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FOREWORD

The 2010 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.

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

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Co-editors, Research Progress Report
Western Society of Weed Science
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Evaluation of aminocyclopyrachlor for cattail, poison ivy, and Russian olive control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminocyclopyrachlor (KJM44-062 or MAT28) is a new and currently non-classified herbicide from E. I. DuPont company. Initial evaluations of this compound found this herbicide controlled wide spread invasive weeds such as leafy spurge and Canada thistle. However, the effect of aminocyclopyrachlor on other invasive or troublesome weeds is largely unknown. The purpose of this research was to evaluate aminocyclopyrachlor efficacy on cattail (*Typha* spp.), poison ivy [*Toxiodendron rydbergii* (Small ex Rydb.) Greene], and Russian olive (*Elaeagnus angustifolia* L.).

The first study was established along a drainage ditch near Fargo, ND that was heavily infested with cattails. Herbicides were applied using a four-wheel all terrain vehicle with a flexible boom that maintained a 10 foot spray pattern with 8002 nozzles delivering 17.5 gpa. Experimental plots were 10 by 30 feet and replicated four times. Plot sequence was linear in a west to east direction along the drainage and treatments were randomized within each rep. Herbicides were applied on June 10, 2008 when cattails were in the vegetative growth stage and 3 to 4 feet tall or on July 22, 2008 when plants were 5 to 8 feet tall with catkins present. Control was evaluated visually using percent stand reduction compared to the untreated control.

Aminocyclopyrachlor provided very good cattail control the year after treatment when applied during flowering, but did not control cattails when applied earlier in the growing season (Table 1). Initial cattail control with aminocyclopyrachlor was less than 20% during the season of application regardless of timing. However, aminocyclopyrachlor provided 92 to 96% control in June 2009, 11 MAT (months after treatment) and 80 to 96% 13 MAT. Cattail control increased as aminocyclopyrachlor application rate increased and was similar to the standard glyphosate treatment.

The study to evaluate poison ivy control was established on the Albert Ekre Ranch near Walcott, ND. Herbicides were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 20 feet and replicated three times in a randomized complete block design. Smooth bromegrass and Kentucky bluegrass were the only other plant species in the study site. Herbicides were applied on September 12, 2008 when poison ivy was 8 to 18 inches tall, with red leaves and beginning to set seed or on June 10, 2009 when plants were 6 to 10 inches tall with green leaves.

Aminocyclopyrachlor provided good initial poison ivy control and also reduced smooth bromegrass cover by an average of 95% when applied at 2 or 3 oz/A in September (Table 2). Poison ivy control averaged 100% in June 2009 regardless of aminocyclopyrachlor application rate in the fall, but control declined to 56% or less 12 MAT. Aminocyclopyrachlor applied in June provided an average of 72% poison ivy control 20 days after treatment but control increased to an average of 90% by3 MAT. Smooth bromegrass cover decreased by 91% 12 MAT with aminocyclopyrachlor applied at 3 oz/A in the fall, but only 36% 3 months after a spring applied treatment. Kentucky bluegrass cover was not reduced by aminocyclopyrachlor.

A study to evaluate aminocyclopyrachlor as a cut-stump treatment for control of Russian olive regrowth was established on the Sheyenne National Grassland in cooperation with the U.S. Forest Service near Hankinson, ND. Russian olive originally had been planted as part of a shelter belt but had spread into an adjacent pasture. The trees were 15 to 25 feet tall and ranged in age from approximately 10 to over 50 years old. The trees were cut by Forest Service personnel on April 21, 2008 and herbicides were applied to the stumps on May 28, 2008. Each treatment was applied to 6 trees (reps) and each replicate consisted of similar size tree stumps. The first replicate contained the smallest tree stumps which averaged 11 inches in diameter while replicate 6 contained the largest diameter stumps which averaged 19.5 inches.

Herbicides were applied on a percent solution basis in a petroleum based oil (herbicide:oil v:v) with a single nozzle hand-held pump sprayer. The aminocyclopyrachlor formulation was DPX MAT28-038 2 SL. Stumps were thoroughly covered to the point of run-off. Control was evaluated by counting the number of shoots arising from the stump and root collar of treated compared to non-treated stumps.

All cut-stump treatments provided excellent control of Russian olive regrowth (Table 3). An average of 98 stems/stump regrew from untreated trees compared to near zero regrowth from any of the treated stumps. No regrowth was observed on any treated stump in 2009, 13 MAT, compared to an average of 68 and 33 stems/stump in the untreated control in June and August 2009, respectively. Although aminocyclopyrachlor provided excellent control of regrowth from Russian olive cut-stumps the spray solution became increasingly viscous as the aminocyclopyrachlor rate increased. Aminocyclopyrachlor treatments applied at 15 or 30% were extremely difficult to apply and resembled frosting applied to cake rather than a smooth oil coating of the stump. Also, grass and brush species surrounding the cut-stumps died even though the herbicide was not directly applied to these plants. The area of total vegetation control around each stump increased as the aminocyclopyrachlor application rate increased.

In summary, aminocyclopyrachlor controlled cattail similarly to the standard treatment of glyphosate when applied at the catkin growth stage. Poison ivy control was variable as spring but not fall-applied treatments provided season-long control. Aminocyclopyrachlor provided excellent Russian olive control when applied as a cut-stump treatment, but the liquid formulation was difficult to apply at the higher treatment rates. Severe reduction of smooth bromegrass and control of non-treated plants in the cut-stump experiment indicate this herbicide has efficacy on many species.

Table 1. Aminocyclopyrachlor evaluated for cattail control at two growth stages near Fargo, ND.

		Evaluation date				
		2008			2009	
Cattail growth stage/ treatment[1]	Rate	25 June	28 July	29 Aug	2 June	28 Aug
	— oz/A —	% control				
Vegetative						
Aminocyclopyrachlor	2 + 0.25 %	1	5	4	15	15
Aminocyclopyrachlor	4 + 0.25 %	1	1	4	0	5
Aminocyclopyrachlor	8 + 0.25 %	1	8	0	0	0
Glyphosate[2]	40 + 0.25 %	12	14	16	15	13
Flowering						
Aminocyclopyrachlor	2 + 0.25 %		2	4	92	80
Aminocyclopyrachlor	4 + 0.25 %		3	1	95	86
Aminocyclopyrachlor	8 + 0.25 %		4	15	98	96
Glyphosate[2]	40 + 0.25 %		51	71	96	87
Untreated	...	0	0	0	5	3
LSD (0.05)		2	4	12	16	15

[1] Herbicide treatments were applied with surfactant X-77 from Loveland Products Inc. PO Box 1296 Greeley, CO 80632-1286 on either June 10 (vegetative) or July 22, 2009 (flowering).
[2] Commercial formulation - Rodeo from Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.

Table 2. Evaluation of fall or spring applied aminocyclopyrachlor for poison ivy control at Walcott, ND.

		Evaluation date				
		30 June 2009			Sept 2009	
Treatment[1]		Poison ivy	Smooth brome	Kentucky bluegrass	Poison ivy	Smooth brome
	— oz/A —	% control				
Applied Sept. 2008						
Aminocyclopyrachlor	1	100	78	0	33	66
Aminocyclopyrachlor	2	100	95	3	53	83
Aminocyclopyrachlor	3	100	97	2	56	91
Triclopyr	24	83	18	0	67	10
Applied June 2009						
Aminocyclopyrachlor	1	51	0	0	79	30
Aminocyclopyrachlor	2	80	0	0	94	30
Aminocyclopyrachlor	3	85	3	0	97	36
Triclopyr	24	99	3	0	87	80
LSD (0.05)		10	37	NS	43	38

[1] All treatments were applied with MSO at 1% v/v on September 28, 2008 (fall) or June 10, 2009 (spring). The MSO was Scoil, by AGSCO, 20600 Mill Rd, Grand Forks, ND 58203.

Table 3. Evaluation of aminocyclopyrachlor in combination with bark oil as a cut stump treatment for Russian olive control on the Sheyenne Grassland near Hankinson, ND

		Evaluation date			
		2008		2009	
Treatment[1]	Rate	2 July	12 Sept	3 June	18 Aug
	— % v/v —	stem regrowth/stump			
Aminocyclopyrachlor[2]	2.5	<1	0	0	0
Aminocyclopyrachlor	5	0	0	0	0
Aminocyclopyrachlor	10	0	0	0	0
Aminocyclopyrachlor	15	<1	0	0	0
Triclopyr ester[3]	30	0	0	0	0
Triclopyr ester	15	0	0	0	0
2,4-D ester	21	<1	<1	0	0
Triclopyr ester + imazapyr[4]	20 + 1	0	0	0	0
Aminocyclopyrachlor + imazapyr	10 + 1	0	0	0	0
Untreated		98	95	68	33
LSD (0.05)		30	16	25	28

[1] All herbicides applied on May 28, 2008 in Bark Oil Blue LT from UAP Distribution Inc., 7251 West 4th St., Greeley, CO 80634.

[2] The aminocyclopyrachlor formulation was DPX MAT28-038 LS.

[3] Commercial formulation - Garlon 4 from Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.

[4] Commercial formulation - Stalker from BASF Corporation, 100 Campus Drive, Florham Park, ND 07932.

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 experiment was 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, October 2008, and October 2009 (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, 49% at 26 MAT, and 39% at 38 MAT. In our previous research, metsulfuron controlled 93 and 86% of CLEOR 12 and 24 MAT. Application timing in previous experiments was at the bud to very early flower growth stages where as, 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 and 38 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 38 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	September 2009
	oz ai/A	(%)			
Metsulfuron	0.6	29	80	49	39
2,4-D Amine	16	79	85	70	60
2,4-D Amine	32	90	100	100	100
Aminopyralid	0.8	97	100	100	100
Aminopyralid	1.3	97	100	99	99
Aminopyralid	1.8	93	100	100	100
Aminopyralid + 2,4-D amine	0.8 + 16	98	100	100	100
Control		0	0	0	0
LSD (0.05)		10	8	10	19

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

Evaluation of aminocyclopyrachlor for weed control in pasture and rangeland. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminocyclopyrachlor (KJM44-062 or MAT28) is a new and currently non-classified herbicide from E. I. DuPont company. Initial evaluations of this compound for general pasture and invasive weed control was promising on a variety of species. The purpose of this research was to evaluate aminocyclopyrachlor for control of invasive and troublesome weeds in pasture and rangeland.

For all studies the aminocyclopyrachlor methyl ester (DPX KJM44-062) was used. 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 aminocyclopyrachlor 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. All herbicides were reapplied on June 30, 2009 to evaluate long-term control and possible grass injury. 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.

Aminocyclopyrachlor 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, aminocyclopyrachlor 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. Control averaged >80% with aminocyclopyrachlor at 2 to 3 oz/A in June 2009 (24 MAT) but had declined to 48 to 65% with aminocyclopyrachlor applied at 1 to 1.5 oz/A. The major grass species present were Kentucky bluegrass and smooth brome and less than 5% grass injury was observed 2 MAT (data not shown). Control was greater than 90% in August 2009 following reapplication of the herbicides in June.

Leafy spurge control 11 MAT with aminocyclopyrachlor 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 . No grass injury was observed with either herbicide (data not shown). Leafy spurge control averaged over treatments was 97% in June 2009 but declined to 83% by September (24 MAT).

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 aminocyclopyrachlor. 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 aminocyclopyrachlor 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, aminocyclopyrachlor 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. Aminocyclopyrachlor provided complete control of dandelion but did not control curly dock regardless of application rate.

Canada thistle control with aminocyclopyrachlor 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 aminocyclopyrachlor remained high the year after treatment. Control in June and September 2008 with aminocyclopyrachlor at 1.5 oz/A or more averaged 97 and 95%, respectively, compared to 58% or less with picloram and aminopyralid. Aminocyclopyrachlor provided excellent control of perennial sowthistle in the year of treatment, but control averaged less than 50% by 12 MAT regardless of application rate. Canada thistle control averaged 95% control in June 2009 (21 MAT) with aminocyclopyrachlor applied at 2 to 3 oz/A compared to 0 and 23% with picloram and aminopyralid.

In summary, aminocyclopyrachlor provided similar or better control of leafy spurge, Canada thistle, and perennial sowthistle than commonly used herbicides. Aminocyclopyrachlor did not provide adequate control of curly dock.

This herbicide shows promise for broadleaf weed control including several invasive species and should be further evaluated. The soil residual potential of aminocyclopyrachlor to move off site or into groundwater is not yet known.

Table 1. Evaluation of aminocyclopyrachlor for leafy spurge control applied in June 2007 and again in June 2009 near Walcott, ND.

		Leafy spurge control/evaluation date				
		2007	2008		2009	
Treatment	Rate	6 Aug	9 June	19 Aug	10 June	18 Aug
	—— oz/A ——			%		
Aminocyclopyrachlor[1]	1	92	79	55	48	92
Aminocyclopyrachlor	1.5	98	87	71	65	95
Aminocyclopyrachlor	2	99	90	88	81	95
Aminocyclopyrachlor	2.5	99	97	92	86	98
Aminocyclopyrachlor	3	99	96	92	87	100
Picloram	8	86	58	45	41	98
Picloram + imazapic + 2,4-D	4 + 1 + 16	97	45	56	38	95
LSD (0.05)		7	31	23	36	NS

[1] MSO was added to all treatments at 1% v/v except at 1 qt/A with picloram + imazapic + 2,4-D. Scoil by AGSCO, 1168 12th St NE, Grand Forks, ND 58201.

Table 2. Evaluation of aminocyclopyrachlor for leafy spurge control applied in September 2007 at Fargo, ND.

		Leafy spurge control/evaluation date			
		2008		2009	
Treatment	Rate	20 June	20 Aug	12 June	3 Sept
	—— oz/A ——		%		
Aminocyclopyrachlor[1]	1	93	89	92	74
Aminocyclopyrachlor	2	99	97	98	85
Aminocyclopyrachlor	3	100	99	98	89
Picloram	16	99	97	98	82
LSD(0.05)		NS	7	4	NS

[1] MSO was added to all treatments at 1% v/v except at 1 qt/A with picloram. Scoil by AGSCO, 1168 12th St NE, Grand Forks, ND 58201.

Table 3. Evaluation of aminocyclopyrachlor applied in June 2007 for Canada thistle, perennial sowthistle, curly dock, and dandelion control at Fargo, ND.

		Control/evaluation date/species										
		2007							2008			2009
		29 June				5 September			20 June		26 Sept.	29 June
Treatment	Rate	CT[1]	PEST[1]	Curly dock	Dande lion	CT	PEST	Curly dock	CT	PEST	CT	CT
	— oz/A —	%										
Aminocyclopyrachlor[2]	1	43	35	0	100	54	100	25	56	0	43	37
Aminocyclopyrachlor	1.5	75	71	0	100	93	99	0	95	6	88	76
Aminocyclopyrachlor	2	79	75	0	100	100	100	0	97	45	95	91
Aminocyclopyrachlor	2.5	82	77	0	100	99	100	0	98	47	99	98
Aminocyclopyrachlor	3	84	77	5	100	93	100	38	97	39	97	96
Picloram	8	96	88	41	100	88	98	100	5	86	0	0
Aminopyralid[3]	1.5 + 0.25%	92	80	16	96	92	92	100	30	58	58	23
LSD (0.05)		12	15	8	NS	17	5	35	29	43	39	22

[1] Abbreviations: CT = Canada thistle, PEST = perennial sowthistle.

[2] MSO was added to all treatments at 1% v/v except Activator 90 was applied with aminopyralid. Scoil, by AGSCO, 1168 12th St N, Grand Forks, ND 58201. [3] Activator 90 surfactant by Loveland Products, Inc. P.O. Box 1286 Greeley, CO 80632.

Nuttall's saltbush injury and halogeton control 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 states. It is well adapted to alkaline soils and semi-arid environments. HALGL produces 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 (Table 1) for control compared to non-treated plots were conducted approximately 2, 13, and 28 months after treatment (MAT). Ultra-low to standard rates of metsulfuron, chlorsulfuron, and metsulfuron plus chlorsulfuron tank mixes were used in this study.

All treatments controlled 24 to 73% HALGL approximately 2 MAT. Metsulfuron or chlorsulfuron treatments controlled 29 to 86% or 66 to 100% HALGL, respectively (Table 2) at 13 MAT. There does not appear to be any advantage to tank mixing metsulfuron with chlorsulfuron to control HALGL since there was similar control with the same rates of chlorsulfuron sprayed alone. For example, metsulfuron plus chlorsulfuron at 0.011 + 0.017 oz ai/A controlled 59% HALGL, which was similar to 66% HALGL control with 0.017 oz ai/A of chlorsulfuron sprayed alone. HALGL appears to be extremely susceptible to control with ultra-low rates of chlorsulfuron. Metsulfuron at 0.3 oz ai/a controlled 86% HALGL compared to 89% HALGL control with only 0.035 oz ai/A of chlorsulfuron.

HALGL control dropped the second growing season after treatment. Chlorsulfuron (> 0.141 oz ai/A) controlled 60 to 80% of HALGL 28 MAT. All other treatments controlled 0 to 43% HALGL 28 MAT.

Chlorsulfuron at 0.375 oz ai/A was the only treatment in this study that decreased saltbush stand counts 13 MAT; however, the saltbush recovered in this treatment 28 MAT. The change in saltbush density from baseline saltbush stand counts from chlorsulfuron (0.375 oz ai/A) was -17% compared to 4% change in untreated checks 13 MAT. Zero percent change would be similar densities to baseline counts and negative change would be a loss of HALGL. There was a -4% to -12% decrease in saltbush in untreated and the lowest rates of metsulfuron (0011 and 0.023 oz ai/A) 28 MAT. The decrease in saltbush may have been a result of competition with HALGL. All other treatments in this experiment provided 0 to 39% change in saltbush density with no loss of saltbush from herbicide treatments. We have conducted several experiments in northwest Colorado to control HALGL 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 HALGL control was 100% from all rates. Large scale commercial applications subsequent to the experiment reported here have since been made at 0.19 oz ai/A of chlorsulfuron with zero to minor injury to Nuttall's saltbush and 95 to 100% HALGL control.

Bottlebrush squirreltail increased in all treatments except for metsulfuron (0.023 oz ai/A) where there was -67% change compared to untreated plots. Bottlebrush squirreltail density tended to increase with increasing rates of chlorsulfuron. This mirrors increased HALGL control with increasing rates of chlorsulfuron. Bottlebrush squirreltail likely increases in density with the increase in HALGL control.

Our data indicates that low rates of chlorsulfuron (< 0.375 oz ai/A) is the best choice for controlling HALGL (66 to 100% control) with no injury or stand loss to Nuttall's saltbush. Caution should be used when spraying HALGL with chlorsulfuron (≥0.375 oz ai/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

Table 2. Halogeton control on Colorado rangeland.

Herbicide[1]	Rate	Halogeton control 2007	 2008	 2009
	(ozai/A)		(%)	
Metsulfuron	0.011	24	35	13
	0.023	34	29	0
	0.045	47	61	11
	0.09	63	57	4
	0.3	65	86	34
Chlorsulfuron	0.017	29	66	11
	0.035	43	89	38
	0.07	56	95	43
	0.14	69	100	80
	0.38	69	100	75
Metsulfuron + chlorsulfuron	0.011 + 0.017	42	59	9
	0.023 + 0.035	64	88	25
	0.045 + 0.07	63	97	38
	0.09 + 0.141	73	97	60
Control		0	0	0
LSD (0.05)		13	18	20

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

Table 3. Saltbrush and Bottlebrush squirreltail density.

		Saltbush			Saltbush		Bottlebrush squirreltail
Herbicide[1]	Rate	Baseline	2008	2009	2008	2009	2009
	(oz ai/A)	-------------Density (#/Plot)-----------			------% Change------		--% of Check--
Metsulfuron	0.011	26	26	25	0	-4	96
	0.023	21	30	20	30	-5	-67
	0.045	20	23	22	23	9	34
	0.09	13	16	13	19	0	34
	0.3	19	20	21	5	10	17
Chlorsulfuron	0.017	23	31	28	23	18	92
	0.035	29	28	33	-3	12	83
	0.071	22	28	36	21	39	188
	0.141	26	33	32	21	19	494
	0.375	18	15	19	-17	5	388
Metsulfuron + chlorsulfuron	0.011 + 0.017	26	28	27	7	4	71
	0.023 + 0.035	27	34	30	21	10	254
	0.045 + 0.071	21	26	31	19	32	97
	0.09 + 0.141	25	27	27	7	7	367
Control		24	25	21	4	-12	0
LSD (0.05)		14	16	16	12	16	139

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[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 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 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 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 Nuttall'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, July 10, 2008, and October 17, 2009 (Table 2), approximately 3, 13, and 28 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 (1.9 or 2.5 oz ai/A) controlled 89 or 99% HALGL 13 MAT and 83 or 94% HALGL control 28 MAT. There was no saltbush injury with imazamox in this experiment. Although there was 21 to 29% saltbush injury with 2,4-D LV, 2,4-D amine, and dicamba 2 MAT, the saltbush injury disappeared by 13 MAT.

Our data indicates that imazamox would be an excellent choice for controlling HALGL (83 to 99%) with little injury or stand loss to Nuttaill's saltbush, however, it is not registered to use in rangeland

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
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 and Nuttall's saltbush injury on Colorado rangeland

Herbicide[1]	Rate	Halogeton 2007	Halogeton 2008	Halogeton 2009	Saltbush 2007	Saltbush 2008	Saltbush 2009
	(oz ai/A)	-------------(Control %)-------------			------------(Injury %)------------		
Imazamox	1.9	25	89	83	0	0	0
Imazamox	2.5	24	99	94	0	0	0
Fluroxypyr	4	33	9	9	6	0	0
Fluroxypyr	6	29	19	24	0	0	0
2,4-D amine	23	70	8	8	21	0	0
2,4-D lv	23	97	0	0	29	0	0
Dicamba	16	71	68	55	26	0	0
LSD (0.05)		9	19	17	9	0	0

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

Perennial grass yield response following meadow hawkweed control. John Wallace and Tim Prather. (Plant Science Divison, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Santa, Idaho in 2005 to evaluate meadow hawkweed (*Hieracium caespitosum* Dumort; HIECA) control with aminopyralid, clopyralid, and a mixture of clopyralid and triclopyr applied at three growth stages; spring (bolting stage), summer (flowering stage), and fall (senescence). 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 data for meadow hawkweed control.

Weed growth stage	Bolting	Flowering	Senescence
Application date	May 24, 2005	June 24, 2005	October 21, 2005
Air Temp (F)	54	57	38
Relative humidity (%)	46	57	71
Wind (mph, direction)	3 to 5, E	N/A	0
Cloud cover (%)	100	25	Foggy
Soil temp at 2 inches (F)	56	N/A	42

Meadow hawkweed and perennial grass biomass was sampled for three years (2006-2008) after treatment (YAT) to determine plant community responses. Meadow hawkweed control varied across growth stages 1 YAT. Excellent control resulted from treatments timed to the bolting (>95%) and flowering (>80%) stages of growth, whereas the fall application timed to senesced rosettes resulted in poor control <30% (data not shown; see 2006 WSWS Progress Report). Within treatment timing, mean meadow hawkweed and perennial grass biomass did not differ over years. Biomass of perennial grass was higher for some herbicides applied at the bolting stage when contrasted to the senesced stage. All flower or bolting timings had greater biomass than the senesced timing and the untreated check. Averaged over years and treatments, perennial grass biomass was 5.2 oz/yd^2 in treatment plots timed to the rosette stage, 3.8 oz/yd^2 for the flowering stage, 2.0 oz/yd^2 for the senesced stage and 0.8 oz/yd^2 in the untreated check. Averaged over years and treatments, meadow hawkweed biomass was 0.2 oz/yd^2 in treatment plots timed to the rosette stage, 0.4 oz/yd^2 for the flowering stage, 1.6 oz/yd^2 for the senesced stage and 2.8 oz/yd^2 in the untreated check.

Table 2. Meadow hawkweed and perennial grass biomass yields 1 to 3 YAT.

			Aboveground biomass (oz/yd^2)							
Treatment[1]	Rate	Stage	Meadow hawkweed				Perennial grass			
	oz ae/A	---	1 YAT	2 YAT	3 YAT	Total	1 YAT	2 YAT	3 YAT	Total
Aminopyralid	0.75	bolt	0	0.2	0.2	0.2	5.6	5.8	6.0	5.8
Aminopyralid	1.75	bolt	0	0	0	0	6.0	5.4	5.4	5.6
Clopyralid	5	bolt	0.4	0.6	0	0.2	4.8	2.8	4.6	4.2
Triclopyr/clopyralid	14	bolt	0	0.2	0.6	0.2	6.0	4.0	4.8	5.0
Mean						*0.2*				*5.2*
Aminopyralid	0.75	flower	0	0	0.2	0	3.0	4.4	4.0	3.6
Aminopyralid	1.75	flower	0	0.6	0.2	0.2	5.2	3.6	4.6	4.6
Clopyralid	5	flower	1.4	0.4	1.0	1.0	1.8	3.4	3.2	3.0
Triclopyr/clopyralid	14	flower	0	0.2	0.6	0.2	5.0	3.8	3.0	3.8
Mean						*0.4*				*3.8*
Aminopyralid	0.75	senesced	2	1.2	1.0	1.4	4.0	2.2	2.4	2.4
Aminopyralid	1.75	senesced	0.6	2.2	1.0	1.2	2.8	0.4	1.8	2.0
Clopyralid	5	senesced	2.4	1.8	1.4	1.8	1.2	1.8	2.2	1.8
Triclopyr/clopyralid	14	senesced	1.2	2.2	1.8	1.8	2.4	0.6	1.4	1.6
Mean						*1.6*				*2.0*
Untreated check			4.4	2.6	2.2	2.8	1.2	0.6	0.8	0.8
Tukey's Studentized Range HSD (0.05)			2.8	2	1.2	1.0	7.2	2.8	2.8	2.4

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

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. Recently, 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 and October June 10, 2009 (Table2).

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.

Aminopyralid (1.8 oz ai/A) sprayed alone did not effectively control CYWOF (24 or 5% control) regardless of spring or fall application timing 24 MAT. Spring-applied aminopyralid tank mixes tended to control CYWOF better than similar tank mixes sprayed in the fall. Spring-applied aminopyralid tank mixes controlled 91 to 100% bolted CYWOF plants compared to 69 to 100% control with similar fall-applied tank mixes. Spring-applied aminopyralid tank mixes controlled 80 to 100% CYWOF rosettes vs 69 to 79% control from fall treatments. Aminopyralid plus metsulfuron (lowest rate) controlled 69 to 91% CYWOF vs 85 to 100% CYWOF control with all other tank mixes.

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*) from all metsulfuron tank mixes.

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	Timing	Houndstongue control October 8, 2008 Bolted	 Rosettes	 June 10, 2009[1] Bolted	 Rosettes
	oz ai/A		-------------------	--------(%)--------	-------------------	-------------------
Aminopyralid	1.8	Spring	92	23	24	24
Metsulfuron	0.3	Spring	100	100	100	100
Aminopyralid + metsulfuron	1.2	Spring	100	79	91	79
Aminopyralid + metsulfuron	1.6	Spring	100	100	100	100
Aminopyralid + metsulfuron	2	Spring	100	100	100	99
Aminopyralid + metsulfuron + 2,4-D	1.6 + 7.6	Spring	100	100	100	93
Aminopyralid + 2,4-D	1.8 + 7.6	Spring	100	96	100	80
Metsulfuron + chlorsulfuron	0.2 + 0.2	Spring	100	100	100	100
Aminopyralid	1.8	Fall	--	--	5	5
Metsulfuron	0.3	Fall	--	--	94	79
Aminopyralid + metsulfuron	1.2	Fall	--	--	69	69
Aminopyralid + metsulfuron	1.6	Fall	--	--	81	77
Aminopyralid + metsulfuron	2	Fall	--	--	86	75
Aminopyralid + metsulfuron + 2,4-D	1.6 + 7.6	Fall	--	--	89	76
Aminopyralid + 2,4-D	1.8 + 7.6	Fall	--	--	85	75
Metsulfuron + chlorsulfuron	0.2 + 0.2	Fall	--	--	100	79
LSD (0.05)			5	14	15	18

[1] No evaluation was conducted for October 8, 2008 treatments until the June 10, 2009 evaluation.

[2] Nonionic surfactant added to all treatments at 0.25% v/v.

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

Wand mullein control with spring and fall herbicide applications. Kimberly Edvarchuk and Corey Ransom. (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) Wand mullein (*Verbascum virgatum S.*) is a non-native biennial introduced from Europe that has been found spreading on western rangelands in the United States. The goal of this field research was to compare the effectiveness of fall- and spring- applied herbicide treatments for wand mullein control on Antelope Island State Park. Individual plots measuring 10 by 30 feet were arranged in a randomized complete block design with four replications. The fall treatments were applied on October 14, 2008 when wand mullein was dormant. A second trial was applied May 15, 2009 to wand mullein rosettes. Herbicide treatments were applied using a CO2 backsprayer calibrated to deliver 19 gallons per acre. Non-ionic surfactant was added to all treatments at the rate of 0.25% v/v. Plots were visually evaluated and density counts taken on May 8, July 10, and October 9, 2009. Timing was not a significant factor in control effectiveness. Chlorosulfuron was the only treatment to significantly differ in control effectiveness and provided 80% control. All other treatments provided excellent control. The number of plants per plot was not significantly different other than those treated with chlorosulfuron. Plants found in plots treated with chlorosulfuron were similar to those in the untreated.

Table. Wand mullein control on Antelope Island State Park, UT.

Treatment[1]	Rate	Wand mullein Control	 Density
	lb ae/A	%	no. / plot
Untreated	--	--	55.7 a
2,4-D amine	1.016	100 b	1.6 b
2,4-D ester	1.016	100 b	1.0 b
2,4-D amine + dicamba	0.75 + 0.25	100 b	0.4 b
Chlorsulfuron	0.023	80 a	58.9 a
Metsulfuron	0.019	99 b	1.1 b
Aminopyralid	0.078	97 b	2.5 b
Aminopyralid + 2,4-D	0.083 + 0.668	100 b	0.1 b
Picloram	0.375	100 b	0.1 b
Picloram + 2,4-D	0.27 + 1.08	100 b	0 b

[1] NIS was included with all herbicide treatments at 0.25% v/v. Chlorsulfuron and metsulfuron rates are in lb ai/A.

Feral rye *(Secale cereale* L.*)* patch expansion on 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) Feral rye expansion has been observed on the base of the Bear River Mountains. Four isolated sites at the upper end of the expansion were selected. The sites were mapped using a one foot grid system in the fall of 2008 and 2009. If one plant was observed in the square foot it was recorded as infested. A spreadsheet was made to record the presence or absence of feral rye in each point. To visually demonstrate expansion the spreadsheets from 2008 and 2009 were overlaid to create a sheet to which infestation values were assigned (Figure). A value of -1 represents a previously infested point that was no longer infested, a value of 0 represents a point that was not infested either year, a value of 1 represents a point that was infested both years, and value of 2 represents a point with new infestation. The number of infested cells in the spreadsheets from 2008 and 2009 were used to calculate expansion at each site (Table). Expansion ranged from 17 to 113% and the weighted average was 60%. Weighted average was used to take into account varying sizes of the individual patches. Initial landscape scale photo analysis indicated feral rye increased an average of approximately 17% per year over 18 years (1990-2008). This data shows much higher individual patch expansion rates.

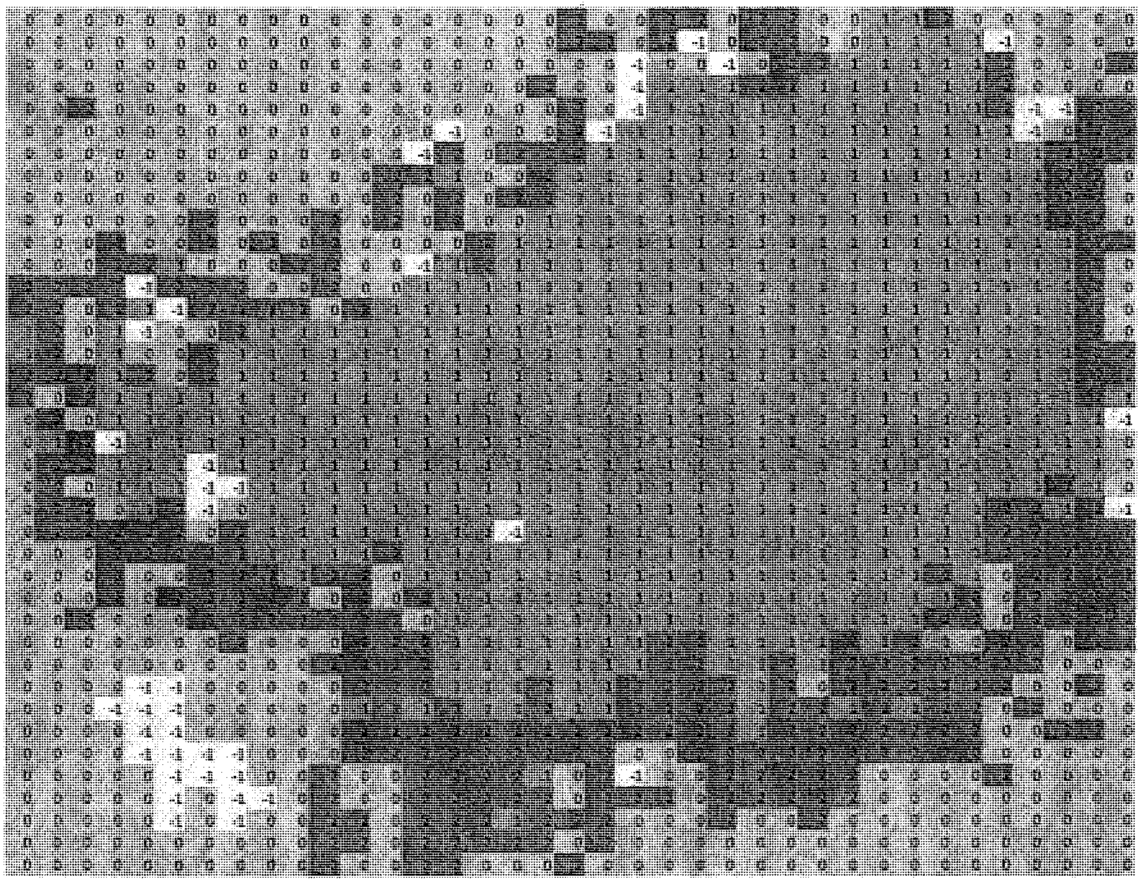

Figure. Combined 2008 and 2009 data for feral rye presence. A value of -1 represents a previously infested point that was no longer infested, a value of 0 represents a point that was not infested either year, a value of 1 represents a point that was infested both years, and value of 2 represents a point with new infestation.

Table. Expansion percentage for each site.

Location	Percent expansion
	--------%--------
Site one	43.6
Site two	41.5
Site three	17.2
Site four	112.5
Weighted average	60.0

Rush skeletonweed 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 Cambridge, ID in sagebrush-steppe to evaluate rush skeletonweed (*Chondrilla juncea* L.; CHOJU) control with various aminopyralid mixes at the rosette stage in the spring and late fall. The experiment was blocked by timing 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 17, 2008	April 20, 2009
Weed growth stage	Fall – Rosette	Spring - Rosette
Air Temp (F)	54	82
Relative humidity (%)	50	30
Wind (mph, direction)	0-1, W	1-3, NW
Cloud cover (%)	70	10
Soil temp at 2 inches (F)	50	80
Soil Type	sandy loam	sandy loam

A visual evaluation was timed to the rush skeletonweed bolting stage on May 21, 2009. Rush skeletonweed density averaged 3 plants/ft^2 in the untreated check. Rush skeletonweed control was 100% in all treatments timed to the fall rosette treatment approximately six months after treatments (MAT); no rosettes were observed in plots (Table 2). Control ranged from 88 to 100% in treatments timed to spring rosettes, approximately 1 MAT. Treatments had prevented bolting and rosettes exhibited severe necrotic symptoms. The fall rosette treatment timing resulted in the suppression of seedhead formation in two fall-germinating weedy grasses, bulbous bluegrass (*Poa bulbosa* L.) and downy brome (*Bromus tectorum* L.), in comparison to the spring rosette timing (data not shown). No differences in the cover of these grasses were detected in comparison of treatment timings.

A visual evaluation was also conducted on November 16, 2009, approximately 7 MAT for the spring timing and 12 MAT for the fall timing, to determine treatment effects on rush skeletonweed rosette establishment. Mean rosette density was 6 plants per ft^2 in the untreated control (Table 2). Rosette density was lower in treated plots in comparison to the control, but no differences were detected between treatments. Treatments will be evaluated in spring of 2010 to determine long-term control of spring and fall timed treatments.

Table 2. Rush skeletonweed (CHOJU) control following herbicide treatments near Cambridge, ID.

			Rush skeletonweed	
Treatment [1]	Rate	Timing	Control[2]	Rosette density[3]
	oz ae /A		--------%-------	--plts/ft^2---
Aminopyralid	1.75	Fall Rosette	100	1.5
Picloram	8	Fall Rosette	100	1.1
Aminopyralid + picloram	1.25 + 3	Fall Rosette	100	0.4
Aminopyralid + picloram	1.25 + 4.5	Fall Rosette	100	0.9
Aminopyralid + picloram	1.75 + 4	Fall Rosette	100	0.0
Aminopyralid + picloram	1.75 + 6	Fall Rosette	100	0.3
Aminopyralid potassium/metsulfuron methyl	2	Fall Rosette	100	0.7
	1.75		88	2.4
		Spring Rosette		
Aminopyralid				
Picloram	8	Spring Rosette	88	0.9
Aminopyralid + picloram	1.25 + 3	Spring Rosette	100	0.1
Aminopyralid + picloram	1.25 + 4.5	Spring Rosette	100	0.1
Aminopyralid + picloram	1.75 + 4	Spring Rosette	100	0.0
Aminopyralid + picloram	1.75 + 6	Spring Rosette	99	0.0
Aminopyralid potassium/metsulfuron methyl	2	Spring Rosette	94	0.7
Untreated check	--	--	0	6
Tukey's HSD			23	4

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

[2] Rush skeletonweed control evaluated on May 21, 2009; 1 MAT for spring timing and 6 MAT for fall timing

[3] Density of rush skeletonweed rosettes evaluated on November 16, 2009; 7 MAT for spring timing and 12 MAT for fall timing.

Evaluation of leafy spurge and yellow toadflax control with pyrasulfotole plus bromoxynil. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58108-6050). Pyrasulfotole plus bromoxynil (trade name Huskie by Bayer CropScience) is commonly used to control weeds in small grain crops. Recent research in Colorado indicated pyrasulfotole plus bromoxynil may control several species of invasive weeds found in pasture and rangeland. The purpose of this research was to evaluate pyrasulfotole applied with bromoxynil and other herbicides for leafy spurge and yellow toadflax control.

For both 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 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 study evaluated the control of leafy spurge with pyrasulfotole plus bromoxynil applied alone or with MCPA or 2,4-D. The experiment was established near Walcott, ND in an ungrazed area of pasture with a dense stand of leafy spurge (> 90 stems/ sq yd). Treatments were applied June 16, 2008 when leafy spurge was in the true-flower growth stage.

Pyrasulfotole plus bromoxynil did not control leafy spurge (Table 1). Leafy spurge control 1 MAT (month after treatment) was 5% or less with all pyrasulfotole plus bromoxynil treatments except when 2,4-D was included. 2,4-D commonly kills leafy spurge topgrowth, but the plant regrows within 2 to 3 months. Leafy spurge control averaged over all treatments that included pyrasulfotole plus bromoxynil was only 38% 2 MAT (August 2008) compared to 93% with the standard treatment of picloram plus 2,4-D plus imazapic. Leafy spurge was not controlled with any treatment that included pyrasulfotole plus bromoxynil 12 MAT (data not shown).

The second study was established on a wildlife production area in Barnes County, ND that had recently become infested with yellow toadflax. The treatments were applied July 14, 2008 when yellow toadflax was in the vegetative to flowering growth stage and 12 to 20 inches tall.

Pyrasulfotole plus bromoxynil did not control yellow toadflax regardless if applied alone or with MCPA or 2,4-D 1 or 13 MAT (Table 2). In summary, pyrasulfotole plus bromoxynil did not provide satisfactory leafy spurge or yellow toadflax control.

Table 1. Leafy spurge control with pyrasulfotole plus bromoxynil applied on June 16, 2008 near Walcott, ND.

		Evaluation 2008	
Treatment	Rate	17 July	19 Aug
	—— oz/A ——	— % control	—
Pyrasulfotole & bromoxynil[1] + X-77 + AMS	3.5+0.5%+8	3	21
Pyrasulfotole & bromoxynil + X-77 + AMS	3.9+0.5%+8	4	34
Pyrasulfotole & bromoxynil + MCPA + X-77 + AMS	3.5+6+0.5%+8	5	33
Pyrasulfotole & bromoxynil + MCPA + X-77 + AMS	3.9+6+0.5%+8	5	18
Pyrasulfotole & bromoxynil + 2,4-D ester + X-77 + AMS	3.5+15.2+0.5%+8	97	53
Pyrasulfotole & bromoxynil + 2,4-D amine + X-77 + AMS	3.5+15.2+0.5%+8	95	68
Picloram + 2,4-D amine	6 +15.2	97	83
Picloram + 2,4-D amine + imazapic + MSO	4+16+1+1 qt	99	93
LSD (0.05)		3	28

[1] Commercial formulation - Huskie from Bayer CropScience, 2 T.W. Alexander Drive, Research Triangle PK, NC 27709.

Table 2. Yellow toadflax control with pyrasulfotole plus bromoxynil applied on July 14, 2008 at a wildlife production area near Valley City, ND

		Evaluation date			
		13 Aug 08		4 Aug 09	
Treatment	Rate	YETF[1] control	Grs[1] inj.	YETF control	Grs inj
	——— oz/A ———	——— % ———			
Pyrasulfotole & bromoxynil[2] + X-77 + AMS	3.5+0.5%+8	0	0	0	0
Pyrasulfotole & bromoxynil + X-77 + AMS	3.9+0.5%+8	0	0	3	0
Pyrasulfotole & bromoxynil + MCPA + X-77 + AMS	3.5+6+0.5%+8	1	0	0	0
Pyrasulfotole & bromoxynil + MCPA + X-77 + AMS	3.9+6+0.5%+8	7	0	4	0
Pyrasulfotole & bromoxynil + 2,4-D ester + X-77 + AMS	3.5+15.2+0.5%+8	12	0	8	0
Pyrasulfotole & bromoxynil + 2,4-D amine + X-77 + AMS	3.5+15.2+0.5%+8	10	0	3	0
Picloram + 2,4-D amine	6+15.2	15	4	8	0
Picloram + diflufenzopyr + X-77	16+6.4+0.25%	56	21	74	15
LSD (0.05)		6	2	13	2

[1] Abbreviations: YETF = yellow toadflax; Grs. inj. = grass injury.

[2] Commercial formulation - Huskie from Bayer CropScience, 2 T.W. Alexander Drive, Research Triangle PK, NC 27709.

St. Johnswort control with DPX-MAT28 at various rates. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Harrison, ID in an abandoned pasture to evaluate St. Johnswort (*Hypericum perforatum* L. ; HYPPE) control with DPX-MAT28, metsulfuron, chlorsulfuron, and 2,4-D timed to the pre-flower stage. Treatments were randomly assigned and replicated three times. Plot size was 10 by 30 feet. All treatments were applied with a CO_2-pressurized backpack sprayer at 16 gpa (Table 1).

Table 1. Application and soil data.

Application date	June 4, 2009
Weed growth stage	Pre-flower
Air Temp (F)	81
Relative humidity (%)	33
Wind (mph, direction)	2 to 5, W
Cloud cover (%)	50
Soil temp at 2 inches (F)	62
Soil Type	sandy loam

A visual evaluation was conducted 15 and 35 days after treatment (DAT) to determine St. Johnswort control following treatments timed to the pre-flower stage. Whole plots were visually evaluated for injury symptoms including stem and leaf curling, leaf chlorosis, and injury to growing points, and assigned a percent injury rate in comparison to the untreated check. At 15 DAT, injury symptoms were observed in DPX-MAT28 treatments applied at rates of 0.75 oz ai/A and below, but did not differ from the untreated control (Table 2). DPX-MAT28 applied at 1 and 1.5 oz ai/A resulted in greater injury, 50 and 73% respectively. Metsulfuron and chlorsulfuron in combination with DPX-MAT28, and metsulfuron alone resulted in significant injury symptoms, greater than 80%. DPX-MAT28 at 1.5 oz ai/A did not differ from these treatments. Injury symptoms generally increased across treatments at 35 DAT, but were similar in differences between treatments. DPXMAT-28 at 1 and 1.5 oz ai/A did not differ from metsulfuron treatments. Plant mortality as a result of herbicide injury was low (<10%) across treatments with the exception of the DPX-MAT28 + metsulfuron combination (23%; data no shown). Suppression of seed production was estimated as the percent of total number of St. Johnswort plants that did not flower at the end of the growing season (95 DAT). DPX-MAT28 in combination with metsulfuron and chlorsulfuron, as well as metsulfuron alone, resulted in greater than 50% seed production suppression.

Table 2. St. Johnswort control near Harrison, ID in 2009.

		HYPPE injury		HYPPE seed suppression
Treatment[1]	Rate	15 DAT[3]	35 DAT	95 DAT
	oz ai/A[2]	-----------%-----------		----------%----------
DPX-MAT28	0.25	5	18	16
DPX-MAT28	0.50	6	18	28
DPX-MAT28	0.75	26	50	22
DPX-MAT28	1.00	50	55	40
DPX-MAT28	1.50	73	70	40
2,4-D DMA	12.4	58	53	23
Metsulfuron	0.36	88	88	50
DPX-MAT28 + metsulfuron	0.50 + 0.36	81	92	74
DPX-MAT28 + chlorsulfuron	0.50 + 0.15	85	58	57
DPX-MAT28 + 2,4-D DMA	0.50 + 3.1	10	21	30
Untreated check	--	0	0	8
Tukey's HSD		28	41	30

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

[2] 2,4-D DMA expressed as oz ae /A

[3] DAT = days after treatment

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.; CHOJU) 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 plant community variability across site. 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 May 21, 2009 to determine rush skeletonweed control in treatments timed to the spring-rosette stage (12 MAT), floral bud stage (10 MAT), and the fall-rosette stage (6 MAT). Percent control was calculated using the formula:

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

Herbicide treatments resulted in high levels of rush skeletonweed control at each timing in comparison to the untreated check (Table 2). No treatment or timing effects were detected. A trend was observed, in which increased rates of DPX-MAT28 resulted in greater rush skeletonweed control when applied at the spring rosette and floral bud stage.

Bulbous bluegrass (*Poa bulbosa* L.; POABU) and downy brome (*Bromus tectorum* L.; BROTE) cover were also evaluated across treatments (Table 2). These species, both undesirable forage grasses that predominantly germinate in the fall, were present throughout the site. Significant timing effects were detected in the evaluation of the cover of these grasses combined. Application of treatments at the fall rosette stage resulted in significantly less cover in comparison to floral bud and spring rosette stage (Table 2). Application of treatments at the floral bud stage resulted in less cover than the spring rosette stage. These results suggest that treatments timed to the fall rosette stage may result in suppression of fall-germinating weedy grasses.

Rush skeletonweed rosette density was evaluated in the fall, November 16, 2009, to determine treatment effects on rosette recruitment. Rosette density in each treatment by application timing did not differ in comparison to the untreated check. A significant application timing effect was detected. Averaged over treatments, the fall application timing resulted in greater rosette density in comparison to other timings. However, DPX-MAT28 applied at 2 and 3 oz ai/A in the fall, did not differ from other timings of the same treatments.

Two perennial grasses, red threeawn (*Aristida purpurea* Nutt.) and intermediate wheatgrass (*Thinopyrum intermedium* Barkworth & D.R. Dewey) were present at the study site. Perennial grass density was calculated for whole plots at the fall evaluation. Density was low across plots and no treatment effects were detected. Two shrubs, big sagebrush (*Artemisia tridentata* Nutt.) and bitterbrush (*Purshia tridentata* Pursh) were also present at the study site and appeared uninjured at the fall evaluation date (data not shown).

Table 2. Rush skeletonweed (CHOJU) control and bulbous bluegrass (POABU)/downy brome (BROTE) cover following herbicide treatments near Cambridge, ID. Evaluation conducted on May 21, 2009; 12 months after spring rosette treatment, 10 months after flower bud treatment, and 6 months after fall rosette treatment. Treatment effect on rush skeletonweed fall-rosette density, evaluated on November 16, 2009.

			5/21/09 evaluation		11/16/09 evaluation
Treatment [1]	Rate	Timing	CHOJU	POABU/BROTE	CHOJU density
	oz ai /A		-- % control --	-- % cover --	--plts/yd^2--
DPX-MAT28	1	Spring Rosette	90	66	34
DPX-MAT28	2	Spring Rosette	97	75	23
DPX-MAT28	3	Spring Rosette	98	76	13
Aminopyralid	1.75	Spring Rosette	95	66	28
DPX-KJM44	2.88	Spring Rosette	97	68	20
Untreated Check	--	Spring Rosette	0	38	53
Mean[2]			*95*	*70*	*23*
DPX-MAT28	1	Floral Bud	62	58	63
DPX-MAT28	2	Floral Bud	81	48	59
DPX-MAT28	3	Floral Bud	99	29	53
Aminopyralid	1.75	Floral Bud	99	27	20
DPX-KJM44	2.88	Floral Bud	99	34	38
Untreated Check	--	Floral Bud	0	50	39
Mean			*88*	*39*	*46*
DPX-MAT28	1	Fall Rosette	99	37	167
DPX-MAT28	2	Fall Rosette	99	30	44
DPX-MAT28	3	Fall Rosette	99	18	22
Aminopyralid	1.75	Fall Rosette	100	15	115
DPX-KJM44	2.88	Fall Rosette	99	25	83
Untreated check	--	Fall Rosette	0	20	191
Mean			*99*	*25*	*86*
Tukey's HSD			37	42	169

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

[2] Treatment means averaged over timing; excludes untreated check.

Yellow toadflax control in Colorado. James R. Sebastian and K.G. Beck. (Department of Bioagricultural 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. LINVU is a major problem 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 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 and September 16, 2009 (Table 2), approximately 13 and 24 months after treatment (MAT).

Dicamba or diflufenzopyr plus dicamba controlled 8 to 30% LINVU approximately 13 to 24 MAT. Picloram (32 or 64 oz/A) sprayed alone controlled 53 to 70% LINVU; however, when the same rates of picloram were tank mixed with diflufenzopyr plus dicamba, LINVU controlled increased to 94 to 98% 13 to 24 MAT. There was a significant advantage to the picloram plus diflufenzopyr plus dicamba tank mixed compared to these same herbicides sprayed alone. There was 53 to 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%). Grass stunting disappeared 24 MAT.

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 provided excellent LINVU control with minor stunting to perennial grass species 13 to 24 MAT. It may be possible to lower picloram rates and increase long term LINVU control by tank mixing picloram plus diflufenzopyr plus dicamba.

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 2008	Yellow toadflax control 2009	Grass injury 2008	Grass injury 2009
	oz ai/A	(%)			
Dicamba	4	29	8	8	0
Diflufenzopyr + dicamba	0.8 + 2	30	26	0	0
Picloram	8	63	53	0	0
Picloram	16	70	68	8	0
Picloram + diflufenzopyr + dicamba	8 + 0.8 + 2	97	98	28	0
Picloram + diflufenzopyr + dicamba	16 + 0.8 + 2	94	94	13	0
Picloram + dicamba	16 + 4	73	66	10	0
LSD (0.05)		14	10	19	0

[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 aminocyclopyrachlor. James R. Sebastian and K.G. Beck. (Department of Bioagricultural 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. LINVU is a significant problem 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 control.

An experiment was established near Crested Butte, CO on August 29, 2007 to evaluate chemical control of LINVU with a new herbicide aminocyclopyrachlor-methyl ester (KJM44) from DuPont Crop Protection. 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 and September 16, 2009 (Table 2), approximately 13 and 24 months after treatment (MAT).

LINVU control increased with increasing rates of KJM44. There was 30 or 19% LINVU control from 0.3 oz ai/a of KJM44 and 100% LINVU control from 12 oz ai/A of KJM44 approximately 13 or 24 MAT, however, the 12 oz ai/A is well above what will be the highest registered use rate. KJM44 at 4 oz ai/A controlled 91 and 90% of LINVU 13 and 24 MAT and this is approximately the highest use rate. Although there didn't appear to be perennial grass stand loss from KJM44, there was significant stunting of grass species (especially at the higher rates) 13 MAT; however, grass recovered from injury 24 MAT.

Grass canopy cover tended to increase with increasing rates of KJM44 approximately 24 MAT. This was likely due to the lack of competition from LINVU and other forbs that decreased in density with increasing LINVU control. There was 5% grass cover in untreated checks compared to 20 to 100% grass cover in KJM44 plots.

There are currently few herbicides available for effective long term yellow toadflax control in rangeland. This experiment has shown that KJM44 provides good to excellent LINVU control with minor stunting to perennial grass species 13 to 24 MAT.

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

		Yellow toadflax control		Grass injury		Grass cover
Herbicide[1]	Rate	2008	2009	2008	2009	2009
	oz ai/A	(%)				
KJM44[2]	0.3	30	19	10	0	20
KJM44	0.5	40	36	8	0	33
KJM44	1	51	40	19	0	25
KJM44	2	67	60	36	0	63
KJM44	4	91	90	33	0	81
KJM44	8	98	100	51	0	100
KJM44	12	100	100	45	0	94
Untreated		0	0	0	0	5
LSD (0.05)		9	11	16	0	24

[1] Methylated seed oil added to all treatments at 1% v/v.
[2] Aminocyclopyrachlor-methyl ester.

Aminopyralid applied alone or in combination with metsulfuron or picloram for absinth wormwood control. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58108-6050). Absinth wormwood is a perennial fragrant forb or herb that regrows from the soil level each spring from a large taproot. Absinth wormwood causes economic losses by reducing available forage, tainting the milk of cattle that graze it, and medically as a pollen source for allergies and asthma. The purpose of this research was to evaluate aminopyralid applied alone or with other herbicides in the spring or fall for absinth wormwood control.

The study was established on a wildlife production area in Barnes County, ND that recently had become infested with absinth wormwood. The treatments were applied June 26 or September 17, 2008 in separate experiments. June treatments were applied to absinth wormwood in the vegetative to bolting growth stage and 15 to 30 inches tall while plants were post-flower with woody stems and 24 to 36 inches tall when herbicides were applied in the fall.

Herbicides were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 30 feet and replicated four times in a randomized complete block design. Absinth wormwood control was evaluated visually using percent stand reduction compared to the untreated control.

Aminopyralid applied alone or with picloram in the spring or fall provided excellent absinth wormwood control (Tables 1 and 2). For instance, aminopyralid applied at 1.75 oz/A in the spring or fall averaged 100 and 99% control 12 MAT (months after treatment), respectively. However, absinth wormwood control with aminopyralid applied with metsulfuron tended to provide lower short-term control when spring applied and much lower control when fall applied than aminopyralid applied alone. Absinth wormwood control with aminopyralid plus metsulfuron applied in June was 55% in July averaged over application rate and adjuvant compared to an average of 91% with aminopyralid applied alone or with picloram (Table 1). Control increased to an average of 83% when 2,4-D ester was applied with aminopyralid plus metsulfuron. The reduction was short-lived and control increased to 99 to 100% regardless of treatment by June 2009 (12 MAT).

Aminopyralid applied with metsulfuron in the fall provided inconsistent absinth wormwood control. Control with aminopyralid plus metsulfuron applied at 1.05 + 0.19 oz/A with Activator 90 averaged 99% in Sept. 2009 but control averaged over the remaining three aminopyralid plus metsulfuron treatments was only 54% (Table 2). The addition of 2,4-D to the aminopyralid plus metsulfuron combination increased control to an average of 85%.

In summary, aminopyralid applied alone or with picloram provided excellent long-term absinth wormwood control regardless if applied in the spring or fall. However, absinth wormwood control with aminopyralid plus metsulfuron provided lower initial control in the spring and in general much lower long-term control in the fall than aminopyralid alone. Thus, aminopyralid alone provided the most cost-effective and consistent absinth wormwood control of the treatments evaluated in this study.

Table 1. Aminopyralid applied alone or with other herbicides and various adjuvants for absinth wormwood control in Barnes County, ND, on June 26, 2008.

		2008		2009	
Treatment	Rate	14 July	13 Aug	4 June	1 Sept
	oz/A	% control			
Aminopyralid + Activator 90[1]	1.75 + 0.25%	90	100	100	100
Picloram + Activator 90	6 + 0.25%	84	99	100	100
Aminopyralid + picloram + Activator 90	1.25 + 4.5 + 0.5%	92	100	100	100
Aminopyralid + metsulfuron[2] + Activator 90	1.05 + 0.19 + 0.25%	44	95	95	95
Aminopyralid + metsulfuron + Syl-Tac[3]	1.05 + 0.19 + 4%	53	99	99	99
Aminopyralid + metsulfuron + 2,4-D ester + Activator 90	1.05 + 0.19 + 8 + 0.25%	85	100	100	100
Aminopyralid + metsulfuron + Activator 90	1.32 + 0.23 + 0.25%	60	100	100	100
Aminopyralid + metsulfuron + 2,4-D ester + Activator 90	1.32 + 0.23 + 8 + 0.25%	82	99	99	99
Aminopyralid + metsulfuron + Activator 90	1.58 + 0.28 + 0.25%	62	98	100	100
Aminopyralid + picloram + Activator 90	1.25 + 3 + 0.25%	89	100	99	99
LSD (0.05)		27	3	NS	4

[1] Activator 90 surfactant by Loveland Products, Inc. P.O. Box 1286 Greeley, CO 80632.

[2] Aminopyralid plus metsulfuron was GF-2050 commercial formulation - Chaparral from Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.

[3] Syl-Tac surfactant by Wilbur-Ellis, 1801 Oakland Boulevard, Suite 210, Walnut Creek, CA 94596.

Table 2. Aminopyralid applied alone or with other herbicides and various adjuvants for absinth wormwood control in Barnes County ND, on September 17, 2008.

		2009	
Treatment	Rate	4 June	1 Sept
	oz/A	% control	
Aminopyralid + Activator 90[1]	1.75 + 0.25%	100	100
Picloram + Activator 90	6 + 0.25%	99	100
Aminopyralid + picloram + Activator 90	1.25 + 4.5 + 0.5%	99	99
Aminopyralid + metsufuron[2] + Activator 90	1.05 + 0.19 + 0.25%	99	99
Aminopyralid + metsulfuron + Syl-Tac[3]	1.05 + 0.19 + 4%	87	77
Aminopyralid + metsulfuron + 2,4-D ester + Activator 90	1.05 + 0.19 + 8 + 0.25%	94	83
Aminopyralid + metsulfuron + Activator 90	1.32 + 0.23 + 0.25%	69	47
Aminopyralid + metsulfuron + 2,4-D ester + Activator 90	1.32 + 0.23 + 8 + 0.25%	94	86
Aminopyralid + metsulfuron + Activator 90	1.58 + 0.28 + 0.25%	60	38
Aminopyralid + picloram + Activator 90	1.25 + 3 + 0.25%	99	99
LSD (0.05)		14	26

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[1] Activator 90 surfactant by Loveland Products, Inc. P.O. Box 1286 Greeley, CO 80632.

[2] Aminopyralid plus metsulfuron was GF-2050 commercial formulation - Chaparral from Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.

[3] Syl-Tac surfactant by Wilbur-Ellis, 1801 Oakland Boulevard, Suite 210, Walnut Creek, CA 94596.

Tolerance of rangeland forbs to various rates of DPX-MAT28. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Moscow, ID in Palouse Prairie remnant to evaluate the level of impact of various rates of DPX-MAT28 on desirable rangeland forbs. The experiment was designed as a randomized complete block with three replications and conducted at two sites located within the same remnant. Plot size was 8 by 40 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 21, 2009
Target growth stage	Actively growing plants
Air Temp (F)	68
Relative humidity (%)	32
Wind (mph, direction)	0 to 2, W
Cloud cover (%)	0
Soil temp at 2 inches (F)	60
Soil Type	loam

Injury symptoms on desirable forb species were evaluated in comparison to the untreated control 30 days after treatment (DAT). Injury symptoms included stem twisting, leaf chlorosis, and injury to growing points. Increased severity of symptoms and the presence of multiple symptoms resulted in higher injury ratings. The primary forb species evaluated were: arrowleaf balsamroot (BALSA), fernleaf biscuitroot (LOMDI), snowberry (SYMAL), wood's rose (ROSWO), Lupine species (LU SPP.), and yellow salsify (TRODU). Analysis of injury symptoms is pooled across sites.

Significant treatment effects were detected for BALSA, LOMDI, and SYMAL in comparison to the untreated check 30 DAT (Table 2). ROSWO, LU. SPP and TRODU were not present throughout treatments, thus hereafter only means are reported. Treatment rates did not significantly affect the rate of injury, but a general trend of increasing injury symptoms with increasing rate was observed.

The rate of flowering was evaluated 60 DAT (Table 3). Natural variation in dessication of forbs at this point in the growing season precluded a complete assessment of treatment effects. The percentage of flowering plants following treatments did not differ from the untreated check.

Table 2. Percent injury of six forb species 30 DAT.

Treatment[1]	Rate[2]	BALSA[3]	LOMDI	SYMAL	ROSWO	LU SPP.	TRODU
	oz ai /A	------------------------------			% injury ------------------------------		
DPX-MAT28	0.5	11	51	8	15	4	0
DPX-MAT28	1	19	60	7	10	0	--
DPX-MAT28	2	38	66	12	12	8	5
DPX-MAT28 + 2,4-D DMA	1 + 6.2	26	60	24	8	0	80
DPX-MAT28 + chlorsulfuron	1 + 0.15	17	48	9	9	3	0
Untreated check	--	3	17	3	5	0	0
Tukeys HSD		14	21	10	--	--	--

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

[2] 2,4-D DMA expressed as oz ae/A

[3] BALSA = arrowleaf balsamroot, LOMDI = fernleaf biscuitroot, SYMAL = snowberry, ROSWO = wood's rose, LU SP. = *Lupine* species, TRODU = yellow salsify.

Table 3. Percent flowering of six forb species 60 DAT.

Treatment [1]	Rate[2]	BALSA[3]	LOMDI	SYMAL	ROSWO	LU SPP.	TRODU
	oz ai /A	------------------------------		% flowering		------------------------------	
DPX-MAT28	0.5	100	70	10	50	50	32
DPX-MAT28	1	100	64	0	25	40	40
DPX-MAT28	2	100	60	0	25	32	80
DPX-MAT28 + 2,4-D DMA	1 + 6.2	100	56	2	27	75	22
DPX-MAT28 + chlorsulfuron	1 + 0.15	100	70	4	13	33	88
Untreated check	--	100	95	33	50	98	78
Tukeys HSD		0	37	16	--	--	--

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

[2] 2,4-D DMA expressed as oz ae/A

[3] BALSA = arrowleaf balsamroot, LOMDI = fernleaf biscuitroot, SYMAL = snowberry, ROSWO = wood's rose, LU SP. = *Lupine* species, TRODU = yellow salsify.

Tolerance of fall seeded grasses to fall applied herbicides. Clarke G. Alder and Corey V. Ransom. (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) An experiment was conducted evaluating fall applied herbicide tolerance of desirable forage grasses using herbicides common in rangeland reclamation and weed management practices. Trials were conducted in Logan, UT during 2008 and 2009. Herbicides were organized in a randomized complete block. Varieties were planted in randomized strips across herbicide blocks. Anatone Germplasm bluebunch wheatgrass, 'Rimrock' indian ricegrass, 'Magnar' great basin wildrye, Toe Jam Creek Germplalsm bottlebrush squirreltail, 'Sherman' big bluegrass, and 'Alkar' tall wheatgrass were individually broadcast planted using a Brillion seeder at 12.45, 11.41, 15.32, 10.92, 2.49, and 14.36 lb/A respectively. Sulfosulfuron and imazapic were applied on 11/8/08, two weeks prior to planting, and aminopyralid was applied one week after planting on 12/1/08. All herbicides were applied using a CO_2-pressurized backpack sprayer calibrated to deliver 20 gpa at 30 psi. Sulfosulfuron was applied at 0.035, 0.0623, and 0.094 lb ai/A, imazapic at 0.094 and 0.125 lb ai/A, and aminopyralid at 0.078, 0.109, and 0.219 lb ae/A. Injury was evaluated visually while density was evaluated using 1 ft^2 frames. Data show that sulfosulfuron caused the most injury across all grass species for all rates followed by imazapic and aminopyralid (Table). The two highest rates of sulfosulfuron also produced among the lowest density values in both 'Rimrock' and 'Alkar'. For all other species density did not differ significantly from the untreated plots. Evaluations showed higher density counts in some treated plots versus the untreated plots. Weed competition in the untreated plots may be a possible cause for the lower density counts. (Refer to table for complete data set).

Table. Visual injury and density evaluation of desirable forage grasses in response to pre-plant and preemergence herbicide treatments.

			Injury 7/7/09[1]					
Herbicide	Rate[2]	Timing	Anatone	Rimrock	Magnar	Toe Jam Cr.	Sherman	Alkar
	lb ai/A		--------------------------------%------------------------------					
Untreated	--	--	--	--	--	--	--	--
Sulfosulfuron[3]	0.035	PRE	73 a	96 a	79 a	70 a	45 b	92 a
	0.062	PRE	91 a	99 a	94 a	89 a	84 a	98 a
	0.094	PRE	96 a	99 a	98 a	88 a	95 a	99 a
Imazapic[4]	0.094	PRE	15 b	23 b	13 b	23 b	16 bc	3 d
	0.125	PRE	15 b	19 b	23 b	30 b	20 bc	23 b
Aminopyralid	0.078	POST	13 b	10 b	13 b	11 b	15 bc	5 cd
	0.109	POST	20 b	16 b	26 b	31 b	16 bc	15 bcd
	0.219	POST	29 b	13 b	28 b	34 b	9 c	19 bc
			Injury 10/22/09					
Untreated	--	--	--	--	--	--	--	--
Sulfosulfuron	0.035	PRE	64 b	87 a	83 a	56 b	41 b	74 b
	0.062	PRE	88 a	96 a	97 a	88 a	83 a	95 a
	0.094	PRE	93 a	97 a	99 a	93 a	94 a	98 a
Imazapic	0.094	PRE	5 c	5 b	10 b	0 c	13 c	0 c
	0.125	PRE	4 c	3 b	13 b	5 c	13 c	4 c
Aminopyralid	0.078	POST	5 c	8 b	0 b	8 c	10 c	0 c
	0.109	POST	6 c	5 b	6 b	14 c	0 c	0 c
	0.219	POST	0 c	6 b	8 b	9 c	6 c	4 c
			Density 6/2/09					
			------------------------------No/ft^2------------------------------					
Untreated	--	--	12 a	3 bcd	8 a	18 a	3 a	17 a
Sulfosulfuron	0.035	PRE	14 a	3 bcd	14 a	20 a	5 a	12 ab
	0.062	PRE	8 a	2 cd	9 a	15 a	1 a	6 b
	0.094	PRE	11 a	1 d	5 a	23 a	2 a	6 b
Imazapic	0.094	PRE	13 a	6 ab	10 a	18 a	4 a	17 a
	0.125	PRE	16 a	4 abcd	13 a	13 a	3 a	14 a
Aminopyralid	0.078	POST	10 a	5 abc	14 a	13 a	5 a	12 ab
	0.109	POST	11 a	7 a	11 a	18 a	3 a	15 a
	0.219	POST	16 a	4 abcd	10 a	13 a	6 a	16 a

[1] Values within the same column followed by different letters are significantly different at P=0.05.

[2] Sulfosulfuron and imazapic rates are lb ai/A and aminopyralid rate is lb ae/A.

[3] Includes 0.25% v/v non-ionic surfactant.

[4] Includes 0.25% v/v methylated seed oil.

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

A visual evaluation was conducted on June 16, 2009, approximately 24 MAT for the 2007 study and 12 MAT for the 2008 study. Injury symptoms were evaluated by observing the development of new candle and needle growth. 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 2-3). 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.

Few terminal candle injury symptoms were observed for aminopyralid treatments in both studies (Table 2). Injury ranged from no symptoms to candle twisting. Though no differences were detected, patterns suggest a greater frequency of injury symptoms for aminopyralid at 1.75 oz ae/A in comparison to aminopyralid at 0.75 oz ae/A and aminopyralid + clopyralid treatments. Greater injury symptoms were detected in picloram treatments. Mortality of terminal candles ranged from 50 to 80% across studies. Similar treatment effects were observed in estimates of lateral candle injury (Table 3). Injury was minimal across aminopyralid treatments. Severity of lateral candle injury following picloram treatments was greater in the 2008 study, where the frequency of lateral candle mortality was estimated at 70%.

In both studies, twisting of new needle growth was minimal (data not shown). The percentage of total branches with observed delayed elongation is reported (Table 4). Delayed elongation was minimal 24 MAT in the 2007 study. The only treatments showing this injury symptom were aminopyralid at 1.75 oz ae/A (10%) and picloram (17%). In the 2008 study, the percentage of branches with delayed elongation ranged from 1 to 31% in aminopyralid treatments. Picloram treatments resulted in 91% of branches with delayed elongation 12 MAT.

In summary, herbicide injury symptoms were minimal 12 and 24 MAT across aminopyralid treatments. Observations suggest that the high rate of aminopyralid (1.75 oz ae/A) results in greater injury than the low rate (0.75 oz ae/A). Severe injury symptoms were observed following picloram treatments in both studies. Injury included mortality of terminal and lateral candles. In most instances, mortality of a terminal bud resulted in initiation of growth from lateral or sessile buds the following growing season. However, the 2008 study will most likely result in the mortality of 40% of picloram-treated trees, indicating significant variation in picloram results across studies.

Table 2. Terminal candle injury following 2007 and 2008 herbicide treatments beneath ponderosa pine canopies near Santa, ID.

		Terminal candle injury (Scale 0-4)									
		2007 study (24 MAT)[2]					2008 study (12 MAT)[3]				
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	80	20	0	0	0
Aminopyralid	1.75	10	80	0	0	10	40	60	0	0	0
Aminopyralid + clopyralid	0.75 + 1.5	60	40	0	0	0	60	40	0	0	0
Picloram	4	20	30	0	0	50	0	20	0	0	80
Untreated check		0	0	0	0	0	90	10	0	0	0

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

[2] Distribution of injury ratings is significantly different across treatments (Pearson Chi-Square, P = 0.0049)

[3] Distribution of injury ratings is significantly different across treatments (Pearson Chi-Square, P = 0.0002)

Table 3. Lateral candle injury following 2007 and 2008 herbicide treatments beneath ponderosa pine canopies near Santa, ID.

		Lateral candle injury (Scale 0-4)									
		2007 study (24 MAT)[2]					2008 study (12 MAT)[3]				
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	70	30	0	0	0	70	20	10	0	0
Aminopyralid + clopyralid	0.75 + 1.5	90	10	0	0	0	70	30	0	0	0
Picloram	4	10	80	0	10	0	0	0	20	10	70
Untreated check		0	0	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.

[2] Distribution of injury ratings is significantly different across treatments (Pearson Chi-Square, P = 0.0958)

[3] Distribution of injury ratings is significantly different across treatments (Pearson Chi-Square, P < 0.0001)

Table 4. Delayed elongation (%) of ponderosa pine needles following 2007 and 2008 herbicide treatments beneath the tree canopy approximately 12 MAT and 24 MAT.

		Delayed elongation	
Treatment[1]	Rate	2007 study 24 MAT	2008 study 12 MAT
	oz ae/A	% of total branches	
Aminopyralid	0.75	0	1
Aminopyralid	1.75	10	31
Aminopyralid + clopyralid	0.75 + 1.5	0	14
Picloram	4	17	91
Untreated check		0	0
Tukey's Studentized Range HSD (0.05)		15	31

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

Postemergence herbicides for southwestern cupgrass control in turf. Kai Umeda. (University of Arizona, Maricopa County Cooperative Extension, Phoenix, AZ 85040) Two small plot field experiments were conducted to evaluate efficacy of POST herbicides for southwestern cupgrass control in turf. The first experiment compared quinclorac formulated as Drive XLR8 with the addition of various adjuvants and as a pre-mix product, Onetime, at the Karsten Golf Course in Tempe, AZ. The experiment consisted of individual plots that measured 5 ft by 7 ft and replicated three times in a randomized complete block design. The second experiment compared the efficacy of four postemergence herbicides. The individual plots measured 5 ft by 5 ft and were replicated three times in a randomized complete block design. All sprays were applied using a backpack CO_2 sprayer equipped with a hand-held boom with three flat-fan 8003 nozzles spaced 20-inches apart. The sprays were pressurized to 25 psi and the dilutions in water were sprayed at 75 and 77 gpa, respectively, for each experiment. Experiment 2 was sprayed with methylated seed oil (MSO) added to the mixtures at 1 qt/A. Experiment 1 was sprayed on 04 June 2009 when the air temperature was approaching 100°F, clear sky, and no wind. Cupgrass had multiple leaves and was tillering. Experiment 2 was sprayed on 14 July 2009 when it was100°F, clear sky, and no wind. Weed control ratings were taken and data collected at intervals after sprays were made.

Quinclorac formulated as Drive XLR8 or Onetime was active against southwestern cupgrass. Drive XLR8 plus ammonium sulfate tended to be slightly more active than the addition of methylated seed oil (MSO), non-ionic surfactant (NIS), or nothing added. Onetime plus MSO was only slightly better than the addition of NIS against cupgrass. Foramsulfuron exhibited moderate efficacy against cupgrass.

Table 1. Comparison of adjuvants for quinclorac weed control efficacy at Karsten Golf Course, Tempe, AZ

Treatment[1]	Rate	Southwestern cupgrass control 16 Jun	26 Jun	06 Jul	19 Aug	Wild celery control 16 Jun	26 Jun
		%				%	
Untreated check		0	0	0	0	0	0
Quinclorac	0.75 lb a.e./A	73	78	72	72	33	17
Quinclorac + MSO	0.75 lb a.e./A + 1 qt/A	77	81	77	72	50	23
Quinclorac + NIS	0.75 lb a.e./A + 0.25% v/v	80	78	72	75	50	40
Quinclorac + AMS	0.75 lb a.e./A + 0.5 lb N/A	85	91	83	78	58	45
Onetime* + MSO	1.45 oz/1000 ft^2 + 1 qt/A	85	85	82	82	70	92
Onetime* + NIS	1.45 oz/1000 ft^2 + 0.25% v/v	80	68	70	78	65	86
BAS-800 + MSO	4 oz/A + 1 qt/A	0	0	0	17	17	0
LSD (p=0.05)		7.6	14.3	16.6	24.3	29.4	42.8

[1]Treatments applied 04 June 2009. Onetime* = quinclorac (1.5 lb a.e./gal) + MCPP acid (0.75 lb a.e./gal) + dicamba acid (0.2 lb a.e./gal). MSO = methylated seed oil, NIS = non-ionic surfactant Latron CS-7, AMS = ammonium sulfate (21%).

Table 2. Comparison of postemergence grass herbicides efficacy against cupgrass

Treatment[1]	Rate	Southwestern cupgrass control 23 Jul	05 Aug	19 Aug	01 Sep
		%			
Untreated check		0	0	0	0
MSMA	3.0 lb a.i./A	80	99	99	99
Quinclorac	0.75 lb a.e./A	62	58	98	99
Foramsulfuron	0.038 lb a.i./A	23	42	78	73
Fenoxaprop	0.13 lb a.i./A	22	27	50	0
LSD (p=0.05)		12.9	39.2	26.3	12.9

[1]Treatments applied 14 July 2009. Methylated seed oil added to all treatments at 1 qt/A.

Single application of V-10142 for nutsedge control in turf. Kai Umeda. (University of Arizona, Maricopa County Cooperative Extension, Phoenix, AZ 85040) Two small plot field experiments were conducted at the Camelback Golf Club, Scottsdale, AZ and Dobson Ranch Golf Course, Mesa, AZ. At the Camelback GC, an early spring application was evaluated on an unknown bermudagrass turf cultivar that was winter overseeded in the fall of 2008 with perennial ryegrass. The site was an area surrounding a practice putting green that was mowed regularly at approximately 0.5-inch height. Single applications were made on 3 April 2009 when air temperature was about 80°F, clear sky, and occasional wind gusts up to 10 mph. The experiment was established with each treatment replicated four times in a randomized complete block design. Plots measuring 5 ft by 6 ft were sprayed with a backpack CO_2 sprayer equipped with a hand-held boom with three 8003 LP flat fan nozzles spaced 20 inches apart. Sprays were mixed in 50 gpa water and delivered at 25 psi pressure. At Dobson Ranch GC, conventional summer application timing was evaluated on common bermudagrass that was mowed once per week at about 1.5 inch height. Plots measuring 5 ft by 10 ft were replicated three times in a randomized complete block design. The same spray equipment was used and delivered 46 gpa water. On 30 June during applications, air temperature was 102°F, clear, no wind and dry turf. All sprays included a non-ionic surfactant, Latron CS-7 at 0.25% v/v.

The early spring timing of application of V-10142 demonstrated very good control of nutsedge (Table 1). No injury was observed on perennial ryegrass with any treatment. Nutsedge regrowth occurred and V-101242 treated plots showed better reduction of nutsedge compared to the plots treated with halosulfuron or sulfentrazone. For summer applications, V-10142 performed comparably to all commercially available herbicides for nutsedge control (Table 2). V-10142 gave effective control for 6 weeks after treatment.

Table 1. V-0142 early season nutsedge control in turf at Camelback GC, Scottsdale, AZ

Treatment[1]	Rate	Purple nutsedge control		Turf injury
		11 May	28 May	11 May
	lb a.i./A	---------- % ----------		%
Untreated check		0	0	0
V-10142	0.38	93	59	0
V-10142	0.50	92	70	0
Halosulfuron	0.06	76	34	0
Sulfentrazone	0.38	13	25	0
MSMA	3.0	0	0	0
LSD (p=0.05)		19.0	32.3	-

[1] Application on 03 April 2009. All sprays included Latron CS-7 at 0.25% v/v.

Table 2. V-10142 summer application for nutsedge control at Dobson Ranch GC, Mesa, AZ

Treatment[1]	Rate	Purple nutsedge control				
		13 Jul	27 Jul	11 Aug	26 Aug	15 Sep
	lb a.i./A	------------------------------ % ------------------------------				
Untreated check		0	0	0	0	0
V-10142	0.25	90	92	85	77	57
V10142	0.38	85	93	87	78	73
Halosulfuron	0.062	90	87	72	80	78
Sulfosulfuron	0.059	87	92	83	67	67
Trifloxysulfuron	0.025	93	90	82	75	70
Imazaquin	0.5	92	95	88	75	40
Flazasulfuron	0.047	90	77	63	57	52
LSD (p=0.05)		9.3	10.0	22.1	15.6	35.7

[1] Application on 30 June 2009. All sprays included Latron CS-7 at 0.25% v/v.

Blackberry tolerance to quinclorac herbicide. Ed Peachey and Diane Kaufman. (Horticulture Department, Oregon State University, Corvallis, 97330 and North Willamette Research and Extension Center, Aurora, OR, 97002) Quinclorac (75 DF) was applied at 0.375 and 0.75 lbs ai/A to Marion blackberries at two sites near Dayton and two sites near Corvallis, OR. Quinclorac was applied to bare soil or primocanes lying on the soil in a 2.5 ft band on either side of the blackberry row with 8004E nozzles. Herbicide was delivered with water at 20 GPA with a CO_2 pressurized backpack sprayer at 25 PSI. UAN and MSO were added to the spray mixture at 2.5 and 1% v/v, respectively. Field bindweed was present in plots at the Dayton site. Hand hoeing was used to keep weed density low.

No statistically significant effects were noted on growth or yield at either Dayton or Corvallis (Tables 1 to 4). However, trends at Corvallis in 2008 suggested that quinclorac at 0.75 lbs ai/A may have reduced yield slightly (Table 3). Slight injury was noted at Dayton in the non-bearing year when quinclorac was sequentially applied at 0.75 lbs ai/A in both May and October, but cane number and length were unaffected (Table 1). Likewise, cane length at Corvallis in 2009 (measured prior to training of the vines in August) may have been suppressed with quinclorac applied at 0.75 lbs ai/A in June.

Table 1. Effect of quinclorac applied in the spring on Alternate Year (AY) Marion blackberries, Dayton (average of 2 harvests, n=3)

			2008 (July, bearing year)		2009 (June, non-bearing year)	
Herbicide	Date	Rate	Yield	Avg. berry wt	No. canes/vine	Avg. cane length
		lbs ai/A	*lb/plot*	*oz*		*ft*
1 Quinclorac	24-May-08	0.375	10.7	0.148	19.0	9.2
2 Quinclorac	24-May-08 1-Oct-08	0.375+ 0.375	-		21.0	9.5
3 Quinclorac	24-May-08	0.750	11.1	0.159	23.5	9.8
4 Quinclorac	24-May-08 1-Oct-08	0.750+ 0.750	-		21.7	9.8
5 Check	-	-	11.3	0.144	20.3	8.5
FPLSD (0.05)			ns	ns	ns	ns

Table 2. Effect of quinclorac applied in the spring on Alternate-year (AY) Marion blackberries, Dayton, 2009 (average of 3 harvests, n=3).

Herbicide	Date	Rate	Yield	Avg. berry wt
		lb ai/A	*lbs/ft of row*	*oz*
1 Quinclorac	9-June-09	0.375	1.7	0.166
2 Quinclorac	9-June-09	0.750	1.7	0.180
3 Check	-	-	1.9	0.180
FPLSD (0.05)			ns	ns

Table 3. Effect of quinclorac on Every-year (EY) Marion blackberry yield, Corvallis, 2008 (1 harvest) and 2009 (n=3).

			July, 2008		July, 2009	
Herbicide	Date	Rate *lbs ai/A*	Yield *lb/vine*	Avg. berry wt *oz*	Yield *lb/vine*	Avg. berry wt *oz*
1 Quinclorac	18-Jun-08	0.375	9.6	0.180	8.7	0.139
2 Quinclorac	18-Jun-08	0.75	8.2	0.175	7.0	0.132
3 Quinclorac	30-Aug-08	0.75	-	-	7.7	0.138
4 Check	-	-	5.5	0.181	8.1	0.123
FPLSD (0.05)			*ns*	*ns*	*ns*	*ns*

Table 4. Effect of quinclorac on Every-year (EY) Marion blackberry yield, Corvallis, 2009 (average of 2 harvests, n=4).

					Cane number and length at training on Aug 10, 2009	
Treatment	Date	Rate	Yield	Avg. berry wt.		
		lbs ai/A	*lbs/vine*	*oz*	*no.*	*length (ft)*
1 Quinclorac	18-Jun-08	0.375	8.1	0.179	9.1	8.3
2 Quinclorac	18-Jun-08	0.75	7.3	0.175	8.1	8.1
3 Check	-	-	7.9	0.178	9.9	9.1
FPLSD (Alpha = 0.1)			ns	ns	1.5	0.8

Potato crop safety and weed control with dimethenamid-p alone or in tank mixtures ground-applied or chemigated preemergence or chemigated early postemergence or flumioxazin ground-applied or chemigated early postemergence. Pamela J.S. Hutchinson, Brent Beutler, and JaNan Farr (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objectives of this trial were to 1) compare weed control and potato crop safety with dimethenamid-p (alone and in tank mixtures) ground-applied or chemigated preemergence (PRE) or early postemergence (EPOST) and 2) determine weed control and potato crop safety with flumioxazin + metribuzin ground-applied or chemigated PRE or EPOST.

The trial area was fertilized on April 28, 2008 with 180 lb N, 230 lb P_2O_5, 45 K, 30 lb S, and 7 lb Zn/A based on soil tests before planting and received additional N injected through the sprinkler system on July 28, 2008. 'Russet Burbank' potatoes were planted May 14, 2008. Potatoes were planted 5 inches deep at 12-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.5 % organic matter and pH 8.2.

Potatoes were hilled and 0.27 lb ai/A imidacloprid was applied on May 26, 2008, prior to potato and weed emergence. Dimethenamid-p was ground-applied or chemigated PRE or chemigated EPOST at 0.84 lb ai/A alone or in two-way tank mixtures with metribuzin at 0.5, pendimethalin at 1.0, or EPTC at 5.3 lb ai/A. Flumioxazin at 0.47 + metribuzin at 0.5 lb ai/A was ground-applied or chemigated PRE or EPOST. Ground-applied PRE or EPOST treatments were made May 30 or June 21, 2008, respectively, with a CO_2-pressurized backpack sprayer delivering 17.5 GPA at 30 psi and immediately sprinkler incorporated with 0.5 inches irrigation water. Chemigated PRE and EPOST treatments were applied May 31 and June 21, 2008, respectively, in 0.25 inches irrigation water followed immediately by another 0.25 inches irrigation water. No potato or weed plants were exposed at PRE application times. Redroot pigweed, common lambsquarters, hairy nightshade, and green foxtail densities EPOST were 3, 3, 2, and 5 per sq ft, respectively; the broadleaves were 0.25 to 0.5 inch and green foxtail was 0.5 to 1 inch tall; and potatoes were 5 inches tall. Nontreated weed-free and weedy controls were included for yield comparisons. The experimental design was a randomized complete block with three replications and plot size was 18 by 40 ft.

Potatoes were sprinkler irrigated and additional N and fungicides were applied via the irrigation system as needed throughout the growing season. Crop injury was rated visually at 2 wk after treatment (WAT) and at potato row closure approximately 6 WAT on a scale of 0 = no injury to 100 = complete death. Weed control was rated 2 WAT, at potato row closure, and just prior to potato harvest on a scale similar to that used for crop injury. The last rating is representative of season-long control and is shown and discussed in this report. Potato vines were desiccated with 0.5 lb ai/A diquat Sep 11, 2008. Tubers were harvested from 20 feet of each of the two center rows in each plot using a single-row mechanical harvester on Oct. 10, 2008 and graded according to USDA standards.

Although some slight differences between treatments occurred, season-long redroot pigweed control ranged from 93 to 100% (Table). Hairy nightshade control was 97 to 100% with no treatment differences regardless of application method or timing. With the exception of 88% control by flumioxazin + metribuzin chemigated EPOST, green foxtail also was controlled 97 to 100% with no other treatment differences (Table). Common lambsquarters control by PRE ground-applied dimethenamid-p alone or in tank mixtures with pendimethalin, metribuzin, or EPTC was not different than the same treatments chemigated PRE (Table). Dimethenamid-p alone controlled this weed 67 to 68% while the tank mixtures improved control to 93 to 100%. However, chemigated EPOST dimethenamid-p alone provided only 30% common lambsquarters control; control by dimethenamid-p + EPTC or pendimethalin chemigated EPOST was 57or 85% and less than control by the same combinations applied PRE; while this application method and timing with metribuzin as the tank-mix partner resulted in 100% control. Common lambsquarters control by flumioxazin + metribuzin ground-applied or chemigated PRE or EPOST was no different and ranged from 98 to 100% (Table).

Regardless of application method or timing, crop injury consisting mainly of stunting was 5% or less with dimethenamid-p alone or in tank mixtures (Table). Chateau + metribuzin applied PRE with either method also caused 5% or less injury. In contrast, this combination applied EPOST by ground resulted in 35% injury while the chemigation method safened the herbicide somewhat by causing only 12% injury. Injury was not apparent by 2 to 3 wks after row closure (data not shown). Tuber yield and quality was seemingly more affected by common lambsquarters control than early injury since the treatments providing the least control, dimethenamid-p alone ground-applied PRE or chemigated PRE or EPOST, or dimethenamid-p + EPTC chemigated EPOST resulted in U.S. No. 1/total tuber yields of 108/240, 135/268, 66/159, or 135/287 cwt/A, respectively, which were numerically or significantly less according to a Fisher's Protected LSD Test at $p = 0.05$ than U.S. No. 1/total yields of the other treatments ranging from 145/321 to 230/421 cwt/A and similar to the weedy control yields of 63/164 cwt/A (data not shown).

Table. Season-long weed control and potato crop response with dimethenamid-p alone or in tank mixtures ground-applied or chemigated preemergence or chemigated early postemergence or flumioxazin + metribuzin ground-applied or chemigated early postemergence at the Aberdeen R&E Center in 2008.

			Weed control[a]				
Treatment	Rate	Method/Timing[b]	LAMAM	CHEAL	SOLSA	SETVI	Crop injury[c]
	lb ai/A		%				
Dimethenamid-p	**0.84**	Ground/PRE	95 bc	68 c	100 a	98 a	0 c
+ pendimethalin	1.0	Ground/PRE	98 ab	98 a	100 a	100 a	3c
+ metribuzin	0.5	Ground/PRE	100 a	100 a	100 a	100 a	2 c
+ EPTC	5.3	Ground/PRE	100 a	95 ab	100 a	100 a	5 c
Dimethenamid-p	**0.84**	Chem/PRE	100 a	67 cd	100 a	100 a	2 c
+ pendimethalin	1.0	Chem/PRE	100 a	100 a	100 a	100 a	0 c
+ metribuzin	0.5	Chem/PRE	100 a	100 a	100 a	100 a	2 c
+ EPTC	5.3	Chem/PRE	100 a	93 ab	100 a	100 a	2 c
Dimethenamid-p	**0.84**	Chem/EPOST	93 c	30 e	97 a	97 a	3 c
+ pendimethalin	1.0	Chem/EPOST	98 ab	85 b	100 a	98 a	2 c
+ metribuzin	0.5	Chem/EPOST	100 a	100 a	98 a	100 a	2 c
+ EPTC	5.3	Chem/EPOST	100 a	57 d	100 a	100 a	2 c
Flumioxazin + metribuzin	0.047 + 0.5	Ground/PRE	100 a	100 a	100 a	100 a	5 c
Flumioxazin + metribuzin	0.047 + 0.5	Chem/PRE	100 a	100 a	100 a	100 a	3 c
Flumioxazin + metribuzin	0.047 + 0.5	Ground/EPOST	100 a	100 a	100 a	97 a	35 a
Flumioxazin + metribuzin	0.047 + 0.5	Chem/EPOST	100 a	98 a	100 a	88 b	12 b

[a] Means in the same column followed by the same letter(s) are not significantly different according to a Duncan's New Multiple Range Test ($p = 0.05$). Nontreated control means were not included in this weed control mean separation analyses.

[b] Ground - ground-applied with a backpack sprayer and sprinkler-incorporated with 0.5 inches irrigation water within 24 h of application; Chem - chemigated in 0.25 inches irrigation followed immediately by another 0.25 inches water; PRE - preemergence to potatoes 'Russet Burbank' and weeds; EPOST - potatoes were 5 inches tall, the broadleaves were 0.25 to 0.5 inch tall and green foxtail was 0.5 to 1 inch tall.

[c] Means in the same column followed by the same letter(s) are not significantly different according to a Fisher's Protected LSD Test ($p = 0.05$). Nontreated control means were not included in the crop injury mean separation analyses.

Efficacy and potato crop safety with two metribuzin 75 DF brands applied preemergence or early postemergence. Pamela J.S. Hutchinson, Brent R. Beutler, and JaNan Farr. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this trial was to compare weed control and potato crop safety with various rates of a generic formulation of metribuzin 75 DF marketed by Cheminova Inc. vs Sencor 75 DF® applied preemergence (PRE) or early postemergence (EPOST).

The trial area was fertilized on April 21, 2008 before planting with 140 lb N, 145 lb P_2O_5, 30 lb S, and 4 lb Zn/A based on soil tests and received additional N injected through the sprinkler system on July 15 and August 1, 2008. 'Russet Burbank' potatoes were planted on April 28, 2008 5 inches deep at 12-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.5% organic matter and pH 8.0. Potatoes were hilled and 0.27 lb ai/A imidacloprid was applied on May 17, 2008, prior to potato emergence. Treatments were arranged in a randomized complete block design with three replications and plot size of 12 by 30 ft.

Herbicide treatments consisted of metribuzin 75 DF applied PRE at 0.5 and 1.0 lb ai/A or at 0.25, 0.5 and 1.0 lb ai/A EPOST. Sencor 75 DF® was applied at 0.5 lb ai/A PRE or 0.25 lb ai/A EPOST. Nontreated weedy and weed-free controls were included for yield comparisons. PRE and EPOST applications were made May 21 and June 14, 2008, respectively, with a CO_2-pressurized backpack sprayer that delivered 17.5 GPA at 30 psi. PRE treatments were incorporated within 24 h of application with a combination of rain and sprinkler irrigation totaling 0.6 inches of water. No potato plants were exposed at this time of application. At the EPOST timing, weed densities/hts in the weedy control plots were 45/1.0 inch redroot pigweed, 45/0.5 inch common lambsquarters, 15/0.5 inch hairy nightshade, and 5/1.0 inch green foxtail per sq m; and potato were 5 inches tall.

Potatoes were sprinkler irrigated as needed throughout the growing season. Crop injury was rated visually at 2 wk after treatment (WAT) and at potato row closure approximately 6 WAT on a scale of 0 = no injury to 100 = complete death. Weed control was rated 2 WAT, at potato row closure, and just prior to potato harvest on a scale similar to that used for crop injury. The last rating is representative of season-long control and is shown and discussed. Potato vines were desiccated with 0.5 lb ai/A diquat August 22, 2008. Tubers were harvested from 20 feet of each of the two center rows in each plot using a single-row mechanical harvester on Sept. 16, 2008 and graded according to USDA standards.

Redroot pigweed, hairy nightshade, or green foxtail control by metribuzin 75 DF compared with the same rates of Sencor 75 DF® rates was not different (Table). Redroot pigweed control by either brand applied EPOST at 0.25 lb/A ranged from 88 to 92% and was less than control by 0.5 or 1.0 lb/A applied PRE or EPOST which ranged from 98 to 100%. Regardless of brand, rate, or application timing, hairy nightshade control was similar and ranged from 40 to 63% while green foxtail control by all herbicide treatments also was similar and ranged from 97 to 100% (Table). Common lambsquarters control by metribuzin 75 DF applied EPOST at 0.25 lb/A was statistically less than control by the same EPOST rate of Sencor 75 DF®, however, control by the generic was 93% compared with 100% control by all other treatments (Table).

No treatment caused visible crop injury (data not shown). Herbicide treatment U.S. No. 1 and total tuber yields were similar, ranged from 178 to 236 and 359 to 469 cwt/A, respectively, were greater than weedy control yields, and not different than weed-free control yields according to a Fisher's Protected LSD Test performed at the 0.05 probability level (data not shown).

Table. Season-long weed control with metribuzin 75 DF or Sencor 75 DF® applied preemergence or early postemergence at the Aberdeen R&E Center in 2008.

			Weed control[a]			
Treatment[b]	Rate	Timing[c]	LAMAM	CHEAL	SOLSA	SETVI
	lb ai/A		%			
Metribuzin 75 DF	0.5	PRE	100 a	100 a	53 a	100 a
Metribuzin 75 DF	1.0	PRE	100 a	100 a	63 a	100 a
Sencor 75 DF®	0.5	PRE	98 a	100 a	53 a	97 a
Metribuzin 75 DF	0.25	EPOST	88 b	93 b	40 a	97 a
Metribuzin 75 DF	0.5	EPOST	98 a	100 a	53 a	97 a
Metribuzin 75 DF	1.0	EPOST	100 a	100 a	63 a	100 a
Sencor 75 DF®	0.25	EPOST	92 b	100 a	43 a	97 a

[a] Means in the same column followed by the same letter are not significantly different according to a Duncan's New Multiple Range Test ($p = 0.05$). Nontreated control means were not included in the mean separation analyses.

[b] metribuzin 75 DF is marketed by Cheminova Inc.; Sencor 75 DF® is a registered trademark of Bayer CropScience and the active ingredient is metribuzin.

Weed control and potato crop safety with fomesafen tank mixtures. Pamela J.S. Hutchinson, Brent R. Beutler, and JaNan Farr. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). Fomesafen herbicide is labeled for use in several crops, but not currently labeled for use in potatoes. The objective of this study was to determine weed control and potato crop safety with fomesafen alone or in tank mixtures with several standard potato herbicides.

The trial area was fertilized on April 21, 2008 before planting with 140 lb N, 145 lb P_2O_5, 30 lb S, and 4 lb Zn/A based on soil tests. On April 28, 2008, 'Russet Burbank' potatoes were planted 5 inches deep at 12-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.5% organic matter and pH 8.0. Treatments were arranged in a randomized complete block design with three replications and plot size of 12 by 30 ft.

Potatoes were hilled and 0.27 lb ai/A imidacloprid was applied on May 17, 2008, prior to potato emergence. Treatments consisted of preemergence (PRE) fomesafen alone or with s-metolachlor, dimethenamid-p, or a pre-mix of s-metolachlor and metribuzin, or with the pre-mix + rimsulfuron, pendimethalin or additional metribuzin; the pre-mix alone or with rimsulfuron or additional metribuzin; or s-metolachlor alone (see the Table for combinations and rates). A sequential treatment of the pre-mix applied PRE + rimsulfuron applied EPOST also was included. PRE and EPOST applications were made May 21 and June 14, 2008, respectively, with a CO_2-pressurized backpack sprayer that delivered 17.5 GPA at 30 psi. PRE treatments were incorporated within 24 h of application with a combination of rain and sprinkler irrigation totaling 0.6 inches of water. No potato plants were exposed at the PRE application. At the EPOST timing, weed densities/hts in the nontreated control plots were 45/1.0 inch redroot pigweed, 45/0.5 inch common lambsquarters, 15/0.5 inch hairy nightshade; and potatoes were 5 inches tall.

Potatoes were sprinkler irrigated as needed throughout the growing season. Additional N was injected through the sprinkler system on July 15 and August 1, 2008. Crop injury was rated visually at 2 wk after treatment (WAT) and at potato row closure approximately 6 WAT on a scale of 0 = no injury to 100 = complete death. Weed control was rated 2 WAT, at potato row closure, and just prior to potato harvest on a scale similar to that used for crop injury. The last rating is representative of season-long control and is shown and discussed. Potato vines were desiccated with 0.5 lb ai/A diquat August 22, 2008. Tubers were harvested from 20 feet of each of the two center rows in each plot using a single-row mechanical harvester on Sept. 16, 2008 and graded according to USDA standards.

Season-long redroot pigweed control was similar and ranged from 88 to 100% for all treatments except s-metolachlor alone which provided only 80% control (Table). Hairy nightshade control ranged from 92 to 100% and was similar with the exception of s-metolachlor alone or the pre-mix alone or with pendimethalin which resulted in 70, 73, or 85% control, respectively (Table). In contrast, fomesafen alone at 0.25 lb or 0.5 ai/A, or at 0.25 lb ai/A tank-mixed with s-metolachlor or either rate of dimethenamid-p used, provided 85 to 88% common lambsquarters control whereas control usually was improved when fomesafen was combined with the pre-mix or the pre-mix + metribuzin, pendimethalin, or rimsulfuron which resulted in 92 to 100% (Table). Common lambsquarters control by s-metolachlor alone only was 68%. All weeds present were controlled similarly by the pre-mix applied PRE with rimsulfuron PRE or EPOST and control ranged from 97 to 100% (Table).

Crop injury 2 WAT or at row closure was never greater than 2% (data not shown). Although the aforementioned treatments which provided 88% or less common lambsquarters control sometimes resulted in numerically lower U.S. No. 1 and total tuber yields than treatments providing greater control, treatment yields were not significantly different according to a Fisher's Protected LSD Test ($p = 0.05$) and ranged from 214 to 284 and 349 to 439 cwt/A, respectively (data not shown). All treatments resulted in U.S. No. 1 and total tuber yields greater than those of the weedy control, 88 and 160 cwt/A, respectively, and similar to the weed-free control yields, 214 and 377 cwt/A, respectively (data not show).

In summary, fomesafen alone or in combination with the standard potato herbicides included in this trial usually provided greater than 90% redroot pigweed and hairy nightshade control. The pre-mix of s-metolachlor and metribuzin alone or with additional metribuzin did not provide greater than 85% hairy nightshade control while the addition of rimsulfuron PRE or EPOST to the pre-mix resulted in 97 to 100% control of this weed. Common lambsquarters control by fomesafen in combination with the other herbicides except s-metolachlor or dimethenamid-p usually improved compared with control by fomesafen applied alone. Regardless of the fomesafen rate in the fomesafen + pre-mix treatments, control of all three weeds present in the trial was similar and ranged from 95 to 100%.

Table. Season-long control of redroot pigweed, common lambsquarters, and hairy nightshade with preemergence applications of fomesafen or a pre-mix of s-metolachlor + metribuzin alone or in tank mixtures with other standard potato herbicides at the Aberdeen R&E Center in 2008.

			Weed control[a]		
Treatment[b]	Rate	Timing[c]	LAMAM	CHEAL	SOLSA
	lb ai/A		%		
Fomesafen	**0.25**	PRE	95 a-d	85 d	92 ab
+ s-metolachlor	1.31	PRE	88 d	87 d	95 a
+ s-metolachlor + metribuzin (pre-mix)	1.31 + 0.31	PRE	98 ab	97 ab	97 a
+ s-metolachlor + metribuzin (pre-mix)	1.31 + 0.31				
+ rimsulfuron	+ 0.023	PRE	100 a	97 ab	100 a
+ s-metolachlor + metribuzin (pre-mix)	1.31 + 0.31				
+ rimsulfuron	+ 0.016	PRE	97 abc	92 bcd	93 a
+ s-metolachlor + metribuzin (pre-mix)	0.98 + 0.23				
+ rimsulfuron	+ 0.023	PRE	100 a	100 a	100 a
+ s-metolachlor + metribuzin (pre-mix)	0.98 + 0.23				
+ metribuzin	+ 0.25	PRE	95 a-d	98 ab	97 a
+ s-metolachlor + metribuzin (pre-mix)	0.98 + 0.23				
+ pendimethalin	+ 1.0	PRE	92 bcd	95 abc	92 ab
+ dimethenamid-p	0.84	PRE	90 cd	88 cd	100 a
+ dimethenamid-p	1.0	PRE	95 a-d	88 cd	93 a
Fomesafen	**0.5**	PRE	98 ab	88 cd	97 a
+ s-metolachlor + metribuzin (pre-mix)	1.31 + 0.31	PRE	98 ab	95 abc	98 a
s-Metolachlor + metribuzin (pre-mix)	**1.31 + 0.31**	PRE	95 a-d	95 abc	73 c
+ metribuzin	0.19	PRE	98 ab	98 ab	85 b
+ rimsulfuron	0.023	PRE	98 ab	98 ab	97 a
+ rimsulfuron	0.023	EPOST	100 a	100 a	100 a
Fomesafen	**0.125**				
+ s-metolachlor + metribuzin (pre-mix)	**+ 1.31 + 0.31**	PRE	100 a	98 ab	98 a
s-Metolachlor	**1.31**	PRE	80 e	68 e	70 c

[a] Means in the same column followed by the same letter(s) are not significantly different according to a Duncan's New Multiple Range Test ($p = 0.05$). Nontreated control means were not included in the mean separation analyses.

[b] The pre-mix is a 6.5 lb ai/gal formulated product of s-metolachlor + metribuzin at 5.25 + 1.25 lb ai/gal.

[c] PRE, preemergence; EPOST, early postemergence.

Tolerance of six specialty potato varieties to dimethenamid-p applied preemergence at 0, 1, and 2X rates. Pamela J.S. Hutchinson, Brent Beutler, and JaNan Farr. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210.) Most dimethenamid-p potato tolerance research has been conducted on russet and white-skinned varieties. Specialty potato variety production is increasing in Idaho. The objective of this study therefore was to evaluate the tolerance of one chipping, four red- and one yellow-skinned variety to preemergence dimethenamid-p applied at 0, 1, and 2X standard rates. A replicated field trial was conducted in 2008 at the Aberdeen Research and Extension Center in Aberdeen, ID.

The experimental area was fertilized on April 21, 2008 with 140 lb N, 145 lb P_2O_5, 30 lb S, and 4 lb Zn/A before planting based on soil tests and received additional N injected through the sprinkler system on July 15 and August 1, 2008. Four red-skinned - 'Dark Red Norland' 'Sangre' 'Modoc' 'Nordonna' one yellow-skinned - 'Yukon Gold', and one chipping potato variety - 'Chipeta' were planted on April 29, 2008. Potatoes were planted 5 inches deep at 12-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.5% organic matter and pH 8.0. Treatments were arranged in a strip block design with the six varieties as the main plots and three dimethenamid-p rates of 0, 0.84 (1X), or 1.68 (2X) lb ai/A as the subplots. Treatments were replicated three times and plot size was 12 by 30 ft.

Potatoes were hilled and 0.27 lb ai/A imidacloprid was applied on May 17, 2008, prior to potato emergence. Herbicide treatments were applied May 19, 2008 with a CO_2-pressurized backpack sprayer that delivered 17.5 GPA at 30 psi and were incorporated within 24 h of application with 0.6 inch of water by a combination of rain and sprinkler irrigation. No potato plants were exposed at time of application. The trial area was kept weed free by hoeing as needed.

Percent visual injury was assessed 2, 6, 8, and 10 wks after treatment (WAT) on a scale of 0 = no injury to 100 = complete death. Potato plant ht measurements were conducted on 5 randomly-selected plants in each of the two center rows weekly from 3 to 9 WAT. Potatoes were sprinkler irrigated as needed throughout the growing season. Potato vines were desiccated with 0.5 lb ai/A diquat August 22, 2008. Tubers were harvested from 20 feet of each of the two center rows in each plot using a single-row mechanical harvester on Sept. 15, 2008 and graded according to USDA standards.

An analysis of variance was performed on the crop injury, plant ht, and tuber yield data after percent injury were arcsine square root transformed to mitigate the skewness of the data. If variety by herbicide rate interactions were significant, data were sorted by variety and the rate effect within each variety was determined. If significant, trend contrasts were performed to determine if the response was linear or quadratic. If there were no interactions and rate effect was significant, trend contrasts also were performed on data averaged over varieties. If the variety effect was significant then a Fisher's Protected LSD test at the 0.05 probability level was performed on data averaged over rates. Non-transformed means are shown in the table with transformed mean separations.

Less than 10% visual injury was observed early consisting mainly of stunting and none was evident by 10 WAT (data not shown). The rate by variety interaction as well as the rate effect was not significant for plant hts 2 to 7 WAT (data not shown). As could be expected, however, the variety effect was significant for hts at these measurement times. For example, at 6 WAT and averaged across dimethenamid-p rates, Chipeta was the tallest variety, followed by Yukon Gold and Dark Red Norland, then Nordonna, Modoc, and Sangre (Table 1). After 7 WAT, there was a rate by variety interaction, data were sorted by variety, and it was determined that ht of Modoc 8 WAT and Yukon Gold 8 and 9 WAT decreased in a quadratic manner as the dimethenamid-p rate increased from 0 to 2X the standard rate (Table 2).

The rate by variety interaction was significant for 4 to 6 oz tuber yields, and after sorting by varieties, it was determined that only Chipeta yield in this grade category were affected by the dimethenamid-p rate, decreasing in a linear manner as rate increased from 0 to 2X (Table 2). There were no rate by variety interactions for the other yield grades. As with hts, the variety effect was significant for these grades including total tuber yields as shown in Table 1. Averaged across dimethenamid-p rates, total yields ranged from 296 to 396 cwt/A, Modoc yield was the greatest, and Yukon Gold yield the least.

In summary, although some slight stunting occurred early season with a few varieties, and Chipeta 4 to 6 oz tuber yield was affected, the herbicide had no effect on other Chipeta yield grade categories including U.S. No. 1 and total tuber yields or yields of any other variety in the trial.

Table 1. The effect of 0, 0.84, and 1.68 lb/A dimethenamid-p on plant height at 6 wks after treatment (WAT) and total tuber yields of six specialty potato varieties at Aberdeen, ID in 2008[a].

Variety	Plant hts 6 WAT	Total tuber yield[b]
	-- inches --	--- cwt/A ---
Sangre	9 cd	354.2 bc
Nordonna	11 c	321.2 d
Chipeta	19 a	325.1 cd
Yukon Gold	15 b	296.3 e
Modoc	11 c	395.9 a
Dark Red Norland	15 b	364.8 b
LSD (p=0.05)	3	29.9

[a]The rate by variety interactions were not significant and the variety effect was significant for hts and yields therefore they were averaged across dimethenamid-p rates. Means within a column followed by the same letter are not significantly different according to a Fisher's Protected LSD test at the 0.05 probability level.

Table 2. The effect of dimethenamid-p rate on plant hts 8 and 9 wks after treatment (WAT) and 4 to 6 oz tuber yields of six specialty potato varieties at Aberdeen, ID in 2008[a].

	Plant hts			
	8 WAT		9 WAT	4 to 6 oz tuber yield
Dimethenamid-p rate	Modoc	Yukon Gold	Yukon Gold	Chipeta
------ lb/A -----	-------------------- inches --------------------			cwt/A
0	25	29	31	45.8
0.84	23	26	28	30.4
1.68	24	27	28	28.6
		------------------ Pr > F ------------------		
Rate effect[b]	0.05	0.05	0.05	0.04
Linear effect	0.1	0.13	0.04	0.02
Quadratic effect	0.05	0.04	NS	NS

[a]The rate by variety interaction was significant for plant hts 8 and 9 WAT and 4 to 6 oz tuber yields so the data were sorted by variety and the rate effect within each variety was analyzed. Only Modoc and Yukon Gold hts at 8 WAT, Yukon Gold plant hts at 9 WAT, and Chipeta 4 to 6 oz tuber yield were affected by rate and are shown here.

[b]Orthogonal contrasts were used to determine if the dimethenamid-p rate effect was significant, and if it was, trend contrasts were performed to determine if the response was linear or quadratic.

Evaluation of MON 63413 for weed control in sugar beet. 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 field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho, to evaluate MON 63413, an encapsulated acetochlor formulation, for weed control in sugar beet. Experimental design was a randomized complete block with four replications. Soil type was a Portneuf silt loam (17.7% sand, 68.3% silt, and 14% clay) with a pH of 8.0, 1.40% organic matter, and CEC of 17-meq/100 g soil. 'Betaseed 26RR-14' sugar beet was planted April 24, 2009, in 22-inch rows at a rate of 57,024 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), annual sowthistle (SONOL), common mallow (MALNE), 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 was evaluated 15 and 98 days after the last herbicide application (DALA) on July 10 and October 1. Weed control was evaluated visually 11 and 98 DALA on July 6 and October 1. The two center rows of each plot were harvested mechanically October 1.

Table 1. Environmental conditions at application.

Application date	May 4	May 23	June 3	June 23
Application timing[1]	Preemergence	2 leaf	6 leaf	11 to 12 leaf
Air temperature (F)	50	81	75	75
Soil temperature (F)	60	72	66	76
Relative humidity (%)	60	33.1	42	33
Wind velocity (mph)	4.5	1.1	2.0	7.0
Cloud cover (%)	95	95	30	0
Time of day	1430	1400	1000	1430

[1] Application timing based on crop growth stage.

No significant differences in crop injury were observed 15 or 98 DALA, although injury ranged from 0 to 10% at the later evaluation date (Table 2). However, stand counts taken at harvest (data not shown) showed that MON 63413 applied preemergence at 2.25 lb ai/A followed by (fb) two postemergence glyphosate applications reduced stand compared to postemergence MON 63413 applications with glyphosate. MON 63413 applied preemergence at 1.125 or 2.25 lb ai/A fb two postemergence glyphosate applications and glyphosate + dimethenamid-P applied at 2 leaf or 6 leaf controlled all weeds 91% or better at both evaluation dates. All other treatments that included MON 63413 applied in tank mixture with glyphosate also controlled all weed species 93% or better, with the exception of late season MALNE control. Late season MALNE control with these treatments ranged from 45 to 88%. Glyphosate alone applied at 2 and 6 leaf growth stages did not control CHEAL, AMARE, SONOL, MALNE, and SETVI as well as those treatments that included MON 63413 or dimethenamid-P. All herbicide treatments had higher yields (43 to 48 ton/A) than the untreated check, which yielded 6 ton/A. Even though MON 63413 applied preemergence at 2.25 lb ai/A reduced plant stand, root and sucrose yield was higher than glyphosate applied at 2 leaf followed by glyphosate + MON 63413 at 2.25 lb ai/A and glyphosate + dimethenamid-P applied at 2 leaf fb glyphosate alone at 6 leaf. All other herbicide treatments were statistically equal. Sucrose yield responded similarly.

Table 2. Crop injury, weed control, root and sucrose yield with glyphosate and MON 63413 in sugar beet, near Kimberly, ID.[1]

Treatment[3]	Application rate	Application dates	Crop injury 7/10	Crop injury 9/30	Weed control[2] CHEAL 7/6	CHEAL 9/30	KCHSC 7/6	KCHSC 9/30	AMARE 7/6	AMARE 9/30	SONOL 9/30	MALNE 7/6	MALNE 9/30	SETVI 7/6	SETVI 9/30	7	Root yield	ERS[4]
	lb ae/A		%														ton/A	lb/A
Check			-	-	-	-	-	-	-	-	-	-	-	-	-		6 c	1,644 c
Glyphosate	0.75	5/23, 6/3	0 a	0 a	88 d	91 b	100 a	100 a	89 c	79 b	66 a	94 c	45 b	94 d	81 b	9	45 ab	11,242 ab
MON 63413 Glyphosate	1.125 lb ai/A 0.75	5/4, 6/3, 6/23	0 a	4 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	96 a	100 a	100 a	10	44 ab	11,194 ab
Glyphosate + MON 63413 Glyphosate	0.75 + 1.125 lb ai/A 0.75	5/23, 6/3	0 a	2 a	93 cd	89 b	99 a	100 a	100 a	100 a	96 a	97 ab	79 ab	100 a	100 a	10	46 ab	12,146 ab
Glyphosate Glyphosate + MON 63413	0.75 0.75 + 1.125 lb ai/A	5/23, 6/3	0 a	0 a	95 bc	96 ab	100 a	100 a	99 ab	100 a	100 a	97 ab	45 b	99 bc	100 a	9	45 ab	11,122 ab
MON 63413 Glyphosate	2.25 lb ai/A 0.75	5/4, 6/3, 6/23	3 a	10 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	95 a	100 a	99 a	10	48 a	12,750 a
Glyphosate + MON 63413 Glyphosate	0.75 + 2.25 lb ai/A 0.75	5/23, 6/3	0 a	2 a	93 cd	93 b	100 a	100 a	99 ab	100 a	98 a	96 bc	86 a	100 a	100 a	10	47 ab	11,884 ab
Glyphosate Glyphosate + MON 63413	0.75 0.75 + 2.25 lb ai/A	5/23, 6/3	0 a	9 a	96 bc	94 b	100 a	100 a	100 a	100 a	100 a	97 ab	88 a	100 a	100 a	10	43 b	11,320 ab
Glyphosate + dimthnmd-P Glyphosate	0.75 + 0.98 lb ai/A 0.75	5/23, 6/3	0 a	4 a	98 b	97 ab	100 a	100 a	99 b	100 a	98 a	97 ab	93 a	100 a	100 a	10	43 b	10,967 b
Glyphosate Glyphosate + dimthnmd-P	0.75 0.75 + 0.98 lb ai/A	5/23, 6/3	0 a	5 a	95 bc	97 ab	100 a	100 a	99 b	100 a	95 a	98 ab	91 a	99 c	100 a	9	44 ab	11,353 ab

[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), annual sowthistle (SONOL nallow MALNE), green foxtail (SETVI) and barnyardgrass (ECHCG).

[3] Ammonium sulfate was added to all glyphosate treatments at 2% v/v. MON 63413 is an encapsulated acetochlor formulation. Dimthnmd-P is di l-P

[4] ERS is estimated recoverable sugar.

Timing of weed removal with glyphosate in glyphosate tolerant sugar beet. 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 field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho, to determine the optimum time for controlling weeds in glyphosate tolerant sugar beet. Experimental design was a randomized complete block with four replications. Soil type was a Portneuf silt loam (17.7% sand, 68.3% silt, and 14.0% clay) with a pH of 8.0, 1.4% organic matter, and CEC of 17-meq/100 g soil. 'Betaseed 26RR-14' sugar beet seed was planted April 24, 2009, in 22-inch rows at a rate of 57,024 seeds/A. Application timing was based on growing degree day (GDD) accumulation or on weed height. The first applications were applied at 300 GDD after crop emergence, which coincided with 1-inch tall weeds. The second application was made at 600 GDD, which coincided with 2-inch weeds. Applications made June 8 and 11 were on weeds that had re-grown to 1-inch and 4-inch weeds, respectively. All remaining applications were made at the respective GDD intervals listed in Table 1. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), annual sowthistle (SONOL), Russian-thistle (SASKR), common mallow (MALNE), 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 15 and 79 days after the last herbicide application (DALA) on August 5 and October 8. However, only the data from the evaluation taken 15 DALA is shown in Table 2. The two center rows of each plot were harvested mechanically October 12.

Table 1. Environmental conditions at application.

Application date	May 23	June 3	June 8	June 11	June 19	June 22	June 25	July 7	July 15	July 21
Application timing[1]	300 GDD & 1 inch weeds	600 GDD & 2 inch weeds	1 inch re-growth weeds	4 inch weeds	900 GDD	6 inch weeds	1200 GDD	1500 GDD	1800 GDD	2100 GDD
Air temp. (F)	76	77	76	70	72	68	84	68	78	72
Soil temp. (F)	65	70	76	64	65	68	82	67	69	66
Rel. humid. (%)	39	43	43	48	56	40	21	57	39	40
Wind (mph)	2	8	3	1	1	1	1	2	4	1
Cloud cov. (%)	100	0	25	30	0	10	20	0	0	0
Time of day	1100	1400	1400	1130	1015	1430	1500	1100	1100	0845

[1] GDD refers to growing degree days after crop emergence.

Crop injury 15 DALA ranged from 0 to 18% (Table 2). Glyphosate applied at 1.13 lb ae/A two times on July 7 and 15 and on July 15 and 21 injured the crop 9 and 18%, respectively. All other treatments were equal and injury ranged from 0 to 3%. By 79 DALA, no injury was observed in any of the treatments (data not shown). Glyphosate at 0.75 lb ae/A applied only one time at 300 GDD had the poorest overall weed control. CHEAL, KCHSC, SOLSA, SONOL, SASKR, MALNE, SETVI and ECHCG were controlled 16, 53, 23, 13, 15, 4, 10, 10, and 6%, respectively. Only AMARE was controlled satisfactorily (92%) with the single glyphosate application. Glyphosate applied two times at 0.75 lb ae/A beginning at 600, 900, or 1200 GDD controlled all weed species 91% or better 15 DALA. Three or more glyphosate applications beginning at 300 GDD also controlled all weeds 93% or better. Multiple glyphosate applications using 1.13 lb/A also controlled all weeds species >90%, but the injury associated with these treatments apparently reduced sugar beet root and sucrose yield. All herbicide treatments had yields greater than the untreated check (4 ton/A) with the exception of glyphosate at 0.75 lb ae/A applied one time at 300 GDD (6 ton/A). Interestingly, glyphosate applied at 1.13 lb ae/A one-time at 4-inch weed height yielded 31 ton/A, compared to two or more glyphosate applications, which averaged 27 ton/A.

Table 2. Crop injury, weed control, root and sucrose yield in sugar beet influence by glyphosate application timing and rate, near Kimberly, Idaho

	Application		Crop	Weed control[2]								Root	
Treatment[3]	rate	dates	injury	CHEAL	KCHSC	AMARE	SOLSA	SONOL	SASKR	MALNE	SETVI	yield	ERS[4]
	lb ae/A		--------	--------	--------	--------	%	--------	--------	--------	--------	ton/A	lb/A
Check			-	-	-	-	-	-	-	-	-	4 f	1413 e
Glyphosate	0.75	5/23, 6/3	0 c	84 b	98 a	79 g	98 abc	68 b	99 ab	68 b	75 c	25 cd	6,754 c
Glyphosate	0.75	6/3, 6/19	0 c	91 ab	98 a	93 cde	97 abc	94 a	94 b	93 ab	93 ab	30 a-d	8,063 abc
Glyphosate	0.75	6/19, 6/25	0 c	96 ab	100 a	90 f	99 abc	99 a	100 a	93 a	90 b	28 a-d	7,394 abc
Glyphosate	0.75	6/25, 7/7	0 c	91 ab	100 a	98 bcd	96 bc	96 a	100 a	93 a	95 ab	27 a-d	7,323 abc
Glyphosate	1.13	7/7, 7/15	9 b	96 ab	100 a	94 c-f	100 a	97 a	100 a	98 a	98 a	25 cd	6,888 bc
Glyphosate	1.13	7/15, 7/21	18 a	97 a	100 a	96 cde	100 a	97 a	100 a	99 a	98 a	15 e	3,753 d
Glyphosate Glyphosate	1.13 0.75	5/23, 6/8	0 c	89 ab	100 a	90 f	99 abc	93 a	100 a	86 a	80 c	28 a-d	7,956 abc
Glyphosate Glyphosate	1.13 0.75	6/8, 7/21	1 c	99 a	100 a	100 a	100 a	99 a	100 a	94 a	99 a	32 ab	8,497 ab
Glyphosate	1.13	6/11	0 c	100 a	100 a	100 ab	100 a	100 a	100 a	93 a	98 a	31 abc	8499 ab
Glyphosate	1.13	6/22	3 c	99 a	100 a	93 ef	94 c	95 a	100 a	91 a	89 b	26 bcd	6,951 bc
Glyphosate	0.75	5/23	0 c	16 c	53 b	92 ef	23 d	13 c	15 c	4 d	10 e	6 f	2,191de
Glyphosate	0.75	5/23, 6/3	0 c	88 ab	100 a	81 f	100 a	76 b	100 a	33 c	64 d	25 d	6,738 c
Glyphosate	0.75	5/23, 6/3 & 6/19	0 c	95 ab	99 a	98 bc	97 abc	96 a	100 a	95 a	93 ab	27 a-d	7,470 abc
Glyphosate	0.75	5/23, 6/3, 6/19 & 6/25	1 c	98 a	100 a	96 cde	100 a	97 a	100 a	95 a	94 ab	32 ab	8,966 a
Glyphosate	0.75	5/23, 6/3, 6/19, 6/25 & 7/7	0 c	99 a	100 a	100 a	100 a	100 a	100 a	95 a	98 a	32 ab	8,693 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), annual sowthistle (SONOL) mallow (MALNE), hairy nightshade (SOLSA), Russian-thistle (SASKR), green foxtail (SETVI) and barnyardgrass (ECHCG). Weed control eval August 5, 2009.

[3] Ammonium sulfate was applied with all glyphosate applications at 2.55 lb/A.

[4] ERS is estimated recoverable sugar.

Comparison of generic glyphosate and ethofumesate and adjuvant combinations for weed control in sugar beet. 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 field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho, to compare generic glyphosate and ethofumesate tank mixtures to proprietary products and also to evaluate three adjuvants used with glyphosate. Experimental design was a randomized complete block with four replications. Soil type was a Portneuf silt loam (17.7% sand, 68.3% silt, and 14% clay) with a pH of 8.0, 1.4% organic matter, and CEC of 17-meq/100 g soil. 'Betaseed 26RR-14' sugar beet seed was planted April 24, 2009, in 22-inch rows at a rate of 57,024 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), annual sowthistle (SONOL), Russian-thistle (SASKR), common mallow (MALNE), 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 17 and 109 days after the last herbicide application (DALA) on July 9 and October 9, however only the data from the 17 DALA evaluation are shown in Table 2. The two center rows of each plot were harvested mechanically October 13.

Table 1. Environmental conditions at application.

Application date	May 4	May 23	June 3	June 22
Application timing[1]	Preemergence	2 leaf	6 leaf	10 leaf
Air temperature (F)	59	76	77	70
Soil temperature (F)	62	65	80	68
Relative humidity (%)	39	39	42	40
Wind velocity (mph)	2	2	3	3
Cloud cover (%)	100	100	90	10
Time of day	1300	1100	1545	1500

[1] Application timing was based on crop growth stage.

Glyphosate + dimethenamid + Wet Sol followed by (fb) glyphosate + AMS injured the crop 4% at the 17 DALA evaluation (Table 2). No other treatment injured the crop more than 1%. By 109 DALA, there were no differences in crop injury (data not shown). No differences in KCHSC and SASKR control were observed 17 DALA and control ranged from 91 to 100%. CHEAL and AMARE control also ranged from 91 to 100%, but for both weed species control with ethofumesate applied preemergence or at 0.375 lb ai/A at the 2 leaf growth stage had significantly lower control and averaged 92%. SONOL, MALNE, SETVI, AND ECHCG control was also lowest with the same two treatments ranging from 85 to 91% control. Late season (109 DALA) control of AMARE, SONOL, SETVI, and ECHCG with these two treatments ranged from 60 to 70% (data not shown). All other herbicide treatments controlled all weed species 93 to 100%. There was no difference in weed control with or without Coverage G-20, In-Place or Wet Sol and three AMS rates (0.85, 1.7, and 2.55 lb/A) However, precipitation in June was the highest on record so the weeds were never water stressed. Sugar beet root yields among herbicide treatments ranged from 31 to 39 ton/A. The untreated check averaged 4 ton/A. Among the herbicide treatments, ethofumesate applied preemergence fb glyphosate + AMS and ethofumesate + glyphosate + AMS fb glyphosate + AMS were the only two treatments that yielded (31 ton/A) less than the highest yielding treatments. Sugar yield followed the same ranking as the root yield.

Table 2. Crop injury, weed control, root and sugar yield with generic glyphosate and ethofumesate and adjuvant combinations, near , Idaho.[1]

	Application		Crop	Weed control[2]							Root	
Treatment[3]	rate	dates	injury	KCHSC	CHEAL	AMARE	SONOL	SASKR	MALNE	SETVI	yield	ERS[4]
	lb ae/A		-----------	-----------	-----------	-----------	%	-----------	-----------	-----------	ton/A	lb/A
Check			-	-	-	-	-	-	-	-	4 d	1,186 d
Ethofumesate	1.0 lb ai/A	5/4	0 b	95 a	92 cd	92 d	89 c	93 a	85 c	91 c	31 bc	8,398 c
Glyphosate + AMS	0.75 + 2.55 lb ai/A	6/3										
Ethofumesate + glyphosate + AMS	0.375 lb ai/A + 0.75 + 2.55 lb ai/A	5/23	0 b	97 a	91 d	92 d	90 c	91 a	86 c	88 c	31 bc	8,468 bc
Glyphosate + AMS	0.75 + 2.55 lb ai/A	6/3										
Glyphosate + AMS	0.75 + 2.55 lb ai/A	5/23	1 b	99 a	96 bc	95 cd	97 b	91 a	93 b	96 b	35 abc	9,564 abc
Ethofumesate + glyphosate + AMS	0.375 lb ai/A + 0.75 + 2.55 lb ai/A	6/3										
KFD-56-01 + AMS	0.75 lb + 2.55 lb ai/A	5/23,6/3, 6/22	0 b	100 a	98 ab	100 a	100 a	99 a	98 a	99 a	35 abc	9,526 abc
KFD-51-01 + AMS	0.75 lb + 2.55 lb ai/A	5/23,6/3, 6/22	1 b	100 a	97 ab	99 ab	99 a	95 a	97 a	99 a	36 ab	9,800 ab
Glyphosate + AMS + Coverage G-20	0.75 + 0.75 lb ai/A + 4 fl oz/A	5/23,6/3, 6/22	0 b	100 a	98 ab	100 a	99 a	98 a	97 a	99 a	37 a	9,963 a
Glyphosate + AMS + In-Place	0.75 + 0.75 lb ai/A + 5.5 fl oz/A	5/23,6/3, 6/22	0 b	100 a	99 a	99 ab	99 a	100 a	95 ab	99 a	39 a	10,549 a
Glyphosate	0.75	5/23,6/3, 6/22	0 b	100 a	98 ab	98 bc	99 a	98 a	95 ab	98 ab	37 a	10,102 a
Glyphosate + AMS	0.75 + 0.85 lb ai/A	5/23,6/3, 6/22	0 b	98 a	99 a	100 a	100 a	98 a	97 a	99 a	37 a	10,121 a
Glyphosate + AMS	0.75 + 1.7 lb ai/A	5/23,6/3, 6/22	0 b	100 a	99 a	100 a	99 a	99 a	98 a	99 a	35 abc	9,543 abc

Table 2. continued

Treatment[3]	Application rate	Application dates	Crop injury	Weed control[2] KCHSC	CHEAL	AMARE	SONOL	SASKR	MALNE	SETVI	Root yield	ERS[4]
	lb ae/A		---	---	---	---	%	---	---	---	ton/A	lb/A
Glyphosate + AMS	0.75 + 2.55 lb ai/A	5/23,6/3, 6/22	0 b	99 a	99 a	100 a	100 a	96 a	98 a	98 ab	35 abc	9,554 abc
Glyphosate + dimethenamid-P + Wet Sol	0.75 + 0.875 lb ai/A + 1.0 gal/A	5/23	4 a	100 a	99 a	100 a	100 a	100 a	98 a	99 a	37 a	9,969 a
Glyphosate + AMS	0.75 + 1.7 lb ai/A	6/3, 6/22										
Glyphosate + dimethenamid-P + Wet Sol + AMS	0.75 + 0.875 lb ai/A + 1.0 gal/A + 0.85 lb ai/A	5/23	0 b	100 a	99 a	99 ab	99 a	99 a	97 a	99 a	36 abc	9,647 abc
Glyphosate + AMS	0.75 + 2.55 lb ai/A	6/3, 6/22										
Glyphosate + dimethenamid-P + Wet Sol + AMS	0.75 + 0.875 lb ai/A + 1.0 gal/A + 1.7 lb ai/A	5/23	1 b	100 a	98 ab	99 ab	99 a	94 a	93 b	99 a	36 ab	9,758 ab
Glyphosate + AMS	0.75 + 2.55 lb ai/A	6/3, 6/22										
Glyphosate + dimethenamid-P + Wet Sol + AMS	0.75 + 0.875 lb ai/A + 1.0 gal/A + 2.55 lb ai/A	5/23	1 b	100 a	98 ab	99 ab	99 a	96 a	98 a	99 a	37 a	9,884 a
Glyphosate + AMS	0.75 + 2.55 lb ai/A	6/3, 6/22										

[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), annual sowt (SONOL), Russian thistle (SASKR), common mallow (MALNE), and two grass species, green foxtail (SETVI) and barnyardgras). Weed control evaluation taken July 9,17 days after the last herbicide application.

[3] AMS is ammonium sulfate, ethofumesate is Ethotron, glyphosate is Roundup PowerMax; Coverage G-20 and In-Place are drift c ts and Wet Sol is a soil conditioner and adjuvant.

[4] ERS is estimated recoverable sugar.

Glyphosate tank mixtures with soil active herbicides used in sugar beet. 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 field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare glyphosate tank mixtures with soil active herbicides for crop injury and weed control in glyphosate tolerant sugar beet. Experimental design was a randomized complete block with four replications. Individual plots were 4 rows by 30 ft. Soil type was a Portneuf silt loam (17.7% sand, 68.3% silt, and 14% clay) with a pH of 7.9, 1.40% organic matter, and CEC of 17-meq/100 g soil. 'Betaseed 26RR-14' sugar beet seed was planted April 24, 2009, in 22-inch rows at a rate of 57,024 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), annual sowthistle (SONOL), Russian-thistle (SASKR), common mallow (MALNE), 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 17 and 107 days after the last herbicide (DALA) application on July 9 and October 7. However, only the 17 DALA evaluation data is presented in Table 2. The two center rows of each plot were harvested mechanically on October 12.

Table 1. Environmental conditions at application.

Application date	May 4	May 23	June 3	June 22
Application timing	pre	2 leaf	6 leaf	10 leaf
Air temperature (F)	59	72	69	70
Soil temperature (F)	62	62	62	68
Relative humidity (%)	39	46	34	40
Wind velocity (mph)	2	2	1	1
Cloud cover (%)	100	20	20	10
Time of day	1245	0900	1100	1400

Very little or no injury was observed from the herbicide treatments (Table 2). A single glyphosate application had the poorest overall weed control. Russian thistle, green foxtail, and barnyardgrass control averaged 67, 77, and 77%, respectively. Weed control with the single application of glyphosate plus s-metolachlor had the best overall weed control among the single application treatments. However, end of season weed control (107 DALA) with all of the single applications averaged less than the multiple applications (data not shown). Ethofumesate applied preemergence followed by one postemergence glyphosate application was among the highest yielding treatments at 33 ton/A. Other treatments with 30 ton/A yields and higher included glyphosate applied three times, glyphosate followed by (fb) glyphosate + dimethenamid-P, glyphosate + ethofumesate fb glyphosate, glyphosate fb glyphosate + *s*-metolachlor, glyphosate fb glyphosate + EPTC, and glyphosate fb glyphosate fb glyphosate + GWN-3200.

Table 2. Crop injury, weed control, root yield and sugar yield with glyphosate tank mixtures with soil-active herbicides, near Kimberly, Idaho.[1]

	Application		Crop	Weed control[2]							Root	
Treatment[3]	rate	dates	injury	CHEAL	KCHSC	AMARE	SONOL	SASKR	MALNE	SETVI	yield	ERS[4]
	lb ae/A		--------	--------	--------	--------	%	--------	--------	--------	ton/A	lb/A
Check			-	-	-	-	-	-	-	-	3 i	834 i
Glyphosate	0.75	5/23	0 a	86 de	92 cde	94 cde	95 bcd	67 e	83 efg	77 g	13 gh	3,412 gh
Glyphosate	0.75	5/23, 6/3	1 a	95 b	99 ab	97 b	93 cd	92 a-d	85 d-g	90 f	27 bcd	7,370 bcd
Glyphosate	0.75	5/23, 6/3, & 6/22	0 a	99 a	100 a	100 a	100 a	98 ab	98 a	100 a	32 abc	8,690 abc
Glyphosate + dimethenamid-P	0.75 + 0.875	5/23	0 a	90 c	96 bcd	95 b-e	92 d	76 cde	80 g	95 de	20 ef	5,388 ef
Glyphosate Glyphosate + dimethenamid-P	0.75 0.75 + 0.875 lb ai/A	5/23 6/3	1 a	95 b	97 abc	97 b	94 cd	84 a-e	92 bcd	97 cd	23 de	6,156 de
Glyphosate Glyphosate + dimethenamid-P	0.75 0.75 + 0.875 lb ai/A	5/23, 6/22 6/3	0 a	98 ab	100 a	100 a	100 a	100 a	98 a	99 b	33 a	8,945 a
Ethofumesate glyphosate	1.0 lb ai/A 0.75	5/4 5/23	0 a	95 b	99 ab	93 de	95 bcd	97 ab	92 b-e	95 de	33 a	8,858 a
Glyphosate + ethofumesate	0.75 + 1.0 lb ai/A	5/23	0 a	90 c	87 de	91 e	94 cd	79 b-e	83 fg	93 ef	15 fgh	4,147 fgh
Glyphosate Glyphosate + ethofumesate	0.75 0.75 + 1.0 lb ai/A	5/23 6/3	0 a	98 ab	99 ab	97 b	96 bc	91 a-d	95 abc	94 e	27 cd	7,340 cd
Glyphosate + ethofumesate Glyphosate	0.75 + 1.0 lb ai/A 0.75	5/23 6/3, 6/22	0 a	99 a	100 a	100 a	100 a	99 ab	99 a	100 a	33 a	8,843 ab
Glyphosate + *s*-metolachlor	0.75 + 1.13 lb ai/A	5/23	0 a	89 cd	86 e	93 de	94 cd	86 a-e	89 c-g	95 de	18 efg	4,860 def

Table 2. continued

Treatment[3]	Application		Crop	Weed control[2]							Root	
	rate	dates	injury	CHEAL	KCHSC	AMARE	SONOL	SASKR	MALNE	SETVI	yield	ERS[4]
	lb ae/A		----------	----------	----------	----------	%	----------	----------	----------	ton/A	lb/A
Glyphosate	0.75	5/23	1 a	97 ab	99 ab	97 b	95 bcd	95 a-d	95 abc	99 b	30 abc	8,179 abc
Glyphosate +	0.75 +	6/3										
s-metolachlor	1.13 lb ai/A											
Glyphosate +	0.75 +	5/23	0 a	85 e	82 e	93 de	95 bcd	70 e	87 d-g	95 de	12 h	3,240 h
EPTC	3.0 lb ai/A											
Glyphosate	0.75	5/23	0 a	96 ab	100 a	97 b	97 b	87 a-e	95 abc	97 cd	30 abc	8,144 abc
Glyphosate +	0.75 +	6/3										
EPTC	3.0											
Glyphosate	0.75	5/23	1 a	98 ab	100 a	100 a	100 a	96 abc	93 bcd	98 bc	32 abc	8,676 abc
Glyphosate	0.75	6/3										
Glyphosate +	0.75 +	6/22										
GWN-3200	3.0 lb ai/A											
Glyphosate +	0.75 +	5/23	0 a	90 c	90 cde	92 e	94 cd	75 de	89 c-f	94 e	15 fgh	4,168 fgh
cycloate	3.0											
Glyphosate	0.75	5/23	0 a	97 ab	99 ab	96 bcd	95 bcd	92 a-d	96 ab	99 bc	29 abc	7,780 abc
Glyphosate +	0.75 +	6/3										
cycloate	3.0 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), annual sowt (SONOL), common mallow (MALNE), Russian thistle (SASKR), green foxtail (SETVI) and barnyardgrass (ECHCG). Crop injur control was evaluated July 9 (17 DALA). A second evaluation was done October 7 (107 DALA), but data are not shown.

[3] Ammonium sulfate was added to all glyphosate treatments at 2.55 lb/A.

[4] ERS is estimated recoverable sugar.

Glyphosate tank mixtures with fungicides and insecticides in glyphosate tolerant sugar beet. 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 field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to evaluate glyphosate tank mixture compatibility with five insecticides and three fungicides currently registered for use in sugar beet. Experimental design was a randomized complete block with four replications. Soil type was a Portneuf silt loam (17.7% sand, 68.3% silt, and 14% clay) with a pH of 8.0, 1.4% organic matter, and CEC of 17-meq/100 g soil. 'Betaseed 26RR-14' sugar beet was planted April 24, 2009, in 22-inch rows at a rate of 57,024 seed/A. Koc hia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), annual sowthistle (SONOL), Russian-thistle (SASKR), common mallow (MALNE), 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 17 and 107 days after the last herbicide (DALA) application on July 9 and October 9. Only the data from the 17 DALA evaluation is presented in Table 2. The two center rows of each plot were harvested mechanically October 12.

Table 1. Environmental conditions at each application date.

Application date	May 23	June 3	June 22
Application timing	2 leaf	4 leaf	10 leaf
Air temperature (F)	72	77	68
Soil temperature (F)	62	70	68
Relative humidity (%)	46	42.6	40
Wind velocity (mph)	2	9	3
Cloud cover (%)	20	0	10
Time of day	0900	1400	1400

No herbicide treatment injured the crop more than 3% (Table 2). On the 17 DALA evaluation all herbicide treatments controlled all weeds 96% or better. At 107 DALA, all herbicide treatments averaged 90% for the control of all weeds with the exception of glyphosate/*s*-metolachlor applied immediately after azoxystrobin was applied alone and followed by another glyphosate application following azoxystrobin applied alone (data not shown). Weed control with this treatment averaged 82, 81, 81, 63, 90, 98, and 99% for CHEAL, KCHSC, AMARE, late emerging SONOL, MALNE, SETVI, and ECHCG, respectively. With the exception of this one treatment these results are similar to the 2008 observations indicating that there is little or no compatibility issues affecting crop safety or weed control when tank mixing these insecticides and fungicides with glyphosate. Sugar beet yields among herbicide treatments ranged from 33 to 39 ton/A. The untreated control yield averaged 3 ton/A. Glyphosate applied without another pesticide yielded 39 ton/A, Only glyphosate + methomyl (33 ton/A), glyphosate + oxamyl (35 ton/A), and glyphosate/s-metolachlor + azoxystrobin (36 ton/A) had root and sugar yields less than glyphosate applied alone.

Table 2. Crop injury, weed control and sugar beet yield using glyphosate tank mixtures with fungicides and insecticides, Kimberly,

Treatment[3]	Application rate	Application date	Crop injury	Weed control[2] CHEAL	KCHSC	AMARE	SONOL	MALNE	SETVI	E	Root yield	ERS[4]
	lb ae/A		---%							---%	ton/A	lb/A
Check			-	-	-	-	-	-	-		3 d	798 d
Glyphosate + AMS	0.75 + 2.5 lb ai/A	5/23, 6/3, 6/22	0 a	99 a	100 a	100 a	100 ab	99 ab	99 a		39 a	10,619 a
Glyphosate + esfenvalerate + AMS	0.75 + 0.05 lb ai/A + 2.5 lb ai/A	5/23, 6/3	0 a	99 a	100 a	100 a	99 bcd	99 ab	99 a		37 abc	9,999 abc
Glyphosate + AMS	0.75 + 2.5 lb ai/A	6/22										
Glyphosate + chlorpyrifos + AMS	0.75 + 0.5 ai/a + 2.5 lb ai/A	5/23, 6/3	1 a	99 a	100 a	100 a	100 ab	99 a	99 a		39 a	10,433 ab
Glyphosate + AMS	0.75 + 2.5 lb ai/A	6/22										
Glyphosate + zeta-cypermethrin + AMS	0.75 + 0.047 lb ai/A + 2.5 lb ai/A	5/23, 6/3	0 a	99 a	100 a	100 a	100 ab	98 abc	99 a		36 abc	9,782 abc
Glyphosate + AMS	0.75 + 2.5 lb ai/A	6/22										
Glyphosate + AMS	0.75 + 2.5 lb ai/A	5/23, 6/22	0 a	99 a	99 a	100 a	100 abc	96 cd	99 a		33 c	9,056 c
Glyphosate + methomyl + AMS	0.75 + 0.9 lb ai/A + 2.5 lb ai/A	6/3										
Glyphosate + oxamyl + AMS	0.75 + 1.0 lb ai/A + 2.5 lb ai/A	5/23, 6/3	0 a	99 a	99 a	99 a	99 bcd	97 bcd	99 a		35 bc	9,479 bc
Glyphosate + AMS	0.75 + 2.5 lb ai/A	6/22										
Glyphosate + AMS	0.75 + 2.5 lb ai/A	5/23	0 a	99 a	100 a	100 a	99 bcd	99 ab	99 a		38 ab	10,409 ab
Glyphosate + trifloxystrobin + AMS	0.75 + 0.109 lb ai/A + 2.5 lb ai/A	6/3, 6/22										

Table 2. Continued

Treatment[3]	Application rate	Application date	Crop injury	Weed control[2] CHEAL	KCHSC	AMARE	SONOL	MALNE	SETVI	E	Root yield	ERS[4]
	lb ae/A		----------	----------	----------	----------	-----%-----	----------	----------	----------	ton/A	lb/A
Glyphosate +	0.75 +	5/23	0 a	99 a	100 a	100 a	99 cd	99 a	99 a		38 ab	10,185 ab
AMS	2.5 lb ai/A											
Glyphosate +	0.75 +	6/3, 6/22										
prothioconazole +	0.178 lb ai/A +											
AMS	2.5 lb ai/A											
Glyphosate +	0.75 +	5/23	3 a	100 a	100 a	100 a	99 bcd	99 ab	99 a		37 ab	10,060 ab
AMS	2.5 lb ai/A											
Glyphosate +	0.75 +	6/3										
ethofumesate +	1.0 lb ai/A +											
prothioconazole +	0.178 lb ai/A +											
AMS	2.5 lb ai/A											
Glyphosate +	0.75 +	6/22										
prothioconazole +	0.178 lb ai/A +											
AMS	2.5 lb ai/A											
Glyphosate +	0.75 +	5/23	0 a	99 a	100 a	99 a	99 d	99 ab	99 a		38 ab	10,312 ab
AMS	2.5 lb ai/A											
Glyphosate +	0.75 +	6/3, 6/22										
azoxystrobin +	0.25 lb ai/A +											
AMS	2.5 lb ai/A											
Glyphosate/	1.97 ai/A +	5/23	0 a	97 b	96 b	98 a	96 e	94 d	99 a		36 bc	9,616 bc
s-metolachlor +												
AMS +	1.0 lb % w/v +											
azoxystrobin	0.6/1000											
Glyphosate-T +	0.75 +	6/3										
AMS +	1.0 lb % w/v +											
azoxystrobin	0.6/1000											
Glyphosate-T +	0.75 +	5/23, 6/3	0 a	99 a	100 a	100 a	100 a	98 abc	99 a		38 ab	10,286 ab
AMS	1.0 lb % w/v											

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[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), annual sowth OL), common mallow (MALNE) green foxtail (SETVI), and barnyardgrass (ECHCG). Crop injury and weed control was evaluated July 9 (17 D/ cond evaluation was made October 9 (109 DALA), but data are not shown.

[3] AMS is ammonium sulfate, glyphosate is Roundup PowerMax and glyphosate-T is Touchdown Total.

Volunteer potato timing of removal using glyphosate in glyphosate tolerant sugar beet. Don W. Morishita, J. Daniel Henningsen, and Donald L. Shouse. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). The final year of a field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho, to determine optimum timing of volunteer potato removal from glyphosate tolerant sugar beet using glyphosate. Experimental design was a randomized complete block with four replications. Individual plots were four rows by 30 ft. Soil type was a Portneuf silt loam (20.4% sand, 71.0% silt, and 8.6% clay) with a pH of 8.6, 1.5% organic matter, and CEC of 17-meq/100 g soil. 'Betaseed 26RR-14' sugar beet seed was planted April 24, 2009, in 22-inch rows at a rate of 57,024 seed/A. To determine potato interference, whole potato tubers ('Russet Burbank') averaging 2 oz each, were planted in each treatment at a density of 8,168 plants/A, with the exception of a no volunteer potato treatment. All volunteer potato and other weeds in the study area were controlled by applying a 1:1:1 formulated mixture of desmedipham:phenmedipham:ethofumesate at 0.33 lb ai/A on May 23. Weeds not controlled with this herbicide were removed by hand as needed. Glyphosate was broadcast-applied with a CO_2-pressurize bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles. Additional environmental and application information is given in Table 1. In other timing of weed removal interference studies with annual species, weed re-growth is not a factor if the weed is severed at ground level. Volunteer potato is different because it is a perennial plant with starch-filled tubers, which can provide energy for shoot re-growth should growth be interrupted, such as by hoeing or herbicide application. Consequently, in addition to the following treatments: spray at 4-inch rosette stage, spray at hooking (pre-tuber initiation), spray at tuber initiation, spray at early tuber bulking, spray at mid-tuber bulking, and potato not sprayed, repeated removal treatments were needed to anticipate shoot re-growth. Those treatments included: spray as needed at 4-inch rosette and spray as needed at tuber hooking. The 'spray as needed' treatments were evaluated weekly to determine when spraying was needed. In those treatments plants were sprayed each time potato plants had re-grown to 4-inch rosettes. Volunteer potato was harvested September 30 by digging four plants in each plot, where plants were present. Tubers were sorted by size, counted, and weighed. Sugar beet yield was determined by mechanically harvesting the two center rows of each plot on October 1, 2009.

Table 1. Environmental conditions at application.

Application date	May 23	June 3	June 11	June 22	July 7	July 21
Application timing[1]	2 leaf	4" rosette	Hooking	Tuber initiation	E. tuber bulk	Mid tuber bulk
Air temperature (F)	77	58	69	68	68	72
Soil temperature (F)	68	63	66	70	67	66
Relative humidity (%)	41	77	40	40	57	40
Wind velocity (mph)	3	1	2	2	2	1
Cloud cover (%)	70	80	90	0	0	0
Time of day	-	-	1530	1545	1040	0845

[1] May 23 application refers to crop growth stage. All other application timing, 4" rosette (plant diameter), hooking, tuber initiation, early and mid tuber bulking refers to potato growth stages.

Volunteer potato re-growth responded very differently after glyphosate applications compared to re-growth when removed by hand in previously reported studies. When hand removed, volunteer potato re-grew when they were removed at the 4-inch rosette and at hooking growth stages. In this study, no volunteer potato re-grew when sprayed only one time at the 4-inch rosette, at hooking, at tuber initiation, and at early and mid-tuber bulking. Thus, no volunteer potato tubers were recovered from any of the treatments where volunteer potato was sprayed before removal at tuber initiation. When volunteer potato was not removed, total tuber yield was 4,568 lb/A and total tubers produced was 150,583 tubers/A. When volunteer potato was not removed until mid or early tuber bulking, tuber yield was 548 lb/A and 2,835 lb/A, respectively. This amount was more than a five-fold difference in tuber yield between these two removal times. However, this was less than the two-fold difference in tuber number between these two treatments (134,732 vs 72,121 tubers/A). With regard to root and sucrose yield, these data show that volunteer potato must be removed by tuber initiation to avoid a yield loss. These results are consistent with previous results where volunteer potato was removed with glyphosate or by hand.

Table 2. Tuber weight, tuber number, and sugar beet root and sucrose yield near Kimberly, Idaho.[1]

Treatment	Volunteer potato[2] <1 oz	1-4 oz	4-6 oz	>6 oz	Total	<1 oz	1-4 oz	4-6 oz	>6 oz	Tc	oot ield	Extractable sugar
	----lb/A----					----tuber number/A----					n/A	lb/A
No volunteer potato	0 b	0 d	0 b	0 c	0 e	0 b	0 c	0 b	0 c		41 ab	10,379 ab
Remove once at 4 inch rosette	0 b	0 d	0 b	0 c	0 e	0 b	0 c	0 b	0 c		44 a	11,342 a
Remove as needed at 4 inch rosette	0 b	0 d	0 b	0 c	0 e	0 b	0 c	0 b	0 c		43 a	11,039 a
Remove once at hooking	0 b	0 d	0 b	0 c	0 e	0 b	0 c	0 b	0 c		43 a	10,943 a
Remove as needed at hooking	0 b	0 d	0 b	0 c	0 e	0 b	0 c	0 b	0 c		42 a	10,854 a
Remove once at tuber initiation	212 a	280 b	0 b	0 c	496 c	56,271 a	19,021 b	0 b	0 c	75,	39 ab	10,068 ab
Remove as needed at tuber initiation	158 a	77 c	0 b	0 c	226 d	62,610 a	7,133 c	0 b	0 c	69,	39 ab	9,862 ab
Remove once at early tuber bulking	205 a	346 b	0 b	0 c	548 c	47,553 a	24,569 b	0 b	0 c	72,	36 bc	9,109 bc
Remove once at mid tuber bulking	140 a	1,312 a	918 a	483 b	2,835 b	43,590 a	64,196 a	21398 a	5548 b	134,	31 c	7,969 c
Not removed	185 a	1,432 a	952 a	2,000 a	4,568 a	43,590 a	64,196 a	19021 a	23776 a	150,	31 c	8,011 c

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

[2] Volunteer potato was 'Russet Burbank'.

Grass weed control in Kentucky bluegrass. Janice Reed and Donn Thill (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339). Studies were conducted near Worley, ID to determine the effect of preemergence and postemergence herbicides on crop response and meadow foxtail and Italian ryegrass control in Kentucky bluegrass. Plots were 8 by 25 ft, arranged in a randomized complete block design with four replications and an untreated check. Treatments in both 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 weed control were evaluated visually as a percent of the untreated check, where 100% was death of the crop or weed, and 0 percent was no bluegrass injury or weed control. Weed density was estimated visually as a percentage of ground cover in the untreated plots.

Table 1. Application and soil data.

	Meadow foxtail control			Italian ryegrass control		
Bluegrass variety		Blue Angel			Argyle	
Application time[1]	fall	early spring	spring	preemergence	early spring	spring
Application date	10/8/08	4/16/09	5/1/09	10/6/08	4/20/09	5/1/09
Growth stage						
Meadow foxtail	6 to 8 inch	boot	head	---	---	---
Italian ryegrass	---	---	---	pre	1 to 2 lf	2 lf
Bluegrass	2 in	2 to 4 in	4 to 6 in	2 to 4 in	2 to 5 in	3 to 6 in
Air temp (F)	56	60	62	61	62	62
Humidity (%)	60	58	48	72	65	48
Wind velocity, direc.	5, NE	3, NE	4, NE	3, SE	0	4, NE
Cloud cover (%)	70	0	10	95	0	10
Soil moisture	good	very wet	good	normal	good	good
Soil temp at 2 in (F)	48	40	45	44	42	45
pH		4.8			5.1	
OM (%)		4.6			3.9	
CEC (meq/100 g)		23			26	
Texture		silt loam			silt loam	

[1] Preemergence application is prior to emergence of Italian ryegrass; early spring is post emergence to Italian ryegrass.

Meadow foxtail control was based on seed head development and production of viable seed as a percent of the untreated check. Meadow foxtail control was best (56 to 89%) with oxyfluorfen + diuron, mesotrione + flucarbazone, mesotrione + primisulfuron, and flucarbazone (Table 2). All other treatments did not control meadow foxtail (0 to 24%). On May 1, bluegrass injury (chlorosis) was 50% from the oxyfluorfen + diuron treatment (data not shown). However, there was no injury visible in this treatment at the time of swathing. Early bluegrass injury from oxyfluorfen + diuron was likely due to spring application of the treatment. Fall postemergence treatments were applied in the early spring due to snow cover in the fall. Bluegrass injury (stunting) in the flufenacet/metribuzin treatment was 12% on June 25, just prior to swathing. No other treatment injured bluegrass.

Italian ryegrass control was best with flufenacet/metribuzin treatments and oxyfluorfen + diuron (Table 3). All other treatments did not control Italian ryegrass (0 to 25%). On May 22, bluegrass injury was 50 to 74% in the flufenacet/metribuzin (stunting), triasulfuron (stand reduction) and oxyfluorfen + diuron (chlorosis) treatments. By June 25, bluegrass injury was 26 to 48% in the flufenacet/metribuzin and triasulfuron treatments. Bluegrass injury in the oxyfluorfen + diuron treatment was not visible at the June 25 evaluation date. Early injury in the oxyfluorfen + diuron treatment was likely due to application in the spring instead of the fall. Postemergence treatments in the Italian ryegrass study were applied in the early spring instead of the fall due to snow cover and no weed emergence in the fall.

Table 2. Meadow foxtail control and bluegrass injury near Worley, ID in 2009.

Treatment[1]	Rate	Application timing	Meadow foxtail control[2,4]	Bluegrass injury[3,4]
	lb ai/A		--------------------%--------------------	
Dimethenamid	0.84	fall	24 b	0 b
Flufenacet/metribuzin	0.425	fall	2 b	12 a
Metolachlor/metribuzin	1.57	fall	0 b	0 b
Metolachlor/mesotrione	1.39	fall	0 b	0 b
Metolachlor/mesotrione	1.39	early spring	21 b	0 b
Oxyflourfen + diuron	0.37 + 0.75	early spring	68 a	0 b
Mesotrione	0.094	early spring	18 b	0 b
Mesotrione + flucarbazone	0.094 + 0.0135	early spring	70 a	0 b
Mesotrione + primisulfuron	0.094 + 0.0356	early spring	56 a	0 b
Mesotrione	0.094	spring	8 b	0 b
Flucarbazone	0.0135	spring	89 a	0 b
Meadow foxtail cover (% cover in untreated check)			25%	

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[1] Non-ionic surfactant (R-11) was applied at 0.25% v/v with metolachlor/mesotrione early spring, oxyflourfen + diuron, and flucarbazone treatments. Crop oil concentrate (Moract) was applied at 1% v/v with mesotrione treatments. Urea ammonium nitrate (URAN) was applied at 2.5% v/v with flucarbazone and mesotrione treatments.

[2] Foxtail control based on seed head development and production of viable seed.

[3] Bluegrass injury rated on June 25, 2009.

[4] Means within a column followed by the same letter do not differ significantly at $p \geq 0.05$.

Table 3. Italian ryegrass control and bluegrass injury near Worley, ID in 2009.

Treatment[1]	Rate	Application timing	Italian ryegrass control[2]	Bluegrass injury[2] May 22	Bluegrass injury[2] June 25
	lb ai/A		--------------------------%------------------------		
Flufenacet/metribuzin	0.425	preemergence	92 a	50 c	26 c
Triasulfuron	0.0263	preemergence	8 bc	68 b	41 b
Flufenacet/metribuzin + triasulfuron	0.425 + 0.0263	preemergence	83 a	74 a	48 a
Metolachlor/metribuzin	1.57	preemergence	15 bc	0 d	0 d
Metolachlor/mesotrione	1.39	preemergence	25 b	0 d	0 d
Metolachlor/mesotrione	1.39	early spring	25 b	0 d	0 d
Oxyflourfen + diuron	0.37 + 0.75	early spring	79 a	50 c	0 d
Mesotrione	0.094	early spring	8 bc	0 d	0 d
Mesotrione + flucarbazone	0.094 + 0.0135	early spring	0 c	0 d	0 d
Mesotrione	0.094	spring	0 c	0 d	0 d
Flucarbazone	0.0135	spring	0 c	0 d	0 d
Italian ryegrass cover (% cover in untreated check)			20-40%		

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[1] Non-ionic surfactant (R-11) was applied at 0.25% v/v with metolachlor/mesotrione early spring, oxyflourfen + diuron, and flucarbazone treatments. Crop oil concentrate (Moract) was applied at 1% v/v with mesotrione alone. Urea ammonium nitrate (URAN) was applied at 2.5% v/v with flucarbazone and mesotrione treatments.

[2] Means within a column followed by the same letter do not differ significantly at $p \geq 0.05$.

Mesotrione on newly seeded Kentucky bluegrass. Janice Reed and Donn Thill (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339). A study was established near Tensed, ID to determine the effect of preemergence and postemergence mesotrione on seedling Kentucky bluegrass. Plots were 8 by 25 ft, arranged in a randomized complete block design with four replications and an untreated check. 'Argyle' Kentucky bluegrass was seeded on May 29, 2009. Treatments 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 weed control were evaluated visually. Bluegrass injury will be evaluated again in spring and summer 2010.

Table 1. Application data.

Application date	June 9, 2009	July 17, 2009
Growth stage		
Kentucky bluegrass	post plant, preemergence	1 to 2 leaf
Redroot pigweed (AMARE)	preemergence	2 in
Witchgrass (PANCE)	preemergence	2 to 3 in
Air temperature (F)	76	89
Humidity (%)	56	54
Wind velocity, direction	3, NW	3, NW
Cloud cover (%)	95	50
Soil moisture	adequate	adequate
Soil temp at 2 in. (F)	56	65

The preemergence treatment of mesotrione injured Kentucky bluegrass 69% on July 14 (data not shown). By August 3, bluegrass injury was 55% in the preemergence mesotrione treatment, and postemergence treatments did not injure bluegrass (Table 2). All treatments controlled AMARE (redroot pigweed) 90 to 100%. Mesotrione applied preemergence controlled PANCE (witchgrass) better than all postemergence treatments. The addition of the high rate of flucarbazone to mesotrione increased PANCE control 31% but was not significantly different from flucarbazone alone or combined with mesotrione at the low rate.

Table 2. Kentucky bluegrass injury and weed control with mesotrione near Tensed, ID.

			Bluegrass[2,3]	Weed control[2,3]	
Treatment[1]	Rate	Application time	injury	AMARE	PANCE
	lb ai/A		-------------------	--%--	-------------------
Untreated check	---	---	--	--	--
Mesotrione	0.188	preemergence	55 a	100 a	98 a
Mesotrione	0.094	postemergence	0 b	100 a	16 c
Flucarbazone	0.026	postemergence	0 b	90 a	40 bc
Mesotrione + flucarbazone	0.094 + 0.026	postemergence	0 b	100 a	52 b
Mesotrione + flucarbazone	0.094 + 0.013	postemergence	0 b	99 a	32 bc

[1] All postemergence treatments applied with non-ionic surfactant (R-11) at 0.25% v/v.

[2] Bluegrass injury and weed control rated August 3, 2009.

[3] Means within a column followed by the same letter do not differ significantly at $p \geq 0.05$.

Searls' prairie clover (*Dalea searlsiae*) tolerance to postemergence herbicide applications. Kyle C. Roerig and Corey V. Ransom. (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) Searls' prairie clover (*Dalea searlsiae*) is a forb native to Utah and the Great Basin. Recent rangeland restoration efforts have lead to an interest in commercial *Dalea* seed production. This trial was designed to evaluate prairie clover tolerance to herbicides that have potential for use in prairie clover seed production. Treatments were applied May 12, 2009 on an established stand at a site in North Logan, Utah. Herbicide treatments were applied using a CO_2-pressurized shielded bicycle-wheeled sprayer calibrated to deliver 20 gallons per acre at 30 psi. Research plots measured 3 by 18 feet and were arranged in a randomized block design with four replications. Plants were spaced at 1.64 ft. Each plot contained a maximum of 22 plants. Injury was visually rated 14 and 44 days after treatments were applied. Biomass was harvested August 6, 2009 dried and weighed. At 14 DAT oxyfluorfen and flumioxazin injury was significantly greater than all other treatments. Pendimethalin, bromoxynil and 2,4-DB were among the least injurious. At 44 DAT, clopyralid injury was greater than all other treatments. Due to plant variability, no differences in foliage, seedhead or total plant biomass were observed.

Table. Prairie clover injury and biomass in response to postemergence herbicides.

		Injury		Biomass		
Treatment[1]	Rate[2]	14 DAT	44 DAT	Foliage	Seedhead	Total
	lb ai or ae/A	-----------%----------		--------------oz/plant--------------		
Untreated		0	0	0.79	0.18	0.97
Pendimethalin	0.71	9	8	0.80	0.20	1.01
Oxyfluorfen	0.25	65	16	0.82	0.25	1.07
Flumioxazin	0.064	58	21	0.77	0.19	0.96
Metribuzin	0.5	28	19	0.86	0.22	1.07
Bromoxynil	0.25	13	6	0.96	0.21	1.17
2,4-DB	0.25	16	5	0.99	0.20	1.20
Clopyralid	0.124	33	44	1.01	0.08	1.09
Quinclorac	0.248	25	16	0.94	0.16	1.10
Imazamox	0.078	36	15	1.05	0.17	1.22
LSD (0.05)		17	19[3]	NS	NS	NS

[1] Quinclorac and imazamox included MSO at 1.0% v/v and flumioxazin and metribuzin included NIS at 0.25% v/v.

[2] All herbicide rates are lb ai/a except 2,4-DB, clopyralid and quinclorac which are listed as lb ae/A.

[3] LSD at P=0.10.

Comparison of generic fluroxypyr and glyphosate to proprietary products and other registered 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 generic fluroxypyr and several generic glyphosate products to proprietary equivalents and other registered herbicides. 'BKC46-60' glyphosate tolerant corn was planted in 30 inch rows May12, 2009, at 36,000 seed/A. Experimental design was a randomized complete block with four replications and individual plots were 10 by 30 ft. Soil type was a Portneuf silt loam (20.4% sand, 7.1% silt, and 8.6% clay) with a pH of 8.1, 1.5% organic matter, and CEC of 17-meq/100 g soil. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), green foxtail (SETVI) and barnyardgrass (ECHCG) were the major weed species present. Herbicides were applied June 12 with a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 22 psi. Corn was in the V4-5 stage. Environmental conditions at application were as follows: air temperature 73 F, soil temperature 64 F, relative humidity 44%, wind speed 3 mph, and 10% cloud cover. Application began at 1100. Crop injury and weed control were evaluated visually 31, 61 and 95 days after application (DAA) on July13, August 12 and September 15. Grain was harvested November 17 with a small-plot combine.

Very little crop injury was observed at 31 or 95 DAA and ranged from 0 to 5% (Table). CHEAL, SETVI and ECHCG control with either fluroxypyr formulation applied alone was poor, ranging from 19 to 65% over both evaluation dates. AMARE control with fluroxypyr was not much better, ranging from 56 to 78% over both evaluation dates. Kochia control ranged from 95 to 100% with all herbicide treatments. Overall weed control with all glyphosate treatments, glyphosate-H1, H2, H3, H4, and M was equal, regardless of whether they were applied alone or in combination with fluroxypyr or dicamba/diflufenzopyr. Weed control with tembotrione + atrazine + MSO + AMS ranged from 89 to 100% for all weeds over both evaluation dates and was equal to the glyphosate treatments. Mesotrione + atrazine + COC responded similarly, with the exception of controlling SETVI and ECHCG. All treatments containing glyphosate were among the highest yielding treatments and collectively averaged 229 bu/A. However, tembotrione + atrazine, mesotrione + atrazine, and nicosulfuron/rimsulfuron had statistically equal yields to the glyphosate treatments. The untreated check yielded 148 bu/A. These results indicate there is no difference in efficacy between proprietary glyphosate and the four generic glyphosate formulations evaluated.

Table. Crop injury, weed control and yield with generic fluroxypyr and glyphosate in field corn, near Kimberly, Idaho.[1]

		Crop injury		Weed control[2]									
	Application			CHEAL		KCHSC		AMARE		SETVI		ICG	Grain
Treatment[3]	rate	7/13	9/15	7/13	9/15	7/13	9/15	7/13	9/15	7/13	9/1	9/15	yield
	lb ae/A	%											bu/A
Check		-	-	-	-	-	-	-	-	-	-	-	148 b
Fluroxypyr-H	0.094	1 a	0 a	51 f	65 cd	100 a	100 a	66 ef	78 cde	33 cd	56 b	56 bc	88 c
Fluroxypyr-H	0.129	0 a	0 a	43 fg	60 de	100 a	100 a	59 f	73 de	20 cd	40 c	40 c	158 b
Fluroxypyr-D	0.129	0 a	0 a	33 g	41 e	100 a	100 a	56 f	63 e	19 d	39 c	34 c	157 b
Glyphosate-H1 NIS AMS	0.7 0.25 % v/v 1.5 lb ai/A	3 a	0 a	81 cde	84 abc	95 a	100 a	83 cd	89 a-d	85 ab	85 a	85 a	225 a
Glyphosate-H2 NIS AMS	0.75 0.25 % v/v 1.5 lb ai/A	5 a	0 a	81 cde	83 abc	97 a	100 a	84 cd	89 a-d	80 ab	81 a	80 ab	220 a
Glyphosate-H3 AMS	0.7 1.5 lb ai/A	0 a	0 a	80 de	84 abc	96 a	100 a	81 cd	86 a-d	84 ab	88 a	88 a	219 a
Glyphosate-H4 AMS	0.7 1.5 lb ai/A	0 a	0 a	85 b-e	85 abc	95 a	100 a	85 c	89 a-d	84 ab	88 a	88 a	248 a
Glyphosate-M AMS	0.77 1.5 lb ai/A	1 a	0 a	83 b-e	85 abc	95 a	100 a	86 c	89 a-d	86 ab	93 a	93 a	235 a
Glyphosate-H2 fluroxypyr-H NIS AMS	0.75 0.094 0.25 % v/v 1.5 lb ai/A	1 a	0 a	88 a-e	86 ab	100 a	100 a	88 c	95 abc	88 ab	94 a	94 a	223 a
Glyphosate-H2 fluroxypyr-H NIS AMS	0.75 0.129 0.25 % v/v 1.5 lb ai/A	1 a	0 a	88 a-e	91 ab	100 a	100 a	89 c	91 abc	91 ab	94 a	94 a	229 a

Table. continued

		Crop injury		Weed control[2]									
	Application			CHEAL		KCHSC		AMARE		SETVI		HCG	Grain
Treatment[3]	rate	7/13	9/15	7/13	9/15	7/13	9/15	7/13	9/15	7/13	9/1	9/15	yield
	lb ae/A	%										----------	bu/A
Clopyralid/fluroxypyr	0.188	1 a	0 a	75 e	73 bcd	100 a	100 a	75 de	81 b-e	38 c	58 b	48 c	133 bc
Glyphosate-M	0.77	4 a	0 a	95 ab	94 a	100 a	98 a	97 b	95 abc	86 ab	84 a	84 a	231 a
dicamba/diflufenzopyr	0.19 lb ai/A												
AMS	1.5 lb ai/A												
Tembotrione	0.082 lb ai/A	4 a	0 a	93 a-d	99 a	100 a	100 a	96 d	100 ab	89 ab	93 a	93 a	228 a
atrazine	0.125 lb ai/A												
MSO	1.0 % v/v												
AMS	1.5 lb ai/A												
Nicosulfuron/rimsulfuron	0.035 lb ai/A	4 a	0 a	94 abc	93 ab	75 b	78 a	100 a	99 ab	96 a	98 a	98 a	232 a
COC	2.0 % v/v												
UAN 28%	4.0 qt/A												
Mesotrione	0.094 lb ai/A	1 a	0 a	100 a	100 a	100 a	100 a	100 a	100 a	76 b	89 a	89 a	223 a
atrazine	0.125 lb ai/A												
COC	1.0 % v/v												

[1] Crop injury and weed control evaluation means and corn yield means followed by the same letter are not significantly different (F

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

[3] AMS is ammonium sulfate. Fluroxypyr -D is sold as Starane Ultra. Fluroxypyr- H, glyphosate -H1, -H2, -H3, and -H4 are manuf
Inc. Glyphosate-M is sold as Roundup PowerMax. MSO is methylated seed oil. COC is crop oil concentrate. All herbicides were

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Comparison of non-glyphosate herbicide combinations with glyphosate for broadleaf and grass weed control in field corn. 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 study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare non-glyphosate herbicide combinations with glyphosate for broadleaf and grass weed control in glyphosate tolerant field corn. 'BKC46-60' RR corn was planted May 12, 2009, on 30 inch rows at 36,000 seed/A. Experimental design was a randomized complete block with four replications and individual plots were 10 by 30 ft. Soil type was a Portneuf silt loam (20.4% sand, 7.1% silt, and 8.6% clay) with a pH of 8.1, 1.5% organic matter, and CEC of 17-meq/100 g soil. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), green foxtail (SETVI) and barnyardgrass (ECHCG) were the major weed species present. Herbicides were applied 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 are in Table 1 below. Weed control was evaluated visually 17, 39, 52, 78 and 119 days after application (DAA) on June 4, June 26, July 9, August 4, and September 14, respectively. Crop injury was evaluated visually 10, 36, and 77 DAA on July 9, August 4 and September 14, respectively. For brevity, only the 39 and 119 DAA evaluations are reported. The crop was harvested November 17 with a small-plot combine.

Table 1. Environmental conditions at application.

Application date	May 18	June 4	June 12	June 29
Application timing	pre	V4	V5	V8
Air temperature (F)	81	67	70	80
Soil temperature (F)	73	67	64	70
Relative humidity (%)	35	51	48	28
Wind velocity (mph)	5	6	1.2	3
Cloud cover (%)	0	10	10	10
Time of day	1100	0950	1000	1130

Crop injury 39 DALA ranged from 0 to 8% (Table 2). Tembotrione + metribuzin had the highest injury at 8%. Acetochlor + glyphosate at 0.75 lb ae/A and acetochlor + glyphosate at 1.13 lb ae/A injured the corn 6 and 3%, respectively. No injury was visible at 119 DALA. Tembotrione + metribuzin mixture had no negative yield effect at harvest and was the second highest yielding treatment at 234 bu/A. Weed control with a single application of glyphosate-T had the poorest overall weed control at the last evaluation, ranging from 70% to 95%. At the last evaluation, all other herbicide treatments controlled weeds 94% or higher. Yields ranged from 120 bu/A (untreated check) to 238 bu/A. The results from this study show that several herbicide combinations can work very well with glyphosate to avoid total reliance on glyphosate for weed control in field corn.

Table 2. Crop injury, weed control and grain yield in field corn, near Kimberly, Idaho.[1]

			Crop		Weed control[2]											
	Application		injury		CHEAL		KCHSC		AMARE		SETVI			ICG	Grain
Treatment[3]	rate	dates	6/26	9/14	6/26	9/14	6/26	9/14	6/26	9/14	6/26	9/1		9/14	yield
	lb ai/A		%												bu/A
Check			-	-	-	-	-	-	-	-	-	-		-	120 c
Tembotrione + MSO + AMS glyphosate + AMS	0.123 + 1.0 % v/v + 1.5 0.95 lb ae/A + 1.5	6/12 6/29	1 c	0 a	100 a	99 ab	100 a	100 a	100 a	100 a	99 ab	99		99 a	207 ab
Tembotrione + atrazine + MSO + AMS	0.123 + 0.25 + 1.0 % v/v + 1.5	6/12	0 c	0 a	100 a	100 a	100 a	100 a	100 a	100 a	98 ab	98		98 a	232 a
Tembotrione + atrazine + MSO + AMS	0.123 + 0.125 + 1.0 % v/v + 1.5	6/12	0 c	0 a	100 a	99 ab	100 a	100 a	100 a	100 a	98 ab	97		99 a	201 ab
Dimethenamid-P + tembotrione + MSO + AMS	0.657 + 0.123 + 1.0 % v/v + 1.5	5/18 6/12	4 abc	0 a	100 a	96 de	100 a	100 a	99 bc	100 a	99 ab	99		100 a	189 b
Tembotrione + bromoxynil + MSO + AMS	0.123 + 0.094 + 1.0 % v/v + 1.5	6/12	0 c	0 a	100 a	97 cd	100 a	100 a	100 a	99 a	93 d	97		97 a	216 ab
Tembotrione + glyphosate + MSO + AMS	0.123 + 0.95 lb ae/A + 1.0 % v/v + 1.5	6/12	3 bc	0 a	100 a	94 e	99 bc	100 a	99 bc	100 a	95 cd	98		98 a	238 a

Table 2. continued

Treatment[3]	Application rate	Application dates	Crop injury 6/26	Crop injury 9/14	Weed control[2] CHEAL 6/26	CHEAL 9/14	KCHSC 6/26	KCHSC 9/14	AMARE 6/26	AMARE 9/14	SETVI 6/26	SETVI 9/1	ICG 9/14	Grain yield
	lb ai/A		------	------	------	------	------	------	-%-	------	------	------	----------	bu/A
Glyphosate + AMS + glyphosate + AMS	0.95 lb ae/A + 1.5 + 0.95 lb ae/A + 1.5	6/12 6/29	3 bc	0 a	98 bc	99 ab	100 a	100 a	100 a	100 a	99 ab	99	99 a	229 a
Tembotrione + metribuzin + MSO + AMS	0.123 + 0.075 + 1.0 % v/v + 0.85	6/12	8 a	0 a	100 a	98 bcd	100 a	100 a	99 c	99 a	97 bc	98	98 a	234 a
Gly/*s*-metolachlor + AMS	1.64 lb ae/A + 0.85	6/4	0 c	0 a	97 c	94 e	88 d	97 b	100 a	100 a	99 ab	99	99 a	220 ab
Gly/*s*-meto/mtrione + NIS + AMS	1.98 lb ae/A + 0.5 % v/v + 0.85	6/4	0 c	0 a	100 a	99 ab	99 bc	100 a	100 a	100 a	99 ab	99	99 a	205 ab
Glyphosate-T + NIS	0.75 lb ae/A + 0.5 % v/v	6/4	4 abc	0 a	95 c	70 f	91 d	95 b	69 d	87 b	83 e	87	87 b	205 ab
Acetochlor + glyphosate + AMS	1.75 ai/A + 0.75 lb ae/A + 0.85	5/18	6 ab	0 a	80 d	98 bcd	100 a	100 a	100 a	100 a	99 ab	99	99 a	213 ab
Acetochlor + glyphosate + AMS	1.75 + 1.13 lb ae/A + 0.85	5/18	3 bc	0 a	80 d	99 ab	100 a	100 a	100 a	100 a	100 a	99	100 a	213 ab

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[1] Weed control evaluation means and corn yield 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), green foxtail nd barnyardgrass (ECHCG).

[3] MSO is methylated seed oil. AMS is ammonium sulfate. NIS is nonionic surfactant. Glyphosate is Roundup PowerMax. Gly/*s*-me s a formulation of glyphosate and s-metolachlor sold as Sequence. Gly/s-meto/mtrione is a formulation of glyphosate, *s*-metolachlor, r sold as Halex GT.

Broadleaf weed control in field corn with postemergence applications of topramezone and diflufenzopyr plus dicamba applied alone or in combination with glyphosate.

Richard N. Arnold, Michael K. O'Neill and Kevin Lombard. (New Mexico State University Agricultural Science Center, Farmington, NM 87499)

Research plots were established on May 7, 2009 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of field corn (var. Dekalb DKC49-32) and annual broadleaf weeds to postemergence applications of topramezone alone or in combination. 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 three replications. Individual plots were 4, 34 in rows 30 ft long. Field corn was planted with flexi-planters equipped with disk openers on May 7. Postemergence treatments were applied on June 3 when corn was in the 4th to 5th leaf stage and weeds were <4 inch in height. S-metolachlor was applied preemergence on May 11 to all treatments at 19 oz ai/A. Russian thistle, prostrate and redroot pigweed infestations were heavy and common lambsquarters and black nightshade infestations were moderate throughout the experimental area. Postemergence treatments were evaluated on July 7.

No injury was noted from any of the treatments. All treatments except the weedy check had 90% or better control of black nightshade, redroot and prostrate pigweed. Glyphosate gave poor control of common lambsquarters and Russian thistle. Topramezone at the low rate gave poor control of Russian thistle.

Table. Broadleaf weed control in field corn with postemergence applications of topramezone applied alone or in combination.

Treatments[1]	Rate	Crop injury[2]	Weed control[2] CHEAL	SOLNI	AMARE	AMABL	SASKR
	oz ai/A	%	%				
Topramezone + COC	0.17 + 1% v/v	0	98	100	100	100	52
Topramezone + glyphosate	0.17+22	0	100	100	100	100	100
Topramezone + COC	0.25 + 1% v/v	0	97	100	98	98	87
Topramezone + glyphosate	0.25+22	0	100	100	100	100	100
Diflufenzopyr/dicamba	1.5	0	98	100	98	97	97
Diflufenzopyr/dicamba+ glyphosate	1.5+22	0	100	98	90	92	100
Diflufenzopyr/dicamba	3.0	0	100	100	94	100	100
Diflufenzopyr/dicamba+ glyphosate	3.0+22	0	100	100	100	100	100
Glyphosate	22	0	68	100	100	98	17
Weedy check		0	0	0	0	0	0

[1] All treatments were applied with ammonium sulfate at 2% v/v. COC is crop oil concentrate.

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

Broadleaf weed control in field corn with preemergence herbicides. Richard N. Arnold, Michael K. O'Neill and Kevin Lombard. (New Mexico State University Agricultural Science Center, Farmington, NM 87499)

Research plots were established on May 7, 2009 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of field corn (var. Pioneer PO541HR) and annual broadleaf weeds to preemergence 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. Field corn was planted with flexi-planters equipped with disk openers on May 7. Preemergence treatments were applied on May 11 and immediately incorporated with 0.75 in of sprinkler applied water. Russian thistle, prostrate and redroot pigweed infestations were heavy and common lambsquarters and black nightshade infestations were moderate throughout the experimental area. Preemergence treatments and crop injury were evaluated on May 28.

No crop injury was noted from any of the treatments. All treatments except the weedy check gave excellent control of all broadleaf weeds.

Table. Broadleaf weed control in field corn with preemergence herbicides.

		Crop	Weed control[1]				
Treatments	Rate	injury[1]	CHEAL	SOLNI	AMARE	AMABL	SASKR
	oz ai/A	%			----------%----------		
Thiencarbazone/isoxaflutole	2.4	0	100	100	100	100	98
Thiencarbazone/isoxaflutole+	2.4	0	100	100	100	100	100
atrazine	1.0						
Isoxaflutole	1.5	0	100	100	100	100	100
Isoxaflutole + atrazine	1.5 + 1.0	0	100	100	100	100	100
Isoxaflutole +	2.5	0	100	100	100	100	100
acetochlor/atrazine	48						
Dimethenamid-p/atrazine	27.5	0	100	100	100	100	99
Weedy check		0	0	0	0	0	0

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

Broadleaf weed control in field corn with early and late applied postemergence herbicides. Richard N. Arnold, Michael K. O'Neill and Kevin Lombard. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 7, 2009 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of field corn (var. Pioneer PO541HR) and annual broadleaf weeds to early and late 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. Field corn was planted with flexi-planters equipped with disk openers on May 7. Early and late postemergence treatments were applied on June 3 and 8 when corn was in the 4th and 6th leaf stage and weeds were <4 in and <6 inch in height. Russian thistle, prostrate and redroot pigweed, infestations were heavy and common lambsquarters and black nightshade infestations were moderate throughout the experimental area. Early and late postemergence treatments were evaluated on July 8 and August 11.

Thiencarbazone + glyphosate + MSO +A MS applied late postemergence injured corn 3%. Thiencarbazone + tembotrione + glufosinate + AMS applied late postemergence gave poor control of broadleaf weeds. Tompramesone + atrazine + COC + UAN applied early postemergence gave poor control of common lambsquarters, redroot and prostrate pigweed and Russian thistle but excellent control of black nightshade. Russian thistle control was excellent with early postemergence applications of thiencarbazone + tembotrione + atrazine combined with either COC or MSO and UAN.

Table. Broadleaf weed control in field corn with early and late postemergence herbicides.

Treatment[1]	Rate	Crop injury[2]	Weed control[2]				
			CHEAL	SOLNI	AMARE	AMABL	SASKR
	oz ai/A	%	---------------------------	%	---------------------------		
Thiencarbazone/tembotrione + glyphosate	0.86 15	0	98	100	98	100	21
Thiencarbazone/tembotrione + glyphosate +MSO +AMS	1.3 7.5	3	92	92	97	98	23
Thiencarbazone/tembotrione + glufosinate +AMS	0.86 6.4	0	65	53	60	43	35
S-metolachlor/glyphosate/ mesotrione +NIS +AMS	63	0	100	100	97	99	91
Thiencarbazone/tembotrione + atrazine +COC + UAN	1.3 8.0	0	100	100	98	100	100
Topramezone + atrazine +COC + UAN	0.25 + 8.0	0	71	100	28	43	20
Thiencarbazone/tembotrione + atrazine +MSO + UAN	1.3 8.0	2	100	100	99	100	100
Tembotrione + atrazine + MSO + UAN	1.7 + 8.0	0	98	100	99	97	98
Weedy check		0	0	0	0	0	0

[1] Treatments applied either with or a combination of a nonionic surfactant, (NIS), crop oil concentrate (COC), methylated seed oil (MSO), urea ammonium nitrate (UAN) or ammonium sulfate (AMS) at 0.25,1, 0.5, 1.5% v/v and 2.8 lbs/A, respectively.

[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 saflufenacil in fallow, spring wheat and pea. 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. Saflufenacil, a protoporphyrinogen oxidase inhibitor broadleaf herbicide, may be used to control acetolactate synthase inhibitor and 2,4-D resistant prickly lettuce in fallow or prior to planting (preplant burndown). Studies were established near Genesee, ID to evaluate crop response and prickly lettuce and common lambsquarters control with saflufenacil combinations compared to glyphosate alone in fallow and prior to seeding. Plots were 8 by 25 feet arranged in a randomized complete block design with four replications and included an untreated check. 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	‘Jed’ spring wheat	‘Aragorn’ spring pea		Fallow
Application date	April 30, 2009	April 30, 2009	May 18, 2009	May 9, 2009
Seeding date	May 16, 2009	May 15, 2009		--
Growth stage				
Prickly lettuce	2 leaf	2 leaf	4 leaf	1 inch rosette
Common lambsquarters	0.5 inch	0.5 inch	0.5 inch	0.5 inch
Air temperature (F)	54	54	75	50
Relative humidity (%)	50	50	54	82
Wind (mph, direction)	2, W	2, W	0	1, NE
Dew present?	No	No	No	Yes
Cloud cover (%)	60	60	20	0
Soil moisture	adequate	adequate	adequate	excessive
Soil temperature at 2 inch (F)	50	50	70	45
pH	5.6			5.3
OM (%)	2.9			3.0
CEC (meq/100g)	28			22
Texture	silt loam			silt loam

In the spring wheat study, no treatment injured spring wheat (data not shown). All treatments controlled prickly lettuce 78 to 84%, including glyphosate applied alone (Table 2). Saflufenacil + dicamba and saflufenacil at the high rate controlled common lambsquarters 84 and 88% but did not differ from saflufenacil + glyphosate at 0.75 lb ae/A (80%).

In the spring pea study, the pendimethalin combination injured spring pea 16% (Table 3). Prickly lettuce control was 95% with the saflufenacil + imazethapyr combination but did not differ from the saflufenacil + imazethapyr + pendimethalin combination (89%). Both treatments controlled prickly lettuce better than glyphosate applied alone (76%). Imazethapyr combinations controlled common lambsquarters 94%. Weed control with all other treatments ranged from 76 to 84% and 45 to 71% for prickly lettuce and common lambsquarters, respectively.

In the fallow study, prickly lettuce control ranged from 81 to 92% (Table 4). No treatment controlled prickly lettuce better than glyphosate applied alone. Dicamba/diflufenzopyr at 0.0875 and 2,4-D ester combinations controlled common lambsquarters 92 to 94% but did not differ from dicamba/diflufenzopyr at the low rate (88%).

Table 2. Prickly lettuce and common lambsquarters control with saflufenacil combinations in spring wheat near Genesee, ID in 2009.

Treatment[1]	Rate[2]	Weed control[3] Prickly lettuce	Weed control[3] Common lambsquarters
	lb ai/A	%	%
Glyphosate +	0.75		
NIS	0.25	82	72
Saflufenacil +	0.0223		
glyphosate +	0.375		
MSO	1	78	72
Saflufenacil +	0.0223		
glyphosate +	0.75		
MSO	1	81	80
Saflufenacil +	0.0334		
glyphosate +	0.75		
MSO	1	84	88
Saflufenacil +	0.0223		
dicamba +	0.0625		
glyphosate +	0.75		
MSO	1	84	84
2,4-D ester +	0.475		
glyphosate +	0.75		
NIS	0.25	84	74
LSD (0.05)		NS	9
Density (plants/ft^2)		15	3

[1] NIS is a nonionic surfactant (M-90). MSO is methylated seed oil. Ammonium sulfate (Bronc) was applied at 17 lb ai/100 gal with all treatments.

[2] Glyphosate and 2,4-D ester rates are in lb ae/A. NIS and MSO rates are in % v/v.

[3] Evaluation date June 17, 2009.

Table 3. Prickly lettuce and common lambsquarters control with saflufenacil combinations in spring pea near Genesee, ID in 2009.

Treatment[1]	Rate[2]	Application timing[3]	Spring pea injury[5]	Weed control Prickly lettuce[4]	 Common lambsquarters[5]
	lb ai/A		%	%	%
Glyphosate +	0.75				
NIS	0.25	Preplant	0	76	45
Saflufenacil +	0.0223				
glyphosate +	0.375				
MSO	1	Preplant	0	84	69
Saflufenacil +	0.0223				
glyphosate +	0.75				
MSO	1	Preplant	0	81	51
Saflufenacil +	0.0445				
glyphosate +	0.75				
MSO	1	Preplant	0	83	71
Carfentrazone +	0.0071				
glyphosate +	0.75				
COC	1	Preplant	0	78	54
Saflufenacil +	0.0445				
glyphosate +	0.75				
imazethapyr +	0.0234				
MSO	1	Preplant	0	95	94
Saflufenacil +	0.0445				
glyphosate +	0.75				
imazethapyr +	0.0234				
pendimethalin +	0.71				
MSO	1	3 DAP	16	89	94
LSD (0.05)				11	13
Density (plants/ft^2)				10	3

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[1] NIS is a nonionic surfactant (R-11). MSO is methylated seed oil. COC is a crop oil concentrate (M-COC) was applied at 1% v/v with carfentrazone. Ammonium sulfate (Bronc) was applied at 17 lb ai/100 gal with all treatments.

[2] Glyphosate rates are in lb ae/A. NIS, MSO, and COC rates are in % v/v.

[3] Application timing based on wheat seeding. DAP is days after planting.

[4] Evaluation date June 5, 2009.

[5] Evaluation date June 17, 2009.

Table 4. Prickly lettuce and common lambsquarters control with saflufenacil combinations in fallow near Genesee, ID in 2008.

		Weed control[3]	
Treatment[1]	Rate[2]	Prickly lettuce	Common lambsquarters
	lb ai/A	%	%
Glyphosate +	0.75		
NIS	0.25	89	79
Saflufenacil +	0.0223		
glyphosate +	0.75		
MSO	1	92	81
2,4-D ester +	0.475		
glyphosate +	0.75		
NIS	0.25	89	92
Dicamba/diflufenzopyr +	0.0875		
glyphosate +	0.75		
MSO	1	82	94
Saflufenacil +	0.0223		
dicamba/diflufenzopyr +	0.0438		
glyphosate +	0.375		
MSO	1	84	88
Saflufenacil +	0.0223		
dicamba/diflufenzopyr +	0.0875		
glyphosate +	0.375		
MSO	1	81	94
LSD (0.05)		NS	9
Density (plants/ft^2)		15	5

[1] NIS is a nonionic surfactant (M-90). MSO is methylated seed oil. Ammonium sulfate (Bronc) was applied at 17 lb ai/100 gal with all treatments.

[2] Glyphosate and 2,4-D ester rates are in lb ae/A. NIS and MSO rates are in % v/v.

[3] Evaluation date June 17, 2009.

Ventenata and downy brome control in timothy hay production. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Potlatch, ID in timothy-hay (*Phleum pratense* L.; PHLPR) to evaluate ventenata (*Ventenata dubia* (Leers) Coss; VETDU) and downy brome (*Bromus tectorum* L.; BROTE) control with various selective herbicides timed as an early POST-emergent application. Treatments were randomly assigned and replicated four times. Plot size was 10 by 30 feet. All treatments were applied with a CO_2-pressurized backpack sprayer at 16 gpa (Table 1).

Table 1. Application and soil data.

Application date	October 23, 2008
Application timing	early-post emergence (1 to 2 leaf stage)
Air Temp (F)	51
Relative humidity (%)	32
Wind (mph, direction)	3 to 7, NE
Soil temp at 2 inches (F)	48
Soil type	loam

A visual evaluation was conducted June 18, 2009, approximately eight months after treatment (MAT), to measure treatment effects on annual grass control and injury symptoms to timothy. Whole plot cover (%) of mature annual grass plants was used as an estimate of control. Timothy height and seedhead formation were estimated in comparison to the untreated check to evaluate tolerance of timothy plants to herbicide treatments. Ventenata and downy brome cover were 49% and 10%, respectively, in the untreated check. Aminopyralid and metribuzin treatments did not differ in comparison to ventenata cover in the untreated check. All other treatments signficantly reduced ventenata cover, which ranged from 0 to 5%. No rate effects were detected in analysis of sulfosulfuron and terbacil. Downy brome cover in herbicide-treated plots did not differ from the untreated check. However, low cover values in the untreated check may confound analysis of herbicide effects for downy brome. Application of imazapic/glyphosate resulted in significant mean height reduction (85%) and lower seedhead formation (18%) of timothy in comparison to the untreated check. Other treatments did not differ from the control, indicating acceptable levels of tolerance. Results suggest that timothy was highly tolerant to applications of flufenacet/metribuzin alone and in combination with sulfonylureas. Moderate reductions in height (28 to 35%) and lower seedhead formation (75 to 90%) were observed in terbacil, rimsulfuron and sulfosulfuron treatments. Trends suggest that lower rates of sulfosulfuron may result in greater timothy tolerance, but greater annual grass density.

Table 2. Ventenata (VETDU) and downy brome (BROTE) cover and timothy (PHLPR) tolerance following various selective herbicide applications 8 MAT.

Treatment [1]	Rate[2]	Annual grass cover		PHLPR injury	
	oz ai/A	VETDU	BROTE	Height reduction	Seedhead formation
		--------------	%------------	-------------	%-------------
Flufenacet /metribuzin	6.7	4	20	0	100
Flufenacet/ metribuzin + sulfosulfuron	6.7 + 0.49	0	13	5	98
Triasulfuron	0.42	3	19	0	100
Flufenacet/metribuzin + triasulfuron	6.7 + 0.42	3	21	8	100
Aminopyralid	0.08	30	16	8	70
Sulfosulfuron	0.49	2	6	3	99
Sulfosulfuron	0.75	0	5	28	90
Terbacil	9.6	5	4	26	75
Terbacil	12.8	3	2	32	75
Imazapic/glyphosate	0.18	0.25	4	85	18
Metribuzin	4.0	20	10	0	100
Rimsulfuron	1.0	3	4	35	75
Untreated check	--	49	10	0	100
Tukey's HSD		30	31	50	64

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

[2] Aminopyralid and imazapic/glyphosate expressed rates as oz ae/A

Rattail fescue control in timothy. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Many annual grasses, including rattail fescue, contaminate timothy hay which decrease stand life and lower quality for foreign export. Few grass herbicides are registered in timothy. A study was established in 5 year old 'Climax' timothy near Princeton, Idaho to evaluate rattail fescue control and timothy response with various herbicides. The study was arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied postemergence using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Timothy response and rattail fescue control were evaluated visually. Timothy biomass was collected at heading from one 2.7ft^2 quadrat per plot on June 22, 2009.

Table 1. Application and soil data.

Location	Princeton, Idaho
Application date	October 23, 2008
Growth stage	
Timothy	3 inches vegetative regrowth
Rattail fescue	1 leaf and 1 inch tall
Air temperature (F)	63
Relative humidity (%)	35
Wind (mph)	0
Cloud cover (%)	15
Soil moisture	dry
Soil temperature at 2 inch (F)	56
pH	4.8
OM (%)	2.5
CEC (meq/100g)	18
Texture	silt loam

All treatments containing flufenacet/metribuzin, sulfosulfuron, or rimsulfuron controlled rattail fescue 80 to 96% (Table 2). All treatments, except flufenacet/metribuzin applied alone, metribuzin and aminopyralid, injured timothy 36% or greater. Flufenacet/metribuzin alone and sulfosulfuron at 0.031 lb ai/A reduced timothy biomass 26 and 31%, respectively, compared to the untreated check.

Table 2. Rattail fescue control and timothy response near Princeton, ID in 2009.

		Rattail fescue	Timothy	
Treatment[1]	Rate[3]	control[2]	Injury[2]	Biomass
	lb ai/A	%	%	g/ft^2
Flufenacet/metribuzin	0.425	92	15	55
Triasulfuron	0.0238	2	42	48
Flufenacet/metribuzin +	0.425			
triasulfuron	0.0238	82	45	53
Sulfosulfuron	0.031	96	36	51
Sulfosulfuron	0.047	93	65	35
Flufenacet/metribuzin +	0.425			
sulfosulfuron	0.031	95	49	48
Terbacil	0.6	25	40	53
Terbacil	0.8	57	65	40
Imazapic/glyphosate	0.188	15	92	6
Rimsulfuron	0.0156	80	68	41
Metribuzin	0.248	18	0	76
Aminopyralid	0.078	8	0	83
Untreated check	--	--	--	74
LSD (0.05)		15	13	18
Density (plants/ft^2)		40		

[1] A nonionic surfactant (R-11) was applied with rimsulfuron and sulfosulfuron treatments at 0.25% v/v. Methylated seed oil (Super Spreader) was applied at 1% v/v with imazapic/glyphosate.

[2] June 22, 2009 evaluation.

Preplant grass weed control with flucarbazone plus glyphosate combinations in wheat. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established with flucarbazone plus glyphosate combinations applied prior to seeding. to evaluate winter wheat response and wild oat control near Moscow, ID and spring wheat response and poverty brome control near Lewiston, ID. ARY-0454-105 is a suspension concentrate formulation of flucarbazone and it was compared to a water dispersible granule flucarbazone formulation. 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). Wheat injury and weed control were evaluated visually at both sites and wheat head height was measured at Moscow. Winter wheat grain was harvested using a small plot combine on August 6, 2009. Spring wheat was not harvested due to variability in the brome stand caused by high disturbance fertilization 2 days after preplant application.

Table 1. Application and soil data.

Location	Moscow, ID		Lewiston, ID	
Application date	9/30/08	5/15/09	4/7/09	5/13/09
Seeding date	10/6/08		4/10/09	
Growth stage				
Winter wheat	preplant	2 tiller	--	--
Spring wheat	--	--	preplant	3 leaf
Wild oat	2 tiller	2 leaf (later flush)	--	--
Poverty brome	--	--	2 tiller	boot
Air temperature (F)	81	57	57	59
Relative humidity (%)	35	72	66	53
Wind (mph, direction)	0	2, W	1, W	1, NE
Dew present?	no	yes	no	no
Cloud cover (%)	15	30	5	100
Soil moisture	adequate	excessive	adequate	adequate
Soil temperature at 2 inch (F)	66	60	46	65
pH	5.0		4.2	
OM (%)	3.0		4.3	
CEC (meq/100g)	23		22	
Texture	silt loam		silt loam	

At Moscow, wheat stand reduction and grain yield were confounded by heavy rodent damage. Stand reduction and grain yield ranged from 2 to 45% and 26 to 50 lb/A, respectively (Table 2). Clodinafop and all postemergence flucarbazone treatments controlled wild oat 81 to 92%. Wheat head height tended to be shorter in treatments with greater wild oat control.

At Lewiston, no treatment injured spring wheat (data not shown). On April 29th, prior to postemergence applications, all treatments tended to control poverty brome 96% or better, except glyphosate + flucarbazone + ARY-0454-105 (75%), but were not significantly different most likely due to poverty brome stand variability caused by high disturbance fertilization two days after preplant treatment application. On June 4th, after postemergence applications, poverty brome control was similar to the April 29th evaluation.

Table 2. Winter wheat response and wild oat control with flucarbazone plus glyphosate combinations near Moscow, ID in 2009.

Treatment[1]	Rate	Application timing[2]	Wheat stand reduction[3]	Wild oat control[4]	Wheat	
					Head height	Yield
	lb ai/A		%	%	cm	lb/A
Glyphosate +	0.4	preplant				
thifen/triben +	0.0187	2 leaf				
bromoxynil/MCPA	0.5	2 leaf	2	30	73	50
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
thifen/triben +	0.0187	2 leaf				
bromoxynil/MCPA	0.5	2 leaf	8	13	72	42
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
tribenuron +	0.00445	preplant				
thifen/triben +	0.0187	2 leaf				
bromoxynil/MCPA	0.5	2 leaf	2	30	72	41
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
pyraflufen+	0.00164	preplant				
thifen/triben +	0.0187	2 leaf				
bromoxynil/MCPA	0.5	2 leaf	20	5	70	30
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
tribenuron +	0.00445	preplant				
flucarbazone +	0.0089	2 leaf				
thifen/triben +	0.0187	2 leaf				
bromoxynil/MCPA	0.5	2 leaf	18	81	66	41
Glyphosate +	0.4	preplant				
flucarbazone +	0.0134	preplant				
pyraflufen+	0.00164	preplant				
flucarbazone +	0.0089	2 leaf				
thifen/triben +	0.0187	2 leaf				
bromoxynil/MCPA	0.5	2 leaf	2	83	67	41
Glyphosate +	0.4	preplant				
flucarbazone +	0.0179	2 leaf				
thifen/triben +	0.0187	2 leaf				
bromoxynil/MCPA	0.5	2 leaf	43	86	67	38
Glyphosate +	0.4	preplant				
clodinafop +	0.05	2 leaf				
thifen/triben +	0.0187	2 leaf				
bromoxynil/MCPA	0.5	2 leaf	45	92	65	26
Untreated check			--	--	72	39
LSD (0.05)			26	25	NS	NS
Density (plants/ft^2)				10		

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[1] Ammonium sulfate (Bronc) was applied preplant at 1 lb ai/gal with all treatments. Nonionic surfactant (R-11) was applied at 0.25 % v/v with all postemergence treatments, except clodinafop. Thifen/triben is thifensulfuron/tribenuron (Audit). Glyphosate and bromoxynil/MCPA rates are in lb ae/A.

[2] Application timing based on wild oat growth stage.

[3] May 15, 2009 evaluation date.

[4] June 25, 2009 evaluation date.

Table 3. Poverty brome control with flucarbazone plus glyphosate combinations near Lewiston, ID in 2009.

Treatment[1]	Rate	Application timing[2]	Poverty brome control 4/29/09	Poverty brome control 6/4/09
	lb ai/A		%	%
Glyphosate	0.4	preplant	99	99
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant	99	99
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant		
flucarbazone	0.0134	boot	99	93
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant		
ARY-0454-105	0.0134	boot	75	62
Glyphosate +	0.4	preplant		
flucarbazone +	0.0134	preplant		
ARY-0454-105 +	0.0134	boot		
thifensulfuron/tribenuron	0.0309	boot	96	89
Glyphosate +	0.4	preplant		
flucarbazone	0.027	boot	99	99
Glyphosate +	0.4	preplant		
ARY-0454-105	0.027	boot	99	99
Glyphosate +	0.4	preplant		
Pyroxsulam/florasulam/fluroxypyr	0.172	boot	99	99
LSD (0.05)			NS	NS
Density (plants/ft^2)			10	

[1] ARY-0454-105 is a suspension concentrate formulation of flucarbazone. Ammonium sulfate (Bronc) was applied preplant at 1 lb ai/gal with all treatments. Quad 7(basic blend) was applied at 1 % v/v with all postemergence treatments, except pyroxsulam/florasulam/fluroxypyr which was applied with nonionic surfactant (R-11) at 0.25% v/v. Glyphosate and pyroxsulam/florasulam/fluroxypyr rates are in lb ae/A.

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

Fluroxypyr/bromoxynil compared to other broadleaf herbicides 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 a fluroxypyr/bromoxynil pre-mixture to other broadleaf herbicides for kochia and other weed species control in spring wheat. 'Alturas' was planted April 8, 2009, 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 May 28 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 74 F, soil temperature 60 F, relative humidity 34%, wind speed 1 mph, and 40% cloud cover. Kochia (KCHSC) and common lambsquarters (CHEAL) averaged 3 and 1 plants/ft^2 respectively. Weed control was evaluated visually 14 and 66 days after application (DAA) on June 11 and Aug 2. Grain was harvested August 11 with a small-plot combine.

No crop injury was observed at either evaluation date (Table). Kochia and common lambsquarters control ranged from 89 to 100% at both evaluation dates. There was no difference in weed control among any of the herbicide treatments, with the exception of fluroxypyr/bromoxynil at 0.3125 lb ae/A. Kochia control with this treatment was significantly lower than those weed control treatments that averaged >94%. All but two herbicide treatments, fluroxypyr/bromoxynil + 2,4-D LVE at 0.3125 + 0.25 lb ae/A and fluroxypyr/bromoxynil + thifensulfuron at 0.3125 lb ae/A + 0.005 lb ai/A had higher yields than the untreated check (84 bu/A).

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

		Crop injury		Weed control[2]				
				KCHSC		CHEAL		
Treatment[3]	Application rate	7/10	8/2	6/11	8/2	6/11	8/2	Grain yield
	lb ae/A	%						bu/A
Check								84 d
Fluroxypyr/bromoxynil	0.3125	0 a	0 a	89 c	100 a	99 a	94 a	103 ab
Fluroxypyr/bromoxynil + MCPA ester	0.3125 + 0.25	0 a	0 a	96 ab	100 a	100 a	100 a	97 abc
Fluroxypyr/bromoxynil + 2,4-D ester LV	0.3125 + 0.25	0 a	0 a	97 ab	95 a	93 a	100 a	90 cd
Fluroxypyr/bromoxynil + thifensulfuron + nonionic surfactant	0.3125 + 0.005 lb ai/A+ 0.25 % v/v	0 a	0 a	94 bc	100 a	100 a	99 a	93 bcd
Fluroxypyr/bromoxynil + MCPA ester	0.48 + 0.25	1 a	0 a	100 a	100 a	100 a	100 a	99 abc
Pyrasulfotole/bromoxynil + ammonium sulfate	0.18 + 0.5 lb/A	0 a	0 a	100 a	99 a	100 a	100 a	99 abc
Pyrasulfotole/bromoxynil + ammonium sulfate + fluroxypyr	0.18 + 0.5 lb/A+ 0.069	0 a	0 a	98 ab	100 a	98 a	100 a	108 a
Pyrasulfotole/bromoxynil + ammonium sulfate	0.22 + 0.5 lb/A	0 a	0 a	100 a	100 a	98 a	100 a	104 ab
Fluroxypyr + 2,4-D ester LV	0.094 + 0.375	3 a	0 a	98 ab	99 a	95 a	100 a	101 abc

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

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

[3] Pyrasulfotole/bromoxynil is a 1:8 formulated mixture of pyrasulfotole and bromoxynil sold as Huskie. Fluroxypyr/bromoxynil is a 1:4.04 formulated mixture of fluroxypyr and bromoxynil sold as Starane NXT.

Broadleaf weed control with pyrasulfotole/bromoxynil in comparison with other broadleaf 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 pyrasulfotole/bromoxynil to other herbicides for broadleaf weed control in "Alturas" spring wheat planted April 6, 2009, 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 (26.4% sand, 65% silt, and 5.6% clay) with a pH of 8.1, 1.6% organic matter, and CEC of 14-meq/100 g soil. Herbicides were applied May 22 with a CO_2-pressurized bicycle-wheel sprayer using 11001 flat fan nozzles calibrated to deliver 10 gpa at 22 psi. Environmental conditions were as follows: air temperature 76 F, soil temperature 66 F, relative humidity 27%, wind speed 4 mph and 10% cloud cover. Kochia (KCHSC), common lambsquarters (CHEAL) and redroot pigweed (AMARE) densities averaged 3, 66 and 1 plants/ft^2, respectively. Crop injury was evaluated visually 4, 49 and 69 days after application (DAA) on May 26, July 10, and July 30. Weed control was evaluated 28 and 69 DAA on June 19 and July 30. Grain was harvested August 17 with a small-plot combine.

Crop injury ranged from 0 to 9% 4 DAA. Greatest injury was with thifensulfuron/tribenuron and tribenuron alone treatments. By 49 DAA, only dicamba applied at 0.25 lb ae/A injured the crop (5%) and by 69 DAA, no herbicide treatment injured the crop. All pyrasulfotole/bromoxynil treatments and bromoxynil/MCPA controlled CHEAL, KCHSC, and AMARE >92% at both evaluation dates. All herbicide treatments with yields >91 bu/A were significantly better than the untreated check. Those treatments that did not have yields that were statistically greater than the check did not control CHEAL or KCHSC, indicating that both species are competitive on their own. However, KCHSC averaged only 3 plants/ft^2 and CHEAL averaged 66 plants/ft^2, indicating that KCHSC may be more competitive than CHEAL.

Table. Crop injury, weed control, and grain yield in spring wheat with broadleaf herbicides, near Kimberly, ID[1].

						Weed control[2]					
			Crop injury			CHEAL		KCHSC		ARE	Grain
Treatment[3]	Application rate	Growth stage	5/26	7/10	7/30	6/19	7/30	6/19	7/30	7/30	yield
	lb ai/A		%								bu/A
Check			-	-	-	-	-	-	-	-	74 d
Pyrslftl/brmxnl + nonionic surfactant + ammonium sulfate	0.177 + 0.25 % v/v + 0.5	<4 inch weeds	4 cde	0 b	1 a	94 a	100 a	93 ab	99 a	100 a	107 ab
Pyrslftl/brmxnl + nonionic surfactant + ammonium sulfate	0.217 + 0.25 % v/v + 0.5	<4 inch weeds	1 ef	0 b	1 a	96 a	100 a	98 a	100 a	100 a	109 ab
Pyrslftl/brmxnl + nonionic surfactant + ammonium sulfate	0.241 + 0.25 % v/v + 0.5	<4 inch weeds	1 ef	0 b	1 a	96 a	100 a	96 ab	96 ab	100 a	106 ab
Fluroxypyr-Do	0.14	<4 inch weeds	0 f	0 b	0 a	33 c	41 b	98 a	100 a	100 a	93 abc
Fluroxy/bromoxy	0.32	<4 inch weeds	0 f	0 b	0 a	85 a	91 a	96 ab	100 a	100 a	110 a
Brmxynl/MCPA	0.75	<4 inch weeds	0 f	0 b	1 a	92 a	98 a	88 ab	95 ab	100 a	91 bcd
Pyrslftl/brmxnl + trflxystrbn/prpcnzl + nonionic surfactant + ammonium sulfate	0.241 + 0.081 + 0.25 % v/v + 0.5	<4 inch weeds	0 f	0 b	0 a	97 a	100 a	93 ab	99 a	100 a	96 abc
Tribenuron-H + nonionic surfactant	0.0155 + 0.25 % v/v	<4 inch weeds	8 ab	0 b	0 a	95 a	100 a	23 e	69 c	100 a	87 cd
Tribenuron-Du + nonionic surfactant	0.0155 + 0.25 % v/v	<4 inch weeds	6 abc	0 b	0 a	95 a	100 a	21 e	43 d	100 a	87 cd
Fluroxypyr-H	0.094 lb ae/A	<4 inch weeds	3 def	0 b	0 a	8 d	3 c	97 ab	100 a	100 a	85 cd
Fluroxypyr-Do	0.094	<4 inch weeds	0 f	0 b	0 a	5 d	0 c	97 ab	100 a	100 a	87 cd
Tribenuron-H + Fluroxypyr-H + nonionic surfactant	0.0155 + 0.094 lb ae/A + 0.25 % v/v	<4 inch weeds	5 bcd	0 b	0 a	95 a	100 a	89 ab	100 a	100 a	102 abc
Thifnslfrn/tribnrn + nonionic surfactant	0.025 + 0.25 % v/v	<4 inch weeds	9 a	0 b	0 a	94 a	100 a	14 e	33 d	99 a	85 cd
Dicamba	0.25 lb ae/A	<4 inch weeds	3 def	5 a	3 a	65 b	89 a	85 b	97 ab	99 a	97 abc
Clpyrld/fluroxypyr	0.188 lb ae/A	<4 inch weeds	1 ef	0 b	0 a	54 b	55 b	96 ab	100 a	100 a	101 abc
Brmxynl/MCPA Adv	0.5 lb ae/A	<4 inch weeds	0 f	0 b	0 a	93 a	100 a	69 c	85 b	100 a	96 abc
2,4-D LVE	0.5 lb ae/A	<4 inch weeds	0 f	0 b	0 a	95 a	100 a	50 d	65 c	100 a	96 abc

[1] Crop injury and weed control means followed by the same letter are not significantly different at P = 0.05. Grain yield means followed ıe letter are not significantly different at P = 0.10.

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

[3] Pyrslftl/brmxnl is a 1:8 formulated mixture of pyrasulfotole and bromoxynil sold as Huskie. Fluroxypyr-Do is Starane Ultra and flurox ɪelm Fluroxypyr.
Fluroxy/bromoxy is a 1:4.04 formulated mixture of fluroxypyr and bromoxynil sold as Starane NXT. Trflxystrbn/prpcnzl is a formulate ɔf trifloxystrobin and
propiconazole sold as Stratego. Brmxynl/MCPA is a 1:1.1 formulated mixture of bromoxynil and MCPA sold as Bronate. Brmxynl/MC a 1:1.1 formulated
mixture of bromoxynil and MCPA sold as Bronate Advanced. Tribenuron-Du is sold as Express SG and tribenuron-H is sold as Helm T Thifnslfrn/tribnrn is a
1:1 ratio of thifensulfuron and tribenuron sold as Affinity BroadSpec. Clpyrld/fluroxypyr is a 1:1.1 formulated mixture of clopyralid an r sold as Widematch.

Comparison of postemergence herbicides for wild oat and broadleaf weed control 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 several postemergence herbicide combinations for wild oat and broadleaf weed control in spring wheat. "Alturas" spring wheat planted April 6, 2009 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 (26.4% sand, 65% silt, and 5.6% clay) with a pH of 8.1, 1.6% organic matter, and CEC of 14-meq/100 g soil. Herbicides were applied May 22, 2009, with a CO_2-pressurized bicycle-wheel sprayer using 11001 flat fan nozzles calibrated to deliver 10 gpa at 22 psi. Environmental conditions at application were as follows: air temperature 76 F, soil temperature 66 F, relative humidity 27%, wind speed 4 mph and 10% cloud cover. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE) and wild oat (AVEFA) densities averaged 0.3, 9, 3 and 5 plants/ft^2, respectively. Crop injury was evaluated visually 47 and 67 days after application (DAA) on July 8 and 28, 2009. Weed control was evaluated 31 and 67 DAA on June 22 and July 28. Grain was harvested August 17 with a small-plot combine.

Crop injury was minimal, ranging from 0 to 2%, at 31 and 67 DAA (Table). CHEAL control at 31 DAA was equal among all herbicide treatments with the exception of florasulam/pinoxaden + fluroxypyr at 0.058 lb ai/A + 0.062 lb ae/A, which averaged 82%. By 67 DAA, CHEAL control ranged from 89 to 100% for all herbicide treatments. KCHSC density was very light and somewhat variable. No difference in KCHSC control was observed at either evaluation date. Although AMARE densities were higher than KCHSC, no differences in AMARE control among herbicide treatments were observed at either evaluation date either. All of the herbicide treatments controlled AVEFA 95 to 100% at both evaluation dates, with the exception of fluroxypyr/dicamba + MCPA LVE + clodinafop, which controlled AVEFA 71% at both evaluation dates. It is not known why AVEFA control was reduced compared to fluroxypyr/dicamba + clodinafop. Both treatments are labeled for use. Spring wheat yields ranged from 53 to 85 bu/A. The untreated check and fluroxypyr/dicamba + MCPA + clodinafop were the two lowest yielding treatments at 53 and 59 bu/A, respectively.

Table. Comparison of postemergence herbicides for wild oat and broadleaf weed control in spring wheat, near Kimberly, Idaho.[1]

		Crop injury		Weed control[2]								
				CHEAL		KCHSC		AMARE		AVEFA		Grain yield
Treatment[3]	Application rate	7/8	7/28	6/22	7/28	6/22	7/28	6/22	7/28	6/22	7/28	
	lb ai/A	%										bu/A
Check		-	-	-	-	-	-	-	-	-	-	53 c
Brxnl/fnxprp/pyrslftl	0.284	0 a	0 a	95 a	97 bcd	94 a	95 a	93 a	100 a	99 abc	100 a	83 a
Fenoxaprop + Pyrslftl/brxnl	0.104 + 0.217	0 a	0 a	97 a	97 bcd	100 a	100 a	90 a	96 a	99 abc	97 a	79 a
Brxnl/fnxprp/pyrslftl + trflxystrbn/prpcnzle	0.284 + 0.081	0 a	0 a	92 a	98 abc	100 a	100 a	99 a	99 a	98 abc	98 a	84 a
Clodinafop + pyrslftl/brxnl	0.05 + 0.217	0 a	0 a	94 a	96 bcd	100 a	100 a	94 a	99 a	98 abc	99 a	78 a
Pinoxaden + pyrslftl/brxnl	0.067 + 0.225	0 a	2 a	95 a	99 ab	100 a	100 a	95 a	95 a	100 a	98 a	71 ab
Fenoxaprop + pyrslftl/brxnl	0.104 + 0.184	0 a	0 a	94 a	97 bc	95 a	100 a	96 a	98 a	97 bc	96 a	72 ab
Florasulam/pinoxaden + MCPA ester + Adigor	0.058 + 0.312 lb ae/A+ 0.6 pt/A	0 a	0 a	90 ab	97 bc	88 a	100 a	88 a	98 a	100 ab	99 a	80 a
Florasulam/pinoxaden + fluroxypyr + Adigor	0.058 + 0.062 lb ae/A+ 0.6 pt/A	0 a	0 a	82 b	92 cd	97 a	100 a	88 a	100 a	100 a	100 a	85 a
Florasulam/pinoxaden + flrxypyr/brxnl + Adigor	0.058 + 0.32 lb ae/A+ 0.6 pt/A	0 a	0 a	90 ab	89 d	100 a	100 a	89 a	97 a	100 ab	99 a	84 a
Florasulam/pinoxaden + bromoxynil/MCPA + Adigor	0.058 + 0.5 + 0.6 pt/A	0 a	0 a	96 a	100 a	100 a	100 a	90 a	98 a	99 abc	99 a	84 a
Florasulam + fluroxypyr + pinoxaden	0.31 lb ae/A+ 0.062 lb ae/A+ 0.054	0 a	0 a	88 ab	98 abc	99 a	98 a	94 a	97 a	100 a	100 a	78 a
Florasulam + flrxypyr/brxnl + pinoxaden	0.31 lb ae/A+ 0.32 lb ae/A+ 0.054	0 a	0 a	97 a	99 ab	100 a	100 a	97 a	99 a	100 a	99 a	80 a
Fluroxypyr/dicamba + clodinafop	0.157 lb ae/a+ 0.05	0 a	0 a	94 a	97 bc	100 a	100 a	90 a	95 a	96 c	95 a	78 a
Fluroxypyr/dicamba + MCPA ester + clodinafop	0.157 lb ae/A+ 0.25 lb ae/A+ 0.05	1 a	0 a	96 a	100 a	100 a	100 a	99 a	100 a	71 d	71 b	59 bc

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

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

[3] Brxnl/fnxprp/pyrslftl is a formulated mixture of bromoxynil, fenoxaprop and pyrasulfotole sold as Wolverine. Pyrslftl/brxnl is a 1:8 formulated mixture of pyrasulfotole and bromoxynil sold as Huskie. Trflxystrbn/prpcnzle is a formulated mixture of trifloxystrobin and propiconazole fungicides sold as Stratego. Adigor is a proprietary adjuvant. Flrxypyr/brxnl is a formulated mixture of fluroxypyr and bromoxynil sold as Starane NXT. Bromoxynil /MCPA is a 1:1 formulated mixture of bromoxynil and MCPA sold as Bronate Advanced. Fluroxypyr/dicamba is a formulated mixture of fluroxypyr and dicamba in a 1:1.28 ratio sold as Pulsar. All herbicides were applied May 22, 2009.

Broadleaf weed control in spring wheat. 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 15, 2009 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of spring wheat (var. Jerome) and broadleaf weeds to 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 6, 10 in rows 30 ft long. Spring wheat was planted at 100 lb/A on April 15. Postemergence treatments were applied on May 14 when winter wheat was 4 to 6 inch in height and weeds were small. Postemergence treatments were applied with a compressed air backpack sprayer equipped with 11004 nozzles calibrated to deliver 30 gal/A at 35 psi. Russian thistle and redroot pigweed infestations were moderate throughout the experimental area. Treatments were evaluated on June 11. Spring wheat was harvested for yield on August 17.

No crop injury was noted from any of the treatments. All treatments except the weedy check gave excellent control of both Russian thistle and redroot pigweed. Yields were 1247 to 1470 lb/A higher in the herbicide treated plots as compared to the weedy check.

Table. Broadleaf weed control and yield of Jerome spring wheat treated with postemergence herbicides.

Treatments[1]	Rate	Crop injury[2]	Weed control[2] SASKR	AMARE	Yield
	oz ai/A	%	%	%	lb/A
Florasulam/fluroxypyr/pyroxsulam + NIS + AMS	1.7	0	100	100	3703
Fenoxaprop + pyrasulfotole/bromoxynil + AMS	1.3 + 2.9	0	100	100	3877
Flucarbazone+clopyralid/fluroxypyr	0.29 + 3.0	0	98	100	3877
Pinoxaden + thifensulfuron/tribenuron+ fluroxypyr	0.9 + 0.3 1.0	0	99	100	3732
Clodinafop + fluroxypyr + MCPA ester	3.2 + 1.5 4.3	0	100	100	3770
Florasulam/fluroxypyr/pyroxsulam + MCPA ester + AMS	1.7 4.3	0	100	100	3770
Thifensulfuron+2,4-D + NIS	0.3 + 4.0	0	100	100	3712
Tribenuron/thifensulfuron + 2,4-D + NIS	0.25 4.0	0	100	100	3770
2,4-D + NIS	6.0	0	97	100	3770
Dicamba + NIS	2.0	0	100	100	3654
Thifensulfuron + dicamba + NSI	0.3 + 1.0	0	100	100	3654
Weedy check		0	0	0	2407

[1] Nonionic surfactant (NIS) applied at 1% v/v and ammonium sulfate (AMS) applied at 3.0 lb/A.

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

Italian ryegrass control in wheat. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established to evaluate crop response and Italian ryegrass (LOLMU) control in winter wheat with 1) flufenacet/metribuzin combinations and 2) pyrasulfotole/bromoxynil combinations with grass herbicides near Pullman, WA and 3) in spring wheat with flucarbazone formulations at two application timings near Moscow, ID. ARY-0454-105 is a suspension concentrate formulation of flucarbazone and it was compared to a water dispersible granule (WDG) flucarbazone formulation. Studies were arranged in a randomized complete block design with four replications and included an untreated check. 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 Pullman, the entire studies were sprayed for broadleaf weed control with metsulfuron at 0.0156 lb ai/A on May 25, 2009 and at Moscow, the study was sprayed with thifensulfuron/tribenuron at 0.025 lb ai/A and bromoxynil/MCPA at 0.25 lb ae/A on June 17, 2009. Wheat response and Italian ryegrass control were evaluated visually. Wheat grain was harvested at the Pullman and Moscow sites with a small plot combine on August 5 and September 2, 2009, respectively.

Table 1. Application and soil data.

Study	Flufenacet/metribuzin		Pyrasulfotole/bromoxynil	Flucarbazone	
Location	Pullman, WA		Pullman, WA	Moscow, ID	
Application date	10/6/09	5/8/09	5/8/09	6/4/09	6/12/09
Growth stage					
Winter wheat	preemergence	3 tiller	3 tiller	--	--
Spring wheat	--	--	--	1 tiller	2 tiller
Italian ryegrass (LOLMU)	preemergence	1 tiller	1 tiller	3 leaf	1 tiller
Air temperature (F)	63	52	52	81	62
Relative humidity (%)	58	82	80	55	76
Wind (mph, direction)	3, W	4, W	2, W	1, W	0
Dew present?	no	no	no	no	yes
Cloud cover (%)	100	40	20	100	20
Soil moisture	adequate	excessive	excessive	adequate	adequate
Soil temperature at 2 in (F)	62	47	45	80	60
pH	5.6			5.9	
OM (%)	3.0			3.0	
CEC (meq/100g)	20			23	
Texture	silt loam			silt loam	

In the flufenacet/metribuzin study, no treatment injured winter wheat (data not shown). Flufenacet/metribuzin plus triasulfuron or any postemergence herbicide, except pinoxaden, controlled Italian ryegrass 83 to 92% (Table 2). Pinoxaden treatments did not control Italian ryegrass most likely due to ACCase resistance. Wheat grain yield was greater in all herbicide treated plots, except pyroxsulam and pyroxsulam/florasulam/fluroxypyr alone treatments, compared to the untreated check. Wheat grain yield tended to increase as Italian ryegrass control increased. Wheat grain test weight ranged from 62 to 64 lb/bu.

In the pyrasulfotole/bromoxynil study, no treatment injured winter wheat (data not shown). Italian ryegrass control ranged from 74 to 80% with all herbicide treatments (Table 3). Pyrasulfotole/bromoxynil combined with mesosulfuron increased wheat grain yield compared to mesosulfuron alone. Wheat grain yield was greater than the untreated check in all herbicide treated plots. Wheat grain test weight ranged from 64 to 65 lb/bu.

In the flucarbazone study, no treatment injured spring wheat (data not shown). Pinoxaden controlled Italian ryegrass 98% (Table 4). Italian ryegrass control was better with flucarbazone WDG compared to ARY-0454-105 treatments at the 3 leaf application timing. Wheat grain yield and test weight ranged from 28 to 39 bu/A and 61 and 63 lb/bu, respectively.

Table 2. Italian ryegrass control and wheat response with flufenacet/metribuzin combinations near Pullman, WA in 2009.

Treatment[1]	Rate	Application timing[2]	LOLMU control[3]	Wheat	
				Yield	Test weight
	lb ai/A		%	bu/A	lb/bu
Flufenacet/metribuzin	0.34	preemergence	60	55	64
Flufenacet/metribuzin	0.425	preemergence	72	62	64
Triasulfuron	0.026	preemergence	51	59	64
Flufenacet/metribuzin +	0.425	preemergence			
triasulfuron	0.026	preemergence	87	68	64
Flufenacet/metribuzin +	0.34	preemergence			
pyroxsulam +	0.0164	1 tiller			
NIS +	0.5	1 tiller			
AMS	1.52	1 tiller	89	63	64
Pyroxsulam +	0.0164	1 tiller			
NIS +	0.5	1 tiller			
AMS	1.52	1 tiller	59	49	64
Pyroxsulam +	0.0164	1 tiller			
NIS	0.5	1 tiller	49	43	64
Flufenacet/metribuzin +	0.34	preemergence			
mesosulfuron +	0.0134	1 tiller			
NIS +	0.5	1 tiller			
AMS	1.52	1 tiller	89	58	64
Mesosulfuron +	0.0134	1 tiller			
NIS +	0.5	1 tiller			
AMS	1.52	1 tiller	70	54	64
Flufenacet/metribuzin	0.34	preemergence			
pyroxsulam/florasulam/fluroxypyr +	0.105	1 tiller			
NIS +	0.5	1 tiller			
AMS	1.52	1 tiller	83	59	64
Pyroxsulam/florasulam/fluroxypyr +	0.105	1 tiller			
NIS +	0.5	1 tiller			
AMS	1.52	1 tiller	56	51	64
Pyroxsulam/florasulam/fluroxypyr +	0.105	1 tiller			
NIS	0.5	1 tiller	59	49	64
Flufenacet/metribuzin +	0.34	preemergence			
mesosulfuron/iodosulfuron +	0.0135	1 tiller			
NIS +	0.5	1 tiller			
UAN	5	1 tiller	92	70	63
Mesosulfuron/iodosulfuron +	0.0135	1 tiller			
NIS +	0.5	1 tiller			
UAN	5	1 tiller	73	55	64
Flufenacet/metribuzin	0.34	preemergence			
pinoxaden	0.0534	1 tiller	78	66	64
Pinoxaden	0.0534	1 tiller	38	54	63
Untreated check	--	--	--	43	64
LSD (0.05)			12	11	NS
Density (plants/ft^2)			25		

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[1] NIS is a non-ionic surfactant (R-11). AMS is ammonium sulfate (dry). UAN is urea ammonium nitrate (URAN). NIS and UAN rates are expressed as % v/v.

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

[3] June 26, 2009 evaluation.

Table 3. Italian ryegrass control and winter wheat response with pyrasulfotole/bromoxynil combinations with grass herbicides near Pullman, WA in 2009.

Treatment[1]	Rate	Italian ryegrass control[2]	Wheat Yield	Wheat Test weight
	lb ai/A	%	bu/A	lb/bu
Mesosulfuron	0.0134	79	60	64
Mesosulfuron +	0.0134			
pyrasulfotole/bromoxynil	0.217	80	76	65
Mesosulfuron/iodosulfuron	0.0158	78	71	65
Mesosulfuron/iodosulfuron +	0.0158			
pyrasulfotole/bromoxynil	0.217	74	63	64
Pyroxsulam	0.0614	76	73	64
Pyroxsulam +	0.0614			
pyrasulfotole/bromoxynil	0.217	74	69	64
Untreated check	--	--	51	64
LSD (0.10)		NS	9	NS
Density (plants/ft^2)		15		

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

[2] June 22, 2009 evaluation.

Table 4. Italian ryegrass control and spring wheat response with flucarbazone formulations at two application timings near Moscow, ID in 2009.

Treatment[1]	Rate	Application timing[2]	LOLMU control[3]	Wheat Yield	Wheat Test weight
	lb ai/A		%	bu/A	lb/bu
ARY-0454-105	0.0268	3 leaf	58	35	63
ARY-0454-105 +	0.0268				
thifensulfuron/tribenuron	0.0188	3 leaf	70	39	62
Flucarbazone WDG	0.0263	3 leaf	85	30	62
ARY-0454-105	0.0268	1 tiller	86	39	63
Pinoxaden	0.054	1 tiller	98	38	63
Flucarbazone WDG +	0.0263				
fenoxaprop	0.0078	1 tiller	81	28	62
Untreated check	--	--	--	29	61
LSD (0.10)			10	NS	NS
Density (plants/ft^2)			10		

[1] ARY-0454-105 is a suspension concentrate formulation of flucarbazone. A basic blend (Quad 7) was applied at 1% v/v with all treatments, except pinoxaden.

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

[3] July 16, 2009 evaluation.

Catchweed bedstraw control in winter wheat with pinoxaden/florasulam. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in 'Paladin' winter wheat near Genesee, Idaho to evaluate catchweed bedstraw control and winter wheat response with pinoxaden/florasulam combined with other broadleaf herbicides. 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 catchweed bedstraw control were evaluated visually.

Table 1. Application and soil data.

Location	Genesee, Idaho
Application date	April 21, 2009
Growth stage	
Winter wheat	4 tiller
Catchweed bedstraw	3 inches tall
Air temperature (F)	80
Relative humidity (%)	35
Wind (mph)	5, SW
Cloud cover (%)	90
Soil moisture	adequate
Soil temperature at 2 inch (F)	65
pH	5.6
OM (%)	3.1
CEC (meq/100g)	28
Texture	silt loam

No treatment visually injured winter wheat (data not shown). On May 15, fluroxypyr/bromoxynil and pyrasulfotole/bromoxynil combinations tended to control catchweed bedstraw 90% or better but they were not significantly different from all other treatments (Table 2). On June 15, all treatments controlled catchweed bedstraw 90% or greater, except pinoxaden + thifensulfuron/tribenuron + MCPA ester (85%) and fenoxaprop/pyrasulfotole/bromoxynil (81%) which were the only treatments that did not contain florasulam.

Table 2. Catchweed bedstraw control with pinoxaden/florasulam near Genesee, ID in 2009.

		Catchweed bedstraw control	
Treatment[1]	Rate[2]	May 15	June 15
	lb ai/A	%	%
Pinoxaden/florasulam	0.058	70	92
Pinoxaden/florasulam +	0.058		
bromoxynil/MPCA	0.5	77	98
Pinoxaden/florasulam +	0.054		
bromoxynil/MCPA	0.5	82	96
Pinoxaden/florasulam +	0.058		
fluroxypyr	0.062	80	94
Pinoxaden/florasulam +	0.054		
fluroxypyr	0.062	88	95
Pinoxaden/florasulam +	0.058		
fluroxypyr/bromoxynil	0.181	94	95
Pinoxaden/florasulam +	0.054		
fluroxypyr/bromoxynil	0.181	90	98
Pinoxaden/florasulam +	0.058		
fluroxypyr/MCPA	0.333	76	98
Pinoxaden/florasulam +	0.054		
fluroxypyr/MCPA	0.333	86	96
Pinoxaden/florasulam +	0.058		
fluroxypyr/clopyralid	0.117	74	98
Pinoxaden/florasulam +	0.054		
fluroxypyr/clopyralid	0.117	85	97
Pinoxaden/florasulam +	0.058		
pyrasulfotole/bromoxynil	0.177	97	98
Pinoxaden/florasulam +	0.054		
pyrasulfotole/bromoxynil	0.177	96	95
Pinoxaden +	0.054		
thifensulfuron/tribenuron +	0.0188		
MCPA ester	0.347	69	85
Pyroxsulam/fluroxypyr/florasulam	0.105	80	96
Fenoxaprop/pyrasulfotole/bromoxynil	0.293	69	86
LSD (0.05)		NS	5
Density (plants/ft^2)		10	

[1] A methylated seed oil (Adigor) was applied with all pinoxaden/florasulam treatments at 0.6 pt/A. Ammonium sulfate (Bronc) was applied at 0.5 lb ai/A with pyrasulfotole/bromoxynil. A nonionic surfactant (R-11) was applied with pyroxsulam/fluroxypyr/florasulam at 0.25% v/v.

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

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 winter wheat to evaluate downy brome control with 1) preemergence and postemergence herbicide combinations near Potlatch, ID; 2) standard grass herbicides at two application times and 3) pyrasulfotole/bromoxynil combined with grass herbicides near Lewiston, ID. Plots were arranged in a randomized complete block design with four replications and included an untreated check. 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 Lewiston site, both studies were oversprayed with clopyralid/MCPA at 0.69 lb ae/A on April 21, 2009 for broadleaf weed control. At the Potlatch site, the study was oversprayed with thifensulfuron/tribenuron at 0.025 lb ai/A and clopyralid/fluroxypyr at 0.25 lb ae/A on May 26, 2009 for broadleaf weed control. In all experiments, wheat injury and downy brome control were evaluated visually. Wheat grain was harvested at the Lewiston site on July 20, 2009. Wheat grain was not harvested at the Potlatch site due to wheat stand variability.

Table 1. Application and soil data.

Experiment	Pre and post combinations			Two application times		Pyrasulfotole/bromoxynil
Location	Potlatch, ID			Lewiston, ID		
Winter wheat variety	OR CF 102			West Bred 528		
Application date	10/19/08	5/1/09	5/22/09	3/27/09	4/16/09	4/16/09
Growth stage						
Winter wheat	preemergence	2 tiller	3 tiller	3 tiller	4 tiller	4 tiller
Downy brome (BROTE)	preemergence	1 tiller	boot	2 leaf	3 tiller	3 tiller
Air temperature (F)	62	63	76	62	50	54
Relative humidity (%)	59	42	33	52	63	63
Wind (mph, direction)	0	3, NE	3, W	0	2, W	2, W
Dew present?	no	no	no	no	yes	yes
Cloud cover (%)	10	20	0	100	50	50
Soil moisture	adequate	adequate	dry	adequate	adequate	adequate
Soil temperature at 2 in (F)	54	50	73	52	50	52
pH	5.2			5.0		
OM (%)	2.5			3.7		
CEC (meq/100g)	18			22		
Texture	silt loam			silt loam		

In the preemergence study, wheat injury ranged from 0 to 18%, but did not differ among treatments (Table 1). Diclofop and flufenacet treatments and the split applications of imazamox and flucarbazone applied at the 1 tiller stage controlled downy brome 75 to 90%.

In the timing study, propoxycarbazone treatments tended to injure winter wheat more at the 2 leaf timing compared to the 3 tiller application (Table 3). Pyroxsulam and treatments containing propoxycarbazone tended to control downy brome better at the 2 leaf timing (90 to 92%) compared to the 3 tiller timing (49 to 69%). Wheat grain yield also tended to be greater at the earlier timing compared to the later timing (average yield 39 versus 36 bu/A). Downy brome control and wheat grain yield were affected by variability in downy brome density within a replication.

In the pyrasulfotole/bromoxynil study, mesosulfuron alone or with pyrasulfotole/bromoxynil, and propoxycarbazone alone injured winter wheat 12 and 16% (Table 4). Pyroxsulam controlled downy brome 95 and 96% but did not differ from propoxycarbazone/mesosulfuron, mesosulfuron or mesosulfuron/iodosulfuron alone, and propoxycarbazone plus pyrasulfotole/bromoxynil. Wheat grain yield ranged from 36 to 42 bu/A for the herbicide treated plots but tended be lowest for the untreated check (35 bu/A).

Table 2. Downy brome control and wheat response with preemergence herbicide combinations near Potlatch, Idaho in 2009.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	BROTE control[3]
	lb ai/A		%	%
Triasulfuron	0.026	preemergence	6	25
Flucarbazone	0.027	preemergence	15	28
Triasulfuron +	0.026	preemergence		
flucarbazone	0.027	preemergence	5	38
Triasulfuron +	0.026	preemergence		
flucarbazone +	0.0134	preemergence		
flucarbazone	0.0134	boot	16	65
Triasulfuron +	0.026	preemergence		
Imazamox	0.0313	boot	6	70
Imazamox	0.0313	boot	10	64
Imazamox	0.047	boot	0	58
Imazamox +	0.0156	1 tiller		
imazamox	0.0156	boot	1	90
Triasulfuron +	0.026	preemergence		
propoxycarbazone/mesosulfuron	0.025	boot	9	62
Propoxycarbazone/mesosulfuron	0.025	boot	14	50
Flucarbazone +	0.018	preemergence		
imazamox	0.0313	boot	8	58
Flucarbazone +	0.018	preemergence		
propoxycarbazone/mesosulfuron	0.025	boot	11	71
Diclofop	1	preemergence	8	75
Diclofop +	1	preemergence		
Flucarbazone	0.018	preemergence	15	85
Flucarbazone +	0.0134	preemergence		
flucarbazone +	0.0134	1 tiller		
NIS +	0.25% v/v	1 tiller		
UAN	2.5% v/v	1 tiller	2	79
Flucarbazone +	0.0134	preemergence		
flucarbazone +	0.0134	1 tiller		
basic blend	1% v/v	1 tiller	5	76
Flufenacet	0.338	preemergence	14	89
Flufenacet +	0.338	preemergence		
diclofop	1	preemergence	12	88
Flufenacet +	0.204	preemergence		
diclofop	1	preemergence	18	90
LSD (0.05)			NS	18
Density (plants/ft^2)				10

[1] NIS is a 90% nonionic surfactant (R-11). NIS was applied at 0.25% v/v with imazamox and flucarbazone at the 1 tiller timing and at 0.5% v/v with propoxycarbazone/mesosulfuron. UAN is urea ammonium nitrate (URAN). UAN was applied at 2.5% v/v with imazamox and flucarbazone at the 1 tiller timing and at 5% v/v with propoxycarbazone/mesosulfuron.

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

[3] June 10, 2009 evaluation.

Table 3. Downy brome control and wheat response with pyroxsulam and standard grass herbicides at two application times near Lewiston, Idaho in 2009.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	BROTE control[3]	Wheat yield
	lb ai/A		%	%	bu/A
Pyroxsulam	0.0164	2 leaf	6	90	40
Propoxycarbazone	0.0394	2 leaf	12	92	37
Propoxycarbazone	0.0525	2 leaf	11	92	34
Propoxycarbazone/mesosulfuron	0.0223	2 leaf	4	92	42
Sulfosulfuron	0.0312	2 leaf	2	62	41
Mesosulfuron	0.0134	2 leaf	0	66	40
Pyroxsulam	0.0164	3 tiller	8	61	37
Propoxycarbazone	0.0394	3 tiller	2	50	34
Propoxycarbazone	0.0525	3 tiller	8	69	39
Propoxycarbazone/mesosulfuron	0.0223	3 tiller	8	49	35
Sulfosulfuron	0.0312	3 tiller	2	70	36
Mesosulfuron	0.0134	3 tiller	2	48	38
Untreated check	--	--	--	--	35
LSD (0.05)			NS	NS	4
Density (plants/ft^2)				10	

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

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

[3] June 4, 2009 evaluation.

Table 4. Downy brome control and wheat response with pyrasulfotole/bromoxynil combinations with grass herbicides near Lewiston, ID in 2009.

Treatment[1]	Rate	Wheat injury[2]	Downy brome control[2]	Wheat yield
	lb ai/A	-------------------%	------------------	bu/A
Propoxycarbazone/mesosulfuron	0.0246	10	91	37
Propoxycarbazone/mesosulfuron +	0.0246			
pyrasulfotole/bromoxynil	0.241	8	94	38
Mesosulfuron	0.0134	16	89	38
Mesosulfuron +	0.0134			
pyrasulfotole/bromoxynil	0.241	12	86	38
Mesosulfuron/iodosulfuron	0.0158	2	90	39
Mesosulfuron/iodosulfuron +	0.0158			
pyrasulfotole/bromoxynil	0.241	9	86	39
Pyroxsulam	0.0164	4	96	39
Pyroxsulam +	0.0164			
pyrasulfotole/bromoxynil	0.241	2	95	42
Propoxycarbazone	0.04	12	82	40
Propoxycarbazone +	0.04			
pyrasulfotole/bromoxynil	0.241	2	91	38
Sulfosulfuron	0.0312	4	82	40
Sulfosulfuron +	0.0312			
pyrasulfotole/bromoxynil	0.241	4	84	36
Untreated check	--	--	--	35
LSD (0.05)		7	9	NS
Density (plants/ft^2)			10	

[1] Nonionic surfactant (R-11) was applied at 0.25% v/v with pyrasulfotole/bromoxynil treatments and at 0.5% v/v with all other treatments. Urea ammonium nitrate (URAN) was applied at 5% v/v with all treatments except propoxycarbazone and pyroxsulam. Ammonium sulfate (Bronc) was applied at 1.5 lb ai/A with pyroxsulam.

[2] June 4, 2009 evaluation.

Mayweed chamomile control in winter wheat. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies were established in a 'Chukar/Hiller' mix winter wheat near Moscow, Idaho to evaluate wheat response and mayweed chamomile control with 1) thifensulfuron/tribenuron herbicides and 2) clopyralid/fluroxypyr compared to pyrasulfotole/bromoxynil. The 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). Wheat response and mayweed chamomile control were evaluated visually.

Table 1. Application and soil data.

	Thifensulfuron/tribenuron study	Clopyralid/fluroxypyr study
Application date	May 18, 2009	May 18, 2009
Growth stage		
Winter wheat	3 tiller	3 tiller
Mayweed chamomile	2 inches	2 inches
Air temperature (F)	77	77
Relative humidity (%)	45	51
Wind (mph)	0	1, N
Cloud cover (%)	30	30
Soil moisture	excessive	excessive
Soil temperature at 2 inch (F)	65	70
pH	5.9	
OM (%)	2.9	
CEC (meq/100g)	22	
Texture	silt loam	

In the thifensulfuron/tribenuron study, no treatment visually injured winter wheat (data not shown). At both evaluation dates, bromoxynil/MCPA plus pinoxaden combinations tended to improve mayweed chamomile control compared to thifensulfuron/tribenuron alone (Table 2). All treatments controlled mayweed chamomile better than Nimble alone, which was applied at a lower rate than other thifensulfuron/tribenuron products.

In the clopyralid/fluroxypyr study, no treatment visually injured winter wheat (data not shown). On June 11, mayweed chamomile control was 84 to 94% with all treatments but by June 30, all treatments controlled mayweed chamomile 90 to 97% (Table 3).

Table 2. Mayweed chamomile control with thifensulfuron/tribenuron herbicides near Moscow, ID in 2009.

		Mayweed chamomile control	
Treatment[1]	Rate[2]	6/11	6/30
	lb ai/A	%	%
Thifensulfuron/tribenuron (Edition Broadspec)	0.0313	92	94
Thifensulfuron/tribenuron (Affinity BroadSpec)	0.0313	91	90
Thifensulfuron/tribenuron (Nimble)	0.014	82	82
Thifensulfuron/tribenuron (Edition Tank Mix) +	0.025		
bromoxynil/MCPA +	0.5		
pinoxaden	0.054	98	97
Thifensulfuron/tribenuron (Affinity TankMix)+	0.025		
bromoxynil/MCPA +	0.5		
pinoxaden	0.054	96	97
Thifensulfuron/tribenuron (Nimble) +	0.0188		
bromoxynil/MCPA +	0.5		
pinoxaden	0.054	95	96
LSD (0.05)		4	5
Density (plants/ft^2)		10	

[1] Trade names included for clarification of formulation comparisons. A nonionic surfactant (R-11) was applied at 0.25% v/v/ with all treatments.

[2] Bromoxynil/MCPA rate is lb ae/A.

Table 3. Mayweed chamomile control with clopyralid/fluroxypyr near Moscow, ID in 2009.

Treatment[1]	Rate[2]	Mayweed chamomile control	
		6/11	6/30
	lb ae/A	%	%
Clopyralid/fluroxypyr	0.25	91	95
Clopyralid/fluroxypyr +	0.25		
MCPA ester	0.25	88	96
Clopyralid/fluroxypyr +	0.25		
2,4-D ester	0.25	89	94
Clopyralid/fluroxypyr +	0.25		
thifensulfuron/tribenuron	0.0078	92	96
Fluroxypyr/bromoxynil +	0.48		
MCPA ester	0.25	94	90
Fluroxypyr/bromoxynil +	0.48		
Florasulam/MCPA	0.315	93	97
Pyrasulfotole/bromoxynil	0.177	84	91
Pyrasulfotole/bromoxynil	0.217	88	91
Pyrasulfotole/bromoxynil +	0.177		
fluroxypyr	0.069	86	92
LSD (0.05)		NS	NS
Density (plants/ft^2)		10	

[1] A nonionic surfactant (R-11) at 0.25% v/v was applied with thifensulfuron/tribenuron. Ammonium sulfate (Bronc) was applied at 0.5 lb ai/A with pyrasulfotole/bromoxynil treatments.

[2] Thifensulfuron/tribenuron rate is in lb ai/A.

Rattail fescue 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 to evaluate rattail fescue control with glyphosate plus flucarbazone combinations applied prior to planting and with flufenacet/metribuzin combinations applied pre and postemergence in 'IDO 587' winter wheat near Moscow, ID. 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). Winter wheat was seeded on September 29, 2008. Both studies were oversprayed for broadleaf weed control with thifensulfuron/tribenuron at 0.0313 lb ai/A and pyrasulfotole/bromoxynil at 0.177 lb ae/A on May 15, 2009. Winter wheat injury and rattail fescue control were evaluated visually during the growing season. Grain was not harvested due to a variable wheat stand caused by winter kill.

Table 1. Application and soil data.

	Glyphosate/flucarbazone study		Flufenacet/metribuzin study	
Application date	9/23/08	5/8/09	10/6/08	5/8/09
Growth stage				
Winter wheat	preplant	1 tiller	preemergence	1 tiller
Rattail fescue (VLPMY)	1 leaf	2 tiller	preemergence	2 tiller
Air temperature (F)	62	59	53	59
Relative humidity (%)	45	60	75	60
Wind (mph, direction)	0	2, W	3, E	2, W
Dew present?	no	no	no	no
Cloud cover (%)	90	20	100	20
Soil moisture	adequate	excessive	adequate	excessive
Soil temperature at 2 inch (F)	60	50	52	50
pH	5.6			
OM (%)	2.8			
CEC (meq/100g)	16			
Texture	silt loam			

In the glyphosate plus flucarbazone combination study, winter wheat was injured in all treatments including the untreated check 12 to 32% (Table 2). Wheat injury was not significant most likely due to a variable wheat stand caused by winter kill. Glyphosate plus flucarbazone preplant (except at the lowest glyphosate rate) or flucarbazone as a split application improved rattail fescue control 82 to 91% compared to glyphosate alone (7%).

In the flufenacet/metribuzin combinations study, winter wheat injury ranged from 24 to 74% in all treatments including the untreated check (Table 3). Wheat injury was not significant most likely due to a variable wheat stand caused by winter kill, but injury was greater in the flufenacet/metribuzin alone, flucarbazone preemergence alone, flufenacet/metribuzin plus flucarbazone preemergence, and diuron treatments (53 to 74%). All treatments containing flufenacet/metribuzin controlled rattail fescue 93 to 99%. Flucarbazone alone postemergence and sulfosulfuron alone controlled rattail fescue 70 and 75%, respectively.

Table 2. Winter wheat response and rattail fescue control with glyphosate plus flucarbazone combinations near Moscow, ID in 2009.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	Rattail fescue control[4]
	lb ai/A		%	%
Glyphosate	0.56	preplant	15	5
Glyphosate	0.75	preplant	18	8
Glyphosate	0.94	preplant	22	8
Glyphosate +	0.56	preplant		
flucarbazone	0.027	preplant	18	15
Glyphosate +	0.75	preplant		
flucarbazone	0.027	preplant	15	45
Glyphosate +	0.94	preplant		
flucarbazone	0.027	preplant	15	68
Glyphosate +	0.56	preplant		
flucarbazone +	0.0135	preplant		
flucarbazone	0.0135	2 tiller	32	74
Glyphosate +	0.75	preplant		
flucarbazone +	0.0135	preplant		
flucarbazone	0.0135	2 tiller	20	40
Glyphosate +	0.94	preplant		
flucarbazone +	0.0135	preplant		
flucarbazone	0.0135	2 tiller	12	50
LSD (0.05)			NS	33
Density (plants/ft^2)				20

[1] Ammonium sulfate (Bronc) was applied at 10 lb ai/100 gal mix with all glyphosate treatments. A nonionic surfactant (R-11) at 0.25% v/v and urea ammonium nitrate (URAN) at 2.5% v/v was applied with flucarbazone at the 2 tiller stage. Glyphosate rate is in lb ae/A.

[2] Application timing based on rattail fescue growth stage.

[3] June 15, 2009 evaluation.

[4] June 15, 2009 evaluation.

Table 3. Winter wheat injury and rattail fescue control with flufenacet/metribuzin combinations near Moscow, ID in 2009.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	Rattail fescue control[4]
	lb ai/A		%	%
Flufenacet/metribuzin	0.425	preemergence	56	93
Flucarbazone	0.027	preemergence	66	15
Flufenacet/metribuzin +	0.425	preemergence		
flucarbazone	0.027	preemergence	53	98
Flufenacet/metribuzin +	0.425	preemergence		
flucarbazone +	0.018	preemergence		
flucarbazone	0.009	2 tiller	44	99
Flucarbazone +	0.018	preemergence		
flucarbazone	0.009	2 tiller	44	39
Flucarbazone	0.027	2 tiller	44	70
Sulfosulfuron	0.031	2 tiller	24	75
Flufenacet/metribuzin +	0.425	preemergence		
sulfosulfuron	0.031	2 tiller	45	99
Sulfosulfuron +	0.031	2 tiller		
metribuzin	0.1875	2 tiller	39	51
Diuron	1	2 tiller	64	45
Flufenacet/metribuzin +	0.425	preemergence		
diuron	1	2 tiller	74	99
LSD (0.05)			NS	26
Density (plants/ft^2)				20

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

[2] Application timing based on rattail fescue growth stage.

[3] June 15, 2009 evaluation.

[4] June 15, 2009 evaluation.

Prickly lettuce control in winter wheat with pyrasulfotole/bromoxynil and fluroxypyr. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in 'Eddy' hard red winter wheat near Lewiston, Idaho to evaluate ALS- resistant prickly lettuce control and wheat response with alternate modes of action, pyrasulfotole/bromoxynil and fluroxypyr. ARY-0548-003 is a water dispersible granule formulation of fluroxypyr and was compared to the emulsifiable concentrate fluroxypyr formulation. The 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). Wheat response and prickly lettuce control were evaluated visually.

Table 1. Application and soil data.

	Pyrasulfotole/bromoxynil study	Fluroxypyr study
Application date	April 21, 2009	April 27, 2009
Growth stage		
Winter wheat	3 tiller	4 tiller
Prickly lettuce	4 leaf and 4 inches tall	4 leaf and 5 inches tall
Air temperature (F)	73	59
Relative humidity (%)	53	48
Wind (mph)	3, SE	3, SE
Cloud cover (%)	20	100
Soil moisture	adequate	adequate
Soil temperature at 2 inch (F)	65	55
pH	5.1	
OM (%)	4.0	
CEC (meq/100g)	24	
Texture	silt loam	

In the pyrasulfotole/bromoxynil study, no treatment visually injured winter wheat (data not shown). At both evaluation dates, prickly lettuce control was 93 to 99% for all treatments (Table 2).

In the fluroxypyr combination study, no treatment visually injured winter wheat (data not shown). At both evaluation dates, MCPA ester and clopyralid treatments controlled prickly lettuce 90 to 96% (Table 3). ARY-0548-003 plus thifensulfuron/tribenuron combinations did not adequately control prickly lettuce. Prickly lettuce control was similar for WDG and EC formulations of fluroxypyr when combined with MCPA ester. The prickly lettuce population was ALS resistant and therefore was not controlled by thifensulfuron/tribenuron alone.

Table 2. Prickly lettuce control with pyrasulfotole/bromoxynil near Lewiston, ID in 2009.

		Prickly lettuce control	
Treatment[1]	Rate[2]	5/26	6/11
	lb ai/A	%	%
Pyrasulfotole/bromoxynil	0.217	96	99
Pyrasulfotole/bromoxynil +	0.177		
MCPA ester	0.347	98	99
Pyrasulfotole/bromoxynil +	0.177		
fluroxypyr	0.062	98	99
Pyrasulfotole/bromoxynil +	0.177		
dicamba	0.125	97	99
Pyrasulfotole/bromoxynil +	0.177		
metsulfuron	0.00375	93	99
Bromoxynil/MCPA +	0.38		
dicamba	0.12	98	99
LSD (0.05)		3	NS
Density (plants/ft^2)		10	

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[1] A nonionic surfactant (R-11) and urea ammonium nitrate (URAN) were applied at 0.5 and 5% v/v, respectively, with all pyrasulfotole/bromoxynil treatments.

[2] MCPA ester and bromoxynil/MCPA rates are lb ae/A.

Table 3. Prickly lettuce control with fluroxypyr combinations near Lewiston, ID in 2009.

Treatment[1]	Rate[2]	Prickly lettuce control	
		5/26	6/11
	lb ai/A	%	%
Thifensulfuron/tribenuron +	0.0187		
NIS	0.25	18	8
Thifensulfuron/tribenuron +	0.00625		
clopyralid/fluroxypyr	0.14	94	90
Thifensulfuron/tribenuron +	0.0061		
ARY-0548-003 +	0.0549		
NIS	0.25	36	29
Thifensulfuron/tribenuron +	0.0081		
ARY-0548-003 +	0.0729		
NIS	0.25	52	48
Thifensulfuron/tribenuron +	0.0102		
ARY-0548-003 +	0.0918		
NIS	0.25	74	71
Thifensulfuron/tribenuron +	0.0122		
ARY-0548-003 +	0.1098		
NIS	0.25	69	61
Thifensulfuron/tribenuron +	0.0081		
ARY-0548-003 +	0.0729		
MCPA ester +	0.231		
NIS	0.25	95	94
Thifensulfuron/tribenuron +	0.0081		
ARY-0548-003 +	0.0729		
MCPA ester +	0.231		
NIS	0.25	96	91
ARY-0548-003 +	0.0624		
MCPA ester	0.347	98	96
Fluroxypyr EC+	0.0624		
MCPA ester	0.347	91	90
MCPA ester +	0.347		
clopyralid/fluroxypyr	0.188	96	95
LSD (0.05)		21	25
Density (plants/ft^2)		15	

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[1] ARY-0548-003 is a water dispersible granule formulation of fluroxypyr. NIS is nonionic surfactant (R-11) and its rate is in %v/v. EC is an emulsifiable concentrate formulation.

[2] Clopyralid/fluroxypyr, MCPA ester and fluroxypyr EC rates are lb ae/A.

Tumble mustard control in winter wheat. 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 September 10, 2008 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of winter wheat (var. Jagaline) and tumble mustard to 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 8, 16 in rows 30 ft long. Winter wheat was planted at 100 lb/A on September 10. Postemergence treatments were applied on March 2, 2009 when winter wheat was in the fourth or fifth tiller stage and tumble mustard was in the two inch rosette stage. Postemergence treatments were applied with a crop oil concentrate and Uran 32 at 0.5 and 1% v/v. Treatments were applied with a compressed air backpack sprayer equipped with 11004 nozzles calibrated to deliver 30 gal/A at 35 psi. Tumble mustard infestations were heavy throughout the experimental area. Treatments were evaluated on April 2. Winter wheat was harvested for yield on July 30, 2009.

No crop injury was noted from any of the treatments. All treatments except the weedy check gave over 90% or better control of tumble mustard. Yield was 3602 to 3961 lb/A higher in the herbicide treated plots as compared to the weedy check.

Table. Tumble mustard control and yield of Jagaline winter wheat treated with postemergence herbicides.

Treatments[1]	Rate	Crop injury[2]	Weed control[2] SSYAL	Yield
	oz ai/A	%	%	lb/A
Pyroxsulam	0.19	0	92	4487
Pyroxsulam	0.26	0	96	4580
Pyrasulfotole/bromoxynil +	2.9	0	100	4725
propoxycarbazone/mesosulfuron	0.33			
Pyrasulfotole/bromoxynil +	3.3	0	100	4846
propoxycarbazone/mesosulfuron	0.33			
Pyroxsulam + pendimethalin	0.19+15	0	91	4636
Pyroxsulam + pendimethalin	0.26+15	0	93	4741
Pyrasulfotole/bromoxynil +	2.9	0	99	4830
propoxycarbazone/mesosulfuron +	0.33			
pendimethalin	15			
Pyrasulfotole/bromoxynil+	3.3	0	100	4669
propoxycarbazone/mesosulfuron +	0.33			
pendimethalin	15			
Thifensulfuron + 2,4-D	0.38 + 6	0	98	4749
Weedy check		0	0	885

[1] All treatments were applied with a crop oil concentrate and urea ammonium nitrate at 2 and 1% v/v, respectively.
[1] Rated on a scale from 0 to 100 with 0 being no control or crop injury and 100 being dead plants.

Dry pea improves winter wheat tolerance to wild rye. Randy L. Anderson. (USDA-ARS, Brookings SD 57006). In previous research, we found that winter wheat tolerance to wild rye was affected by the preceding crop. Yield loss was only 6% following oat/pea but 18% following either spring wheat or soybean when 200 g/yd^2 of wild rye was present in winter wheat. Decreased tolerance following spring wheat is likely due to root diseases, but we were surprised that soybean was not beneficial to winter wheat tolerance compared to spring wheat. One possible reason may be that winter wheat was planted three weeks later because of late harvest of soybean. Delayed planting may have altered the interaction between winter wheat and wild rye, and possibly suppressed the benefit of soybean to winter wheat growth.

Therefore, we conducted a study to compare winter wheat tolerance to wild rye when preceded by soybean of two different maturity classes: 00.3 and 1.1. The earlier harvest of 00.3 maturity soybean will allow us to compare different planting dates of winter wheat following soybean. An oat/pea mixture (harvested for forage) and dry pea were also included as preceding crop treatments.

Methodology: The preceding crop treatments were established in the spring of 2008. Oat/pea and dry pea were harvested in early August; the 00.3 maturity soybean was harvested September 1 whereas the 1.1 cultivar was harvested September 30.

Winter wheat 'Harding' was planted September 10, 2008 into dry pea, oat/pea, and soybean (00.3) residue, and October 1 into soybean (1.1) stubble. Seeding rate of winter wheat was 100 lb/ac. A starter fertilizer consisting of 10 lb N/ac + 15 lb P/ac was banded with the seed, followed by N broadcast when wheat was in pseudostem development. The N rate was based on a yield goal of 75 bu/ac, and adjusted for N credits when legumes were the preceding crop. Environmental conditions were favorable for winter wheat growth.

Wild rye was established in 1 yd by 2 yd quadrats, three days after winter wheat had emerged. Rye was planted by hand at 15 seeds/yd^2 between wheat rows and 12 inches apart within the interrow area. One week before wheat harvest, rye was harvested to determine biomass per quadrat; dry weight was 350 $\pm$ 23 g/yd^2 averaged across all treatments. Winter wheat grain yield was determined from the rye-infested quadrat as well as an adjacent rye-free quadrat of the same size by hand harvesting and bundle threshing; the rye-free quadrat was located in the same planted rows as the rye quadrat with a separation of 2 feet between quadrats. Yield loss (%) was determined by comparing adjacent weed-free and rye-infested quadrats.

Results: Winter wheat was most tolerant of wild rye following dry pea; yield loss due to rye interference was only 9% (see figure below). In contrast, winter wheat yield loss due to wild rye was more than 30% following either soybean cultivar. The difference in planting dates between the two soybean treatments did not affect winter wheat yield in either weed-free or wild rye-infested condition. The dry pea/oat mixture was also more favorable for winter wheat than either soybean treatment.

An intriguing trend was that winter wheat yielded more following dry pea than either soybean treatment, in both weed-free and rye-infested conditions. We were surprised at this difference, since both crops are legumes. Apparently, these crops affect winter wheat growth differently. One possible reason may be that dry pea improves water-use-efficiency (WUE) of winter wheat, thus minimizing impact of wild rye competition for water. In the semiarid Great Plains, winter wheat WUE was more than 30% higher following dry pea compared with fallow, winter wheat, or proso millet are preceding crops [J. Sustain. Agric. 26:97; 2005]. Other research has shown that soybean does not improve WUE of following crops [Agron. J. 85:203; 1993].

Management Implications: Producers can control weeds in crops with less herbicides by using a population-centered approach to weed management [Agron. J. 97:1579; 2005]. A key to this approach is devising rotations to include a diversity of crops, especially crops with different life cycles. Identifying crop sequences that improve tolerance to weeds will further strengthen population-centered management.

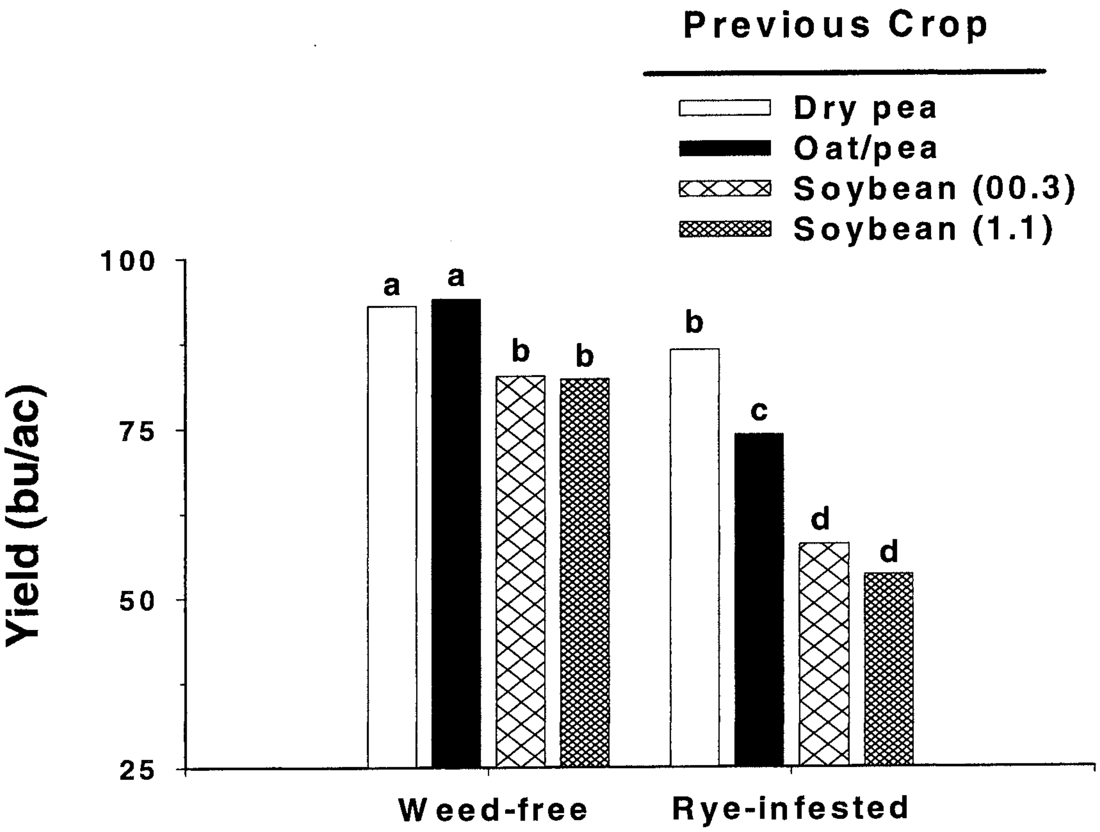

Figure. Yield of winter wheat as affected by preceding crop and wild rye interference. Bars with identical letters are not significantly different as determined by the Fischer's Protected LSD (0.05).

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). 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 with bromoxynil/MCPA applied during freezing night or large low to high temperature fluctuation. Identical studies were conducted near Pullman, WA and Pendleton, OR 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 ORCF 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, five days had freezing temperatures and at least 25 degree temperature fluctuation. Two weeks after the application date, one day had freezing temperatures and 10 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 15, 2009. 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 6, 2009.

Table 1. Application and soil data.

Planting date	September 26, 2008
Application date	April 5, 2009
Wheat growth stage	2 to 4 tiller
Air temperature (F)	60
Relative humidity (%)	45
Wind (mph, direction)	2, E
Cloud cover (%)	30
Soil moisture	excessive
Soil temperature at 2 inch (F)	58
pH	5.1
OM (%)	3.1
CEC (meq/100g)	17
Texture	silt loam

The variety by treatment interaction was not significant for wheat injury, yield, or test weight. At 7, 14 and 21 DAT, mesosulfuron plus bromoxynil/MCPA and mesosulfuron alone injured wheat 7, 10 and 9% and 4, 5, and 3%, respectively (Table 2). Eddy wheat injury at 7 DAT (4%) was greater than all other varieties (3%) (Table 3). By 14 DAT, wheat injury did not differ among varieties (data not shown). Wheat grain yield was lowest for Boundary compared to all other varieties (Table 3). Wheat grain yield and test weight did not differ among herbicide treatments and the untreated check (data not shown).

Table 2. Winter wheat injury averaged over winter wheat varieties in 2009.

		Wheat injury[2]		
Treatment[1]	Rate	7 DAT	14 DAT	21 DAT
	lb ai/A	%	%	%
Bromoxynil/MCPA	0.75	1c	0c	0c
Mesosulfuron	0.0134	4b	5b	3b
Mesosulfuron +	0.0134			
bromoxynil/MCPA	0.75	7a	10a	9a
Untreated check	--	--	--	--

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[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 3. Winter wheat injury and yield averaged over treatment in 2009.

Variety	Description	Wheat 7 DAT injury[1]	 Yield[1]
		%	lb/A
Eddy	hard red common	4a	5901a
Brundage 96	soft white common	3b	5870a
Madsen	soft white common	3b	5596a
Chukar	soft white club	3b	5481a
ORCF 102	soft white common	3b	5407a
Boundary	hard red common	3b	4585b

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

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). A study was established near Moscow, ID to evaluate the response of winter wheat varieties seeded into soil treated with fall applied imazethapyr followed by spring postemergence application of 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), and subplots were six imazethapyr doses (0, 0.005, 0.01, 0.05, 0.1, 0.5, and 1 times 0.047 lb ai/A, the use rate in legumes). 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, six days had freezing temperatures and four days had at least a 25 degree temperature fluctuation. Two weeks after the application date, eight days had freezing temperatures and 10 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 15, 2009. Two plant counts (one yard of row each) in each plot were taken on November 2, 2008. Wheat injury was evaluated visually during the growing season. Wheat grain was harvested with a small plot combine on August 11, 2009.

Table 1. Application and soil data.

Planting date	September 26, 2008	
Application date	September 26, 2008	April 14, 2009
Wheat growth stage	preplant incorporated[1]	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)	64	34
Relative humidity (%)	53	65
Wind (mph, direction)	2, E	5, NW
Cloud cover (%)	5	50
Soil moisture	good	excessive
Soil temperature at 2 inch (F)	55	38
pH	5.1	
OM (%)	3.1	
CEC (meq/100g)	17	
Texture	silt loam	

[1] Herbicide treatments were incorporated by two perpendicular passes with a field cultivator

No 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). Mesosulfuron injured ORCF 102 less (7%) than Brundage 96 and Tubbs 06 (9%) 7 days after treatment (DAT) (Table 2). At 7 and 14 DAT of mesosulfuron, all wheat varieties were injured 18 and 8%, respectively, (Table 3) but did not differ between varieties or imazethapyr dose (data not shown). By 21 DAT of mesosulfuron, wheat injury was not visible (data not shown). Wheat grain yield and test weight did not differ between varieties, imazethapyr dose, and mesosulfuron application (Table 4 – imazethapyr dose).

Table 2. Winter wheat plant counts and wheat injury averaged over imazethapyr dose and mesosulfuron application in 2009.

Variety	Plant counts[1]	Wheat injury 7 DAT[1,2]
	no./yd of row	%
ORCF 102	18b	7b
Brundage 96	20a	9a
Tubbs 06	17b	9a

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

[2] Seven days after application of mesosulfuron.

Table 3. Winter wheat injury averaged over winter wheat varieties and imazethapyr dose in 2009.

		Wheat injury[2]	
Treatment[1]	Rate	7 DAT	14 DAT
	lb ai/A	%	%
Mesosulfuron	0.0134	18a	8a
Mesosulfuron	0	0b	0b

[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] Seven and 14 days after application of mesosulfuron. Means followed by the same letter do not differ significantly at $P \leq 0.05$.

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

		Wheat[1]	
Treatment	Rate	Yield	Test weight
	lb ai/A	lb/A	lb/bu
Imazethapyr	0.000235	6129a	60a
Imazethapyr	0.00047	6070a	60a
Imazethapyr	0.00235	6303a	60a
Imazethapyr	0.0047	6531a	60a
Imazethapyr	0.0235	6294a	60a
Imazethapyr	0.047	6305a	60a
Imazethapyr	0	6448a	60a

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

Newly reported exotic species in Idaho for 2009. 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 229 specimens for identification in 2009. The utilization of the lab remained down with complete loss of state funding (Figure 1). One hundred twenty eight exotic species were identified. The lab received no weedy species not previously reported in the state although eight cultivated / native species not normally growing in Idaho were sent in for identification. One species native to Texas and of concern for Idaho was Hairseed Bahia (*Bahia absinthifolia*) found in Clearwater County and has invaded a long section of county road right-of-way. Common persimmon (*Diospyros virginana*) was sent in from Nez Perce County and is a national record for the northern most specimen of this tree. The final plant of noteworthy mention was upland cotton from Canyon County. The lab identified 23 exotic species that were new county records (see Tables 1 and Figure 2). A total of 25 counties in Idaho submitted samples (Figure 3) and we had on-line photo submissions from four states and Egypt. Species in Table 1 are new county records and have not previously been reported to the Erickson Weed Diagnostic Laboratory or the USDA Plants Database, although previously reported in one or more counties in Idaho.

Table 1. Identified introduced species with new to county status based on USDA Plants Database.

COUNTY	FAMILY	*GENUS*	*SPECIES*	COMMON NAME
Ada	Rosaceae	*Cotoneaster*	*lucidus*	shiny cotoneaster
Adams	Caryophyllaceae	*Dianthus*	*armeria*	deptford pink
Bingham	Caprifoliaceae	*Viburnum*	*opulus*	European cranberrybush
Bingham	Malvaceae	*Hibiscus*	*syriacus*	rose of Sharon
Bingham	Vitaceae	*Parthenocissus*	*quinquefolia*	Virgina creeper
Bonneville	Tamaricaea	*Tamarix*	*parviflora*	smallflower tamarisk
Canyon	Malvaceae	*Gossypium*	*hirsutum*	upland cotton
Cassia	Brassicaceae	*Lepidium*	*campestre*	field pepperweed
Custer	Brassicaceae	*Alyssum*	*alyssoides*	pale madwort / yellow alyssum
Custer	Polygonaceae	*Polygonum*	*persicaria*	spotted ladysthumb
Elmore	Asteraceae	*Leucanthemum*	*vulgare*	oxeye daisy
Franklin	Poaceae	*Taeniatherum*	*caput-medusae*	medusahead wildrye
Franklin	Poaceae	*Ventenata*	*dubia*	ventenata or North Africa Grass
Idaho	Asteraceae	*Hieracium*	*piloselloides*	tall hawkweed (king devil)
Kootenai	Boraginaceae	*Cynoglossum*	*officinale*	houndstonge
Latah	Fabaceae	*Securigera*	*varia*	crownvetch
Lewis	Asteraceae	*Hypochaeris*	*radicata*	hairy cat's ear
Lewis	Violaceae	*Viola*	*arvensis*	European field pansy
Nez Perce	Asteraceae	*Bahia*	*absinthifolia*	hairseed bahia
Nez Perce	Cyperaceae	*Cyperus*	*esulentus*	yellow nutsedge
Nez Perce	Ebenaceae	*Diospyros*	*virginiana*	common persimmon
Teton	Asteraceae	*Arctium*	*minus*	lesser burdock
Valley	Poaceae	*Poa*	*annua*	annual bluegrass

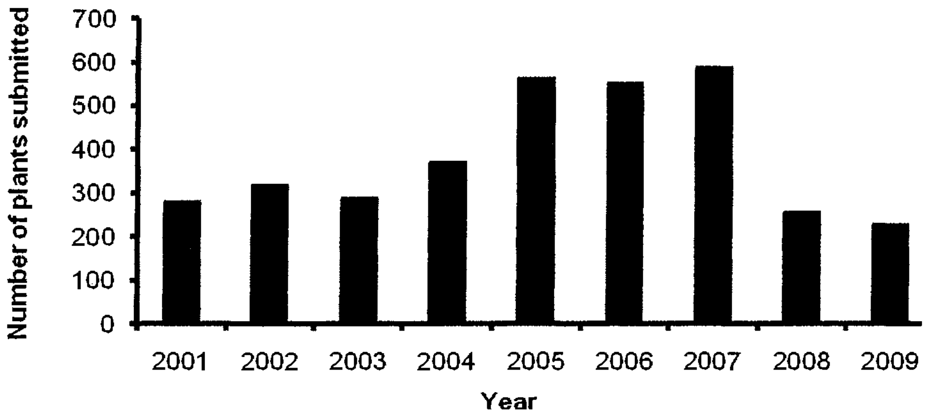

Figure 1. Erickson Weed Diagnostic Laboratory received 229 plant specimens for identification in 2009.

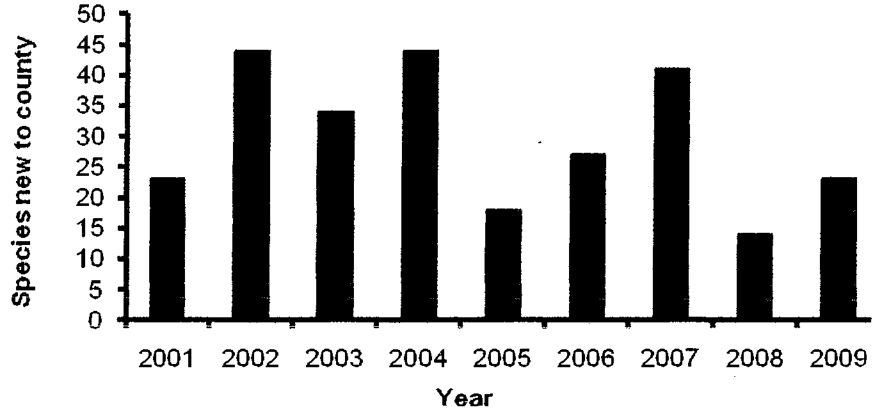

Figure 2. The lab identified 23 exotic species that were new Idaho records.

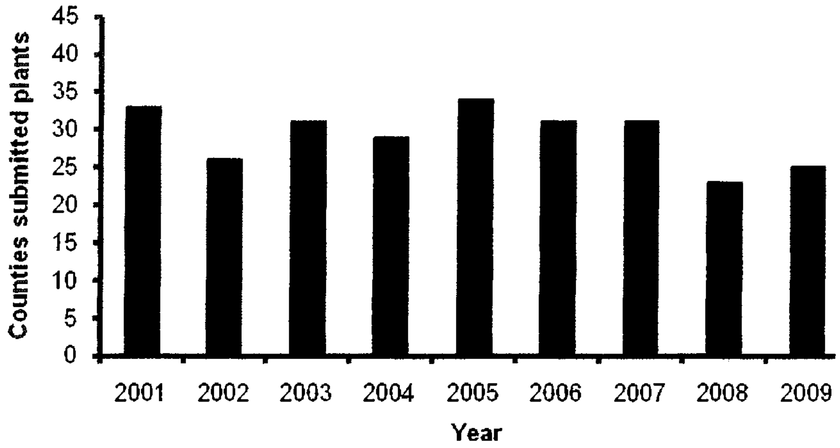

Figure 3. Twenty-five Idaho counties submitted plants in 2009.

Imazapyr, imazamox and glyphosate for common cattail control. Carl E. Bell. (Cooperative Extension, University of California, San Diego, CA 92123). Common cattail is a widespread weed problem that impedes water movement in the earthen drainage canals in the Imperial Irrigation District in the Imperial Valley of southeastern California. Current practice is to remove common cattails with a backhoe scraper on a biennial basis. This practice is very effective initially, but the common cattail re-grows quickly. This practice also results in significant silt movement into the drain system because of the disturbance and because the ditch inner banks are left bare. A field experiment was initiated in August 2008 to evaluate herbicides that would kill or reduce common cattail without soil disturbance. Secondarily, we hoped to find a treatment that was selective enough to leave smaller stature plant species in place which would not greatly impede water movement and help hold soil in place. The experiment compared imazapyr, imazamox and glyphosate, each applied alone, and combinations of imazapyr and glyphosate. The treatment site was a drainage canal within the Imperial Irrigation District near Holtville, CA. Plots were arranged along a south facing inner bank with a slope of about 45^0 of an east-west oriented earthen drainage ditch. Plot width was 10 feet starting at the top of the ditch and was 30 feet long. Common cattail plants had been removed mechanically with a backhoe scraper in April 2008. Treated plants were re-growing from rhizomes from the bottom of the ditch to near the top of the bank and were 6 to 8 feet tall but without flowers. The experiment used a randomized complete block design with four replications; blocks were arranged along the ditch. Herbicides were applied on August 20, 2008 as a foliar spray to common cattail using a CO_2 pressured sprayer with a single boomless nozzle (Boominator 1400rs). The treated swath was 7 feet wide. Pressure was 40 psi and spray volume was 41gpa. Weather at time of application was 78° F, clear skies, and wind speed from 0-8 mph. Applications were made only when the wind speed was measured to be less than 5 mph. Non-ionic surfactant at 0.25% v/v was added to all imazapyr and glyphosate treatments. Imazamox treatments included methylated seed oil at 0.50% v/v. The experiment was visually evaluated for control of common cattail, curly dock, common bermudagrass, seaside heliotrope, and rabbitfoot polypogon on April 5, 2009 (Table), about eight months after treatment. All treatments were very effective in controlling common cattail. Of the four other plant species, all except curly dock are small stature and might be desirable components of the drainage system in terms of reducing silt erosion and not significantly impeding water flow. These data suggest that imazapyr and the lower rates of imazamox are able to control common cattail without causing much damage to these desirable species. Another result is the lack of sufficient control of curly dock by any of these herbicide treatments. The relative large stature and root structure of curly dock might be of equal concern for water impedance as common cattail.

Table. Common cattail control with imazapyr, imazamox and glyphosate in Holtville, CA.

		Weed control - April 5, 2009 (8 months after treatment)				
Treatment	Rate[1]	Common cattail	Curly dock	Rabbitfoot polypogon	Bermudagrass	Seaside heliotrope
	lb/A	--	----------	----%----	----------	--
Imazapyr	1.0	99	15	74	50	0
Glyphosate	3.8	92	21	24	83	44
Imazapyr	0.5	99	5	0	50	0
Glyphosate	1.9	90	0	50	98	0
Imazapyr + glyphosate	0.5 + 1.9	99	1	0	10	0
Imazapyr + glyphosate	0.25 + 0.95	99	15	0	98	0
Imazamox	0.25	96	0	14	0	10
Imazamox	0.38	87	27	21	58	0
Imazamox	0.5	99	12	93	73	38
Untreated control		0	0	0	0	0

[1] Rates for glyphosate are acid equivalent (ae), and are active ingredient (ai) for imazapyr and imazamox.

Year-round treatment of Russian olive (*Elaeagnus angustifolia*) with glyphosate or 2,4-D by frill or drill methods. R. Patterson (Carbon County, Utah), D. Worwood (Emery County, Utah), and R.E. Whitesides. (Plants, Soils, and Climate Department, Utah State University, Logan, UT 84322-4820) Herbicide applications of glyphosate or 2,4-D amine concentrate (4.0 lbs ae/gallon) were made monthly in Carbon or Emery Counties, Utah during 2006 and 2007 with visual evaluations conducted in 2008. Russian olive trees were treated with 2,4-D amine in Carbon County and glyphosate in Emery County. These are adjacent counties in Utah with similar environments and soil types. Herbicides were applied at a rate of 1 cc per inch of tree trunk diameter (approximately 1 to 2 feet above the soil surface) per tree. Trees ranged in height from 8 to 20 feet. Visual evaluations were conducted on May 29, 2008 (Carbon County) and May 30, 2008 (Emery County). Russian olive trees in the test areas were tagged but not treated in October 2006 and were used as control plants for visual evaluations made in 2008. When herbicide applications were made using the frill technique enough horizontal cuts were made to the bark to permit application of the appropriate herbicide treatment rate without girdling the tree. Drill applications were made using a 5/16 inch drill bit and injecting 1 cc per hole. Visual ratings were based on 100% control defined as no suckers or visible bud development and complete dieback in the top of the tree. A rating of 98% control showed minor or unhealthy sucker growth but complete dieback in the top of the tree. Ratings of 95% had more significant sucker growth and some new bud development along the trunk of the tree but no growth on the remainder of the tree. All other visual evaluations were based on visual dieback in the to p of the tree. Applications of 2,4-D amine by drill or frill techniques were not as effective as frill applications of glyphosate (glyphosate was only applied using the frill method). All herbicide treatments were consistently effective when applications were made during the period May to September. Among herbicide treatments glyphosate frill applications were most effective (100%), followed by 2,4-D amine drill applications (96%), followed by 2,4-D amine frill applications (92%). Applications of 2,4-D amine during months other than the May to September timing were much less effective. However, there was one notable exception. Glyphosate frill application applied in January also provided 100% control of Russian olive. Months that immediately preceded or followed the January glyphosate application were not as effective.

Common reed control with imazapyr, imazamox and glyphosate. Carl E. Bell. (Cooperative Extension, University of California, San Diego, CA 92123). Common reed is a widespread weed problem in the earthen drainage canals in the Imperial Irrigation District in the Imperial Valley of southeastern California. Current practice is to remove common reeds with a backhoe scraper on a biennial basis. This practice is very effective initially, but the common reed re-grows quickly. This practice also results in significant silt movement into the drain system because of the disturbance and because the ditch inner banks are left bare. A field experiment was initiated in August 2008 to evaluate herbicides that would kill or reduce common reed. The experiment compared imazapyr, imazamox and glyphosate, each applied alone, and combinations of imazapyr and glyphosate. The treatment site was a drainage canal within the Imperial Irrigation District near Holtville, CA. Plots were arranged along a north facing inner bank with a slope of about 45^0 of an east-west oriented earthen drainage ditch. Common reed formed a solid monoculture with stems from 8 to 10 feet tall along the upper edge of the ditch bank. Plots were laid out in a single linear dimension 20 feet long. The experiment used a randomized complete block design with four replications; blocks were arranged along the ditch. Herbicides were applied on April 11, 2008 as a foliar spray to common reed using a CO_2 pressured sprayer with a single boomless nozzle (Boominator 1400rs). The spray nozzle was held vertically in order to treat about 7 feet of the plants measured from the top of the average stem. The herbicide spray penetrated about 2 feet into the canopy. Pressure was 50 psi and spray volume was 40 gpa. Weather at time of application was 64^o F, clear skies, and calm with wind speed from 0-2 mph. Non-ionic surfactant at 0.25% v/v was added to all treatments. The experiment was visually assessed for percent control of common reed, May 15, 2009 (one month after treatment (MAT)) and again on May 5, 2009 (13 MAT) (Table). This assessment only evaluated the treated edge of the common reed population that had been sprayed with the herbicide treatments. Control of common reed was excellent (>90%) with the two high rate treatments of glyphosate or imazapyr. The two combination treatments of imazapyr and glyphosate also worked well. Lower rates of imazapyr or glyphosate, along with the imazamox treatments did not provide an acceptable level of common reed control.

Table. Common reed control with imazapyr, imazamox and glyphosate in Holtville, CA.

		Common reed control	
		May 15, 2008 (one month after treatment)	May 5, 2009 (13 months after treatment)
Treatment	Rate[1]		
	lb/A	%	%
Imazapyr	1.0	31	92
Glyphosate	3.8	61	98
Imazapyr	0.5	10	53
Glyphosate	1.9	50	79
Imazapyr + glyphosate	0.5 + 1.9	46	83
Imazapyr + glyphosate	0.25 + 0.95	31	85
Imazamox	0.25	14	73
Imazamox	0.38	27	38
Imazamox	0.5	23	15
Untreated control		0	0

[1] Rates for glyphosate are acid equivalent (ae), and are active ingredient (ai) for imazapyr and imazamox.

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. The purpose of this study was to evaluate alternative herbicides to the standard 2,4-D amine treatment. 2,4-D amine provides only 1 growing season of CARCA control without significantly injuring hay grass or clover.

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).

Visual evaluations for CARCA control compared to untreated check plots were collected on August 14, 2008 and July 14, 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.

The grass hay recovered (0 to 10% height reduction) 13 MAT after the June 16, 2008 treatments and 0 to 23% grass height reduction with October 7, 2008 treatments. The only treatment with acceptable clover stand loss was 2,4-D amine at both timings (44% loss spring and 23% fall treatment). All other treatments provided 84 to 100% clover loss.

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				Grass height reduction		Clover stand reduction	
		2008		2009					
Herbicide[1]	Rate	Rosettes	Bolted	Rosettes	Bolted	2008		2009	
	oz ai/A	%							
Spring applied									
2,4-D Amine	15.2	93	99	86	100	10	0	64	44
Aminopyralid	1	58	64	41	61	5	10	95	100
Aminopyralid + 2,4-D	1 + 15.2	96	99	81	100	0	0	100	100
Aminopyralid + metsulfuron	1.2	94	100	87	100	66	0	100	100
Aminopyralid + metsulfuron	1.6	95	100	87	100	68	0	100	100
Aminopyralid + metsulfuron	1.9	93	98	87	100	70	0	100	100
Metsulfuron + 2,4-D	0.2 + 7.6	90	98	85	100	50	0	91	84
Metsulfuron + 2,4-D	0.3 + 7.6	93	99	89	100	65	0	99	100
Fall applied									
2,4-D Amine	15.2	--	--	25	33	--	23	--	23
Aminopyralid	1	--	--	0	0	--	5	--	100
Aminopyralid + 2,4-D	1 + 15.2	--	--	0	34	--	0	--	100
Aminopyralid + metsulfuron	1.2	--	--	6	5	--	0	--	84
Aminopyralid + metsulfuron	1.6	--	--	18	10	--	5	--	100
Aminopyralid + metsulfuron	1.9	--	--	25	34	--	14	--	100
Metsulfuron + 2,4-D	0.2 + 7.6	--	--	0	0	--	10	--	91
Metsulfuron + 2,4-D	0.3 + 7.6	--	--	5	10	--	10	--	96
LSD (0.05)		11	13	21	27	18	1	9	27

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

Table 3. Wild caraway and forage biomass in a Colorado hay meadow (2008).

		Wild caraway biomass		Forage biomass			
Herbicide[1]	Rate	Green	Dead stand	Clover	Grass	Misc.	Desirable
	oz ai/A	----------------lb/A----------------					
2,4-D Amine	15.2	1	14	172	2054	2	2226
Aminopyralid	1	76	0	0	2529	6	2530
Aminopyralid + 2,4-D	1 + 15.2	0	0	0	3784	0	3784
Aminopyralid[2] + metsulfuron	1.2	0	11	0	607	1	607
Aminopyralid + metsulfuron	1.6	0	9	0	961	0	961
Aminopyralid + metsulfuron	1.9	0	13	0	880	2	880
Metsulfuron + 2,4-D	0.2 + 7.6	1	14	6	1255	15	1261
Metsulfuron + 2,4-D	0.3 + 7.6	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.

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