ai/A								
AMS	2.5 lb/A +								
Glyphosate +	0.75 +	5/23	0 a	85 b	58 d	61 b	78 bc	56 c	28 c
AMS	2.5 lb/A								

[1] Means followed by the same letter are not significantly different (P=0.05).

[2] Weeds evaluated for control on July 11 were common lambsquarters (CHEAL), kochia (KCHSC), redroot pigweed (AMARE), mallow (MALNE), and green foxtail (SETVI).

[3] AMS is ammonium sulfate. Efs/dmp/pmp is a 1:1:1 mixture of ethofumesate, desmedipham, and phenmedipham and sold as Progress.

[4] ERS is estimated recoverable sugar.

Herbicide tank mixtures with glyphosate for weed control in sugar beet. Don W. Morishita, Donald L. Shouse, and J. Daniel Henningsen. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare various glyphosate tank mixtures with soil-active herbicides for weed control in sugar beet. Experimental design was a randomized complete block with four replications. Soil type was a Portneuf silt loam (20.4% sand, 71.0% silt, and 8.6% clay) with a pH of 8.1, 1.50% organic matter, and CEC of 17-meq/100 g soil. 'CT02RR08' sugar beet was planted April 16, 2008 in 22-inch rows at a rate of 57,024 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), hairy nightshade (SOLSA), annual sowthistle (SONOL), green foxtail (SETVI), and barnyardgrass (ECHCG), and were the major weed species present. Herbicides were applied broadcast with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 22, 29 (data not included) and 121 days after the last herbicide application (DALA) on June 24 and October 1. The two center rows of each plot were harvested mechanically October 15.

Table 1. Environmental conditions at application.

Application date	April 29	May 20	June 2
Application timing	pre	2 leaf	6 leaf
Air temperature (F)	63	87	62
Soil temperature (F)	56	76	68
Relative humidity (%)	34	22	63
Wind velocity (mph)	5	12	6
Cloud cover (%)	0	100	20
Time of day	0915	1245	0930
Weed species/ft2			
lambsquarters, common	-	6	8
kochia	-	1	2
pigweed, redroot	-	10	6
nightshade, hairy	-	-	1
grass weeds[1]	-	5	8

[1] Grass weeds were green foxtail (SETVI) and barnyardgrass (ECHCG).

Some early crop injury symptoms were observed with the EPTC liquid and granular and cycloate treatments, but the crop quickly grew out of the injury (data not shown). By 22 DALA, no crop injury was observed for any of the herbicide treatments (Table 2). Common lambsquarters control ranged from 84 to 99% 22 DALA. Glyphosate + ethofumesate-E at 0.75 lb ae + 1.0 lb ai/A had the poorest control (84%), but was still acceptable. A second visual evaluation (data not shown) was taken 29 DALA and all levels of weed control were similar to 22 DALA. Common lambsquarters control 121 DALA declined compared to the earlier evaluations. Common lambsquarters control with two glyphosate applications with or without a tank mix partner was 86% or better and ethofumesate applied preemergence followed by one glyphosate + ammonium sulfate (AMS) postemergence application controlled common lambsquarters 84%. Only the single application of glyphosate + dimethenamid-P + AMS at 0.75 lb ae + 0.875 lb ai + 2.5 lb/A controlled common lambsquarters equal to multiple glyphosate applications. Other single applications of glyphosate + ethofumesate with ethofumesate rates ranging from 0.375 to 1.5 lb ai/A did not control common lambsquarters better than 78%. Kochia control 22 DALA ranged from 91 to 100% for all herbicide treatments. By 121 DALA, all herbicide treatments except glyphosate + ethofumesate applied one time at ethofumesate rates of 0.375, 1.0, and 1.5 lb ai/A controlled kochia 88% or better. These three treatments averaged 71, 68, and 60% control, respectively. Redroot pigweed control ranged from 89 to 100% control 22 DALA and 66 to 93% 121 DALA. At the later evaluation date, the single application of glyphosate alone at 0.75 lb ae/A was among those with the poorest redroot pigweed control. Single applications of glyphosate + ethofumesate ranged from 77 to 83%, and were not statistically different. Hairy nightshade control was evaluated 22 DALA only because Colorado potato beetle ate them after the first evaluation. Hairy nightshade control 22 DALA ranged from 94 to 100% for all herbicide treatments. Annual sowthistle is typically a later emerging weed that also is not very competitive. All of the herbicide treatments controlled annual sowthistle ≥98% compared to the untreated check. Green foxtail and barnyardgrass control were pooled due to lower densities of both weed species and are reported as Grass weeds. Grass control 22 DALA was good (85%) to excellent (100%) with all herbicide treatments. However, at 121 DALA, grass control had declined with several treatments; primarily treatments with one application. Glyphosate applied alone one time and glyphosate + ethofumesate with ethofumesate rates of 0.375, 0.5, and 1.0 lb ai/A all controlled the two grass species <70%. All of the glyphosate + dimethenamid treatments and glyphosate + EPTC or cycloate controlled the grasses ≥90% and were statistically better than to glyphosate + AMS applications alone at 0.75 lb ae + 2.5 lb/A. Root and sugar yield of the untreated check averaged 8 ton/A and 2,230 lb/A and were significantly less than all of the herbicide treatments. Glyphosate applied alone one time yielded 40 ton/A and was equal to the highest ranked treatment consisting of glyphosate followed by glyphosate + EPTC granules, which yielded 47 ton/A. Most of the single glyphosate + ethofumesate applications had yields lower than multiple glyphosate applications.

Table 2. Crop injury, weed control, and yield with glyphosate tank mixtures with other pesticides, near Kimberly, Idaho.[1]

	Application		Crop injury	Weed control[2]										Root	
				CHEAL		KCHSC		AMARE		SOLSA	SONOL	Grass			
Treatment[3]	rate	dates	6/24	6/24	10/01	6/24	10/01	6/24	10/01	6/24	10/01	6/24	10/01	yield	ERS[4]
			---%---											ton/A	lb/A
Check			-	-	-	-	-	-	-	-	-	-	-	8 f	2,230 f
Glyphosate + AMS	0.75 lb ae/A + 2.5 lb/A	5/20	0 a	93 cde	68 c	98 a-d	89 abc	91 de	66 d	94 d	100 a	85 g	58 f	40 abc	11,294 abc
Glyphosate + AMS	0.75 lb ae/A + 2.5 lb/A	5/20 & 6/02	0a	97 abc	88 ab	100 a	100 a	97 abc	83 abc	100 a	98 a	95 de	78 de	42 abc	11,707 abc
Glyphosate + dimethenamid-P + AMS	0.75 lb ae/A + 0.875 lb ai/A + 2.5 lb/A	5/20 &	0 a	97 bcd	90 a	100 a	96 a	97 abc	89 abc	100 a	100 a	99 ab	93 ab	43 ab	12,010 ab
Glyphosate + AMS	0.75 lb ae/A + 2.5 lb/A	6/02													
Glyphosate + AMS	0.75 lb ae/A + 2.5 lb ai/A	5/20 &	0 a	98 ab	93 a	100 a	100 a	98 ab	93 a	100 a	100 a	99 ab	95 a	44 ab	12,508 ab
Glyphosate + dimethenamid-P + AMS	0.75 lb ae/A + 0.875 lb ai/A + 2.5 lb/A	6/02													
Glyphosate + dimethenamid-P + AMS	0.75 lb ae/A + 0.875 lb ai/A + 2.5 lb/A	5/20	0 a	96 bcd	86 ab	99 abc	96 a	97 abc	90 ab	100 a	99 a	97 cd	94 ab	42 ab	11,884 ab
Ethofumesate-E	1 lb ai/A	4/29 &	0 a	94 cde	84 ab	99 abc	93 ab	95 b-e	84 abc	100 a	100 a	94 def	84 a-d	42 ab	11,771 ab
Glyphosate + AMS	0.75 lb ae/A + 2.5 lb/A	5/20													
Glyphosate + ethofumesate-E + AMS	0.75 lb ae/A + 0.375 lb ai/A + 2.5 lb/A	5/20	0 a	89 ef	69 c	96 cde	71 bcd	91 de	81 abc	97 a-d	100 a	89 fg	63 f	34 cde	9,516 cde
Glyphosate + ethofumesate-E + AMS	0.75 lb ae/A + 0.5 lb ai/A + 2.5 lb/A	5/20	0 a	94 cde	78 bc	100 a	93 ab	94 b-e	83 abc	95 cd	100 a	92 efg	68 ef	37 b-e	10,400 b-e
Glyphosate + ethofumesate-E + AMS	0.75 lb ae/A + 1.0 lb ai/A + 2.5 lb/A	5/20	0 a	84 f	68 c	91 e	68 cd	92 cde	81 abc	95 bcd	99 a	92 efg	56 f	32 de	8,947 de
Glyphosate + ethofumesate-E + AMS	0.75 lb ae/A + 1.5 lb ai/A + 2.5 lb/A	5/20	0 a	90 ef	78 bc	97 bcd	60 d	89 e	77 cd	94 d	100 a	94 def	81 bcd	31 e	8794 e
Glyphosate + ethofumesate-N + AMS	0.75 lb ae/A + 0.375 lb ai/A + 2.5 lb/A	5/20	0 a	93 cde	78 bc	96 de	88 abc	96 bcd	79 bcd	97 a-d	100 a	96 cde	79 cde	39 a-d	11,121 a-d
Glyphosate + ethofumesate-N + AMS	0.75 lb ae/A + 0.188 lb ai/A + 2.5 lb/A	5/20 & 6/02	0 a	97 abc	86 ab	99 a-d	95 ab	97 abc	78 bcd	100 a	100 a	99 abc	78 de	42 ab	11,733 ab

Table 2. continued

Treatment[3]	Application rate	Application dates	Crop injury 6/24	Weed control[2] CHEAL 6/24	CHEAL 10/01	KCHSC 6/24	KCHSC 10/01	AMARE 6/24	AMARE 10/01	SOLSA 6/24	SONOL 10/01	Grass 6/24	Grass 10/01	Root yield	ERS[4]
			------	------	------	------	------	%	------	------	------	------	------	ton/A	lb/A
Glyphosate + AMS	0.75 lb ae/A + 2.5 lb ai/A	5/20 &	0 a	97 abc	86 ab	100 a	95 ab	95 b-e	80 abc	100 a	100 a	97 bcd	78 de	42 ab	11,934 ab
Glyphosate + ethofumesate-N + AMS	0.75 lb ae/A + 0.375 lb ai/A + 2.5 lb/A	6/02													
Glyphosate + AMS	0.75 lb ae/A + 2.5 lb/A	5/20 &	0 a	98 ab	90 a	99 abc	96 ab	98 ab	86 abc	100 a	99 a	99 abc	95 a	44 ab	12,331 ab
Glyphosate + EPTC-EC + AMS	0.75 lb ae/A + 3 lb/A + 2.5 lb/A	6/02													
Glyphosate + AMS	0.75 lb ae/A + 2.5 lb/A	5/20 &	0 a	99 a	93 a	99 abc	99 a	100 a	89 abc	100 a	100 a	100 a	95 a	47 a	13,138 a
Glyphosate + EPTC-GR + AMS	0.75 lb ae/A + 3 lb/A + 2.5 lb/A	6/02													
Glyphosate-H + AMS	0.75 lb ae/A + 2.5 lb/A	5/20 &	0 a	99 a	91 a	100 a	91 ab	98 ab	88 abc	100 a	99 a	99 abc	90 abc	41 abc	11,569 abc
Glyphosate-H + cycloate + AMS	0.75 lb ae/A + 3 lb/A + 2.5 lb/A	6/02													

[1] Means followed by the same letter are not significantly different (P=0.05).

[2] Weeds evaluated for control were common lambsquarters (CHEAL), kochia (KCHSC), redroot pigweed (AMARE), hairy nightshade (SOLSA), annual sowthistle (SONOL) and two grass species, green foxtail (SETVI) and barnyardgrass (ECHCG).

[3] Glyphosate is Roundup Power Max, AMS is ammonium sulfate, glyphosate-H is Helosate Plus, ethofumesate-E is Ethotron. Ethofumesate-N is Nortron, EPTC-EC is Eptam 7E, and EPTC-GR is Eptam 20G.

[4] ERS is estimated recoverable sugar.

<u>Downy brome control in established Kentucky bluegrass</u>. Janice Reed and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were conducted at three sites near Mt. Hope, WA to determine the effect of several pre-emergence and post-emergence herbicides on crop response and downy brome control in established Kentucky bluegrass. All experiments were conducted in stands of 'Kenblue' bluegrass. Plots were 8 by 30 ft, arranged in a randomized complete block design with four replications and an untreated check. Treatments in all studies were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Crop injury and downy brome control were evaluated visually. Downy brome density was estimated visually as a percentage of ground cover in the untreated plots. The crop response study (Site C) was swathed and harvested at maturity. Downy brome control studies were not harvested.

Table 1. Application and soil data.

Location	Site A					Site B					Site C				
Application date	9/26/07	10/30/07	4/17/08	5/2/08	5/15/08	9/26/07	10/30/07	4/16/08	4/28/08	5/13/08	9/26/07	10/23/07	4/16/08	4/28/08	5/13/08
Timing[1]	Pre	Fall	E Sp	Sp	L Sp	Pre	Fall	E Sp	Sp	L Sp	Pre	Fall	E Sp	Sp	L Sp
Growth stage															
Downy brome	Pre	---	---	---	---	Pre	1-2 leaf	4 leaf	1 tiller	2 tiller	Pre	1 leaf	4 leaf	1 tiller	2 tiller
Bluegrass	1-4 in	2-6 in	6-8 in	9-12 in	boot	3-6 in	4-8 in	8-10 in	10-12 in	boot	5-8 in	4-10 in	10-12 in	12-14 in	boot
Air temp (F)	66	51	50	56	69	68	52	43	67	60	70	66	48	66	59
Humidity (%)	48	49	61	60	69	46	56	68	60	57	44	58	64	59	57
Wind speed, direction	4, SW	3, SE	7, SW	5, NE	2, SE	5, SW	3, SE	6, SW	6, SW	4, SW	4, SW	4, NE	7, SW	6, SW	7, SW
Cloud cover (%)	0	0	10	25	100	0	0	50	40	100	0	0	70	60	100
Soil moisture	low	low	high	high	med	low	med	high	med	med	low	med	high	med	med
Soil temp at 2 in (F)	54	46	38	42	52	56	48	35	48	46	59	52	38	50	50
pH			5.0					4.6					4.4		
OM (%)			3.2					3.8					4.3		
CEC(meq/100 g)			20					22					22		
Texture			silt loam					silt loam					silt loam		

[1]Pre is preemergence to downy brome; Fall is post emergence to downy brome; ESp is early spring; Sp is spring; LSp is late spring

At all sites, bluegrass injury from mesosulfuron alone (85 to 94%) was higher than all other treatments (Table 2). Metolachlor, ethofumesate, sulfosulfuron, and oxyfluorfen + diuron injured bluegrass 0 to 5%. Primisulfuron + flucarbazone applied in the fall did not injure bluegrass (0 to 1%) but primisulfuron applied in the fall alone, followed by primisulfuron + flucarbazone in the spring injured bluegrass 11 to 24%. Dicamba alone or with sulfosulfuron injured bluegrass 0 to 5%, but when applied with propoxycarbazone/mesosulfuron, injury was 14 to 19%.

At both sites, mesosulfuron, primisulfuron applied late spring, and dicamba alone did not control downy brome (0 to 5%). Downy brome control at Site B was best with flufenacet/metribuzin treatments (94 to 98%), ethofumesate (94%), and oxyfluorfen + diuron (100%). Downy brome control with metolachlor treatments and ethofumesate (preemergence herbicides) was lower at Site C, likely due to a heavy amount of post-harvest residue on the soil surface. Primisulfuron + flucarbazone treatments controlled downy brome better at site C (90 to 95%).

There was no consistent correlation between downy brome control and bluegrass seed yield. Plots treated with mesosulfuron tended to have the lowest seed yield (90 lb/ac) due to severe injury. Seed yield from flufenacet/metribuzin + metribuzin, propoxycarbazone, and propoxycarbazone/mesosulfuron alone was lower but did not differ from other treatments.

Table 2. Downy brome control and Kentucky bluegrass injury and seed yield with pre- and post-emergence herbicides near Mt. Hope, WA in 2007-2008.

Treatment[1]	Rate	Application Timing[2]	Bluegrass injury[3,4]			Downy brome control[3,4]		Seed yield[5]
			Site A	Site B	Site C	Site B	Site C[6]	Site C
	lb ai/ac		--------------------%--------------------			-------------%-------------		lb/A
Untreated check	---	----	---	---	---	---	---	307 ab
Flufenacet/metribuzin	0.51	pre	28 c	21 bc	21 bdc	98 a	90	257 abc
Flufenacet/metribuzin + metribuzin	0.51 + 0.24	pre + fall	40 b	16 bc	30 b	97 a	95	208 bc
Metolachlor	1.27	pre	2 e	1 d	1 f	78 ab	50	319 ab
Metolachlor + flufenacet/metribuzin	0.635 + 0.25	pre + pre	12 cde	14 bc	13 def	94 a	75	284 abc
Dicamba	2	pre	1 e	0 d	5 ef	5 d	0	240 abc
Dicamba + sulfosulfuron	2 + 0.031	pre + fall	2 e	2 d	4 ef	75 ab	70	254 abc
Dicamba + propoxycarbazone/mesosulfuron	1 + 0.025	pre + fall	19 cd	14 bc	18 cde	65 bc	60	245 abc
Ethofumesate	1	pre	0 e	0 d	0 f	94 a	60	234 abc
Oxyfluorfen + diuron	0.375 + 0.75	fall + fall	1 e	1 d	4 ef	100 a	99	244 abc
Sulfosulfuron	0.031	fall	5 de	0 d	5 ef	65 bc	85	232 abc
Propoxycarbazone	0.04	fall	6 de	10 cd	9 def	50 bc	50	190 bc
Propoxycarbazone/mesosulfuron	0.025	fall	26 c	19 bc	28 bc	60 bc	60	200 bc
Primisulfuron + flucarbazone	0.0178 + 0.0135	fall +fall	1 e	0 d	0 f	62 bc	95	351 ab
Primisulfuron + primisulfuron + flucarbazone	0.0108 + 0.0178 + 0.0135	fall + spring + spring	14 cde	24 b	11 def	55 bc	90	367 ab
Primisulfuron	0.0356	early spring	12 cde	16 bc	10 def	38 c	20	379 ab
Primisulfuron	0.0356	late spring	20 cd	16 b	13 def	5 d	0	432 a
Mesosulfuron	0.0134	spring	85 a	89 a	94 a	0 d	0	90 c
Downy brome cover (% stand in untreated check)						25-50 %	30-60 %	

[1] Non-ionic surfactant (R-11) was applied at 0.5% v/v with sulfosulfuron, propoxycarbazone, flucarbazone, and mesosulfuron, and at 0.25% v/v with diuron. Primisulfuron alone was applied with crop oil concentrate (Moract) at 2.5% v/v. Urea ammonium nitrate (UAN) was applied at 2 qt/A with propoxycarbazone, propoxycarbazone/mesosulfuron treatments and mesosulfuron.

[2] Pre = pre-emergence to downy brome. Fall treatments were applied to emerged (1-2 leaf) downy brome. Early spring is before April 10 and late spring is after April 20. Spring treatments were applied later than specified due to prolonged snow cover.

[3] Downy brome control and crop injury are expressed as a percent of the untreated check. Bluegrass injury and downy brome control rated on 6/24/08.

[4] Means in a column followed by the same letter do not differ significantly at $P \leq 0.05$.

[5] Only 3 replications were used for statistical analysis of yield due to brome infestation in rep 1.

[6] Downy brome present in rep 1 only, therefore data could not be analyzed statistically.

Corn yield is affected by its frequency in a rotation. Randy L. Anderson. (USDA-ARS, Brookings SD 57006). Weed management is expanding its conceptual approach to include cultural strategies related to weed population management [Anderson (2005) Agron. J. 97:1579]. This change in weed management has been stimulated by increased diversity in crop rotations because of no-till systems. Producers in the Central Great Plains are managing weeds with 50% less inputs with a population-centered approach compared with conventional management.

Weed management is a major production cost for producers in the western Corn Belt. To reduce these input costs, we are seeking to develop population–centered weed management in this region. One key component of population-centered management is competitive crops that suppress weed growth and subsequent seed production. We have been examining impact of alternative crops on corn canopy development and interaction with weeds. Corn tolerance to weeds varies with preceding crop; corn yields more following dry pea compared with soybean or spring wheat in weed-infested conditions.

A further study is evaluating the interaction between preceding crop and corn population on corn yield. With this study, a unique field setup provided an opportunity to measure impact of the frequency corn appears in a rotation on corn yield. This report summarizes corn yield as affected by different cropping histories.

Methodology:

The study's primary objective is to compare corn yield as affected by preceding crop (dry pea, soybean, and spring wheat) and corn population. The study was established with no-till at two sites. At the first site, the preceding crop treatments were established in corn stubble, whereas at the second site, the alternative crops were established in soybean, but the cropping history was corn-spring wheat-soybean-alternative crops-corn. Thus, the cropping frequency for corn at site 2 was once every four years, contrasting with site 1 and its cropping frequency of corn once every 2 years.

Field pea, soybean, and spring wheat were grown in designated plots during 2006. In 2007, corn (DeKalb 47-10 RR/YGCB) was planted at 14,000, 17,000, and 20,000 plants/ac in all preceding crops. Weeds in corn were controlled by a pre-emergence application of S-metolachlor, a post application of glyphosate, and hand weeding. Weeds present at time of planting in both subplots were controlled with glyphosate. Plot size was 20 feet by 10 feet.

At physiological maturity, 5 corn plants were harvested for dry matter weight; grain yield was determined by harvesting the entire plot.

Results:

Corn yielded 24% more at site 2 with a cropping frequency of 4 compared with site 1 and a 2-year cropping frequency (Table 1). Other studies have shown that corn yield is influenced by its frequency in the rotation. In a tilled system in Minnesota, corn yielded 5% more in a corn-soybean-soybean rotation compared to corn-soybean [Porter et al. (1997) Agron. J. 98:247]. However, Zhang et al. [(1996) Can. J. Plant Sci. 76:795] reported that corn yielded 41% more in a winter wheat-corn-soybean rotation compared with corn-soybean in Ontario. Thus, it appears that crop diversity may interact with crop frequency to affect corn yield.

Corn yield was less following spring wheat compared with the two legumes as preceding crops at both sites. The suppression of corn yield following spring wheat may reflect allelopathic injury by spring wheat, which has been observed in the northern Corn Belt when temperatures during the seedling growth interval are cooler than normal.

Corn yield did not differ between dry pea and soybean as preceding crops, contrasting with previous research where corn yielded 12% more after dry pea across 4 years. We speculate that a change in N fertilizer management may have altered the preceding crop effect. In this study, we broadcast all of the N fertilizer at planting, contrasting with earlier studies where most of the N was applied at the V-6 growth stage. The early N application may have masked the favorable impact of dry pea on corn compared with soybean.

Table 1. Corn yield as affected by frequency of corn in the rotation.

Preceding crop	Cropping frequency of corn in rotation Once every 4 years	 Once every 2 years
	bu/ac	*bu/ac*
Soybean	147	121
Dry pea	145	118
Spring wheat	136	105
Average	143	115

Implications for Weed Management

In our program, we have observed that crop sequencing affects corn tolerance to weeds. Corn was 3-fold more tolerant to a uniform infestation of foxtail millet (*Setaria italica*) when following dry pea compared with soybean [Anderson (2008) WSWS research reports, p. 70]. This current study shows corn growth and yield also may be affected by the frequency of corn in the rotation. We speculate that this enhanced growth with corn by crop frequency may further improve corn tolerance to weeds.

However, we noted a surprising trend in our study when we compared yield among corn populations. The impact of cropping frequency was more pronounced at lower populations with all preceding crop treatments. Yield was 35% higher at 14,000 plants/ac with a 4-year cropping frequency compared to the 2-year cropping frequency (Table 2). In contrast, yield gain was only 13% with the 20,000 plant population.

This trend may seem anomalous, but some scientists consider low population a density stress for corn growth [Tollenaar (1992) Maydica 37:305]. Porter et al. (1997; Agron. J. 89:441) observed that the benefit of crop diversity on corn growth was more pronounced in stressed environments; our population yield response agrees with this premise if low populations are a stress for corn in this environment.

If this population-by-crop frequency trend is consistent across years, it may provide a management option for producers to reduce input costs. Corn could be planted at lower populations in diverse crop rotations, yet still accrue similar yield levels compared with rotations of less crop diversity. Also, corn is grown throughout in the Great Plains region, where environmental conditions can vary widely. We suggest that rotation design and crop frequency may have a greater impact on corn production in the drier regions of the Great Plains.

Table 2. Gain in corn yield and biomass with a 4-year cropping frequency compared to a 2-year frequency, as affected by corn population. Yields averaged across preceding crops (pea, soybean, and spring wheat).

Corn Population	Biomass	Yield
Plants/acre	*% Gain*	*% Gain*
14,000	27	35
17,000	11	29
20,000	7	13

Pea synergism to corn is not related to seedling growth. Randy L. Anderson. (USDA-ARS, Brookings SD 57006). We have found that corn tolerance to weeds is affected by the preceding crop in no-till [2008 WSWS research reports, pages 79-80]. With a uniform infestation of foxtail millet [*Setaria italica* (L.) Beauv], corn yielded 2-fold more following dry pea compared with soybean. Corn also yielded 13% more grain following pea in weed-free conditions than following soybean.

We wondered if this synergistic effect of dry pea was related to corn seedling development, as rapid growth and development of seedlings often improves crop tolerance to weeds. Identifying the plant variable most responsive to crop sequence may provide insight for enhancing the benefit of preceding crop on corn growth. Therefore, we monitored corn seedling development and growth following three preceding crops to see if we could identify which plant response may be related to the synergism between pea and corn.

Methodology:

In 2008, corn was established at 20,000 plants/acre with no-till into stubble of dry pea, soybean, and spring wheat grown in 2007. The hybrid was DeKalb 47-10 RR/YGCB; nitrogen and phosphorus was banded by the seed at planting at the rate of 7 lb N + 25 lbs P/acre.

We measured seedling emergence rate and development until the 6th leaf stage. At this stage, we measured biomass, plant height, and concentration of various nutrients in plants. We also recorded when ear silks were visible.

To determine if residues of the preceding crop affected weed seedling emergence, seeds of foxtail millet were spread on the soil surface in a 0.5 yd^2 quadrat and seedling emergence recorded weekly. After counting, seedlings were removed by hand. In the rest of the plot area, weeds were controlled by a pre-emergence application of S-metolachlor, a post application of glyphosate, and hand weeding. Weeds present at time of planting were controlled with glyphosate. Plot size was 20 feet by 10 feet, and there were four replications for each preceding crop. Grain yield was determined by harvesting the entire plot.

Results:

For all parameters with one exception, corn following dry pea did not show a growth advantage compared to following soybean (Table). The only exception was grain yield; corn yielded 11% more following dry pea. Yield did not differ when corn followed either soybean or spring wheat.

We also measured nutrient concentrations in corn plants to see if the preceding crop effect may be related to soil microbial factors. Differences in N concentration may reflect more favorable N cycling in the soil whereas higher P, Cu, and Zn concentrations in corn indicate that mycorrhizae may be more prominent following some crops. Yet, no differences occurred with corn following any crop; apparently, soil and microbial changes due to dry pea, soybean, or spring wheat were not affecting corn growth.

Foxtail millet seedling emergence did not differ between soybean and dry pea, but density was higher in the spring wheat stubble. Emergence was delayed in spring wheat stubble (see Figure), which we attribute to cooler soil temperatures because of wheat residues on the soil surface.

Based on our results, we suggest that the beneficial impact of dry pea on corn yield may be physiological, as morphological differences with corn growth did not occur that would favor corn following dry pea. In some way, dry pea synergistically improves corn yield and tolerance to weeds.

Our long-term goal is to develop cropping systems that enhance natural benefits inherent in the agroecosystem. Because the sequence of dry pea followed by corn is more favorable for both grain yield and weed tolerance than soybean, we are pursuing further research to integrate this sequence into Corn Belt cropping systems.

Table. Agronomic response of corn to preceding crop. Asterisk (*) indicates that a mean for an agronomic variable with either pea or spring wheat differs from soybean mean.

	Preceding crop		
Agronomic Variable	Soybean	Pea	Spring wheat
Corn seedling data			
Mean emergence rate (days)	17.6	18.3	19.8*
V-6 leaf stage (days after June 1)	21	23	23
Measurements at V-6 stage			
Height (inches)	17.3	14.1*	12.2*
Biomass (gm/plant)	3.7	2.5*	2.3*
N (%)	3.3	3.2	3.1
P (%)	0.48	0.47	0.50
Zn (ppm)	36	36	39
Cu (ppm)	9	9	8
Height at V-9 (inches)	59	54*	45*
Silking (days after July 1)	29	30	33*
Yield (bu/ac)	95	104*	94
Weed density (plants/yd^2)	52	49	63*

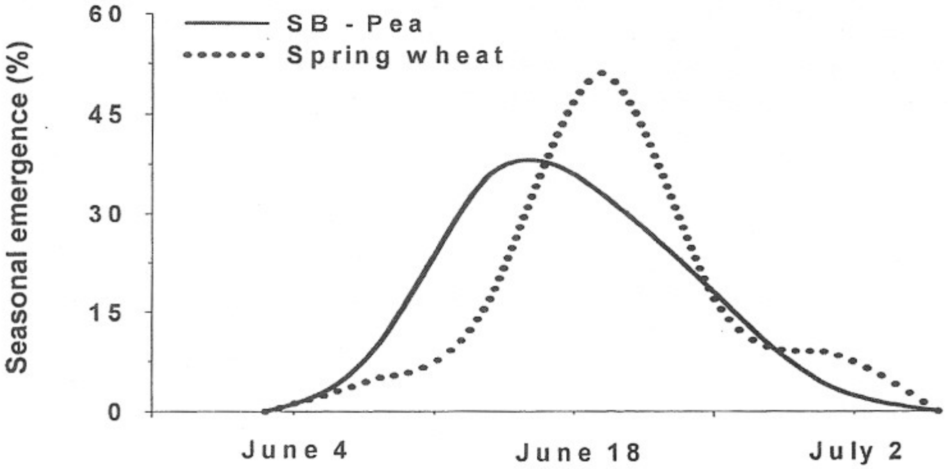

Figure. Seedling emergence of foxtail millet as affected by preceding crop.

Prickly lettuce control in fallow. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) An experiment was established in fallow to determine prickly lettuce control with saflufenacil. The experiment was located at the University of Idaho Kambitsch farm near Genesee, Idaho (Latah County). Herbicides were applied with a CO_2 pressurized backpack sprayer on May 13, 2008. The saflufenacil + glyphosate 5 gpa treatment was applied at 5 gpa and all other herbicides were applied at 10 gpa. Prickly lettuce had 2 to 4 leaves and the population averaged 1 plant/ft^2. Air and soil temperature, relative humidity, and wind velocity were 54 and 56 F, 44%, and southwest at 2 mph, respectively. The sky was overcast and the soil was dry on the surface. Soil pH, organic matter, CEC, and texture were 5.1, 3.5%, 20 cmol/kg, and silt loam, respectively. The untreated control and the saflufenacil alone treatments were sprayed with quizalofop + crop oil concentrate (0.07 lb ai/a + 1% v/v) on May 27 to control volunteer wheat. The experimental design was a randomized complete block with four replications, and experimental units were 8 by 30 ft. Prickly lettuce control was evaluated visually.

On June 11, prickly lettuce control was 90% with saflufenacil + glyphosate (0.0445 + 0.75 lb/a) and saflufenacil + glyphosate + dicamba (0.016 + 0.5 + 0.125 lb/a) although control was not statistically different from other treatments resulting in 80% control and higher (Table). Prickly lettuce control was least with saflufenacil alone and carfentrazone + glyphosate (0.008 + 0.75 lb/a) at 75 and 68%, respectively. By July 14, prickly lettuce was re-growing, control had dropped below 63% for all treatments, and there were no differences among treatments.

Table. Prickly lettuce control in fallow near Genesee, Idaho.

Treatment[1]	Rate[2]	Prickly lettuce control	
		June 11	July 14
	lb/a	---------------- % -------------	
Saflufenacil	0.016	75 cd[3]	62 a
Glyphosate	0.75	83 abc	37 a
Saflufenacil + glyphosate	0.016 + 0.75	80 abc	23 a
Saflufenacil + glyphosate	0.0223 + 0.75	78 bcd	33 a
Saflufenacil + glyphosate	0.0445 + 0.75	90 a	53 a
Saflufenacil + glyphosate + dicamba	0.016 + 0.5 + 0.125	90 a	43 a
Carfentrazone + glyphosate	0.008 + 0.75	68 d	17 a
2,4-D amine + glyphosate	0.475 + 0.75	80 abc	25 a
Saflufenacil + glyphosate applied at 5 gpa	0.016 + 0.75	88 ab	45 a

[1] Crop oil concentrate and ammonium sulfate were added to all treatments at 1% v/v and 17 lb ai/a, respectively, except carfentrazone + glyphosate in which the rates were 1.5% v/v and 20 lb ai/a, respectively.

[2] All rates are expressed as lb ai/a except glyphosate and 2,4-D which are lb ae/a.

[3] Means followed by the same letter are not significantly different according to $LSD_{(0.05)}$.

Tillage affects imazamox carryover in yellow mustard. Jonquil R. Rood, Traci A. Rauch, Donald C. Thill and Bahman Shafii (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339), Rodney J. Rood and Joseph P. Yenish (Crop and Soil Sciences, Washington State University, Pullman, WA 99163), and Daniel A. Ball and Larry Bennett (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801). Studies were established in fall 2006 near Genesee, ID, Davenport, WA, and Pendleton, OR in 'ORCF-101' winter wheat to determine how tillage affects imazamox persistence in soil. Studies were arranged in a split block, split plot with four replications and included an untreated check. Treatments are three tillage systems (conventional, minimum, and direct seed) and seven herbicide treatments (1, 2, and 3x rates of imazamox applied in fall 2006 and spring 2007, plus an untreated control). Wheat seed was harvested with a small plot combine at Genesee on August 13, Davenport on August 1, and Pendleton on July 24, 2007 (data not shown). Moldboard and chisel plow tillage strips were applied fall 2007 and were field cultivated prior to spring planting at all three sites. In spring 2008, 'IdaGold' yellow mustard was seeded with a Fabro no-till drill at all three sites. Yellow mustard seed was harvested with a small plot combine at Genesee on August 28, Davenport on September 9, and Pendleton on July 31.

Table 1. Application and soil data.

Location	Genesee, ID		Davenport, WA		Pendleton, OR	
Application date	12/14/06	5/11/07	10/27/06	4/26/07	11/20/06	3/22/07
Wheat growth stage	3-4 leaves	2-3 tillers	3-4 leaves	2-3 tillers	3-4 leaves	2-3 tillers
Air temperature (F)	48	80	39	52	54	64
Relative humidity (%)	90	58	89	48	64	52
Wind (mph, direction)	2, N	5.5, N	6.5, N	7, N	1, N	3, N
Cloud cover (%)	100	0	100	20	50	80
Soil moisture	wet	moist	dry	moist	wet	dry
Soil temperature at 2 in (F)	40	42	40	42	52	62
pH	6.0		4.9		5.0	
OM (%)	4.0		3.1		2.4	
CEC (meq/100g)	28		19		20	
Texture	silt loam		silt loam		silt loam	

Yellow mustard data are expressed as a percentage of the untreated control (Tables 2-5). Data are presented by location and separated by treatment and tillage for both the Davenport and Genesee sites because there were no significant treatment by tillage interactions. There was a significant treatment by tillage interaction for the Pendleton site, however only main affect means are presented here.

At Pendleton and Genesee, seed yield was reduced the least by the 1X fall and spring rates of imazamox compared to other treatments (Table 2). At Davenport, the 1X imazamox rate applied in the fall had significantly higher mustard yield than all other treatments.

At Pendleton and Genesee, mustard injury was the same among tillage treatments, while at Davenport, injury was least in the minimum tillage (Table 3). At all three locations, biomass and yield was not significantly different among tillage treatments. Seed yield was not different between fall and spring applied imazamox treatments at Pendleton and Genesee (Tables 4 and 5). At Davenport, seed yield was less with spring applied imazamox compared to fall application. Injury was always greater for the 2X versus the 1X application rate at all locations. At all locations, injury was reduced and seed yield increased at the 1X application rate compared to the 2X and 3X application rate, while biomass increased only at Pendleton and Genesee.

Table 2. Mustard injury, biomass, and yield averaged over tillages as a percentage of the untreated control for Pendleton, Genesee, and Davenport in 2008.

Treatment	Rate	Application timing	Pendleton			Genesee			Davenport		
			Injury	Biomass	Yield	Injury	Biomass	Yield	Injury	Biomass	Yield
	lb ai/A						%				
Imazamox	0.047	Fall	39	44	57	48	68	66	48	38	69
Imazamox	0.094	Fall	64	33	15	64	45	36	80	57	15
Imazamox	0.140	Fall	73	22	10	79	25	19	89	12	11
Imazamox	0.047	Spring	45	24	50	50	43	51	81	34	25
Imazamox	0.094	Spring	68	7	18	71	29	26	95	8	6
Imazamox	0.0140	Spring	82	7	7	81	32	14	98	1	0
$LSD_{0.05}$			9	16	12	12	21	24	8	NS	15

Table 3. Mustard injury, biomass, and yield averaged over treatments for Pendleton, Genesee, and Davenport in 2008.

Tillage	Pendleton			Genesee			Davenport		
	Injury	Biomass	Yield	Injury	Biomass	Yield	Injury	Biomass	Yield
					%				
Conventional	62	11	29	67	38	28	84	6	15
Minimum	64	21	23	70	29	30	79	15	23
Direct-seed	60	35	27	59	55	50	83	54	26
$LSD_{0.05}$	NS	NS	NS	NS	NS	NS	4	NS	NS

Table 4. Mustard injury, biomass, and yield contrasts for Pendleton, Genesee, and Davenport in 2008.

Contrasts	Pendleton			Genesee			Davenport		
	Injury	Biomass	Yield	Injury	Biomass	Yield	Injury	Biomass	Yield
					%				
Fall vs. Spring	0.0092	<.0001	0.5095	0.6046	0.0246	0.2840	<.0001	0.1298	<.0001
1X vs. 2X	<.0001	0.0171	<.0001	<.0001	0.0057	0.0014	<.0001	0.8449	<.0001
1X vs. 2&3X	<.0001	0.0013	<.0001	<.0001	0.0006	<.0001	<.0001	0.2790	<.0001

DF=1

Table 5. Mustard injury, biomass, and yield contrast means for Pendleton, Genesee, and Davenport in 2008.

	Fall vs. Spring			1X vs. 2X			1X vs. 2&3X		
	Injury	Biomass	Yield	Injury	Biomass	Yield	Injury	Biomass	Yield
	%								
Pendleton	59/65	33/12	27/25	42/66	34/20	54/17	42/72	34/17	54/13
Genesee	62/64	49/34	41/33	46/66	58/36	61/32	46/72	58/34	61/26
Davenport	72/91	36/14	32/10	64/87	36/33	47/11	64/90	36/20	47/8

[1] Numbers to the left of the slash represent means for the fall while numbers to the right of the slash represent means for the spring.

[2] Numbers to the left of the slash represent means for 1X while numbers to the right of the slash represent means for 2X.

[3] Numbers to the left of the slash represent means for 1X while numbers to the right of the slash represent means for 2&3X.

Broadleaf weed control in tribenuron tolerant sunflower with preemergence followed by sequential postemergence herbicides. Richard N. Arnold, Michael K. O'Neill and Kevin A. Lombard. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on June 2, 2008 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of tribenuron tolerant sunflower (var. Pioneer 63N82) and annual broadleaf weeds to preemergence followed by sequential postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with four replications. Individual plots were 4, 34 in rows 30 ft long. Sunflower was planted with flexi-planters equipped with disk openers on June 2. Preemergence treatments were applied on June 3 and immediately incorporated with 0.75 in of sprinkler-applied water. Postemergence treatments were applied on July 3 when sunflowers were in the V3 to V4 leaf stage and weeds were <3 in tall. All postemergence treatments had crop oil concentrate (Clean Crop) applied at 1.0% v/v. Black nightshade, prostrate and redroot pigweed were heavy, common lambsquarters were moderate and Russian thistle infestations were light throughout the experimental area. Treatments were evaluated on August 4. Sunflowers were harvested for yield on September 22.

No crop injury was noted from any of the treatments. Tribenuron applied preemergence at either 0.031 or 0.062 lb ai/A gave poor control of Russian thistle. Common lambsquarters, black nightshade, redroot and prostrate pigweed control were excellent with all treatments except the weedy check. Yields were 2176 to 2336 lb/A higher in the herbicide treated plots as compared to the weedy check.

Table. Broadleaf weed control in tribenuron tolerant sunflower with preemergence followed by sequential postemergence herbicides.

		Crop			Weed control[2]			
Treatments[1]	Rate	injury[2]	CHEAL	SOLNI	AMARE	AMABL	SASKR	Yield
	lb ai/A	—%—			—%—			lb/A
Tribenuron	0.031	0	94	98	97	96	82	3456
Tribenuron	0062	0	96	99	97	99	82	3552
Sulfentrazone	0.094	0	100	97	100	100	100	3513
Sulfentrazone	0.14	0	100	100	100	100	100	3616
Sulfentrazone+ tribenuron	0.14+0.007	0	100	100	100	100	100	3558
Sulfentrazone+ tribenuron	0.14+0.015	0	100	100	100	100	100	3603
Sulfentrazone/tribenuron	0.094/0.007	0	100	100	100	100	100	3488
Sulfentrazone/tribenuron	0.094/0.015	0	100	100	100	100	100	3494
S-metolachlor/tribenuron	1.25/0.015	0	98	100	100	100	98	3456
Pendimethalin/tribenuron	0.8/0.015	0	98	99	98	96	98	3462
Weedy check		0	0	0	0	0	0	1280
LSD (0.05)		0	1	1	1	1	2	303

[1] First treatment applied preemergence then a slash, followed by a sequential postemergence treatment.

[2] Rated on a scale from 0 to 100 with 0 being no control or crop injury and 100 being dead plants.

Preplant broadleaf weed control with BAS 800H in spring pea and wheat. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Prickly lettuce, a broadleaf weed often found in direct seed systems, has sometimes shown tolerance to glyphosate alone. Glyphosate is often combined with a broadleaf herbicide to improve prickly lettuce control. BAS 800H, a PPO inhibitor broadleaf herbicide, may be used to control ALS and 2,4-D resistant prickly lettuce prior to planting (preplant burndown). Studies were established near Genesee, ID to evaluate visual crop injury and prickly lettuce and volunteer canola control with BAS 800H combinations compared to glyphosate alone prior to seeding spring pea or wheat. All plots were 8 by 30 feet arranged in a randomized complete block design with four replications. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Crop injury and broadleaf weed control were evaluated visually.

Table 1. Application and soil data.

Crop	'Aregon' spring pea	'Alturus' spring wheat
Application date	May 1, 2008	May 1, 2008
Seeding date	May 12, 2008	May 15, 2008
Growth stage		
Prickly lettuce	3 inch	2 inch
Volunteer canola	--	2 leaf
Air temperature (F)	55	55
Relative humidity (%)	47	46
Wind (mph, direction)	3, SW	2, W
Cloud cover (%)	75	80
Soil moisture	adequate	adequate
Soil temperature at 2 inch (F)	50	52
pH	5.7	5.4
OM (%)	2.9	2.5
CEC (meq/100g)	28	28
Texture	silt loam	silt loam

At both sites and all evaluation times, prickly lettuce control was 91% or greater for all treatments containing glyphosate (Table 2 and 3). Volunteer canola control was 96 to 99% at 27 days after treatment (DAT) and 73 to 92% at 38 DAT for all glyphosate treatments. BAS 800H alone did not control prickly lettuce or volunteer canola.

Table 2. Prickly lettuce control with BAS 800H combinations in spring pea near Genesee, ID in 2008.

		Prickly lettuce control	
Treatment[1]	Rate	12 DAT	39 DAT
	lb ai/A	--------------------%--------------------	
Glyphosate +	0.375		
NIS	0.25% v/v	92	98
Glyphosate +	0.75		
NIS	0.25% v/v	91	98
BAS 800H	0.0223	15	8
BAS 800H +	0.0223		
glyphosate	0.75	99	99
BAS 800H +	0.0445		
glyphosate	0.75	99	99
Carfentrazone +	0.0084		
glyphosate	0.75	99	99
LSD (0.05)		9	4
Density (plants/ft^2)		5	

[1] NIS is a nonionic surfactant (R-11). Crop oil concentrate (Moract) was applied at 1% v/v with BAS 800H and carfentrazone treatments. Ammonium sulfate (Bronc) was applied at 17 lb ai/100 gal with all treatments. Glyphosate rates are in lb ae/A.

Table 3. Prickly lettuce and volunteer canola control with BAS 800H combinations in spring wheat near Genesee, ID in 2008.

		Prickly lettuce control		Volunteer canola control	
Treatment[1]	Rate	27 DAT	38 DAT	27 DAT	38 DAT
	lb ai/A	--------------------------------%-------------------------------			
Glyphosate +	0.375				
NIS	0.25% v/v	99	96	98	88
Glyphosate +	0.75				
NIS	0.25% v/v	99	92	98	86
BAS 800H	0.016	54	0	29	0
BAS 800H +	0.016				
glyphosate	0.75	99	96	96	73
BAS 800H +	0.034				
glyphosate	0.75	99	96	97	92
2,4-D amine +	0.475				
glyphosate +	0.75				
NIS	0.25%v/v	99	96	99	94
LSD (0.05)		19	7	19	25
Density (plants/ft^2)		2		15	

[1] NIS is a nonionic surfactant (R-11). Crop oil concentrate (Moract) was applied at 1% v/v with all BAS 800H treatments. Ammonium sulfate (Bronc) was applied at 17 lb ai/100 gal with all treatments. Glyphosate and 2,4-D amine rates are in lb ae/A.

Preplant broadleaf and grass weed control with flucarbazone plus glyphosate in spring wheat. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established near Genesee and Moscow ID to evaluate spring wheat response, and broadleaf weed, wild oat and Italian ryegrass control with flucarbazone plus glyphosate combinations compared to glyphosate alone applied prior to seeding spring wheat. All plots were arranged in a randomized complete block design with four replications. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Crop injury and weed control were evaluated visually. Spring wheat grain was harvested using a small plot combine at the broadleaf weed and wild oat sites on September 2 and 3, 2008, respectively. The Italian ryegrass site was not harvested.

Table 1. Application and soil data.

	Broadleaf weed site		Wild oat site		Italian ryegrass site	
Location	Genesee, ID		Moscow, ID		Moscow, ID	
Application date	5/1/08	6/8/08	5/1/08	6/8/08	5/1/08	6/3/08
Seeding date	5/15/08		5/16/08		5/7/08	
Growth stage						
Spring wheat	preplant	3 leaf	preplant	2 leaf	preplant	3 leaf
Prickly lettuce (LACSE)	2 inch	3 inch	--	--	--	--
Volunteer canola (BRSNS)	2 leaf	3 leaf	--	--	--	--
Wild oat (AVEFA)	--	--	spike	3 leaf	--	--
Italian ryegrass (LOLMU)	--	--	--	--	preemergence	2 leaf
Air temperature (F)	55	69	45	61	56	51
Relative humidity (%)	46	50	58	59	42	84
Wind (mph, direction)	2, W	0	0	3, SW	1, W	1, SE
Dew present?	no	no	yes	no	no	yes
Cloud cover (%)	80	60	30	50	50	60
Soil moisture	adequate	adequate	adequate	adequate	excessive	adequate
Soil temperature at 2 inch (F)	52	62	44	60	52	52
pH	5.4		5.3		5.0	
OM (%)	2.5		3.3		3.4	
CEC (meq/100g)	28		26		22	
Texture	silt loam		silt loam		silt loam	

At the broadleaf weed site, no treatment injured spring wheat (data not shown). Prickly lettuce (LACSE) control was 61 to 99% and did not differ among treatments (Table 2). All treatments controlled volunteer canola (BRSNS) 99%. Wheat grain yield and test weight ranged from 47 to 53 bu/A and 59.8 to 60.6 lb/bu, respectively, and did not differ among treatments.

At the wild oat site, no treatment injured spring wheat (data not shown). On July 9, pyroxsulam treatments and pinoxaden plus glyphosate controlled wild oat 94 to 98% which was better than treatments containing clodinafop, propoxycarbazone and all preplant only treatments (5 to 75%). By July 28, pinoxaden plus glyphosate controlled wild oat (94%) better than all treatments except pinoxaden plus glyphosate combined with BAS 800H and pyroxsulam at 0.0164 lb ai/A (91 and 81%). Wheat grain yield was greater in the clodinafop, pyroxsulam at 0.0164 lb ai/A, and pinoxaden plus glyphosate treatments compared to all preplant only treatments, except glyphosate plus flucarbazone and dicamba all applied preplant.

At the Italian ryegrass site, pyroxsulam treatments injured spring wheat 3 and 4% (Table 4). Pinoxaden treatments controlled Italian ryegrass 93 to 97% which was better than treatments containing clodinafop and all preplant only treatments (0 to 40%).

Table 2. Spring wheat response and prickly lettuce and volunteer canola control with flucarbazone plus glyphosate combinations near Genesee, ID in 2008.

		Application	Weed control[3]		Wheat	
Treatment[1]	Rate	timing[2]	LACSE	BRSNS	Yield	Test weight
	lb ai/A		%	%	bu/A	lb/bu
Glyphosate	0.4	preplant	99	99	49	60.3
Glyphosate +	0.4	preplant				
fluroxypyr/clopyralid +	0.187	3 leaf				
MCPA ester	0.25	3 leaf	99	99	53	60.4
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
fluroxypyr/clopyralid +	0.187	3 leaf				
MCPA ester	0.25	3 leaf	99	99	48	60.4
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
dicamba +	0.0625	preplant				
fluroxypyr/clopyralid +	0.187	3 leaf				
MCPA ester	0.25	3 leaf	61	99	51	60.3
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
pyraflufen +	0.0016	preplant				
fluroxypyr/clopyralid +	0.187	3 leaf				
MCPA ester	0.25	3 leaf	79	99	50	60.0
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
dicamba +	0.0625	preplant				
fluroxypyr/clopyralid +	0.187	3 leaf				
MCPA ester +	0.25	3 leaf				
flucarbazone +	0.0089	3 leaf				
NIS	0.25% v/v	3 leaf	83	99	49	60.6
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
pyraflufen +	0.0016	preplant				
fluroxypyr/clopyralid +	0.187	3 leaf				
MCPA ester +	0.25	3 leaf				
flucarbazone	0.0089	3 leaf	80	99	47	60.3
Glyphosate +	0.4	preplant				
fluroxypyr/clopyralid +	0.187	3 leaf				
MCPA ester +	0.25	3 leaf				
flucarbazone	0.0179	3 leaf	99	99	49	60.3
Glyphosate +	0.4	preplant				
fluroxypyr/clopyralid +	0.187	3 leaf				
MCPA ester +	0.25	3 leaf				
clodinafop	0.05	3 leaf	99	99	49	59.8
LSD (0.05)			NS	NS	NS	NS
Density (plants/ft^2)			0.5	1		

[1] Ammonium sulfate (Bronc) was applied preplant at 1 lb ai/gal with all treatments. NIS is a nonionic surfactant (R-11). Glyphosate, fluroxypyr/clopyralid and MCPA ester rates are in lb ae/A.

[2] Application timing based on spring wheat growth stage.

[3] July 16, 2008 evaluation date.

Table 3. Spring wheat response and wild oat control with flucarbazone plus glyphosate combinations near Moscow, ID in 2008.

Treatment[1]	Rate	Application timing[2]	Wild oat control		Wheat yield
			7/9/08	7/28/08	
	lb ai/A		%	%	lb/A
Glyphosate	0.4	preplant	5	0	636
Glyphosate +	0.4	preplant			
flucarbazone +	0.0134	preplant			
dicamba	0.0625	preplant	13	5	836
Glyphosate +	0.4	preplant			
flucarbazone +	0.0134	preplant			
dicamba +	0.0625	preplant			
flucarbazone	0.0089	2 leaf	81	56	909
Glyphosate +	0.4	preplant			
flucarbazone +	0.0134	preplant			
dicamba +	0.0625	preplant			
flucarbazone	0.0134	2 leaf	88	64	913
Glyphosate +	0.4	preplant			
flucarbazone +	0.0134	preplant			
dicamba +	0.0625	preplant			
propoxycarbazone	0.00875	2 leaf	75	51	1112
Glyphosate +	0.4	preplant			
flucarbazone +	0.0134	preplant			
dicamba +	0.0625	preplant			
clodinafop	0.025	2 leaf	65	65	1135
Glyphosate +	0.4	preplant			
pinoxaden	0.054	2 leaf	98	94	1130
Glyphosate +	0.4	preplant			
BAS 800H	0.016	preplant	5	2	569
Glyphosate +	0.4	preplant			
BAS 800H +	0.016	preplant			
flucarbazone	0.0134	preplant	8	0	746
Glyphosate +	0.4	preplant			
flucarbazone +	0.0134	preplant			
dicamba +	0.0625	preplant			
pyroxsulam	0.0082	2 leaf	96	66	1118
Glyphosate +	0.4	preplant			
pyroxsulam	0.0164	2 leaf	94	81	1176
Glyphosate +	0.4	preplant			
flucarbazone	0.027	2 leaf	90	76	985
Glyphosate +	0.4	preplant			
BAS 800H +	0.016	preplant			
pinoxaden	0.054	2 leaf	89	91	1072
Glyphosate +	0.4	preplant			
BAS 800H +	0.016	preplant			
flucarbazone +	0.0134	preplant			
flucarbazone	0.0134	2 leaf	87	69	885
LSD (0.05)			17	16	380
Density (plants/ft^2)			30		

[1] Ammonium sulfate (Bronc) was applied at 1 and 1.5 lb ai/gal with glyphosate preplant and pyroxsulam at the 2 leaf stage, respectively. A crop oil concentrate (Moract) and basic blend (Quad 7) were applied at 1% v/v with all BAS 800H and flucarbazone at the 2 leaf stage, respectively. A nonionic surfactant (R-11) at 0.5% v/v was applied with pyroxsulam. Glyphosate rate is in lb ae/A.

[2] Application timing based on spring wheat growth stage.

Table 4. Spring wheat injury and Italian ryegrass control with flucarbazone plus glyphosate combinations near Moscow, ID in 2008.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	Italian ryegrass control[4]
	lb ai/A		%	%
Glyphosate	0.4	preplant	0	0
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant		
dicamba	0.0625	preplant	0	0
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant		
dicamba +	0.0625	preplant		
flucarbazone	0.0089	3 leaf	0	64
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant		
dicamba +	0.0625	preplant		
flucarbazone	0.0134	3 leaf	0	68
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant		
dicamba +	0.0625	preplant		
propoxycarbazone	0.00875	3 leaf	0	80
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant		
dicamba +	0.0625	preplant		
clodinafop	0.025	3 leaf	0	25
Glyphosate +	0.4	preplant		
pinoxaden	0.054	3 leaf	0	93
Glyphosate +	0.4	preplant		
BAS 800H	0.016	preplant	0	40
Glyphosate +	0.4	preplant		
BAS 800H +	0.016	preplant		
flucarbazone	0.0134	preplant	0	25
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant		
dicamba +	0.0625	preplant		
pyroxsulam	0.0082	3 leaf	4	83
Glyphosate +	0.4	preplant		
pyroxsulam	0.0164	3 leaf	3	88
Glyphosate +	0.4	preplant		
flucarbazone	0.027	3 leaf	0	84
Glyphosate +	0.4	preplant		
BAS 800H +	0.016	preplant		
pinoxaden	0.054	3 leaf	0	97
Glyphosate +	0.4	preplant		
BAS 800H +	0.016	preplant		
flucarbazone +	0.0134	preplant		
flucarbazone	0.0134	3 leaf	0	68
LSD (0.05)			2	30
Density (plants/ft^2)				

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[1] Ammonium sulfate (Bronc) was applied at 1 and 1.5 lb ai/gal with glyphosate preplant and pyroxsulam at the 3 leaf stage, respectively. A crop oil concentrate (Moract) and basic blend (Quad 7) were applied at 1% v/v with all BAS 800H and flucarbazone at the 3 leaf stage, respectively. A nonionic surfactant (R-11) at 0.5% v/v was applied with pyroxsulam. Glyphosate rate is in lb ae/A.

[2] Application timing based on spring wheat growth stage.

[3] June 10, 2008 evaluation date.

[4] July 9, 2008 evaluation date.

Common lambsquarters control in spring wheat with pyrasulfotole/bromoxynil. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in 'Alpowa' spring wheat near Moscow, Idaho to evaluate common lambsquarters control and spring wheat response with pyrasulfotole/bromoxynil, an alternate mode of action for ALS resistant broadleaf weeds. The study was arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Wheat response and common lambsquarters control were evaluated visually. Wheat grain was harvested with a small plot combine on September 2, 2008.

Table 1. Application and soil data.

Location	Moscow, Idaho
Application date	June 16, 2008
Growth stage	
Spring wheat	3 tiller
Common lambsquarters (CHEAL)	5 leaf and 2 inches tall
Air temperature (F)	58
Relative humidity (%)	78
Wind (mph)	0
Cloud cover (%)	0
Soil moisture	adequate
Soil temperature at 2 inch (F)	54
pH	6.2
OM (%)	6.4
CEC (meq/100g)	30
Texture	silt loam

No treatment visually injured spring wheat (data not shown). All treatments controlled common lambsquarters (CHEAL) 95 to 98%, except fluroxypyr/clopyralid (71%) (Table 2). Spring wheat yield did not correlate with common lambsquarters control due to contamination and increased moisture from weed biomass. Spring wheat yield and test weight were greater for all treated plots compared to the untreated check.

Table 2. Common lambsquarters control and spring wheat response with pyrasulfotole/bromoxynil near Moscow, ID in 2008.

		CHEAL	Spring wheat	
Treatment[1]	Rate[2]	control[3]	Yield	Test weight
	lb ai/A	%	bu/A	lb/A
Pyrasulfotole/bromoxynil	0.18	95	65	61.3
Pyrasulfotole/bromoxynil	0.21	95	64	61.3
Pyrasulfotole/bromoxynil	0.24	96	63	61.4
Thifensulfuron/tribenuron	0.0188	96	56	60.7
MCPA amine	0.5	98	60	61.8
Fluroxypyr/bromoxynil	0.477	95	64	61.9
Fluroxypyr/clopyralid	0.25	71	66	61.7
Bromoxynil/MCPA	0.5	96	57	61.3
Florasulam/MCPA	0.315	97	57	61.3
Untreated check	--	--	49	56.9
LSD (0.05)		13	10	1.3
Density (plants/ft^2)		15		

[1] A nonionic surfactant (R-11) was applied with thifensulfuron/tribenuron at 0.25% v/v.

[2] Rate is in lb ae/A for bromoxynil/MCPA, MCPA amine and all treatments containing fluroxypyr.

[3] July 25, 2008 evaluation.

Table. Crop injury, wild oat and broadleaf weed control and yield with pyroxsulam in spring wheat, near Kimberly, Idaho.[1]

		Crop injury				Weed control[2]						
	Application	Chlorosis		Growth inhib.		KCHSC		CHEAL		AVEFA		Grain
Treatment[3]	rate	6/3	6/26	6/3	7/14	6/26	7/14	6/26	7/14	6/26	7/14	yield
		-%-										bu/A
Check		-	-	-	-	-	-	-	-	-	-	60 f
GF-1848+ NIS+ AMS	0.079 lb ae/A+ 0.5% v/v + 2.5 lb/A	19 a	0 a	18 ab	8 a	100 a	100 a	100 a	100 a	100 a	100 a	80 a-e
GF-1848+ NIS	0.105 lb ae/A+ 0.5% v/v	19 a	0 a	15 a-d	0 a	100 a	100 a	99 bc	100 a	100 a	100 a	90 a
GF-1848+ NIS+ AMS	0.105 lb ae/A+ 0.5% v/v + 2.5 lb/A	16 ab	0 a	15 a-d	4 a	100 a	100 a	100 a	100 a	99 b	100 a	84 abc
GF-1848+ Mineral oil	0.105 lb ae/A+ 0.8% v/v	16 ab	0 a	14 b-e	3 a	100 a	100 a	100 a	100 a	100 a	100 a	79 a-e
GF-1848+ MSO	0.105 lb ae/A+ 0.8% v/v	15 abc	0 a	13 c-f	3 a	100 a	100 a	100 a	100 a	100 a	100 a	88 ab
GF-1848+ 2,4-D LVE+ AMS	0.105 lb ae/A+ 0.25 lb ae/A+ 2.5 lb/A	15 abc	0 a	18 ab	8 a	100 a	100 a	100 a	100 a	100 a	100 a	81a-d
GF-1848+ MCPA LV4 AMS	0.105 lb ae/A+ 0.375 lb ae/A+ 2.5 lb/A	15abc	0 a	14 b-e	4 a	100 a	100 a	100 a	100 a	100 a	100 a	77a-e
GF-1848 +	0.105 lb ae/A+	11 cd	0 a	9 fgh	4 a	100 a	100 a	97 d	98 a	100 a	100 a	71 c-f
GF-1847+ NIS	0.013 lb ai/A + 0.5 lb ai/A	18 a	0 a	19 a	3 a	99 a	100a	98 cd	99 a	100 a	100 a	73 c-f
GF-1847+ NIS+ AMS	0.013 lb ai/A+ 0.5% v/v + 2.5 lb/A	16 ab	0 a	15 a-d	5 a	100 a	100 a	100 a	100 a	100 a	100 a	75 b-e
GF-1847+ AMS+ clprld/flrxpyr + MCPA LV4	0.013 lb ai/A+ 2.5 lb/A 0.187 lb ae/A+ 0.25 lb ae/A	16ab	0 a	16 abc	5 a	100 a	100 a	100 a	100 a	100 a	100 a	72 c-f
GF-1847+ fluroxypyr + 2,4-D LVE AMS+	0.013 lb ai/A+ 0.094 lb ae/A+ 0.25 lb ae/A 2.5 lb/A	16 ab	0 a	19 a	8 a	100 a	100 a	100 a	100 a	100 a	100 a	77 a-e
GF-1847 + NIS + AMS + GF-2257	0.013 lb ai/A+ 0.5% v/v + 2.5 lb/A 0.094 lb ae/A	15 abc	0 a	13 c-f	5 a	100 a	100 a	100 a	100 a	100 a	99 a	73 c-f
GF-1847 +	0.013 lb ai/A+	16 ab	0 a	11 d-g	3 a	100 a	99 b	98 cd	99 a	100 a	100 a	70 def
Pinoxaden + clprld/flrxpyr + MCPA LV4	0.054 lb ai/A+ 0.187 lb ae/A+ 0.375 lb ae/A	13 bc	0 a	9 fgh	4 a	100 a	100 a	100 a	100 a	100 a	96 b	72 c-f
Fenoxaprop + pyrslftl/brmxynl+ AMS	0.082 lb ai/A+ 0.178 lb ae/A+ 0.156 lb/A	18 a	0 a	9 fgh	3 a	100 a	100 a	100 a	100 a	100 a	99 a	75 b-e
Clodinafop + thfnslfrn/trbnrn	0.05 lb ai/A + 0.019 lb ai/A	8 de	0 a	5 h	3 a	99 a	100 a	100 a	100 a	100 a	96 b	74 cde
Flucarbazone + 2,4-D LVE	0.0178 lb ai/A 0.375 lb ae/A	6 e	0 a	8 gh	1 bc	100 a	100 a	100 a	100 a	100 a	96 b	
Prxcbzn/msflrn + NIS + AMS + brmxynl/MCPA	0.011 lb ai/A+ 0.25 %v/v + 2.5 lb/A 0.5 lb ae/A	15 abc	1 a	10 efg	4 a	100 a	100 a	100 a	100 a	100 a	99 a	72 c-f

[1] Means followed by the same letter are not significantly different at P = 0.05.

[2] Weeds evaluated for control were wild oat (AVEFA), kochia (KCHSC), and common lambsquarters (CHEAL).

[3] GF-1848 is a 1:39.6:5.9 formulated mixture of florasulam, fluroxypyr and pyroxsulam. GF-1847 is pyroxsulam and cloquintocet safener. GF-2257 is a 1:19 formulated mixture of florasulam and fluroxypyr. Clprld/flrxpyr 1:1.1 formulated mixture of clopyralid and fluroxypyr sold as Widematch. Pyrslftl/brmxynl is a 1:8 mixture of pyrasulfotole and bromoxynil sold as Huskie. Thfnslfrn/trbnrrn is a 4:1 formulated mixture of thifensulfuron and tribenuron sold as Affinity TM. Prpxcrbzn/msflrn/ is a 4:1 formulated mixture of propoxycarbazone and mesosulfuron sold as Rimfire. Brmxynl/MCPA is a 1:1 formulated mixture of bromoxynil and MCPA sold as Bronate Advanced. NIS is nonionic surfactant and AMS is ammonium sulfate.

Broadleaf weed control with and without pyroxsulam tank mix partners in spring wheat. Don W. Morishita, J. Daniel Henningsen, and Donald L. Shouse. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare pyroxsulam applied alone and in tank mix combinations for broadleaf weed control in irrigated spring wheat. 'Westbred 936' was planted April 8, 2008 at 100 lb/A. Experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Soil type was a Portneuf silt loam (17.9% sand, 61.8% silt, and 20.3% clay) with a pH of 8.0, 1.7% organic matter, and CEC of 21-meq/100 g soil. Herbicides were applied May 20 with a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 22 psi. Environmental conditions at application were as follows: air temperature 84 F, soil temperature 70 F, relative humidity 30%, wind speed 0 to 6 mph, and 90% cloud cover. Kochia, common lambsquarters, redroot pigweed, and annual sowthistle densities averaged 3, 8, 3, and 2 plants/ft^2, respectively. Application began at 10:50 am. Crop injury (chlorosis and growth inhibition) was evaluated visually 17, 34, and 59 days after application (DAA) on June 6, June 23 and July 18, respectively. Weed control was evaluated visually 34 and 59 DAA. Grain was harvested August 11 with a small-plot combine.

Crop injury (chlorosis and growth inhibition) ranged from 0 to 3% at all evaluation dates. Thus, only chlorosis ratings from two evaluation dates are shown since they are representative of the ratings for growth inhibition (Table). Crop stand throughout the study area was inconsistent due to wireworm damage. Kochia control at both evaluation dates ranged from 28 to 97% among herbicide treatments. Kochia control with GF-1847 + nonionic surfactant (NIS) at 0.0134 lb ai/A + 0.5% v/v with or without ammonium sulfate (AMS) at 1.52 lb ai/A averaged 39 and 53%. Kochia control also was unacceptable (<70%) with clodinafop + thifensulfuron/tribenuron, flucarbazone + 2,4-D LVE, and propoxycarbazone/mesosulfuron + bromoxynil/MCPA. Kochia control with GF-1848, consisting of pyroxsulam, fluroxypyr, and florasulam, applied with NIS, mineral oil, methylated seed oil, AMS, 2,4-D LVE, or MCPA LVE all controlled kochia 90% or better over both evaluation dates. Common lambsquarters control was 90% or better with all GF-1848 treatments at both evaluation dates with the exception of GF-1848 alone at 0.105 lb ae/A on the first evaluation date. GF-1847 + NIS with or without AMS controlled common lambsquarters 3 to 39% over both evaluation dates. Common lambsquarters control also was unacceptable (<70%) with GF-1847 + GF-2257 + NIS + AMS and propoxycarbazone/mesosulfuron + bromoxynil/MCPA + NIS + AMS. Redroot pigweed control ranged from 94 to 100% for all herbicide treatments. Annual sowthistle, which is a late emerging weed, was controlled 90% or better with all herbicides except GF-1847 + NIS + AMS, flucarbazone + 2,4-D LVE, and propoxycarbazone/mesosulfuron + bromoxynil/MCPA + NIS + AMS. Due to the variability of wheat crop stand caused by wireworm, the yields were somewhat variable between replications of various treatments. Consequently, there were no differences in wheat yield among treatments including the untreated check.

Table. Crop injury, broadleaf weed control and spring wheat yield with pyroxsulam, near Kimberly, Idaho.[1]

				Weed control[2]							
	Application	Crop injury		KCHSC		CHEAL		AMARE		SONOL	Grain
Treatment[3]	rate	6/06	6/23	6/23	7/18	6/23	7/18	6/23	7/18	7/18	yield
		%									bu/A
Check		-	-	-	-	-	-	-	-	-	89 a
GF-1848+	0.079 lb ae/A +	1 a	0 a	91 a	97 ab	93 a	92 a	100 a	100 a	97 a	118 a
NIS+	0.5 % v/v +										
AMS	1.52 lb ae/A										
GF-1848+	0.105 lb ae/A +	3 a	0 a	90 a	96 ab	88 a	91 a	100 a	100 a	97 a	92 a
NIS	0.5 % v/v										
GF-1848+	0.105 lb ae/A +	1 a	1 a	93 a	95 ab	91 a	95 a	100 a	100 a	96 ab	95 a
NIS+	0.5 % v/v +										
AMS	1.52 lb ai/A										
GF-1848+	0.105 lb ae/A +	1 a	0 a	91 a	96 ab	90 a	95 a	100 a	100 a	98 a	93 a
Mineral oil	0.8 % v/v										
GF-1848+	0.105 lb ae/A +	0 a	0 a	94 a	97 ab	94 a	97 a	100 a	100 a	99 a	107 a
MSO	0.8 % v/v										
GF-1848+	0.105 lb ae/A +	1 a	0 a	91 a	94 ab	96 a	97 a	100 a	100 a	97 a	101 a
2,4-D LVE+	1.52 lb ai/A +										
AMS	0.25 lb ae/A										
GF-1848+	0.105 lb ae/A +	1 a	0 a	85 ab	79 ab	96 a	99 a	100 a	100 a	95 ab	94 a
MCPA LVE +	1.52 lb ai/A +										
AMS	0.375 lb ae/A										
GF-1848 +	0.105 lb ae/A	0 a	0 a	88 a	95 ab	88 a	92 a	100 a	100 a	99 a	99 a
GF-1847+	0.0134 lb ai/A +	1 a	0 a	39 cd	25 c	39 b	11 c	100 a	98 ab	91 abc	86 a
NIS	0.5 % v/v										
GF-1847+	0.0134 lb ai/A +	0 a	0 a	53 bc	31 c	3 c	18 c	100 a	97 ab	89 bc	92 a
NIS+	0.5 % v/v +										
AMS	1.52 lb ai/A										
GF-1847+	0.0134 lb ai/A +	0 a	0 a	81 ab	93 a	91 a	99 a	100 a	100 a	98 a	90 a
AMS+	1.52 lb ai/A +										
clprld/flrxypyr +	0.187 lb ae/A +										
MCPA LVE	0.25 lb ae/A										
GF-1847+	0.0134 lb ai/A +	0 a	0 a	83 ab	93 a	90 a	94 a	100 a	94 b	95 ab	90 a
AMS+	1.52 lb ai/A +										
fluroxypyr+	0.094 lb ae/A +										
2,4-D LVE	0.25 lb ae/A										
GF-1847+	0.0134 lb ai/A +	0 a	0 a	91 a	99 a	53 b	72 b	100 a	100 a	99 a	89 a
NIS+	0.5 % v/v +										
AMS+	1.52 lb ai/A +										
GF-2257	0.094 lb ae/A										
GF-1847 +	0.0134 lb ai/A	1 a	0 a	24 d	14 c	81 a	92 a	100 a	100 a	95 ab	96 a
Pinoxaden +	0.0535 lb ai/A +	0 a	0 a	76 ab	76 ab	86 a	95 a	100 a	98 ab	96 ab	89 a
clprld/flrxpyr +	0.187 lb ae/A +										
MCPA LVE	0.375 lb ae/A										
Fenoxaprop +	0.082 lb ai/A +	1 a	0 a	83 ab	90 ab	90 a	96 a	100 a	99 a	94 ab	88 a
pyrslftl/brmxnyl +	0.178 lb ae/A +										
AMS	0.5 lb ai/A										
Clodinafop +	0.05 lb ai/A +	1 a	0 a	61 abc	58 b	90 a	94 a	100 a	100 a	95 ab	103 a
thifnslfrn/trbnrn	0.0188 lb ai/A										
Flucarbazone +	0.0178 lb ai/A +	1 a	0 a	61 abc	10 c	89 a	97 a	100 a	100 a	89 bc	96 a
2,4-D LVE	0.375 lb ae/A										
prpxcrbzn/msflrn +	0.0111 lb ai/A +	1 a	0 a	65 abc	12 c	53 b	23 c	100 a	100 a	86 c	86 a
NIS +	0.25 % v/v +										
AMS +	1.52 lb ai/A +										
brmxynl/MCPA	0.5 lb ae/A										

[1] Means followed by the same letter are not significantly different at P = 0.05.

[2] Weeds evaluated for control were wild oat (AVEFA), kochia (KCHSC), and common lambsquarters (CHEAL).

[3] GF-1848 is a 1:39.6:5.9 formulated mixture of florasulam, fluroxypyr and pyroxsulam. GF-1847 is a pyroxsulam formulation with 0.375 lb ai/gal plus cloquintocet safener. NIS is nonionic surfactant. AMS is ammonium sulfate. GF-2257 is a 1:19 formulated mixture of florasulam and fluroxypyr. Clprld/flrxpyr 1:1.1 formulated mixture of clopyralid/fluroxypyr sold as Widematch. Pyrslftl/brmxynl is a 1:8 mixture of pyrasulfotole and bromoxynil sold as Huskie. Thifnslfrn/trbnrn is a 4:1 formulation of thifensulfuron/tribenuron sold as Affinity TM. Prpxcrbzn/msflrn is a 4:1 formulated mixture of propoxycarbazone and mesosulfuron sold as Rimfire. Brmxynl/MCPA is a 1:1 formulated mixture of bromoxynil and MCPA sold as Bronate Advanced.

Broadleaf weed control with and without pyroxsulam tank mix partners in spring wheat. Don W. Morishita, J. Daniel Henningsen, and Donald L. Shouse. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare pyroxsulam applied alone and in tank mix combinations for broadleaf weed control in irrigated spring wheat. 'Westbred 936' was planted April 8, 2008 at 100 lb/A. Experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Soil type was a Portneuf silt loam (17.9% sand, 61.8% silt, and 20.3% clay) with a pH of 8.0, 1.7% organic matter, and CEC of 21-meq/100 g soil. Herbicides were applied May 20 with a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 22 psi. Environmental conditions at application were as follows: air temperature 84 F, soil temperature 70 F, relative humidity 30%, wind speed 0 to 6 mph, and 90% cloud cover. Kochia, common lambsquarters, redroot pigweed, and annual sowthistle densities averaged 3, 8, 3, and 2 plants/ft^2, respectively. Application began at 10:50 am. Crop injury (chlorosis and growth inhibition) was evaluated visually 17, 34, and 59 days after application (DAA) on June 6, June 23 and July 18, respectively. Weed control was evaluated visually 34 and 59 DAA. Grain was harvested August 11 with a small-plot combine.

Crop injury (chlorosis and growth inhibition) ranged from 0 to 3% at all evaluation dates. Thus, only chlorosis ratings from two evaluation dates are shown since they are representative of the ratings for growth inhibition (Table). Crop stand throughout the study area was inconsistent due to wireworm damage. Kochia control at both evaluation dates ranged from 28 to 97% among herbicide treatments. Kochia control with GF-1847 + nonionic surfactant (NIS) at 0.0134 lb ai/A + 0.5% v/v with or without ammonium sulfate (AMS) at 1.52 lb ai/A averaged 39 and 53%. Kochia control also was unacceptable (<70%) with clodinafop + thifensulfuron/tribenuron, flucarbazone + 2,4-D LVE, and propoxycarbazone/mesosulfuron + bromoxynil/MCPA. Kochia control with GF-1848, consisting of pyroxsulam, fluroxypyr, and florasulam, applied with NIS, mineral oil, methylated seed oil, AMS, 2,4-D LVE, or MCPA LVE all controlled kochia 90% or better over both evaluation dates. Common lambsquarters control was 90% or better with all GF-1848 treatments at both evaluation dates with the exception of GF-1848 alone at 0.105 lb ae/A on the first evaluation date. GF-1847 + NIS with or without AMS controlled common lambsquarters 3 to 39% over both evaluation dates. Common lambsquarters control also was unacceptable (<70%) with GF-1847 + GF-2257 + NIS + AMS and propoxycarbazone/mesosulfuron + bromoxynil/MCPA + NIS + AMS. Redroot pigweed control ranged from 94 to 100% for all herbicide treatments. Annual sowthistle, which is a late emerging weed, was controlled 90% or better with all herbicides except GF-1847 + NIS + AMS, flucarbazone + 2,4-D LVE, and propoxycarbazone/mesosulfuron + bromoxynil/MCPA + NIS + AMS. Due to the variability of wheat crop stand caused by wireworm, the yields were somewhat variable between replications of various treatments. Consequently, there were no differences in wheat yield among treatments including the untreated check.

Comparison of generic sulfonylurea herbicides to proprietary sulfonylurea herbicides. Donald L. Shouse, Don W. Morishita and J. Daniel Henningsen. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare some generic sulfonylurea herbicides to proprietary sulfonylurea herbicides for controlling broadleaf weeds in spring wheat. 'Westbred 936' was planted April 8, 2008 at 100 lb/A. Experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Soil type was a Portneuf silt loam (17.9% sand, 61.8% silt, and 20.3% clay) with a pH of 8.0, 1.7% organic matter, and CEC of 21-meq/100 g soil. Herbicides were applied on May 27 with a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 24 psi. Environmental conditions at application were as follows: air temperature 69 F, soil temperature 65 F, relative humidity 48%, wind speed 9 mph, and 60% cloud cover. Application began at 1200. Kochia, common lambsquarters, annual sowthistle, and redroot pigweed, averaged 1, 8, 3, 4 plants/ft^2, respectively. Crop injury and weed control were evaluated visually 29 and 36 days after application (DAA) on June 25 and July 2. Grain was harvested August 11 with a small-plot combine.

Crop injury was minimal ($\leq$1%) and thus, no difference in crop injury at 29 or 36 DAA (Table). Kochia control was 97 to 100% with treatments that included GWN-3135 (fluroxypyr) at 29 and 36 DAA. The sulfonylurea herbicide treatments that did not include fluroxypyr did not consistently control kochia and thifensulfuron applied alone were among the poorest kochia control treatments. Common lambsquarters control 29 DAA was 96% or better with both thifensulfuron/tribenuron products. By 36 DAA, common lambsquarters control with these same treatments continued to rank the highest ranging from 94 to 99% control. Thifensulfuron manufactured by either company did not control common lambsquarters 29 DAA. These treatments ranged from 49 to 65%. Fluroxypyr alone at 0.056 or 0.075 lb ai/A did not control common lambsquarters at either evaluation date. Redroot pigweed was effectively controlled ($\geq$98%) with all treatments except fluroxypyr alone at both evaluation dates. Annual sowthistle control was similar with the sulfonylurea herbicides. Thifensulfuron did not control annual sowthistle as well as thifensulfuron/tribenuron. Due to inconsistency of the crop stand because of wireworm, there were no differences in yield among any of the treatments. The results from this study indicate that the two generic sulfonylurea herbicides performed equally to the proprietary sulfonylureas.

Table. Crop injury, weed control and yield with generic and proprietary sulfonylurea herbicides, near Kimberly, Idaho[1]

	Application	Crop injury		Weed Control[2]									Grain
				KSCHC		CHEAL		AMARE		SONOL		SOLSA	
Treatment[3]	rate	6/25	7/2	6/25	7/2	6/25	7/2	6/25	7/2	6/25	7/2	6/25	yield
	lb ai/A												bu/A
Check		-	-	-	-	-	-	-	-	-	-	-	94 a
Thifensulfuron-G + NIS	0.028 + 0.25 %v/v	0 a	0 a	61 c	69 d	49 b	81 b	100 a	100 a	81 c	53 d	40 b	95 a
Thifensulfuron/ tribenuron-G + NIS	0.028 + 0.25% v/v	0 a	0 a	76 a	75 ab	91 a	97 a	100 a	99 a	100 a	96 a	94 a	98 a
Thifensulfuron-D + NIS	0.028 + 0.25% v/v	0 a	0 a	77 bc	78 bc	65 b	88 ab	100 a	99 a	85 bc	78 bc	58 b	90 a
Thifensulfuron/ tribenuron-D + NIS	0.028 + 0.25% v/v	0 a	1 a	80 abc	78 ab	96 a	98 a	100 a	100 a	100 a	97 a	100	100 a
Thifensulfuron/ tribenuron-G + NIS	0.014 + 0.25% v/v	0 a	0 a	74 bc	86 abc	87 a	96 a	100 a	98 a	97 ab	94 a	100	93 a
Thifensulfuron/ tribenuron-G + NIS	0.0234 + 0.25% v/v	0 a	1 a	93 ab	91 ab	92 a	94 a	100 a	100 a	98 a	96 a	100	94 a
GWN-3135 + NIS	0.056 + 0.25% v/v	0 a	1 a	98 a	100 a	13 c	18 c	69 b	85 b	95 ab	67 cd	83 a	91 a
GWN-3135 + NIS	0.075 + 0.25% v/v	0 a	0 a	99 a	98 a	13 c	11 c	69 b	96 a	100 a	93 ab	98 a	105 a
Thifensulfuron/ tribenuron-G + GWN-3135 + NIS	0.014 + 0.056 + 0.25% v/v	0 a	0 a	98 a	98 a	96 a	97 a	100 a	98 a	97 a	96 a	100	98 a
Thifensulfuron/ tribenuron-G + GWN-3135 + NIS	0.014 + 0.075 + 0.25% v/v	0 a	0 a	99 a	99 a	99 a	99 a	100 a	100 a	100 a	97 a	98 a	85 a
Thifensulfuron/ tribenuron-G + GWN-3135 + NIS	0.0234 + 0.056 + 0.25% v/v	0 a	0 a	99 a	97 a	98 a	99 a	100 a	100 a	100 a	97 a	100	88a
Thifensulfuron/ tribenuron-G + GWN-3135 + NIS	0.0234 + 0.075 + 0.25% v/v	0 a	1 a	99 a	98 a	99 a	99 a	100 a	100 a	100 a	97 a	98 a	100 a

[1] Means followed by the same letter are not significantly different at P = 0.05.

[2] Weeds evaluated for control were kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), annual sowthistle (SONOL), and hairy nightshade (SOLSA).

[3] Thifensulfuron/tribenuron-G is a 2:1 ratio formulated as a 75 DF and sold as TNT Broadleaf. Thifensulfuron/tribenuron-D is a 2:1 ratio formulated as a 50 SG and sold as Harmony Extra SG. Thifensulfuron-G is a 75 WDG formulation and sold as Unity. Thifensulfuron-D is a 50 SG and sold as Harmony SG. GWN-3135 is fluroxypyr and formulated as a 1.5 EC. NIS is nonionic surfactant.

<u>Wild oat control in wheat</u>. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established to evaluate wild oat control with pinoxaden plus a 1:1 or 1:4 ratio of thifensulfuron to tribenuron in combination with other broadleaf herbicides in winter wheat and pyrasulfotole/bromoxynil combined with grass herbicides in winter and spring wheat. The plots were arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Studies were oversprayed for broadleaf weed control with clopyralid at 0.112 lb ae/A and fluroxypyr at 0.113 lb ae/A at the winter wheat sites on May 30 and fluroxypyr/MCPA at 0.666 lb ae /A at the spring wheat site on June 17, 2008. Wheat injury and wild oat control were evaluated visually during the growing season. Grain was harvested with a small plot combine at the winter wheat sites on August 11 and the spring wheat site on September 3, 2008.

Table 1. Application and soil data.

<table>
<tr><th></th><th>Pinoxaden study</th><th colspan="2">Pyrasulfotole/bromoxynil studies</th></tr>
<tr><td>Location</td><td>Moscow, Idaho</td><td>Moscow, Idaho</td><td>Ferdinand, Idaho</td></tr>
<tr><td>Crop</td><td>winter wheat</td><td>winter wheat</td><td>spring wheat</td></tr>
<tr><td>Wheat variety</td><td>ORCF 102</td><td>ORCF 012</td><td>Jefferson</td></tr>
<tr><td>Application date</td><td>5/20/08</td><td>5/27/08</td><td>6/13/08</td></tr>
<tr><td>Growth stage</td><td></td><td></td><td></td></tr>
<tr><td>Wheat</td><td>4 tiller</td><td>4 tiller</td><td>3 tiller</td></tr>
<tr><td>Wild oat</td><td>2 leaf</td><td>3 leaf</td><td>2 tiller</td></tr>
<tr><td>Air temperature (F)</td><td>63</td><td>58</td><td>64</td></tr>
<tr><td>Relative humidity (%)</td><td>67</td><td>64</td><td>56</td></tr>
<tr><td>Wind (mph, direction)</td><td>0</td><td>4, E</td><td>7, NE</td></tr>
<tr><td>Cloud cover (%)</td><td>100</td><td>0</td><td>0</td></tr>
<tr><td>Soil moisture</td><td>dry</td><td>dry</td><td>wet</td></tr>
<tr><td>Dew present</td><td>no</td><td>yes</td><td>no</td></tr>
<tr><td>Soil temperature at 2 inch (F)</td><td>60</td><td>48</td><td>58</td></tr>
<tr><td>pH</td><td colspan="2">5.0</td><td>5.4</td></tr>
<tr><td>OM (%)</td><td colspan="2">3.0</td><td>5.9</td></tr>
<tr><td>CEC (meq/100g)</td><td colspan="2">23</td><td>41</td></tr>
<tr><td>Texture</td><td colspan="2">silt loam</td><td>loam</td></tr>
</table>

In the pinoxaden study, no treatment visually injured winter wheat (data not shown). All treatments controlled wild oat 87 to 97% (Table 2). Wild oat control did not decrease when pinoxaden plus thifensulfuron and tribenuron (at either ratio) were combined with other broadleaf herbicides (87 to 97%) compared to pinoxaden alone (94%). Wheat grain yield and test weight did not differ among treatments and ranged from 74 to 83 bu/A and 60.5 to 61.6 lb/bu, respectively.

In the pyrasulfotole/bromoxynil winter wheat study, no treatment visually injured winter wheat (data not shown). Wild oat control was 88 to 98% with all treatments, except pyrasulfotole/bromoxynil alone (0%) (Table 3). Pyrasulfotole/bromoxynil is a broadleaf herbicide and does not control wild oat. Wild oat control and wheat grain test weight were not affected by the addition of pyrasulfotole/bromoxynil compared to any grass herbicide alone. The addition of pyrasulfotole/bromoxynil decreased wheat grain yield in the pinoxaden and clodinafop treatments.

In the pyrasulfotole/bromoxynil spring wheat study, the addition of pyrasulfotole/bromoxynil to tralkoxydim, pinoxaden, pyroxsulam and flucarbazone injured spring wheat 5 to 13% (Table 4). Wild oat control was not affected by the addition of pyrasulfotole/bromoxynil compared to any grass herbicide alone and pyrasulfotole/bromoxynil, a broadleaf herbicide, did not control wild oat. Wheat grain yield and test weight were not affected by the addition of pyrasulfotole/bromoxynil compared to all grass herbicides alone. Wheat grain yield in all treatments was greater than the untreated check, except pyrasulfotole/bromoxynil alone.

Table 2. Wild oat control and winter wheat response with pinoxaden plus thifensulfuron and tribenuron combined with other broadleaf herbicides near Moscow, Idaho in 2008.

Treatment[1]	Rate	Wild oat control[2]	Winter wheat	
			Yield	Test weight
	lb ai/A	%	bu/A	lb/bu
Pinoxaden	0.054	94	74	61.1
Pinoxaden + fluroxypyr +	0.054 + 0.094			
thifensulfuron +	0.025			
tribenuron	0.00625	96	83	61.6
Pinoxaden + fluroxypyr /clopyralid+	0.054 + 0.188			
thifensulfuron +	0.025			
tribenuron	0.00625	93	82	60.5
Pinoxaden + fluroxypyr/MCPA +	0.054 + 0.666			
thifensulfuron +	0.025			
tribenuron	0.00625	87	78	61.4
Pinoxaden + bromoxynil/MCPA+	0.054 + 0.31			
thifensulfuron +	0.025			
tribenuron	0.00625	96	77	61.2
Pinoxaden + MCPA ester +	0.054 + 0.75			
thifensulfuron +	0.025			
tribenuron	0.00625	94	77	61.0
Pinoxaden + fluroxypyr +	0.054 + 0.094			
thifensulfuron +	0.0125			
tribenuron	0.0125	91	73	61.1
Pinoxaden + fluroxypyr /clopyralid+	0.054 + 0.188			
thifensulfuron +	0.0125			
tribenuron	0.0125	96	77	61.2
Pinoxaden + bromoxynil/MCPA+	0.054 + 0.31			
thifensulfuron +	0.0125			
tribenuron	0.0125	97	75	61.0
Pinoxaden + MCPA ester +	0.054 + 0.75			
thifensulfuron +	0.0125			
tribenuron	0.0125	93	74	61.2
Untreated check	--	--	75	61.2
LSD (0.05)		NS	NS	NS
Density (plants/ft^2)		4		

[1] Thifensulfuron and tribenuron were 50% formulations. A non-ionic surfactant (R-11) was applied with all treatments at 0.25% v/v except pinoxaden alone. Rate is in lb ae/A for herbicides containing fluroxypyr and MCPA.

[2] July 9, 2008 evaluation.

Table 3. Wild oat control and winter wheat response with pyrasulfotole/bromoxynil combined with grass herbicides near Moscow, ID in 2008.

Treatment[1]	Rate	Wild oat control[2,3]	Winter wheat	
			Yield[3]	Test weight[3]
	lb ai/A	%	bu/A	lb/bu
Pyrasulfotole/bromoxynil	0.24	0	74	60.9
Pyroxsulam + AMS + NIS	0.0164 + 1.5 +0.5% v/v	95	103	61.0
Pyroxsulam + AMS + NIS pyrasulfotole/bromoxynil	0.0164 + 1.5 + 0.5% v/v 0.24	88	92	61.0
Mesosulfuron + UAN + NIS	0.0134 + 5% v/v + 0.5% v/v	96	87	60.5
Mesosulfuron + UAN + NIS + pyrasulfotole/bromoxynil	0.0134 + 5% v/v + 0.5% v/v 0.24	88	87	61.0
Mesosulfuron/iodosulfuron + UAN + NIS	0.0135 + 5% v/v + 0.5% v/v	95	94	61.6
Mesosulfuron/iodosulfuron + UAN + NIS + pyrasulfotole/bromoxynil	0.0135 + 5% v/v + 0.5% v/v 0.24	97	100	60.9
Pinoxaden/adjuvant	0.0534	98	98	60.4
Pinoxaden/adjuvant + pyrasulfotole/bromoxynil	0.0534 0.24	97	84	60.7
Clodinafop	0.05	97	97	61.5
Clodinafop + pyrasulfotole/bromoxynil	0.05 0.24	97	83	61.0
Tralkoxydim + NIS/COC + AMS	0.25 + 0.5% v/v + 15 lb ai/100 gal	95	88	61.4
Tralkoxydim + NIS/COC + AMS + pyrasulfotole/bromoxynil	0.25 + 0.5% v/v + 15 lb ai/100 gal 0.24	94	86	61.2
Flucarbazone + UAN + NIS	0.027 + 5% v/v + 0.25% v/v	92	92	61.7
Flucarbazone + UAN + NIS + pyrasulfotole/bromoxynil	0.027 + 5% v/v + 0.25% v/v 0.24	88	95	61.3
Untreated check		--	88	61.4
LSD (0.05)		8	13	0.8
Density (plants/ft^2)		3		

[1] NIS/COC = nonionic surfactant/crop oil concentrate (Supercharge); AMS = ammonium sulfate (Bronc); UAN = urea ammonium nitrate (URAN); and NIS = nonionic surfactant (R-11).

[2] Evaluation date July 7, 2008.

[3] Only three replications used in the analysis due to a smooth brome infestation.

Table 4. Wild oat control and spring wheat response with pyrasulfotole/bromoxynil combined with grass herbicides near Ferdinand, ID in 2008.

Treatment[1]	Rate	Spring wheat injury	Wild oat control[2]	Spring wheat Yield	Spring wheat Test weight
	lb ai/A	%	%	bu/A	lb/bu
Pyrasulfotole/bromoxynil	0.20	0	0	12	58.4
Pyroxsulam + AMS + NIS	0.0136 + 1.24 +0.4% v/v	1	88	30	58.9
Pyroxsulam + AMS + NIS pyrasulfotole/bromoxynil	0.0136 + 1.24 + 0.4% v/v 0.20	11	84	28	59.6
Flucarbazone + UAN + NIS	0.022 + 4% v/v + 0.21% v/v	1	86	24	58.7
Flucarbazone + UAN + NIS + pyrasulfotole/bromoxynil	0.022 + 4% v/v + 0.21% v/v 0.20	13	85	29	59.8
Clodinafop	0.04	0	97	34	59.8
Clodinafop + pyrasulfotole/bromoxynil	0.04 0.20	2	87	32	60.3
Tralkoxydim + NIS/COC + AMS	0.21 + 0.4% v/v + 12.5 lb ai/100 gal	0	83	32	59.9
Tralkoxydim + NIS/COC + AMS + pyrasulfotole/bromoxynil	0.21 + 0.4% v/v + 12.5 lb ai/100 gal 0.20	5	72	32	60.1
Pinoxaden/adjuvant	0.044	0	98	36	60.1
Pinoxaden/adjuvant + pyrasulfotole/bromoxynil	0.044 0.20	6	95	38	60.8
Fenoxaprop	0.066	0	96	33	60.3
Fenoxaprop/pyrasulfotole/bromoxynil	0.235	0	92	38	60.5
Pyroxsulam/florasulam/fluroxypyr + NIS + AMS	0.087 + 0.4% v/v + 1.26	1	81	34	60.2
Untreated check		--	--	10	57.9
LSD (0.05)		4	13	6	1.5
Density (plants/ft^2)			25		

[1] NIS/COC = nonionic surfactant/crop oil concentrate (Supercharge); AMS = ammonium sulfate (Bronc); UAN = urea ammonium nitrate (URAN); and NIS = nonionic surfactant (R-11).

[2] Evaluation date July 11, 2008.

Broadleaf weed control in winter wheat with 2,4-D formulations and sulfonylurea combinations. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in winter wheat near Culdesac, Idaho to evaluate broadleaf weed control and winter wheat response with 2,4-D formulations and sulfonylurea combinations. Studies were arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Studies were sprayed with pinoxaden at 0.0534 lb ai/A on May 2, 2008 to control wild oat. Wheat response and broadleaf weed control were evaluated visually. Wheat grain was harvested with a small plot combine on July 31, 2008.

Table 1. Application and soil data.

	2,4-D study	Sulfonylurea study
Winter wheat variety	Westbred 528 and Lambert mixture	
Application date	April 26, 2008	April 26, 2008
Growth stage		
Winter wheat	4 tiller	4 tiller
Prickly lettuce (LACSE)	2 inch in diameter	2 inch in diameter
Catchweed bedstraw (GALAP)	--	2 inch tall
Mayweed chamomile (ANTCO)	--	1 inch in diameter
Tumble mustard (SSYAL)	2 inch tall	2 inch tall
Air temperature (F)	53	60
Relative humidity (%)	55	40
Wind (mph, direction)	2, N	3, N
Cloud cover (%)	0	0
Soil moisture	adequate	adequate
Soil temperature at 2 inch (F)	48	54
pH	5.2	
OM (%)	5.0	
CEC (meq/100g)	31	
Texture	silt loam	

In the 2,4-D study, Unison at 0.5 lb ae/A injured winter wheat 12% (Table 2). On May 15, Unison and Five Star at 0.5 lb ae/A controlled prickly lettuce (LASCE) (68 and 76%) better than all other treatments except Salvo at 0.5 lb ae/A (65%). By June 17, prickly lettuce control ranged from 84 to 99% but did not differ among treatments. All treatments controlled tumble mustard (SSYAL) 99%. Wheat grain yield and test weight did not differ among treatments and ranged for 82 to 86 bu/A and 57.9 to 59.0 lb/bu, respectively.

In the sulfonylurea study, all treatments containing bromoxynil/MCPA injured wheat 4 to 6% (Table 3). Prickly lettuce control was 96 to 99% with all treatments containing MCPA ester but did not differ from thifensulfuron/tribenuron plus bromoxynil/MCPA and the treatment with pyrasulfotole/bromoxynil (90 and 93%). All treatments containing fluroxypyr controlled catchweed bedstraw (GALAP) 92 to 99%. All treatments controlled mayweed chamomile (ANTCO) 90% or greater, except MCPA ester plus fluroxypyr (Starane) (68%). Tumble mustard was controlled 99% by all treatments. Wheat grain yield and test weight did not differ among treatments but grain yield tended to be lowest in the untreated check.

Table 2. Broadleaf weed control and winter wheat response with 2,4-D formulations near Culdesac, ID in 2008.

			Weed control				
		Wheat	LACSE		SSYAL	Wheat	
Treatment[1]	Rate	injury	5/15	6/17	5/15	Yield	Test weight
	lb ae/A	%	%	%	%	bu/A	lb/bu
Salvo (2,4-D ester)	0.25	0	45	84	99	86	58.3
Salvo (2,4-D ester)	0.5	5	65	94	99	86	58.3
Five Star (2,4-D ester)	0.25	0	35	94	99	85	58.6
Five Star (2,4-D ester)	0.5	4	76	99	99	85	59.0
Unison (2,4-D acid)	0.25	0	38	90	99	84	58.6
Unison (2,4-D acid)	0.5	12	68	92	99	82	57.9
Weedone LV4 (2,4-D ester)	0.25	0	40	92	99	84	58.5
Weedone LV4 (2,4-D ester)	0.5	0	48	95	99	86	59.0
Untreated check	--	--	--	--	--	85	58.8
LSD (0.05)		8	20	NS	NS	NS	NS
Density (plants/ft^2)			2	2	1		

[1] Trade name included for clarification of formulation comparisons. Acidifier deposition aid (LI 700) applied at 0.25% v/v with all treatments.

Table 3. Broadleaf weed control and winter wheat response with sulfonylurea combinations near Culdesac, ID in 2008.

		Wheat	Weed control[2]				Wheat	
Treatment	Rate[1]	injury	LACSE	GALAP	ANTCO	SSYAL	Yield	Test weight
	lb ai/A	-------------------------------------%-------------------------------------					bu/A	lb/bu
Thifensulfuron + tribenuron + NIS	0.014 + 0.0047 0.25% v/v	1	79	34	96	99	83	57.8
Thifensulfuron/tribenuron + bromoxynil/MCPA + MCPA ester + NIS	0.0188 0.5 0.5 0.25% v/v	6	96	18	99	99	83	56.5
Fluroxypyr (Sahara) + MCPA ester + NIS	0.094 0.5 0.25% v/v	0	97	92	90	99	86	58.6
Thifensulfuron + tribenuron + MCPA ester + fluroxypyr (Starane)	0.014 + 0.0047 0.5 0.09	1	96	99	99	99	88	58.0
Thifensulfuron + tribenuron + MCPA ester + fluroxypyr (Sahara) + NIS	0.014 + 0.0047 0.5 0.09 0.25% v/v	1	99	98	99	99	85	56.7
Thifensulfuron + tribenuron + MCPA ester + fluroxypyr /clopyralid+ NIS	0.014 + 0.0047 0.5 0.187 0.25% v/v	0	99	99	99	99	86	57.9
Thifensulfuron +tribenuron + bromoxynil/MCPA + NIS	0.014 + 0.0047 0.5 0.25% v/v	4	85	57	99	99	84	58.4
Thifensulfuron + tribenuron + pyrasulfotole/bromoxynil + NIS	0.014 + 0.0047 0.177 0.25% v/v	0	93	60	97	99	88	58.0
Thifensulfuron/tribenuron + bromoxynil/MCPA + NIS	0.0188 0.5 0.25% v/v	4	90	45	99	99	88	57.6
MCPA ester + fluroxypyr (Starane)	0.5 0.094	0	97	99	68	99	85	58.9
Untreated check	--	--	--	--	--	--	80	58.1
LSD (0.05)		3	11	33	10	NS	NS	NS
Density (plants/ft^2)			3	1	0.5	1		

[1] Trade name included for clarification. Fluroxypyr is Sahara (40% DG) and Starane (1.5 lb/gal EC). Rate is in lb ae/A for bromoxynil/MCPA, MCPA ester, fluroxypyr/clopyralid and fluroxypyr (Starane). NIS is a nonionic surfactant (R-11).

[2] June 17, 2008 evaluation.

Downy brome control in winter wheat. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in 'ORCF 101' winter wheat near Lewiston, ID to evaluate downy brome control with 1) sulfosulfuron or propoxycarbazone/mesosulfuron plus adjuvants; 2) pyroxsulam at two timings and 3) propoxycarbazone and propoxycarbazone/mesosulfuron combinations. All plots were arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). In all experiments, wheat injury and downy brome control were evaluated visually during the growing season, and wheat grain was harvested on July 29, 2008.

Table 1. Application and soil data.

	Adjuvant study	Pyroxsulam study		Propoxycarbazone study
Application date	4/11/08	4/2/08	4/17/08	4/12/08
Growth stage				
Winter wheat	1 tiller	3 leaf	3 tiller	1 tiller
Downy brome (BROTE)	3 leaf	2 leaf	1 tiller	3 leaf
Air temperature (F)	64	51	59	72
Relative humidity (%)	55	50	53	43
Wind (mph, direction)	1, W	1, W	3, NW	2, S
Cloud cover (%)	20	10	0	0
Soil moisture	adequate	adequate	adequate	adequate
Soil temperature at 2 inch (F)	51	42	60	54
pH	5.5			
OM (%)	5.0			
CEC (meq/100g)	35			
Texture	silt loam			

In the adjuvant study, no treatment injured winter wheat (data not shown). Downy brome (BROTE) control was best with propoxycarbazone/mesosulfuron plus AMS treatments (80%) but did not differ from propoxycarbazone/mesosulfuron plus WE 1031-1 alone (64%) (Table 2). Sulfosulfuron alone did not control downy brome (18%) but the addition of an adjuvant increased control to 47 to 58%. Ammonium sulfate (AMS) added to the propoxycarbazone/mesosulfuron treatments increased downy brome control from 51 to 80% compared to propoxycarbazone/mesosulfuron alone. Wheat grain yield was highest in the propoxycarbazone/mesosulfuron plus AMS treatments and sulfosulfuron plus WE 1031-1 but did not differ from any propoxycarbazone/mesosulfuron treatment or sulfosulfuron plus NIS. Wheat grain yield in all treatments was greater than the untreated check except sulfosulfuron alone.

In the pyroxsulam study, no treatment injured winter wheat (data not shown). Pyroxsulam and propoxycarbazone treatments, except propoxycarbazone/mesosulfuron at the 2 leaf stage, controlled downy brome 90 to 97% (Table 3). The 2 leaf application of sulfosulfuron controlled downy brome 89% compared to the 1 tiller application (79%). Wheat grain yield in the untreated check tended to be lower than all other treatments.

In the propoxycarbazone and propoxycarbazone/mesosulfuron combination study, propoxycarbazone/mesosulfuron plus metribuzin injured wheat 5% (Table 4). Propoxycarbazone treatments and pyroxsulam controlled (86 to 88%) downy brome better than sulfosulfuron and flucarbazone (70 and 57%). Wheat grain yield did not differ among treatments and the untreated check.

Table 2. Downy brome control and wheat response with sulfosulfuron or propoxycarbazone/mesosulfuron plus adjuvants near Lewiston, Idaho in 2008.

Treatment[1]	Rate	BROTE control[2]	Wheat yield
	lb ai/A	%	lb/A
Sulfosulfuron	0.0312	18	816
Sulfosulfuron + NIS	0.0312 + 0.5% v/v	58	975
Sulfosulfuron + WE 1031-1	0.0312 + 3.13% v/v	47	1033
Sulfosulfuron + NIS + WE-1031-1	0.0312 + 0.5% v/v 3.13% v/v	50	794
Propoxycarbazone/mesosulfuron	0.0246	51	929
Propoxycarbazone/mesosulfuron + NIS + AMS	0.0246 + 0.5% v/v + 0.17	80	1072
Propoxycarbazone/mesosulfuron + WE-1031-1	0.0246 + 3.13% v/v	64	962
Propoxycarbazone/mesosulfuron + NIS + AMS + WE-1031-1	0.0246 + 0.5% v/v + 0.17 3.13% v/v	80	1016
Untreated check	--	--	676
LSD (0.05)		21	198
Density (plants/ft^2)		20	

[1] NIS is a 90% nonionic surfactant (R-11), AMS is ammonium sulfate (Bronc), and WE-1031-1 is an acidifier (Climb).

[2] May 22, 2008 evaluation.

Table 3. Downy brome control and wheat response with pyroxsulam and standard grass herbicides at two applications times near Lewiston, Idaho in 2008.

Treatment[1]	Rate	Application timing[2]	BROTE control[3,4]	Wheat yield[4]
	lb ai/A		%	lb/A
Pyroxsulam	0.0164	2 leaf	93	1465
Propoxycarbazone	0.0394	2 leaf	90	1747
Propoxycarbazone/mesosulfuron	0.0223	2 leaf	84	1491
Sulfosulfuron	0.0312	2 leaf	89	1583
Pyroxsulam	0.0164	1 tiller	92	1475
Propoxycarbazone	0.0394	1 tiller	94	1646
Propoxycarbazone/mesosulfuron	0.0223	1 tiller	97	1549
Sulfosulfuron	0.0312	1 tiller	79	1532
Untreated check	--	--	--	1388
LSD (0.05)			9	NS
Density (plants/ft^2)			3	

[1] Nonionic surfactant (Agral 90) was applied at 0.5% v/v with all treatments. Ammonium sulfate was applied at 1.5 lb ai/A with pyroxsulam and propoxycarbazone/mesosulfuron treatments.

[2] Application timing based on downy brome growth stage.

[3] Due to low downy brome pressure, only three replications used in the analysis.

[4] May 22, 2008 evaluation.

Table 4. Downy brome control and wheat response with propoxycarbazone and propoxycarbazone/mesosulfuron with and without metribuzin near Lewiston, ID in 2008.

Treatment[1]	Rate	Wheat injury[2]	Downy brome control[3]	Wheat yield
	lb ai/A	------------------%------------------		lb/A
Propoxycarbazone	0.04	0	86	1611
Propoxycarbazone/mesosulfuron	0.0246	0	80	1541
Propoxycarbazone + metribuzin	0.04 + 0.1875	0	88	1555
Propoxycarbazone/mesosulfuron + metribuzin	0.0246 0.1875	5	80	1378
Sulfosulfuron	0.0312	0	70	1566
Mesosulfuron	0.0134	0	80	1707
Pyroxsulam	0.0164	0	88	1753
Flucarbazone	0.027	0	57	1565
Untreated check	--	--	--	1433
LSD (0.05)		1	14	NS
Density (plants/ft^2)			20	

[1] Nonionic surfactant (R-11) was applied at 0.25% v/v with flucarbazone and metribuzin treatments and at 0.5% v/v with all other treatments. Urea ammonium nitrate (URAN) was applied at 5% v/v with sulfosulfuron and all mesosulfuron containing treatments and at 2.5% v/v with flucarbazone. Ammonium sulfate (Bronc) was applied at 1.5 lb ai/A with pyroxsulam.

[2] April 17, 2008 evaluation.

[3] May 22, 2008 evaluation.

Prickly lettuce and mayweed chamomile control with pyrasulfotole combinations in winter wheat. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) An experiment was established in 'IDO587' winter wheat to determine prickly lettuce and mayweed chamomile control with pyrasulfotole/bromoxynil and other broadleaf herbicide combinations. The experiment was located at the University of Idaho Kambitsch farm near Genesee, Idaho (Latah County). Herbicides were applied with a CO_2 pressurized backpack sprayer on May 15, 2008 and herbicide treatments were applied at 10 gpa. Prickly lettuce had 2 to 5 leaves and mayweed chamomile was 0.25 to 3 inch diameter. Air and soil temperature, relative humidity, and wind velocity were 68 F, 60 F and 68%, and east at 0 to 3 mph, respectively. The sky was 40% cloudy and the soil was dry on the surface. Soil pH, organic matter, CEC, and texture were 5.7, 2.9%, 28 cmol/kg, and silt loam, respectively. The experimental design was a randomized complete block with four replications, and experimental units were 8 by 30 ft. Weed control was evaluated visually and wheat grain was harvested at maturity.

Prickly lettuce control was 92% or greater with pyrasulfotole/bromoxynil alone or in combination with other herbicides (Table). Prickly lettuce control was 83% or lower with bromoxynil/MCPA, florasulam/MCPA, pyroxsulam, fluroxypyr/bromoxynil, and thifensulfuron/tribenuron. Poor control of prickly lettuce with thifensulfuron/tribenuron was due to sulfonylurea resistant prickly lettuce. Mayweed chamomile control was 95% with pyrasulfatole/bromoxynil in combination with fluroxyrpyr/bromoxynil, clopyralid/fluroxypyr, and thifensulfuron/tribenuron. Mayweed chamomile control was below 66% with clopyralid/2,4-D, fluroxyrpyr/bromoxynil, and clopyralid/fluroxypyr. Wheat grain yield and test weight did not differ among treatments.

Table. Prickly lettuce and mayweed chamomile control with pyrasulfotole/bromoxynil combinations in winter wheat.

		Weed control		Wheat grain	
Treatment[1]	Rate[1]	Prickly lettuce	Mayweed chamomile	Yield	Test weight
	lb ai/a	---------- % ---------		lb/a	lb/bu
Untreated control	--	--	--	5508 a	59 a
Pyrasulfotole/bromoxynil	0.18	92 a[2]	72 abc	5944 a	61 a
Pyrasulfotole/bromoxynil	0.21	95 a	90 abc	5854 a	60 a
Pyrasulfotole/bromoxynil	0.24	95 a	90 abc	6250 a	62 a
Bromoxynil/MCPA	0.375	80 ab	82 abc	6068 a	60 a
Florasulam/MCPA	0.315	83 ab	90 abc	5790 a	60 a
Pyroxsulam	0.0164	50 d	70 abc	6164 a	58 a
Clopyralid/2,4-D	0.6	93 a	38 d	5446 a	60 a
Fluroxypyr/bromoxynil	0.477	52 cd	62 cd	6066 a	61 a
Clopyralid/fluroxypyr	0.25	92 a	65 bcd	5794 a	62 a
Thifensulfuron/tribenuron	0.18	68 bc	88 abc	6037 a	60 a
Pyrasulfotole/bromoxynil + bromoxynil/MCPA	0.18 0.375	92 a	87 abc	6242 a	61 a
Pyrasulfotole/bromoxynil + florasulam/MCPA	0.18 0.315	95 a	93 ab	5575 a	61 a
Pyrasulfotole/bromoxynil + pyroxsulam	0.18 0.0164	95 a	85 abc	6201 a	60 a
Pyrasulfotole/bromoxynil + clopyralid/2,4-D	0.18 0.6	95 a	92 ab	6068 a	60 a
Pyrasulfotole/bromoxynil + fluroxypyr/bromoxynil	0.18 0.477	95 a	95 a	6227 a	61 a
Pyrasulfotole/bromoxynil + clopyralid/fluroxpyr	0.18 0.25	95 a	95 a	6022 a	61 a
Thifensulfuron/tribenuron	0.18	68 bc	88 abc	6037 a	60 a
Pyrasulfotole/bromoxynil + thifensulfuron/tribenuron	0.3 0.3	95 a	95 a	5634 a	61 a
Weed density(plants/ft^2)		*3*	*1*		

[1] Pyroxsulam was applied with crop oil concentrate and ammonium sulfate at 0.5% v/v and 1.5 lb ai/a, respectively. Thifensulfuron/tribenuron was applied with nonionic surfactant at 0.25% v/v.

[2] Means followed by the same letter within a column are not significantly different according to $LSD_{0.05}$.

Mayweed chamomile control with A15351 in winter wheat. Traci A. Rauch and Donald C. Thill (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in 'Westbred 528' winter wheat to evaluate mayweed chamomile control with A15351 (pinoxaden/florasulam) alone or in combination with other broadleaf herbicides near Genesee, Idaho. The experimental design was a randomized complete block with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The entire study was sprayed with pinoxaden at 0.054 lb ai/A on May 27, 2008 to control Italian ryegrass. Winter wheat injury and mayweed chamomile control were evaluated visually. Winter wheat grain was harvested on August 25, 2008.

Table 1. Application and soil data.

Application date	May 15, 2008
Wheat growth stage	5 tiller
Mayweed chamomile (ANTCO)	1 inch in diameter
Air temperature (F)	76
Relative humidity (%)	69
Wind (mph, direction)	2, SW
Cloud cover (%)	10
Soil moisture	dry
Soil temperature at 2 inch (F)	65
pH	5.0
OM (%)	2.9
CEC (meq/100g)	19
Texture	silt loam

Mesosulfuron + pyrasulfotole/bromoxynil injured winter wheat 5% (Table 2). All treatments controlled mayweed chamomile (ANTCO) 89 to 97%. Wheat grain yield was greater for all herbicide treatments (76 to 83 bu/A) compared to the untreated check (66 bu/A). Wheat grain test weight did not differ among treatments.

Table 2. Mayweed chamomile control and wheat response with A15351 alone or in combinations near Genesee, Idaho in 2008.

		Wheat	ANTCO	Wheat	
Treatment[1]	Rate	injury	control[2]	Yield	Test weight
	lb ai/A	%	%	bu/A	lb/bu
A15351	0.058	0	94	76	55.4
A15351 +	0.058				
bromoxynil/MCPA	0.5	0	94	78	55.2
A15351 +	0.058				
fluroxypyr	0.062	0	89	79	55.2
A15351 +	0.058				
fluroxypyr/bromoxynil	0.317	0	91	78	55.6
A15351 +	0.058				
fluroxypyr/MCPA	0.333	0	91	77	55.5
A15351 +	0.058				
fluroxypyr/clopyralid	0.117	0	97	81	55.2
A15351 +	0.058				
MCPA ester	0.312	0	89	80	55.1
A15351 +	0.058				
pyrasulfotole/bromoxynil	0.177	0	95	83	55.1
Pinoxaden +	0.054				
fluroxypyr/clopyralid +	0.188				
MCPA ester	0.347	0	91	80	55.1
Pinoxaden +	0.054				
bromoxynil +	0.25				
florasulam/MCPA	0.315	0	96	82	54.8
Pinoxaden +	0.054				
clopyralid/MCPA	0.152				
florasulam/MCPA	0.315	0	94	80	55.6
Mesosulfuron +	0.0134				
pyrasulfotole/bromoxynil	0.177	5	95	82	54.4
Untreated check	--	--	--	66	55.7
LSD (0.05)		1	4	8	NS
Density (plants/ft^2)			20		

[1] An adjuvant (Adigor) was applied with all A15351 treatments at 0.6 pt/A. Ammonium sulfate (Bronc) at 0.5 lb ai/A was applied with A15351 + pyrasulfotole/bromoxynil. A nonionic surfactant (R-11) and 32% urea ammonium nitrate (URAN) were applied at 0.25 and 5% v/v, respectively, with mesosulfuron plus pyrasulfotole/bromoxynil.

[2] Evaluation date June 9, 2008.

Broadleaf weed control with sulfonylurea herbicides in winter wheat. Traci A. Rauch and Donald C. Thill (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in 'IDO 587' winter wheat to evaluate broadleaf weed control with sulfonylurea herbicides near Genesee, Idaho. The experimental design was a randomized complete block with four replications and included an untreated check. Plots were 8 by 25 ft. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Weed control was evaluated visually. Winter wheat grain was harvested with a small plot combine on August 12, 2008.

Table 1. Application and soil data.

Application date	April 28, 2008
Growth stage	
Wheat	1 tiller
Volunteer camelina (CAMSA)	3 inch
Field pennycress (THLAR)	1 inch
Prickly lettuce (LACSE)	pre
Air temperature (F)	64
Relative humidity (%)	50
Wind (mph, direction)	5, N
Cloud cover (%)	100
Soil moisture	adequate
Soil temperature at 2 inch (F)	54
pH	5.3
OM (%)	3.3
CEC (meq/100g)	24
Texture	silt loam

No treatment visually injured winter wheat (data not shown). All treatments controlled volunteer camelina (CAMSA) and field pennycress (THLAR) 99% (Table 2). Prickly lettuce control ranged from 86 to 98% but did not differ among treatments. Wheat grain yield and test weight ranged from 50 to 65 bu/A and 55.3 and 59.7 lb/bu, respectively, and did not differ among treatments but yield tended to be lowest in the untreated check.

Table 2. Broadleaf weed control and winter wheat yield with sulfonylurea herbicides near Genesee, ID in 2008.

		Broadleaf weed control			Wheat	
Treatment[1]	Rate	CAMSA	THLAR	LACSE	Yield	Test weight
	lb ai/A	------------------------%------------------------			bu/A	lb/bu
Metsulfuron	0.00375	99	99	86	59	57.4
Thifensulfuron/tribenuron/ metsulfuron	0.178	99	99	89	59	57.4
Tribenuron	0.0155	99	99	93	54	58.1
Thifensulfuron	0.028	99	99	90	54	58.3
Chlorsulfuron	0.0155	99	99	87	51	57.2
Chlorsulfuron/metsulfuron	0.0188	99	99	90	53	56.4
INC-115 + bromoxynil	0.025 0.25	99	99	98	65	55.6
INC-116	0.0313	99	99	88	60	59.7
Thifensulfuron/tribenuron (Nimble)	0.028	99	99	89	55	57.8
Thifensulfuron/tribenuron (Affinity BroadSpectrum)	0.0219	99	99	90	60	55.3
Untreated check	--	--	--	--	50	59.1
LSD (0.05)		NS	NS	NS	NS.	NS
Density (plants/ft^2)		4	1	2		

[1] A nonionic surfactant (R-11) at 0.25% v/v rate was included with all treatments. Nimble and Affinity BroadSpectrum are trade names for thifensulfuron/tribenuron.

[2] Evaluation date July 16, 2008.

Italian ryegrass control in winter wheat. *Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division,* University of Idaho, Moscow, ID 83844-2339) Studies were established in winter wheat to evaluate crop response and ACCase-resistant Italian ryegrass (LOLMU) control with mesosulfuron or mesosulfuron/iodosulfuron mixed with pyrasulfotole/bromoxynil combinations near Moscow, ID and flufenacet/metribuzin and triasulfuron combinations near Pullman, WA. Studies were arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). At the Pullman site, the entire study was sprayed with thifensulfuron/tribenuron at 0.0313 lb ai/A and bromoxynil/MCPA at 0.5 lb ai/A on May 27, 2008 to control broadleaf weeds. Wheat response and Italian ryegrass control were evaluated visually. Wheat grain was harvested at the Moscow and Pullman sites with a small plot combine on August 15 and 29, 2008, respectively.

Table 1. Application and soil data.

Location	Moscow, ID	Pullman WA	
Winter wheat variety	Mohler	Madsen	
Application date	5/9/08	10/15/07	5/13/08
Growth stage			
Wheat	5 tiller	preemergence	4 tiller
Italian ryegrass	2 tiller	preemergence	4 tiller
Air temperature (F)	55	74	55
Relative humidity (%)	50	44	56
Wind (mph, direction)	7,W	0	3, E
Cloud cover (%)	60	10	90
Soil moisture	dry	dry	dry
Soil temperature at 2 inch (F)	64	62	50
pH	5.2	5.1	
OM (%)	3.4	2.7	
CEC (meq/100g)	21	22	
Texture	silt loam	silt loam	

At the Moscow site, bromoxynil/MCPA combined with mesosulfuron or mesosulfuron/iodosulfuron injured wheat 14% (Table 2). Pinoxaden alone controlled Italian ryegrass 88% which was better than all other treatments, except mesosulfuron/iodosulfuron plus bromoxynil/MCPA and pinoxaden plus pyrasulfotole/bromoxynil and thifensulfuron/tribenuron (83 and 81%). Wheat grain yield and test weight ranged from 107 to 116 bu/A and 60.9 to 62.0 lb/bu, respectively, and did not differ among treatments.

At the Pullman site, flufenacet/metribuzin plus mesosulfuron/iodosulfuron and flucarbazone applied at the 4 tiller stage injured wheat 22%, but these treatments did not differ from triasulfuron plus flufenacet/metribuzin, triasulfuron plus mesosulfuron, triasulfuron plus mesosulfuron/iodosulfuron and flufenacet/metribuzin plus mesosulfuron (11 to 16%) (Table 3). All treatments controlled Italian ryegrass 82% or better except mesosulfuron or flucarbazone alone (48 to 69%). Wheat grain yield and test weight ranged from 82 to 108 bu/A and 56.5 to 58.4 lb/bu, respectively, and did not differ among treatments, but yield tended to be lowest in the untreated check (82 bu/A).

Table 2. Italian ryegrass control and winter wheat response with mesosulfuron or mesosulfuron/iodosulfuron combined with pyrasulfotole/bromoxynil near Moscow, ID in 2008.

Treatment[1]	Rate	Wheat injury[2]	LOLMU control[2]	Wheat	
				Yield	Test weight
	lb ai/A	%	%	bu/A	lb/bu
Mesosulfuron	0.0134	4	69	109	61.3
Mesosulfuron + bromoxynil/MCPA	0.0134 0.75	14	80	111	60.9
Mesosulfuron + pyrasulfotole/bromoxynil	0.0134 0.217	0	78	112	61.2
Mesosulfuron + pyrasulfotole/bromoxynil + thifensulfuron/tribenuron	0.0134 0.177 0.0188	2	78	109	61.5
Mesosulfuron + pyrasulfotole/bromoxynil + clopyralid/fluroxypyr	0.0134 0.177 0.14	4	76	109	62.0
Mesosulfuron + pyrasulfotole/bromoxynil + bromoxynil/MCPA	0.0134 0.177 0.325	0	78	116	61.2
Mesosulfuron/iodosulfuron	0.0134	0	80	112	61.4
Mesosulfuron/iodosulfuron + bromoxynil/MCPA	0.0134 0.75	14	83	115	60.9
Mesosulfuron/iodosulfuron + pyrasulfotole/bromoxynil	0.0134 0.217	2	78	111	61.1
Mesosulfuron/iodosulfuron + pyrasulfotole/bromoxynil + thifensulfuron/tribenuron	0.0134 0.177 0.0188	5	78	109	61.2
Mesosulfuron/iodosulfuron + pyrasulfotole/bromoxynil + clopyralid/fluroxypyr	0.0134 0.177 0.14	0	76	113	61.4
Mesosulfuron/iodosulfuron + pyrasulfotole/bromoxynil + bromoxynil/MCPA	0.0134 0.177 0.325	2	80	114	61.4
Pinoxaden + pyrasulfotole/bromoxynil + thifensulfuron/tribenuron	0.0534 0.177 0.0188	4	81	107	61.4
Pinoxaden	0.0534	2	88	110	61.5
Pyrasulfotole/bromoxynil + thifensulfuron/tribenuron	0.177 0.0188	0	--	109	61.8
Untreated check		--	--	113	61.5
LSD (0.10)		7	7	NS	NS
Density (plants/ft^2)			1		

[1] A non-ionic surfactant (R-11) and urea ammonium nitrate (URAN) were applied at 0.5 and 5% v/v, respectively, with mesosulfuron and mesosulfuron/iodosulfuron.

[2] July 25, 2008 evaluation.

Table 3. Italian ryegrass control and wheat response with flufenacet/metribuzin and triasulfuron combinations near Pullman, WA in 2008.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	LOLMU control[4]	Wheat	
					Yield	Test weight
	lb ai/A		%	%	bu/A	lb/bu
Flufenacet/metribuzin	0.425	preemergence	2	92	101	56.7
Triasulfuron	0.026	preemergence	0	82	89	56.5
Flufenacet/metribuzin +	0.425	preemergence				
triasulfuron	0.026	preemergence	11	97	94	57.3
Flufenacet/metribuzin +	0.425	preemergence				
flucarbazone	0.027	preemergence	4	93	98	57.3
Triasulfuron +	0.026	preemergence				
flucarbazone	0.027	preemergence	0	91	107	57.7
Flucarbazone	0.027	preemergence	0	69	89	57.3
Flufenacet/metribuzin +	0.425	preemergence				
mesosulfuron	0.0134	4 tiller	16	96	100	57.4
Triasulfuron +	0.026	preemergence				
mesosulfuron	0.0134	4 tiller	12	95	107	57.1
Mesosulfuron	0.0134	4 tiller	9	71	89	58.0
Flufenacet/metribuzin +	0.425	preemergence				
mesosulfuron/iodosulfuron	0.0135	4 tiller	22	85	92	57.5
Triasulfuron +	0.0.26	preemergence				
mesosulfuron/iodosulfuron	0.0135	4 tiller	12	94	98	58.4
Mesosulfuron/iodosulfuron	0.0135	4 tiller	0	87	97	57.9
Pinoxaden	0.0534	4 tiller	2	94	108	58.1
Pyroxsulam	0.0164	4 tiller	0	94	100	57.3
Flucarbazone	0.027	4 tiller	22	48	92	57.7
Untreated check	--	--	--	--	82	57.5
LSD (0.05)			12	19	NS	NS
Density (plants/ft^2)				25		

[1] A non-ionic surfactant (R-11) was applied at 0.25% v/v with all postemergence flucarbazone and 0.5% v/v with mesosulfuron, mesosulfuron/iodosulfuron, and pyroxsulam. Urea ammonium nitrate (URAN) was applied at 5% v/v with mesosulfuron, mesosulfuron/iodosulfuron and flucarbazone. Ammonium sulfate (Bronc) was applied at 1.5 lb ai/A with pyroxsulam.

[2] Application timing based on Italian ryegrass growth stage.

[3] June 26, 2008 evaluation.

[4] July 28, 2008 evaluation.

Italian ryegrass and ventenata control in winter wheat with flucarbazone. *Traci A. Rauch and Donald C. Thill.* (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in winter wheat near Moscow, ID and Pullman, WA to evaluate ventenata (VENDU) and ACCase-resistant Italian ryegrass (LOLMU) control, respectively, and wheat response with preemergence, postemergence, and split (preemergence and postemergence) applications of flucarbazone alone and in combination. Studies were arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Both sites were sprayed with thifensulfuron/tribenuron at 0.0313 lb ai/A and bromoxynil/MCPA at 0.5 lb ai/A on May 27, 2008 to control broadleaf weeds. Wheat response and weed control were evaluated visually. Wheat grain was harvested at the Moscow and Pullman sites with a small plot combine on August 18 and 29, 2008, respectively.

Table 1. Application and soil data.

Location	Moscow, ID			Pullman, WA		
Application date	10/4/07	5/9/08	5/15/08	10/15/07	5/9/08	5/20/08
Growth stage						
Wheat	preemergence	3 tiller	4 tiller	preemergence	2 tiller	5 tiller
Italian ryegrass (LOLMU)	--	--	--	preemergence	1 tiller	3 tiller
Ventenata (VENDU)	preemergence	4 tiller	5 tiller	--	--	--
Air temperature (F)	54	62	79	74	67	67
Relative humidity (%)	72	45	50	44	45	57
Wind (mph, direction)	0	3, W	0	0	5, W	3, SSW
Cloud cover (%)	90	50	10	10	0	30
Soil moisture	wet	adequate	dry	dry	dry	dry
Soil temperature at 2 inch (F)	48	58	68	62	50	60
pH		6.6			5.1	
OM (%)		3.6			2.7	
CEC (meq/100g)		15			22	
Texture		silt loam			silt loam	

At Moscow, no treatment injured the 'Finch' and 'Mohler' mixture of winter wheat (data not shown). All treatments controlled ventenata 90 to 99% except the single application of flucarbazone preemergence or mesosulfuron (73 and 78%) (Table 2). Wheat grain yield was greater than the untreated check with flufenacet/metribuzin or triasulfuron plus flucarbazone preemergence, triasulfuron plus flucarbazone postemergence, and flufenacet/metribuzin plus mesosulfuron. Wheat grain test weight did not differ among all treatments including the untreated check.

At Pullman, all flufenacet/metribuzin treatments injured 'Madsen' winter wheat 20 to 28% (Table 3). All treatments controlled Italian ryegrass 86% or better, except the flucarbazone applied preemergence alone (40%), flucarbazone split treatments (68 to 69%) and flufenacet/metribuzin plus flucarbazone applied preemergence (78%). Wheat grain yield and test weight did not differ among treatments and the untreated check. Wheat grain yield did not correlate with visual control due to high variability in wheat stand from rill erosion.

Table 2. Ventenata control and winter wheat response with flucarbazone combinations near Moscow, ID in 2008.

Treatment[1]	Rate	Application timing[2]	VENDU control[3]	Wheat Yield	Wheat Test weight
	lb ai/A		%	bu/A	lb/bu
Flufenacet/metribuzin	0.425	preemergence	97	60	59.9
Triasulfuron	0.026	preemergence	97	60	60.6
Flucarbazone	0.027	preemergence	73	66	60.5
Flufenacet/metribuzin +	0.425	preemergence			
flucarbazone	0.027		99	69	60.1
Triasulfuron +	0.026	preemergence			
flucarbazone	0.027		97	71	60.3
Flufenacet/metribuzin +	0.425	preemergence			
flucarbazone	0.027	4 tiller	99	61	59.6
Triasulfuron +	0.026	preemergence			
flucarbazone	0.027	4 tiller	99	70	60.2
Flufenacet/metribuzin +	0.425	preemergence			
flucarbazone +	0.0134	preemergence			
flucarbazone	0.0134	4 tiller	99	59	59.7
Triasulfuron +	0.026	preemergence			
flucarbazone +	0.0134	preemergence			
flucarbazone	0.0134	4 tiller	97	63	60.2
Flucarbazone	0.027	4 tiller	90	59	60.1
Flucarbazone +	0.0178	preemergence			
flucarbazone	0.0089	4 tiller	90	56	59.8
Flucarbazone +	0.0134	preemergence			
flucarbazone	0.0134	4 tiller	98	62	59.9
Flufenacet/metribuzin +	0.34	preemergence			
mesosulfuron	0.026	5 tiller	99	72	60.1
Mesosulfuron	0.0134	5 tiller	78	59	59.9
Untreated check	--	--	--	57	60.1
LSD (0.05)			13	11	NS
Density (plants/ft^2)			1		

[1] A non-ionic surfactant (R-11) was applied at 0.25% v/v with all postemergence flucarbazone and 0.5% v/v with mesosulfuron. Urea ammonium nitrate (URAN) was applied at 2.5% v/v with all postemergence flucarbazone and at 5% v/v with mesosulfuron.

[2] Application timing based on ventenata growth stage.

[3] June 19, 2008 evaluation.

Table 3. Italian ryegrass control and winter wheat response with flucarbazone combinations near Pullman, WA in 2008.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3,4]	LOLMU control[3,4]	Wheat	
					Yield[4]	Test weight[4]
	lb ai/A		%	%	bu/A	lb/bu
Flufenacet/metribuzin	0.425	preemergence	25	95	86	54.8
Triasulfuron	0.026	preemergence	10	95	97	56.1
Flucarbazone	0.027	preemergence	5	40	79	54.8
Flufenacet/metribuzin +	0.425					
flucarbazone	0.027	preemergence	27	78	88	55.8
Triasulfuron +	0.026					
flucarbazone	0.027	preemergence	5	88	85	55.4
Flufenacet/metribuzin +	0.425	preemergence				
flucarbazone	0.027	1 tiller	20	97	94	55.0
Triasulfuron +	0.026	preemergence				
flucarbazone	0.027	1 tiller	3	97	70	54.0
Flufenacet/metribuzin +	0.425	preemergence				
flucarbazone +	0.0134	preemergence				
flucarbazone	0.0134	1 tiller	23	86	103	57.0
Triasulfuron +	0.026	preemergence				
flucarbazone +	0.0134	preemergence				
flucarbazone	0.0134	1 tiller	10	90	103	56.8
Flucarbazone	0.027	1 tiller	8	88	76	52.6
Flucarbazone +	0.0178	preemergence				
flucarbazone	0.0089	1 tiller	7	69	94	55.8
Flucarbazone +	0.0134	preemergence				
flucarbazone	0.0134	1 tiller	7	68	102	56.9
Flufenacet/metribuzin +	0.34	preemergence				
mesosulfuron	0.026	3 tiller	28	95	89	56.4
Mesosulfuron	0.0134	3 tiller	13	93	93	57.5
Untreated check	--	--		--	80	57.7
LSD (0.05)			14	16	NS	NS
Density (plants/ft^2)				30		

[1] A non-ionic surfactant (R-11) was applied at 0.25% v/v with all postemergence flucarbazone and 0.5% v/v with mesosulfuron. Urea ammonium nitrate (URAN) was applied at 2.5% v/v with all postemergence flucarbazone and at 5% v/v with mesosulfuron.

[2] Application timing based on Italian ryegrass growth stage.

[3] July 28, 2008 evaluation.

[4] Only three replications used in the analysis due water logging damage.

Tolerance of winter wheat varieties to imazethapyr and mesosulfuron. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339), Ian Burke Joseph Yenish, Dennis Pittman, and Rodney Rood (Crop and Soil Sciences, Washington State University, Pullman, WA 99163), Daniel Ball and Larry Bennett (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801). A study was established near Moscow, ID to evaluate the response of winter wheat varieties seeded into fall applied imazethapyr followed by spring applied mesosulfuron under adverse environmental conditions (freezing nights or large temperature fluctuations). Identical studies were conducted near Pullman, WA and Pendleton, OR. The experimental design was a randomized complete block, split-split block with four replications. Main plots were three winter wheat varieties (Brundage 96, 0RCF 102, and Tubbs 06), subplots were six imazethapyr doses (0.005, 0.01, 0.05, 0.1, 0.5, and 1 times 0.047 lb ai/A, the use rate in legumes) and included an untreated check. The sub-subplot was the presence or absence of a mesosulfuron application at 0.0134 lb ai/A. The imazethapyr and mesosulfuron treatments were applied in the fall and spring, respectively (Table 1). Two weeks prior to the application date of mesosulfuron, 13 days had freezing temperatures. Two weeks after the application date, nine days had freezing temperatures and five days had at least a 25 degree temperature fluctuation. To control broadleaf weeds, the entire study was sprayed with thifensulfuron/tribenuron at 0.014 lb ai/A on May 9, 2008. Two plant counts (yard of row) in each plot were taken on November 2, 2007. Wheat injury was evaluated visually during the growing season. Wheat grain was harvested with a small plot combine on August 14, 2008.

Table 1. Application and soil data.

Planting date	September 26, 2007	
Application date	September 24, 2007	April 10, 2008
Wheat growth stage	preplant incorporated	1 to 4 tiller
Application method	CO_2 pressurized backpack	tractor with pump
Spray volume	10 gpa	14 gpa
Operating pressure	32 psi	35 psi
Nozzle size	110015	8003
Ground speed	3 mph	5.5 mph
Air temperature (F)	67	35
Relative humidity (%)	44	78
Wind (mph, direction)	2, WNW	2, W
Dew present?	no	yes
Cloud cover (%)	0	100
Soil moisture	very dry	excessive
Soil temperature at 2 inch (F)	62	40
pH	4.9	
OM (%)	3.7	
CEC (meq/100g)	23	
Texture	silt loam	

No two-way or three way interaction was significant for plant counts, wheat injury, yield, or test weight. Fall plant counts did not differ among imazethapyr dose (data not shown). Plant number was greater for the Brundage 96 variety than ORCF 102 or Tubbs 06 (Table 2). At 7, 14, and 21 days after treatment (DAT) of mesosulfuron, all wheat varieties were injured 22, 12, and 3%, respectively (Table 3) but did not differ between varieties or imazethapyr dose (data not shown). Wheat grain yield in the two highest imazethapyr rates (0.0235 and 0.047 lb ai/A) did not differ from the untreated check but tended to be the lowest (Table 4). Wheat grain yield was lowest for Tubbs 06 (Table 2). Wheat grain yield did not differ between mesosulfuron application (data not shown). Test weight did not differ among imazethapyr dose (data not shown). Wheat test weight was greatest for ORCF 102 (Table 2). Wheat test weight was greater in the mesosulfuron treatments compared to the untreated plots (Table 3).

Table 2. Winter wheat plant counts, yield and test weight averaged over imazethapyr dose and mesosulfuron application in 2008.

Variety	Plant counts	Wheat	
		Yield[1]	Test weight[1]
	no./yd of row	lb/A	lb/bu
ORCF 102	29b	6864a	62.7a
Brundage 96	31a	6837a	62.0b
Tubbs 06	29b	6601b	62.0b

[1] Means followed by the same letter do not differ significantly at $P \leq 0.05$.

Table 3. Winter wheat injury averaged over winter wheat varieties and imazethapyr dose in 2008.

Treatment[1]	Rate	Wheat injury[2]			Wheat test weight[2]
		7 DAT	14 DAT	21 DAT	
	lb ai/A	%	%	%	lb/bu
Mesosulfuron	0.0134	22a	12a	3a	62.4a
Untreated check	--	0b	0b	0b	62.2b

[1] Mesosulfuron treatments were applied with 90% non-ionic surfactant (R-11) at 0.5% v/v and 32% urea ammonium nitrate (URAN) at 5% v/v.

[2] Means followed by the same letter do not differ significantly at $P \leq 0.05$.

Table 4. Winter wheat yield averaged over winter wheat varieties and mesosulfuron application in 2008.

Treatment	Rate	Wheat yield[1]
	lb ai/A	lb/A
Imazethapyr	0.000235	6760abc
Imazethapyr	0.00047	6979a
Imazethapyr	0.00235	6883ab
Imazethapyr	0.0047	6906ab
Imazethapyr	0.0235	6628bc
Imazethapyr	0.047	6497c
Untreated check	--	6719abc

[1] Means followed by the same letter do not differ significantly at $P \leq 0.05$.

Tolerance of winter wheat varieties to mesosulfuron applied under adverse environmental conditions. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339), Ian Burke Joseph Yenish, Dennis Pittman, and Rodney Rood (Crop and Soil Sciences, Washington State University, Pullman, WA 99163), Daniel Ball and Larry Bennett (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801). A study was established near Moscow, Idaho to evaluate injury, yield, and test weight of six winter wheat varieties with mesosulfuron alone or in combination applied during freezing night or large low to high temperature fluctuation. The experimental design was a randomized complete block, strip plot with four replications. Main plots were six winter wheat varieties (Boundary, Brundage96, Chukar, Eddy, Madsen, and 0RCF 102) and subplots were three herbicide treatments (mesosulfuron plus bromoxynil, mesosulfuron alone, and bromoxynil alone) and an untreated check. Treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Two weeks prior to the application date, 13 days had freezing temperatures and two weeks after the application date, 8 days had freezing temperatures and 5 days had at least 25 degree temperature fluctuation. To control broadleaf weeds, the entire study was sprayed with thifensulfuron/tribenuron at 0.014 lb ai/A on May 9, 2008. Wheat injury was evaluated visually at 7,14 and 21 days after treatment (DAT) . Plant counts, head height and biomass were taken at heading (data not shown). Wheat grain was harvested with a small plot combine on August 14, 2008.

Table 1. Application and soil data.

Planting date	September 26, 2007
Application date	April 11, 2008
Wheat growth stage	2 to 4 tiller
Air temperature (F)	53
Relative humidity (%)	68
Wind (mph, direction)	3, ESE
Cloud cover (%)	50
Soil moisture	excessive
Soil temperature at 2 inch (F)	42
pH	4.9
OM (%)	3.7
CEC (meq/100g)	23
Texture	silt loam

At 7 and 14 DAT, mesosulfuron plus bromoxynil/MCPA and mesosulfuron alone injured wheat 8 and 17% and 4 and 11%, respectively (Table 2). By 21 DAT, wheat injury was similar for mesosulfuron plus bromoxynil/MCPA and mesosulfuron alone (2 and 3%). Wheat injury did not differ among varieties (data not shown). Wheat grain yield was greatest for Brundage96 but did not differ from ORCF 102 (Table 3). Wheat grain yield was lowest for Eddy but did not differ from Chukar. Wheat grain yield did not differ among treatments (data not shown). Test weight for all herbicide treatments was not different from the untreated check (Table 2). Wheat test weight differed for all varieties except it was similar for ORCF 102 and Madsen (Table 3).

Table 2. Winter wheat injury averaged over winter wheat varieties in 2008.

		Wheat injury[2]			Wheat
Treatment[1]	Rate	7 DAT	14 DAT	21 DAT	test weight[2]
	lb ai/A	%	%	%	lb/bu
Bromoxynil/MCPA	0.75	1c	1c	0b	63.05b
Mesosulfuron	0.0134	11b	4b	2a	63.34a
Mesosulfuron + bromoxynil/MCPA	0.0134 0.75	17a	8a	3a	63.33a
Untreated check	--	--	--	--	63.20ab

[1] Mesosulfuron treatments were applied with 90% non-ionic surfactant (R-11) at 0.5% v/v and 32% urea ammonium nitrate (URAN) at 5% v/v.

[2] Means followed by the same letter do not differ significantly at P≤0.05.

Table 3. Winter wheat yield and test weight averaged over treatment in 2008.

Variety	Description	Wheat	
		Yield[1]	Test weight[1]
		lb/A	lb/bu
Brundage96	soft white common	7845a	62.3d
ORCF 102	soft white common	7570ab	62.9c
Boundary	hard red common	7282b	63.8b
Madsen	soft white common	7174bc	62.8c
Chukar	soft white club	7078bcd	61.8e
Eddy	hard red common	6775d	65.8a

[1] Means followed by the same letter do not differ significantly at $P \leq 0.05$.

Newly reported exotic species in Idaho. Timothy S. Prather and Larry Lass. (Idaho Agricultural Experiment Station, University of Idaho, Moscow, Idaho, 83844-2339). The Lambert C. Erickson Weed Diagnostic Laboratory received 255 specimens for identification in 2008. The utilization of the lab was down with loss of funding (Figure 1). Seventy-six exotic species were identified. Two species reported were new to the state, cutleaf geranium (*Geranium dissectum*) and Jersey cudweed (*Pseudognaphalium luteoalbum*). The lab identified 14 exotic species that were new county records (see Tables 1 and Figure 2). A total of 23 counties in Idaho submitted samples (Figure 3). Species in Table 1 have either not been reported in the state (∞) or not previously been reported from the county to the Erickson Weed Diagnostic Laboratory or the BONAP's Floristic Synthesis of North America, although previously reported in one or more counties in Idaho.

Acknowledgement: We would like to thank Sandra Robins for her seven years of service at the Erickson Weed Lab. She identified over 3000 specimens. We wish her the best at the USFS.

Table 1. Identified species new to the state and/or county based on BONAP's Floristic Synthesis of North America.

County	Family	Scientific Name	Common Name
Ada	Apiaceae	*Torilis arvensis*	Hedgeparsley
Ada	Ranunculaceae	*Adonis aestivalis*	spring Adonis
Adams	Brassicaceae	*Cardaria pubescens*	hairy whitetop
Benewah	Asteraceae	*Conyza bonariensis*	hairy fleabane
Canyon	Fumariaceae	*Fumaria officinalis*	fumitory
Idaho	Brassicaceae	*Cardaria chalapensis*	lens-pod whitetop
Idaho	Euphorbiaceae	*Euphorbia davidii*	David's spurge
Jefferson	Polygonaceae	*Polygonum cuspidatum*	Japanese knotweed
Kootenai	Apiaceae	*Anthriscus caucalis*	bur chervil
Kootenai	Bignoniaceae	*Catalpa bignoniodes*	southern catalpa
Latah	Asteraceae	*Carduus acanthoides*	thistle, plumeless
Latah	Euphorbiaceae	*Euphorbia cyparissias*	cypress spurge
Latah	Geraniaceae	*Geranium dissectum*	cutleaf geranium ∞
Lemhi	Asteraceae	*Pseudognaphalium luteoalbum*	Jersey cudweed ∞

∞ = new to state.

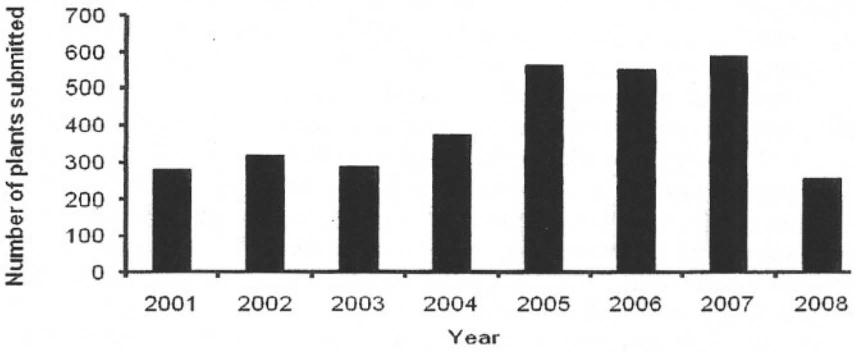

Figure 1. Erickson Weed Diagnostic Laboratory received 255 plant specimens for identification in 2008.

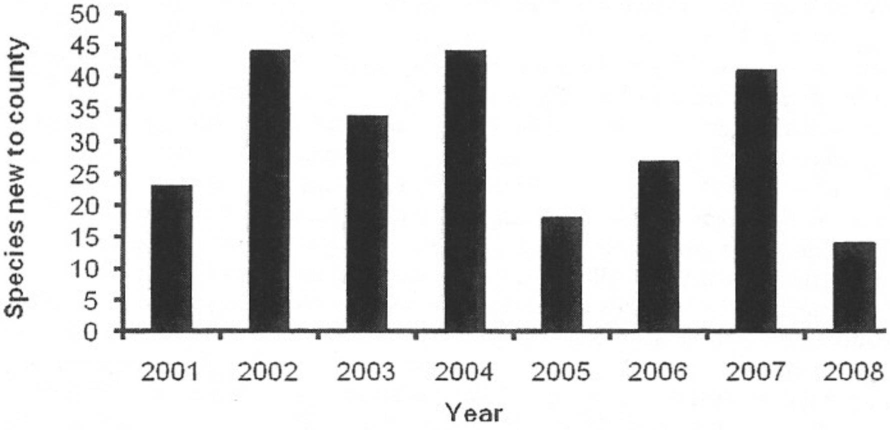

Figure 2. The lab identified 14 exotic species that were new Idaho records.

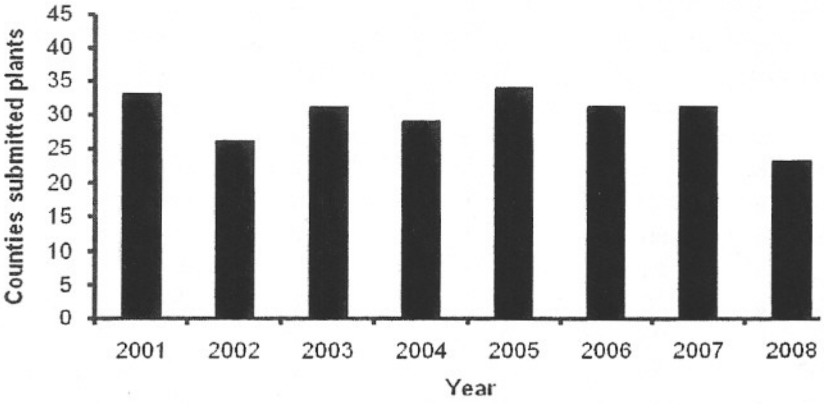

Figure 3. Twenty-three Idaho counties submitted plants.

Herbicides for control of goatsrue (*Galega officinalis*). Michelle Oldham and Corey V. Ransom. (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) Goatsrue response to 2,4-D amine, dicamba, chlorsulfuron, picloram, imazapyr, metsulfuron, aminopyralid, and triclopyr was evaluated in field trials at sites heavily infested with goatsrue in Smithfield and Amalga, in Cache County, Utah. The Smithfield site was a field lot also containing meadow foxtail (*Alopecurus pratensis*), reed canarygrass (*Phalaris arundinacea*), quackgrass (*Agropyron repens*), and smooth brome (*Bromus inermis*). The Amalga site was a long-term pasture of reed canarygrass and a sedge (*Carex spp.*). Plots were 10 ft wide by 30 ft long at Smithfield and 10 ft wide by 20 ft long at Amalga, and arranged in a completely randomized complete block design with four replications. Herbicide applications were made with a CO_2-pressurized backpack sprayer calibrated to deliver 20 gpa at 30 psi, when plants were in full flower (July 3 at Smithfield and July 18 at Amalga, 2007). Treatments were evaluated 12 months after spraying using visual evaluations and a point intercept method to determine vegetation cover. Vegetation was recorded every 1 ft along two parallel 20-ft transects placed 3 ft apart. Data were not combined due to location by treatment interactions. Data were checked for normality and homogeneity of variances prior to analysis. Data from each field site were subjected to an analysis of variance and a Fischer's protected LSD means separation. Some plots had a severe infestation of Canada thistle or field bindweed which became dominant after goatsrue was controlled by the treatments. Thus, plots with greater than 60% perennial weed cover (other than goatsrue) were excluded in the analysis for perennial grass and goatsrue cover at both field sites. Metsulfuron, chlorsulfuron, dicamba, and picloram gave 100% control of established goatsrue plants at both sites (Table). Triclopyr, aminopyralid, and imazapyr, resulted in 100% control at the Amalga site ($P = 0.0001$) and 97, 93, 84% control at the Smithfield site ($P = 0.0001$), respectively. Goatsrue control with 2,4-D was variable providing 98% control at the Amalga site, but only 9% at Smithfield. Variability between sites may be partially attributed to site differences; the Amalga site was in a pasture on a moist north-east facing slope with predominantly reed canarygrass; while the Smithfield site appeared to be drier and had a variety of perennial grasses. Another factor which may have affected the Amalga site was minor livestock damage done to plots 4 weeks after treatment. The line intercept vegetation sampling from Smithfield showed that all treatments excluding 2,4-D and imazapyr, increased perennial grass cover compared to the control plots ($P = 0.0001$). 2,4-D was ineffective in controlling goatsrue, thus perennial grasses did not increase as goatsrue was still dominant. Although imazapyr provided 84% control of perennial goatsrue it also injured perennial grasses; reducing their growth and competitiveness leading to an increase of other weed species. At Amalga, only treatments of dicamba and metsulfuron led to a significant increase of perennial grass cover ($P = 0.0390$) compared to the untreated. All treatments at Amalga may not have led to a significant increase in grass cover as the site had an abundant grass stand prior to treatment. Goatsrue removal at Amalga would be less likely to significantly increase the cover of grass present, as opposed to the removal of an almost completely dominant goatsrue canopy with little perennial grass cover at Smithfield. Imazapyr followed the same trend at Amalga as occurred at Smithfield, good control of goatsrue along with injury to perennial grasses, resulting in the lowest percentage of grass cover (20%) at Amalga. While there were only slight differences in goatsrue control among most herbicide treatments 1 year after application, differences in response to these herbicides may become apparent during plot evaluations in subsequent years.

Table. Herbicide rates, visual percent goatsrue control, percent perennial goatsrue cover, and perennial grass cover 12 months after treatments at two field sites in Cache County,Utah[1].

		Goatsrue control		Goatsrue cover		Perennial grass cover	
Herbicide	Rate[2]	Amalga	Smithfield	Amalga	Smithfield	Amalga	Smithfield
	lb ae/A	%					
Untreated	---	--- ---	--- ---	35 a	89 a	32 cd	2 e
2,4-D	2.0	98 b	9 c	0 b	80 a	61 abc	9 de
Dicamba	2.0	100 a	100 a	0 b	0 b	69 ab	32 cd
Chlorsulfuron	0.047	100 a	100 a	0 b	0 b	50 a-d	59 ab
Imazapyr	0.5	100 a	84 b	0 b	3 b	20 d	9 de
Metsulfuron	0.037	100 a	100 a	0 b	0 b	84 a	78 a
Aminopyralid	0.078	100 a	93 ab	0 b	3 b	39 bcd	74 a
Triclopyr	1.5	100 a	97 a	0 b	0 b	57 abc	48 bc
Picloram	0.5	100 a	100 a	0 b	0 b	38 bcd	57 abc

[1] Values within columns followed by different letters are significantly different at $P = 0.05$.

[2] Chlorsulfuron and imazapyr are in g ai/ha. All treatments included NIS at 0.25% v/v.

Blessed milkthistle and bristly oxtongue control with herbicides. Carl E. Bell, Vanelle Peterson, Bruce Kidd, Hugo Ramirez, and John Ekhoff. (Cooperative Extension, University of California, San Diego, CA 92123; Dow AgroSciences, Mulino, OR 97042; Dow AgroSciences, Murrieta, CA 92562; DuPont Crop Protection, Visalia, CA 93292; and California Department of Fish and Game, San Diego, CA 92123). Two field studies were conducted in San Diego, CA in 2008 to evaluate herbicides applied postemergence for control of blessed milkthistle and bristly oxtongue on the CA Department of Fish and Game Rancho Jamul Ecological Reserve. Both experiments utilized a randomized complete block design with four replications. The field studies were located about 200 yards apart, one site had a uniform population of blessed milk thistle and the other was dominated by bristly oxtongue. Plot size in both sites was 6 by 25 feet. Herbicides were applied on March 26, 2008 with a CO_2 backpack sprayer using 5 – 8002vs flat fan nozzles on a boom covering 6 feet at 40 psi and a spray volume of 66 gpa. Most treatments included non-ionic surfactant at 0.25% v/v. DPX-KJM 44 (aminocyclopyrachlor) treatments utilized methylated seed oil at 1% v/v and the glyphosate treatment did not include surfactant. Blessed milkthistle was in the early bolting stage of growth and varied from 10 to 30 inches wide. Bristly oxtongue was in the rosette stage of growth, with rosettes being 8 to 10 inches wide but had not started to bolt. Weather on March 26, 2008 was 67 F, with winds from 0 to 5 mph, with clear skies.

Weed control was visually evaluated on April 30 and July 23, 2008 (Table). At the first evaluation about 4 WAT, most of the herbicide treatments controlled blessed milkthistle well except for the lowest rates of aminopyralid, DPX-KJM 44 and chlorsulfuron. At the later evaluation about 4 MAT, all of the herbicide treatments controlled blessed milkthistle well to excellent, except for chlorsulfuron. In the case of bristly oxtongue, when evaluated 4 WAT, control by chlorsulfuron was poor, but at 4 MAT was excellent. Bristly oxtongue control at 4 WAT by most of the other herbicides was very good, except for triclopyr and aminopyralid at the lowest rate. At the later evaluation about 4 MAT, all of the herbicide treatments except triclopyr controlled bristly oxtongue weeds well to excellent.

Table. Milk thistle, Italian thistle, and Russian thistle control with postemergence herbicides in San Diego, CA.

		Blessed milkthistle control		Bristly oxtongue control	
Treatment	Rate[1]	April 30, 2008	July 23, 2008	April 30, 2008	July 23, 2008
	lb/A		%		
Aminopyralid	0.05	73	96	73	65
Aminopyralid	0.08	90	99	94	79
Aminopyralid	0.1	95	98	99	95
Clopyralid	0.25	73	96	98	85
Triclopyr	1	90	100	61	42
Glyphosate	3	100	100	100	97
Chlorsulfuron	0.094	45	27	35	100
DPX-KJM 44	0.03	73	90	93	87
DPX-KJM 44	0.06	93	99	99	96
DPX-KJM 44	0.12	94	100	100	99
Untreated control		0	0	0	0

[1] Rates for chlorsulfuron are ai, all others are ae.

Time-of-year influence on frill-cut herbicide applications for control of Russian olive. Ron Patterson, Dennis Worwood, and Steve Dewey. (Utah State University, Logan, UT 84322) The goal of this field research project was to determine the effect of timing on the control of mature Russian olive trees using the frill-cut method of herbicide application. Treatments were made at two locations to single trees arranged in a randomized complete block design with three replications. Herbicides were applied to each tree at one of 11 monthly timings between November, 2006, and September, 2007. Single- as well as multi-trunked trees were included in the study. Tree trunks ranged in caliper size from 3 to 12 inches, measured one foot above the ground. Each trunk of multi-trunked trees was treated with the full amount of chemical specified for its diameter. Frill cuts were made in tree trunks using a conventional hatchet. Horizontal cuts were made at a downward angle (about 45 degrees), penetrating the bark but not cutting deeper than approximately 0.5 inch into live wood. The number of cuts per tree corresponded to tree diameter (1 cut per inch of trunk diameter). Cuts were made between one and three feet of the ground, and were staggered to avoid girdling the trees. Herbicide was applied to each tree within 5 minutes of making the cuts. Herbicides were applied directly into the cuts using a metered syringe. Each tree at location one was treated with 1.0 cc of 2,4-D amine (47.3 percent dimethylamine salt of 2,4-dichlorophenoxyacetic acid) per inch of trunk diameter. Each tree at location two was treated with 1.0 cc of Roundup (41 percent glyphosate) per inch of trunk diameter. Control was determined by visual evaluation on May 29, 2008 based on the amount of live foliage occurring on each tree (Table). Control levels greater than 90 percent resulted from 2,4-D applications made in May, July, August, and September. Control levels greater than 90 percent were obtained by applications of Roundup made in December, January and May – September. A follow-up study has been initiated to evaluate effectiveness of basal bark applications on mature trees.

Table. Control of Russian olive on May 29, 2008, following single frill-cut treatments of 2,4-D amine or Roundup applied on different dates.

	Control	
Application date	2,4-D	Roundup
	---------- % ----------	
November, 2006	70	68
December, 2006	53	92
January, 2007	73	100
February, 2007	82	87
March, 2007	52	60
April, 2007	69	85
May, 2007	92	100
June, 2007	83	100
July, 2007	93	100
August, 2007	93	100
September, 2007	100	100
LSD (0.05)	42	28

Rimsulfuron compared to chlorsulfuron for onionweed control. Carl E. Bell[1], Jessica Vinje[2], and Markus Spiegelberg[2]. ([1]Cooperative Extension, University of California, San Diego, CA 92123; [2]Center for Natural Lands Management, San Diego, CA 92107). A field study was conducted in San Diego, CA in 2008 to compare rimsulfuron to chlorsulfuron for control of onionweed (Table). Previous field research had demonstrated the efficacy of chlorsulfuron for onionweed control, but it's long soil residual and broad spectrum of phytotoxicity to native vegetation make its use difficult in many circumstances. We were interested in seeing if rimsulfuron would provide acceptable control of onionweed without presenting the same difficulties. The experiment utilized a randomized complete block design with four replications. Plot size was 5 by 15 feet. Herbicides were applied on March 20, 2008 with a CO_2 backpack sprayer using 3 - 8003vs flat fan nozzles on a boom covering 5 feet at 35 psi for a spray volume of 74 gpa. Non-ionic surfactant was added to all spray mixes at 0.25% v/v. Onionweed at time of application was variable, ranging from 20 to 30 leaves, 2 to 20 inches tall, with few flowers. A variety of native and weedy plant species were present in the treatment plots. Weather at time of application was 52 F, cloudy, and calm. Plots were visually evaluated for onionweed control and for the percent of healthy looking, unshriveled seed pods on May 16, 2008 (Table). Of the two herbicides tested, only chlorsulfuron provided good control of onionweed.

Table. Herbicide treatments and visual evaluations for onionweed control, San Diego, CA.

		May 16, 2008	
Herbicide	Rate	Percent control	Percent viable seed
	lb ai/A	%	%
Chlorsulfuron	0.047	79	16
Chlorsulfuron	0.094	88	15
Rimsulfuron	0.016	2	50
Rimsulfuron	0.03	21	30
Rimsulfuron	0.06	15	48
Untreated control		0	80

Management inputs for saltcedar control. Ralph Whitesides, Steven Dewey, Michael Bouck, and Kim Edvarchuk. (Utah State University, Department of Plants, Soils, and Climate, Logan, UT 84322) In June 2008 a group of Boy Scouts and other volunteers cut, removed, and treated the stumps of saltcedar plants growing in riparian zones of Central Utah. The project required more than 3 years of preparation and planning and was executed as part of a national series of service projects undertaken to celebrate the upcoming Boy Scouts of America centennial. About 400 Arrowmen, members of ArrowCorp5, an elite group of experienced Scouts, including leaders worked in Joe's Valley, Dry Wash, and the Buckhorn Wash, all in Emery County Utah. Saltcedar was cleared from these three drainages in the Manti-La Sal National Forest and on Bureau of Land Management land that feed into the Colorado River. Scouts used pruners and handsaws to lop limbs from the saltcedar plants. They were followed by agency employees who used chainsaws on the trunks of the trees and sprayed the stumps with herbicide. Crews used Garlon 4 Ultra (a mixture of 60.45% triclopyr and 39.55% methylated seed oil) and an agricultural dye to treat cut stumps. Treatments were applied using hand-held sprayers or back-pack sprayer. Herbicide was applied as a modified cut-stump application where cut stumps and basal bark were treated simultaneously. The average size of the treated area was 4 square feet per tree. Each stump was treated with 3.3 ounces of the spray solution. Crews treated an area, and a quality-control crew followed behind to treat any missed plants. Evaluations completed 60 and 90 days after treatment showed 95 to 99% control along the treated areas. Best control (99%) occurred in the Buckhorn Draw where the most significant effort was made to remove saltcedar. Although saltcedar control was excellent perhaps the most significant development was the partnership formed among 22 different state, city, county and federal agencies that were organized to conduct the project (Table 1). Logistical planning for such a project is extensive and some estimates of the material and time required are listed in Table 2.

Table 1. List of partners involved in saltcedar control during June 2008 in Central Utah.

Bureau of Land Management Utah State Office
Bureau of Land Management Price Field Office
Carbon County Weed Department
Castle Dale City
Castleland Resource Conservation & Development Council, Inc.
Dedicated Hunters
Dow AgriSciences
Emery Water Conservation District
Emery County Parks and Recreation
Emery County School District
Emery County Sheriff's Department & Emergency Medical Services
Emery County Weed Department
Environmental Protection Agency
Huntington Cattlemens Association
Huntington City
Utah State University Extension Service
Individual Volunteers
Intermountain Region Forest Service
Manti-La Sal National Forest
National Fish and Wildlife Fundation
National Park Service
Natural Resources Conservation Service
Order of the Arrow, Boy Scouts of America
San Rafael Conservation District
Skyline Coop. Weed Management Area
Utah Backcountry Volunteers
Utah Department of Agriculture and Food
Utah Div. of Forestry, Fire and State Lands
Utah Division of Water Quality
Utah Division of Wildlife Resources
Utah Legislature
Utah Partners for Conservation and Dev.
Utah State Institutional Trust Lands

Table 2. Input estimates for saltcedar control project during June 2008 in Central Utah.

Item	Quantity or Units	
Number of supporting agency hours	6200	
Gallons of herbicide mixture applied	600	
Number of spray cans	50	
Number of chainsaws	30	
Number of boats	2	
State, city, county and federal supporting agencies	22	
Number of US Forest Service acres evaluated/treated:		
Joe's valley	660 acres	13.65 miles
Dry Wash	265 acres	6.04 miles
Number of BLM acres treated:		
Buckhorn Draw	12,925 acres	26.55 miles
Total Treatment	13,850 acres	46.24 miles
Number of supporting agency personnel	110	
Number of volunteer Scouts and Leaders	400	
Number of neoprene gloves	500 pair	
Chainsaws cleaned	30 per day 150 total cleanings	
Number of chainsaws sharpened	75 per day 375 total sharpenings	
Feet of saw chain used	150	
Number of chainsaw hours	480	

Relative salinity tolerance of foxtail barley (*Hordeum jubatum*) and desirable pasture grasses. Karl R. Israelsen, Corey V. Ransom, and Blair L. Waldron. (Plants, Soils, and Climate Department, Utah State University and USDA-ARS, Forage and Range Research Lab, Logan, UT 84322-4820) A study was conducted during 2008 to determine the relative salinity tolerance of foxtail barley and seven desirable pasture grasses. Grass species included in the study were 'Palaton' reed canarygrass (*Phalaris arundinacea*), 'Climax' timothy (*Phleum pratense*), 'Mustang' altai wildrye (*Leymus angustus*), 'Fawn' tall fescue (*Festuca arundinaceae*), 'Alkar' tall wheatgrass (*Thinopyrum ponticum*), 'Potomac' orchardgrass (*Dactylis glomerata*), 'Garrison' creeping foxtail (*Alopecurus arundinaceus*), and foxtail barley (*Hordeum jubatum*). Grasses were planted in Ray Leach Cone-tainers filled with 70-grit silica sand on January 8, 2008. Plants were hand watered daily with tap water until seedlings emerged. During the week prior to salt treatments, grasses were submerged twice in 20% nutrient solution for 2 minutes and cut to a uniform height before salt treatments were initiated. Salt treatments began February 26, 2008. Grasses were immersed in tanks of salt solution twice each week for 2 minutes. The initial electrical conductivity (EC) was 6 dS m^{-1} NaCl solution, and was increased by 3 dS m^{-1} increments every 2 weeks until EC 24 dS m^{-1} was reached, at which time the EC was increased by 3 dS m^{-1} increments every week. Salt treatments were continued until EC 45 dS m^{-1} was reached July 11, 2008. Beginning April 25, 2008 at EC 18 dS m^{-1}, the number of dead plants was recorded each time grasses were immersed in the salt solution. To account for the time and salt concentration a plant was grown under; a cumulative linear value was calculated that related the number of days a plant was grown at each salt concentration. This value is expressed as EC days. EC days were calculated by multiplying the EC concentration by the number of days at that concentration and summed cumulatively over time. Data were fit to a logistic dose response curve (Figure). Salinity tolerance varied significantly among grass species. Reed canarygrass and timothy were most susceptible; orchardgrass, creeping foxtail, and tall fescue were moderately tolerant; while foxtail barley, altai wildrye, and tall wheatgrass were extremely tolerant to salt.

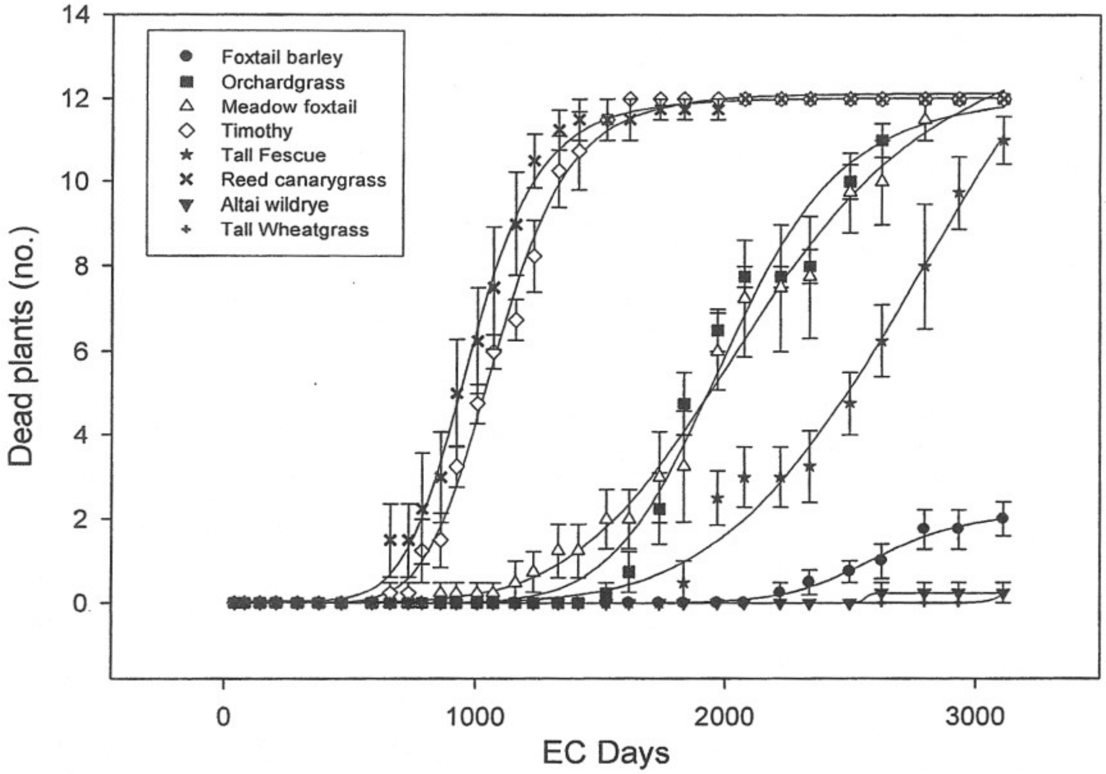

Figure. Grass species death in response to accumulating salinity level and exposure duration (EC days). Symbols represent the data means and whiskers represent the standard error of the mean.

Weed community emergence pattern in eastern South Dakota. Randy L. Anderson. (USDA-ARS, Brookings SD 57006). We are seeking to develop a population-centered approach to weed management in the western Corn Belt, similar to the successful approach used in the Great Plains [Anderson (2005) Agron. J. 97:1579]. A key component of this approach is understanding weed seedling emergence patterns. Therefore, we characterized emergence of the weed community in a field with a cropping history of corn-soybean.

Methodology:

Weed emergence was recorded in permanent quadrats from 2004 to 2006. The study included both no-till and tilled sites: tillage with a chisel plow occurred in the fall of each year. During the growing season, seedling emergence was recorded weekly in each of six 0.5 m^2 sites for both tillage treatments. Counting began on April 1 and continued throughout the growing season; after counting, weeds were removed by hand. Quadrats were maintained for the 3-year duration. Four species, green and yellow foxtail, redroot pigweed, and common lambsquarters, comprised more than 90% of seedlings observed during the study. Crop sequence for the 3 years was corn-soybean-corn. Precipitation during the 3 years was within 10% of normal, with no unusual weather anomalies.

A seedling emergence pattern for the weed community was calculated by converting seedling density observed each week to a percentage of seasonal emergence for the growing season, then developing a average curve for the three years by cubic spline interpolation. We also developed a second curve comparing emergence between tilled and no-till treatments.

Results:

Seedlings begin emerging April 13 and continued through September (Figure 1). More than 80% of the total seasonal emergence occurred between April 28 and June 22.

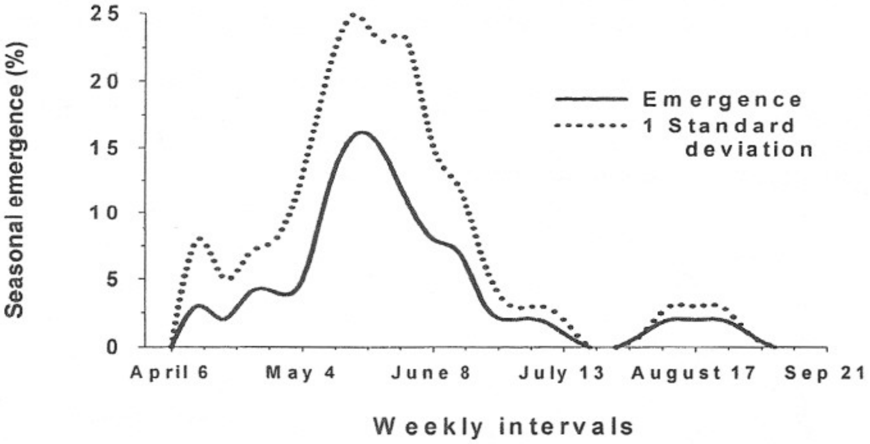

Figure 1. Seasonal emergence pattern of the weed community, average across years and tillage treatments.

Seedling emergence began earlier with tillage (Figure 2). The first major flush of weeds with no-till occurred on May 25; by this time, more than 50% of seedling emergence in the tillage treatment had occurred. A major spike in emergence with tillage occurred in early May.

The number of seedlings emerging declined rapidly across years (Figure 3). With the tilled sites, 626 seedlings emerged in the first year, 316 seedlings in the second year, and 116 seedlings in the third year. In the third year of no-till, only 65 seedlings emerged, or just 10% of seedling emergence in the first year of the tilled treatment. In individual years, seedling emergence was less in no-till compared with tillage.

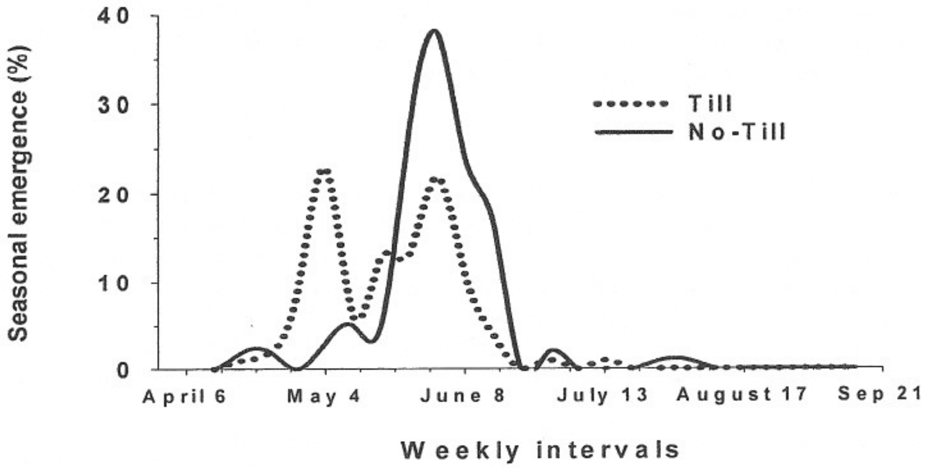

Figure 2. Seasonal emergence pattern of the weed community with no-till and tilled treatments.

Implications for Weed Management:

Adding cool-season crops such as winter wheat may help weed management in corn and soybean. A concern with winter wheat, however, is that warm-season weeds prominent in this region may still establish and produce seeds in the wheat canopy. Establishment will be affected by timing of seedling emergence in relation to winter wheat canopy development. We suggest based on our results that no-till practices will favor winter wheat in minimizing weed establishment because of the delay of weed emergence in April. The later emergence of weed seedlings with no-till should also benefit weed management in other cool-season crops such as spring wheat or canola.

Reduced seedling density across year reflects the natural loss of weed seed in soil across time, and demonstrates the value of including alternative crops in the corn-soybean rotation. For example, if seed production of warm-season weeds can be prevented during two years of cool-season crops with no-till, seedling density can be reduced 85 to 90% due to the natural decline of the weed seed bank across time.

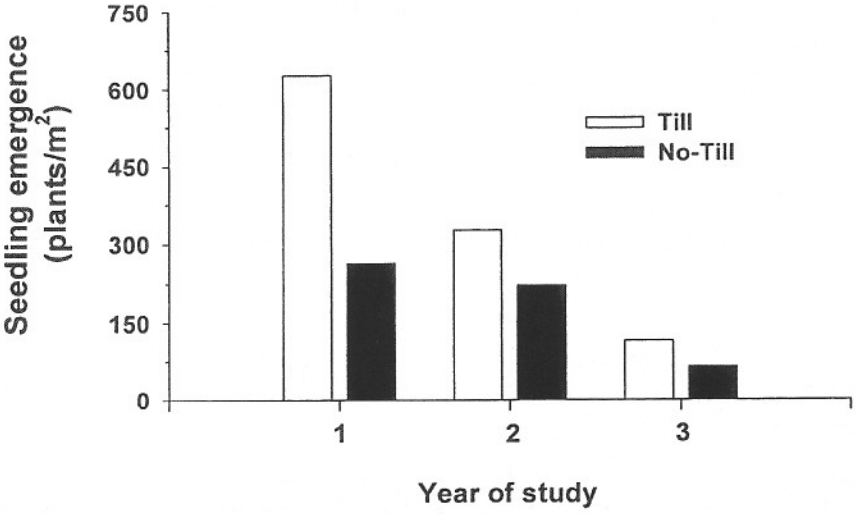

Figure 3. Seedling emergence of the weed community across time, comparing no-till and tilled treatments.

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KEYWORD INDEX