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FOREWORD

The 2005 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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Clematis control on Colorado rangeland. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) *Clematis orientalis* (CLEOR) was established locally in the Clear Creek Valley dating back to the mining times in the late 19^{th} century. CLEOR has extensive climbing vines that smothers 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. Due to its growth pattern and location CLEOR is difficult to control. It often grows on trees and along ditches where many herbicides cannot be used. CLEOR grows as a dense viney canopy and is often found in rough, steep, terrain making herbicide application very difficult.

Two experiments were established near Georgetown, CO to evaluate chemical control of CLEOR. Both studies were sprayed on July 25, 2001 at adjacent rangeland sites but included different herbicides. The experiments were designed as randomized complete blocks with four replications.

Herbicides were applied when CLEOR was in early flower growth stage in both studies. 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. Application information for both studies is presented in Table 1. Visual evaluations for control compared to non-treated plots were collected on October 2001, July 2002 and 2003, and August 2004. Tables 2 and 3 reflect data for each study and will be discussed separately.

Study 1. Metsulfuron controlled 50 to 70% of CLEOR approximately 70 days after treatment (DAT). Metsulfuron at 3 oz ai/a controlled 52% of CLEOR 1 year after treatment (YAT) and 21% at 2 YAT. However, metsulfuron at 0.6 or 0.9 oz ai/a controlled 86% or greater CLEOR 1 YAT to 3 YAT. Clopyralid failed to control CLEOR, but 2,4-D amine at 32 oz ai/a controlled 100% of CLEOR 1 to 3 YAT.

Study 2. Imazapic controlled CLEOR slowly. Imazapic at 3 oz ai/a controlled only 36% of CLEOR 70 DAT, but controlled 96% of CLEOR 1 YAT, 86% 2 YAT, and 76% 3 YAT. Quinclorac failed to control CLEOR. Picloram at 8 oz ai/a controlled 100% of CLEOR at all 4 evaluation dates.

All treatments prevented CLEOR seedset 70 DAT in both studies. Picloram was the only treatment that caused grass injury (leaf curling). Snowberry (*Symphoricarpos albus)* and common gooseberry (*Ribes inerme)*, were killed by 2,4-D, picloram, and imazapic + 2,4-D treatments. Metulfuron, imazapic, and clopyralid treatments injured snowberry and common gooseberry but they recovered 2 YAT. Temporary minor herbicide injury may be more acceptable than the death that occurs from CLEOR as it grows over neighboring plants and smothers them.

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

Environmental data	
Application date	July 25, 2001
Application time	10:30 am
Air temperature, F	80
Relative humidity, %	31
Wind speed, mph	0 to 2

Application date	Species	Common Name	Growth stage	Height
				--(in.)--
July 25, 2001	CLEOR	Oriental clematis	Early flower	36 to 72
	AGRSM	Western wheatgrass	Flower	12 to 18
	BROIN	Smooth brome	Flower	18 to 26

Table 2. Clematis control on Colorado rangeland (Study 1).

Herbicide[1]	Rate	Clematis control October 2001	July 2002	July 2003	August 2004
	oz ai/a	%			
Metsulfuron	0.3	50	52	21	25
Metsulfuron	0.5	64	94	76	75
Metsulfuron	0.6	65	93	95	86
Metsulfuron	0.9	70	95	89	88
2,4-D amine	32.0	89	100	100	100
Clopyralid	4.0	26	36	0	0
Control		0	0	0	0
LSD (0.05)		11	25	19	26

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

Table 3. Clematis control on Colorado rangeland (Study 2).

Herbicide[1]	Rate	Clematis control October 2001	July 2002	July 2003	August 2004
	oz ai/a	%			
Imazapic	3	36	96	86	76
Imazapic +2,4-D	3 + 6	55	100	100	96
Quinclorac	6	20	38	0	0
Picloram	8	100	100	100	100
Control		0	0	0	0
LSD (0.05)		12	13	21	22

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

Very late-season Russian knapweed control with various herbicides. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Russian knapweed is an invasive perennial weed that is very difficult to control with herbicides. Recently, research in Wyoming and Colorado found that herbicides applied very late in the growing season to Russian knapweed following several hard frosts provided greater than 85% control for several seasons (Arnold et al. 2002, WSWS Res. Prog. Rep. p. 3; Whitson and Rose 1999, WSWS Res. Prog. Rep. p. 3; Whitson and Ferrell 2002, WSWS Res. Prog. Rep. p. 2). Similar treatments applied to Russian knapweed in September in North Dakota provided less than 40% control 1 yr after treatment (Lym and Christianson 2002, WSWS Res. Prog. Rep. p. 4-5). The purpose of this research was to evaluate Russian knapweed control with various herbicides applied after a killing frost in North Dakota.

The experiment was established in the South Unit of Theodore Roosevelt National Park near Medora, ND, on October 8, 2002. Russian knapweed plants were 24 to 30 inches tall, and the stems were yellow to grey in color and appeared dormant. The minimum air temperature had reached 29 F or lower five times prior to herbicide application, including three consecutive mornings immediately prior to treatment. The herbicides were applied using a hand-held boom sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 25 feet and replicated three times in a randomized complete block design. The air temperature was 48 F, with a 43 F dew point, and soil temperature at the 4 inch depth was 46 F.

Picloram at 6 oz/A provided near complete Russian knapweed control 21 MAT (months after treatment) with little to no visible grass injury (Table). Control declined to 76% by 24 MAT as Russian knapweed began to spread into the treated area from adjacent plots. Clopyralid applied alone or with triclopyr provided an average of 93% Russian knapweed control 12 MAT and control at 21 and 24 MAT gradually declined to 84 and 66%, respectively. Picloram plus clopyralid plus 2,4-D at 4 + 3 + 16 oz/A provided similar long-term Russian knapweed control to picloram at 6 oz/A applied alone. Imazapic at 3 oz/A provided 100% control through 10 MAT but suppressed grass production, and Russian knapweed control at 12 and 21 MAT declined to 79 and 15%, respectively. Metsulfuron applied with dicamba and 2,4-D did not provide season-long Russian knapweed control and grass injury 8 MAT averaged 30%. Quinclorac only provided short-term Russian knapweed control. Very late-season treatments that contained picloram or clopyralid cost approximately $15 to $30/A at the rates used in this study and could be used to control Russian knapweed in a variety of environments.

Table. Russian knapweed control with various herbicides applied after a killing frost in North Dakota.

		Control							
		8 MAT[1]		10 MAT		12 MAT		21 MAT	24 MAT
Treatment	Rate	RUKW[1]	GI[1]	RUKW	GI	RUKW	GI	RUKW	RUKW
	— oz/A —	— % —							
Picloram	6	100	0	100	0	91	3	99	76
Clopyralid	4	100	3	99	0	94	0	82	58
Clopyralid/triclopyr[2]	6 + 1.1	98	0	97	0	92	1	86	74
Picloram + clopyralid/2,4-D[3]	4 + 3 + 16	100	13	100	7	96	3	98	72
Imazapic + MSO[4]	3 + 1 qt	100	27	100	21	79	3	15	38
Metsulfuron + dicamba/2,4-D[5] + MSO[4]	0.6 + 8 + 23 + 1 qt	100	30	97	22	66	17	39	41
Quinclorac + MSO[3]	8 + 1 qt	97	0	30	0	30	0	0	15
LSD (0.05)		NS	19	36	17	29[6]	NS	30	32

[1] Abbreviations: MAT = Months after treatment, RUKW = Russian knapweed, GI = grass injury.

[2] Commercial formulation - Redeem by Dow AgroSciences, Indianapolis, IN.

[3] Commercial formulation - Curtail by Dow AgroSciences, Indianapolis, IN.

[4] MSO is methylated seed oil, Scoil by AGSCO, Grand Forks, ND.

[5] Commercial formulation - Range Star by DuPont, Wilmington, DE.

[6] LSD (0.15).

Control of medusahead with sulfometuron. Steven A. Dewey and R. William Mace. (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820) Three postemergence herbicides, sulfometuron, chlorsulfuron, and imazapic were evaluated for effectiveness in controlling medusahead (TAEAS) located in a steep cobble pasture near Avon, Utah. Individual treatments were applied to 10 by 30 foot plots with a CO_2 sprayer using Turbojet 015 nozzles providing a 10 foot spray width calibrated to deliver 25 gpa at 40 psi. The soil was a Hibner extremely stony clay loam with 6.9 pH and O.M. content of 3%. Treatments were applied postemergence in the fall on October 28, 2003 and in the spring on April 26, 2004 in a randomized block design, with three replications. Medusahead plants were dormant or not emerged at the time of the fall application. The following spring, treatments were applied to medusahead plants that were from 1 to 2 inches in height. Plant density was uniform with about 100 plants per square foot. Visual evaluations for weed control were completed June 18 and October 24, 2004.

Increasing rates of sulfometuron+chlorsulfuron or sulfometuron/chlorsulfuron proved effective in controlling medusahead. The fall treatment had a slight edge over the spring applications of 2004. The primary objective of the study was to compare the relative effectiveness of the two formulations of sulfometuron, Oust and Oust XP. There were no significant differences between the formulations resulting from the fall application, but there were two instances in which one of the two lowest rates of spring-applied Oust XP did not perform as well as equivalent rates of spring-applied Oust. Medusahead control resulting from the imazapic treatment was significantly lower than that of the high rate of sulfometuron plus chlorsulfuron in September of 2004, regardless of application timing or sulfometuron formulation. Evaluations are scheduled for 2005 to determine if efficacy is maintained for another year.

Table. Evaluation of medusahead control.

		TAEAS			
		Fall Treatment '03		Spring treatment '04	
Treatment	Rate	6/18/04	9/24/04	6/18/04	9/24/04
	lbai /A	-------%-------		--------%--------	
Sulfometuron[a] + chlorsulfuron	0.023+0.012	100	100	100	89
Sulfometuron[a] + chlorsulfuron	0.035+0.18	100	100	100	93
Sulfometuron[a] + chlorsulfuron	0.047+0.023	100	100	98	90
Sulfometuron[a] + chlorsulfuron	0.07+0.035	100	100	100	93
Sulfometuron[b] / chlorsulfuron	0.023+0.012	100	98	94	82
Sulfometuron[b] / chlorsulfuron	0.035+0.18	100	99	95	82
Sulfometuron[b] / chlorsulfuron	0.047+0.023	100	100	98	88
Sulfometuron[b] / chlorsulfuron	0.07+0.035	100	100	100	92
Imazapic[c]	0.125	92	90	97	83
Untreated		0	0	0	0
$LSD_{(0.05)}$		1.6	3	5	8

[a] NIS added at 0.25% v/v (Oust®).
[b] NIS added at 0.25% v/v (OustXP®).
[c] MSO added at 2pt/A.

Russian knapweed control in pasture with chlorsulfuron. Steven A. Dewey and R. William Mace. (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820) Several postemergence herbicides, chlorsulfuron, clopyralid, metsulfuron, imazapic, and triclopyr+clopyralid were evaluated for effectiveness in controlling Russian knapweed (CENRE) located in an alkali pasture in Salt Lake City, Utah. Individual treatments were applied to 10 by 30 foot plots with a CO_2 sprayer using Turbojet 015 nozzles providing a 10 foot spray width calibrated to deliver 25 gpa at 40 psi. The soil was a gravely loam with 7.9 pH and O.M. content of less than 1%. Spring treatments were applied June 17, 2003 and fall treatments were applied October 1, 2003 in a randomized block design, with three replications. Knapweed plants were one to two feet in height at application time. Visual evaluations for weed control were completed August 8, October 1, 2003, and June 5, September 27, 2004

Initial evaluations taken in the fall of 2003 showed no effect from any June 2003 herbicide treatment. The visual evaluation in June of 2004 showed good to excellent results with all treatments other than imazapic. Fall treatments had a marked increase in efficacy over the same spring applications, as much as 30 percent higher for the lower rate of chlorsulfuron+metsulfuron. This was still true at the September evaluation date though generally efficacy did decrease from June to September. Triclopyr/clopyralid was nearly as effective for either timing and provided the highest control of Russian knapweed at both application dates.

Table. Visual evaluation of russian knapweed control.

Treatment	Rate	CENRE weed control			
		8/8/03	10/1/03	6/5/04	9/27/04
Spring	lb ai/A		%		
Chlorsulfuron[1] + clopyralid	0.023+0.25	0	0	58	67
Chlorsulfuron[1] + clopyralid	0.031+0.25	0	0	75	53
Chlorsulfuron[1] + clopyralid	0.047+0.25	0	0	60	63
Chlorsulfuron[1] + clopyralid	0.0625+0.25	0	0	80	70
Clopyralid[1]	0.25	0	0	83	67
Chlorsulfuron[1]	0.0625	0	0	30	23
Chlorsulfuron[1] + metsulfuron	0.047+0.187	0	0	43	30
Chlorsulfuron[1] + metsulfuron	0.0625+0.25	0	0	72	57
Triclopyr /clopyralid[1]	1.5	0	0	94	83
Imazapic[2]	0.188	0	0	27	17
Untreated		0	0	0	0
Fall					
Chlorsulfuron[1] + clopyralid	0.0625+0.25			90	78
Chlorsulfuron[1] + metsulfuron	0.047+0.187			73	48
Chlorsulfuron[1] + metsulfuron	0.0625+0.25			87	73
Triclopyr /clopyralid[2]	1.5			96	88
$LSD_{(0.05)}$		NA	NA	18	13

[1] NIS added at 0.25% v/v added.
[2] MSO added at 2 pt/A

Comparing hebicides to alternatives to control Mediterranean sage on Colorado rangeland. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Mediterranean sage (SALAE) is an escaped biennial ornamental that has recently become a problem on rangeland and along roadsides in Colorado. It is a prolific seed producer and is capable of spreading over large areas in a short period of time. It was only recently introduced into Colorado and there has been a lot of interest in how to selectively control it and prevent its spread.

An experiment was established in Boulder County, CO to evaluate SALAE control with several mechanical and chemical methods. The experiment was designed as a randomized complete block with three replications. Herbicides were applied on April 26, 2004 when SALAE was in rosette growth stage (table 2). All herbicide treatments (other than glyphosate or *Alldown* spot) 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. Glyphosate and *Alldown* were spot sprayed on individual rosette SALAE rather than broadcast sprayed to prevent injury to desirable native forbs and grass species. Glyphosate is a systemic herbicide while Alldown is a non-selective weed and grass herbicide made from organic acetic acid.

Mechanical treatments in this experiment included "dig," "dig deeper," or flamer. "Dig" treatments involved scraping 1" of vegetation off the tops of SALAE rosettes with a shovel, while "dig deeper" treatments were hand dug to a 6" depth with a shovel. A propane flamer was used to burn individual SALAE rosettes.

Visual evaluations for control compared to non-treated plots were collected in June and October 2004 (Table 2). All treatments with metsulfuron, chlorsulfuron, or picloram (alone or tank mixed with other herbicides), controlled 82 to 100% of SALAE in 2004. SALAE control was improved with the addition of 2,4-D amine. Clopyralid or imazapic applied alone did not control SALAE very well (12 or 73%) at approximately 6 months after treatment (MAT). However, when combined with 2,4-D amine they controlled 83 or 98% of SALAE, respectively. There were differences in SALAE control with 2,4-D formulations. 2,4-D amine controlled 62% while 2,4-D ester controlled 98% of SALAE approximately 6 MAT. Future SALAE research with 2,4-D formulations and combinations should be considered due to the beneficial effects it has on controlling SALAE.

Alldown or flamer treatments controlled SALAE poorly in this experiment. The spot spray application of glyphosate controlled 92% of SALAE approximately 2 MAT, but dropped to 75% control approximately 6 MAT most likely due to subsequent recruitment or missed plants when spot sprayed. It would be advised to use a dye with spot treatments to avoid missing rosettes (missed SALAE plants were noted at the June evaluation). Glyphosate was found to be very active in controlling SALAE, but it may take several applications to rid the soil of seed.

Dig and dig deeper treatments controlled 75 and 79% SALAE approximately 6 MAT. Plants that weren't controlled were either missed or emerged after the initial digging took place. Digging provides an excellent alternative for controlling SALAE without the use of herbicides. It may, however, take several years of digging to rid the soil of SALSE seed. This study will be monitored in 2005 for long term SALAE control.

Table 1. Application data for comparing hebicides to alternatives to control Mediterranean sage on Colorado rangeland.

Environmental data	
Application date	April 26, 2004
Application time	1:30 pm
Air temperature, F	68
Relative humidity, %	35
Wind speed, mph	2 to 6

Application date	Species	Common name	Growth stage	Diameter
				--------(in.)-------
April 26, 2004	SALAE	Mediterranean sage	1^{st} year rosettes	2.5 to 4 diameter

Table 2. Control of Mediterranean sage on Colorado rangeland with herbicides and alternative methods

Herbicide[1,2]	Rate	Application timing	Mediterranean sage control June 2004	October 2004
	oz ai/a		------------%-------------	
Metsulfuron	0.6	Rosette	88	100
Metsulfuron + 2,4-D amine	0.6 + 16.0	Rosette	100	100
Chlorsulfuron + 2,4-D amine	0.8 + 16.0	Rosette	90	96
Picloram	8.0	Rosette	96	82
Picloram	12.0	Rosette	100	97
Picloram + chlorsulfuron	8.0 + 0.8	Rosette	98	100
Clopyralid	6.0	Rosette	47	12
Clopyralid + 2,4-D amine	3.0 + 16.0	Rosette	95	83
Diflufenzopyr + dicamba	1.6 + 8.0	Rosette	61	52
Glyphosate	16.0	Rosette	92	75
Imazapic	2.0	Rosette	68	73
Imazapic + 2,4-D amine	2.0 + 16.0	Rosette	95	98
2,4-D amine	16.0	Rosette	68	62
2,4-D ester	16.0	Rosette	99	98
Alldown[3]		Rosette	23	10
Dig		Rosette	74	75
Dig deep		Rosette	87	79
Flamer		Rosette	23	13
Control		Rosette	0	0
LSD (0.05)			21	21

[1] Non-ionic surfactant added to all metsulfuron, chlorsulfuron, clopyralid, 2,4-D, and picloram treatments at 0.25% v/v.

[2] Methylated seed oil added to all imazapic treatments at 1 quart/acre.

[3] *Alldown* is a non-selective weed and grass herbicide made from 5.0% citric acid, 0.2% Garlic. Other ingredients include: 94.8% acetic acid, yucca extracts, and water. These treatments were spot sprayed with 100% concentrate solution that was provided in manufacture's bottle.

Biological control of saltcedar with goats compared to herbicides Ruth Richards, and Ralph E. Whitesides. (Department of Plants, Soils and Biometeorology, Utah State University, Logan, Utah 84322-4820) Two herbicide treatments and grazing by goats were evaluated for effectiveness in controlling Saltcedar (TAARA) in a pasture in Lake Shore, Utah. Individual treatments were applied to a group of three saltcedar trees approximately 12 ft tall. There were four replications for each treatment. Herbicides were applied May 26, 2004. Triclopyr amine and imazapyr were applied at the rate of 1% v/v with the foliage sprayed to wet. A 16 x 16 ft plot was fenced off to restrict goat grazing to three trees. All plots were uniformly grazed based on the size and number of goats. Grazing occurred four times: May 31, June 30, August 4, and September 6, 2004.

Visual evaluations estimate that grazing was the best control treatment at the end of the first season.

Stem cuttings were taken from each tree to compare regrowth potential from stored energy reserves among treatments. Cuttings of 12 in long and approximately ¼ in diameter were taken on October 7, 2004. The cuttings were put 6 in deep into a sandy soil and watered daily for 1 min every 6 hr.

Stem cuttings were evaluated November 4, and November 30, 2004. There was no root or shoot growth.

Table. Visual evaluations of saltcedar control in field plots.

	Rate or Timing	TAARA
		%
Control		0
Triclopyr amine	1% v/v	53
Imazapyr	1% v/v	68
Grazing	May 31, Jun 30, Aug 4, Sep 6	84

Cutleaf teasel control on Colorado rangeland. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Cutleaf teasel (DIWLA) is a biennial that has recently become a problem on wet rangeland sites and along roadsides in Colorado.

An experiment was established in Jefferson County, CO to evaluate DIWLA control. The experiment was designed as a randomized complete block with four replications. Herbicides were applied on June 23, 2003 when DIWLA was in rosette or bolting growth stages (Table 2). All treatments were applied with a CO_2-pressurized backpack sprayer using 11003LP flat fan nozzles calibrated to deliver 21 gal/A at 14 psi. Other application information is presented in Table 1. Plot size was 10 by 30 feet. Non-ionic surfactant was added at 0.25% v/v to all metsulfuron and chlorsulfuron treatments and methylated seed oil was added to all imazapic treatments at 1 qt/A.

Visual evaluations for control compared to non-treated plots were collected in October 2003 and 2004 (Table 2). Metsulfuron alone or in combination controlled 90 to 100% of DIWLA rosettes in 2003. Metsulfuron applied alone controlled 70 to 83% of DIWLA rosettes. Metsulfuron plus chlorsulfuron plus 2,4-D Ester (0.3 + 0.4 + 6 oz/ac) controlled 96% of rosettes in October 2004 (approximately 16 months after treatment (MAT) and provided the greatest long-term DIWLA control in this study.

Clopyralid controlled 99 to 100% of DIWLA rosettes the year of treatment, but only controlled 9% of the rosettes and 100% of the bolted DIWLA plants 16 MAT. It may be possible to prevent seed production with these treatments for 2 consecutive growing sesaons. Clopyralid has the additional benefit of controlling Canada thistle (CIRAR) which is often found in areas with teasel. If both DIWLA and CIRAR are present it would be advantageous to use clopyralid to control both weed species, except where a high water table is present.

Chlorsulfuron + 2,4-D Ester controlled DIWLA similar to imazapic. Both of these treatments controlled 73 to 83% of DIWLA rosettes and bolted plants in 2003 and 69 to 83% of rosettes in 2004. All treatments in this study controlled 98 to 100% of DIWLA bolted plants 16 MAT in 2004.

Table 1. Application data for cutleaf teasel control on Colorado rangeland.

Environmental data	
Application date	June 23, 2003
Application time	9:45 am
Air temperature, F	67
Relative humidity, %	41
Wind speed, mph	1 to 3

Application date	Species	Common name	Growth stage	Height
			-------(in.)-------	----(in.)--
June 23, 2003	DIWLA	Cutleaf teasel	1st year rosettes	1/2 to 14 diameter
	DIWLA	Cutleaf teasel	2nd year rosettes	16 to 24

Table 2. Cutleaf teasel control on Colorado rangeland.

			Teasel control			
		Application	October 2003		October 2004	
Herbicide[1,2]	Rate	timing	Rosette	Bolting	Rosette	Bolting
	oz ai/a		-------------------	%	-------------------	
Metsulfuron	0.3	Rosette	90	97	70	100
Metsulfuron	0.5	Rosette	100	96	82	100
Metsulfuron	0.6	Rosette	95	99	83	100
Imazapic	8.0	Rosette	82	73	69	100
Imazapic	10.0	Rosette	81	79	72	100
Imazapic	12.0	Rosette	81	74	83	100
Clopyralid	6.0	Rosette	100	99	9	100
2,4-D ester	16.0	Rosette	94	91	38	100
Chlorsulfuron + 2,4-D ester	0.4 + 6.0	Rosette	83	75	73	98
Chlorsulfuron + metsulfuron + 2,4-D ester	0.4 + 0.3 + 6.0	Rosette	95	94	96	100
Control			0	0	0	0
LSD (0.05)			13	12	16	2

[1] Non-ionic surfactant added to all metsulfuron and chlorsulfuron treatments at 0.25% v/v.
[2] Methylated seed oil added to all imazapic treatments at 1 qt/A.

Scotch thistle control on rangeland with herbicides applied at the rosette and bolting stage. Rob G. Wilson. (University of California Cooperative Extension, 707 Nevada St., Susanville, CA 96130) Scotch thistle is a persistent, rangeland weed throughout Northeast California. An experiment was established in 2003 near Bieber, CA to evaluate several herbicides applied at the rosette and late bolting stage for Scotch thistle control. The experiment was replicated in 2004 with an expanded treatment list. The soil was a sandy loam. The experiment was arranged in a randomized complete block with three replications. Plot size was 10 by 30 ft. Herbicides were applied with a CO_2-pressurized backpack sprayer using 11002 LP flat fan nozzles at 20 gal/A. Application and site information is presented in Table 1. Scotch thistle control was visually estimated based on percent density reduction compared to the untreated control. Scotch thistle control ratings were taken on July 30, 2003 (for treatments applied in 2003) and July 29, 2004 (for treatments applied in 2003 and 2004).

Herbicides applied at the rosette stage provided the best control of Scotch thistle (Table 2 and 3). In 2003 and 2004, clopyralid at 0.25 lb ai/A applied at the rosette stage provided 95% or better control 4 MAT (months after treatment). None of the bolting treatments offered over 90% control (Table 2 and 3). Although bolting treatments caused considerable visual injury, Scotch thistle plants frequently continued development and produced plump seed especially with clopyralid, 2,4-D ester, and imazapic. The year following treatment, hardly any Scotch thistle seedlings were found in plots treated with clopyralid at the rosette stage compared to hundreds of seedlings in untreated plots suggesting: 1) clopyralid may have residual soil activity on Scotch thistle; or 2) Scotch thistle's population density is strongly correlated to yearly seed production.

Table 1. Herbicide application information.

Rosette application	2003	2004	Bolting application	2003	2004
Date	04/16/03	04/09/04	Date	06/18/03	06/07/04
Time	11:00 am	11:45 am	Time	10:00 am	9:00 am
Air temperature (F)	50	68	Air temperature (F)	80	70
Relative humidity (%)	49	36	Relative humidity (%)	21	28
Wind speed (mph)	0 to 2	3 to 5	Wind speed (mph)	0	0 to 3
Soil moisture (0-2 in)	wet	dry	Soil moisture (0-2 in)	dry	dry
Rosette diameter	4 to 24 inch	1 to 14 inch	Bolting height	3 to 5 feet	2 to 4 feet

Table 2. Scotch thistle control from herbicides applied at the rosette or bolting stage in 2003.

		Scotch thistle control			
		Rosette application		Bolting application	
Herbicide Treatment	Rate	4 MAT[1]	16 MAT	2 MAT	13 MAT
	lb ai/A	----------------------------% control----------------------------			
untreated control	----	0	0	0	0
clopyralid + NIS[2]	0.25	95	97	--[3]	--
clopyralid + 2,4-D ester + NIS	0.19 + 1.0	95	88	--	--
dicamba + 2,4-D ester + NIS	0.25 + 1.0	83	75	72	70
2,4-D ester + NIS	2.0	75	53	62	30
imazapic + MSO[4]	0.13	65	0	--	--
imazapic + MSO	0.19	72	0	48	30
chlorsulfuron + 2,4-D ester + NIS	0.05 + 1.0	73	67	70	80
chlorsulfuron + NIS	0.05	87	69	--	--
$LSD_{(0.05)}$		9	10	9	10

[1] MAT = month after treatment
[2] NIS = non-ionic surfactant (R-11) added at 0.25% v/v
[3] -- = treatment was not applied at the bolting stage
[4] MSO = ethylated seed oil and non-ionic surfactant blend (Hasten) added at 1.0 pt/A

Table 3. Scotch thistle control from herbicides applied at the rosette or bolting stage in 2004.

		Scotch thistle control	
		Rosette application	Bolting application
Herbicide Treatment	Rate	4 MAT[1]	2 MAT
	lb ai/A	-----% control-----	
untreated control	----	0	0
clopyralid + NIS[2]	0.25	100	65
clopyralid + 2,4-D ester + NIS	0.19 + 1.0	83	82
dicamba + 2,4-D ester + NIS	0.25 + 1.0	97	80
2,4-D ester + NIS	2.0	86	75
imazapic + MSO[3]	0.13	88	67
chlorsulfuron + NIS	0.05	95	83
chlorsulfuron + 2,4-D ester + NIS	0.05 + 1.0	--[4]	90
triclopyr + NIS	0.75	38	--
$LSD_{(0.05)}$		11	11

[1] MAT = month after treatment

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

[3] MSO = ethylated seed oil and non-ionic surfactant blend (Hasten) added at 1.0 pt/A

[4] -- = treatment was not applied at the application timing

Control of Canada thistle, perennial sowthistle, fringed sage and other troublesome weeds with metsulfuron. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Previous research at North Dakota State University found that metsulfuron controls some troublesome weeds, such as scentless chamomile and fringed sage, that are difficult to control with commonly used auxin-type herbicides in pasture and rangeland. Metsulfuron is a relatively low cost alternative to these auxin-type herbicides for weed control in pasture, rangeland, and wild lands. The purpose of this research was to evaluate metsulfuron applied alone and in combination with other herbicides for control of several noxious and troublesome weeds.

The first experiment was established on fallow cropland near Fargo to evaluate metsulfuron applied alone or with thifensulfuron plus tribenuron at cropland use rates for perennial sowthistle and Canada thistle control. Treatments were applied on June 20, 2002, using a hand-held boom sprayer delivering 17 gpa at 35 psi. The plots were 9 by 25 feet and replicated four times in a randomized complete block design. Control was based on a visual estimate of percent stand reduction as compared to the untreated check. Perennial sowthistle and Canada thistle were in the rosette growth stage with 4 to 10 leaves.

Metsulfuron provided nearly complete control of perennial sowthistle through 27 MAT (months after treatment) regardless of application rate (Table 1). Metsulfuron at 0.06 oz/A costs less than $1.50/A and could be used in cropland to control perennial sowthistle. Canada thistle control was similar regardless of metsulfuron rate or the addition of thifensulfuron plus tribenuron and averaged 74% control 15 MAT compared to 43% control with clopyralid plus 2,4-D. Canada thistle control 24 MAT declined to 40% or less regardless of treatment.

The second experiment was established to evaluate long-term perennial sowthistle and Canada thistle control with metsulfuron applied alone. Metsulfuron rates were increased 10-fold compared to the first study. Herbicides were applied on June 2, 2003 as previously described except the plots were 10 by 30 feet. The weed species evaluated were in the rosette growth stage. Again, metsulfuron provided near complete control of perennial sowthistle but did not provide long-term Canada thistle control (Table 2).

The third experiment was established to evaluate common burdock control by metsulfuron. Herbicides were applied on June 11, 2003, when common burdock was 10 to 12 inches tall with 6 to 8 leaves. The experiment was located in a moist wooded area near Walcott, ND. The plots were 9 by 30 feet with three replicates.

Common burdock control only averaged 65% 1 MAT with metsulfuron and the commonly used combination of clopyralid plus 2,4-D, but by 3 MAT control improved to an average of 93% (Table 3). All treatments provided nearly complete control 12 MAT but only clopyralid plus 2,4-D controlled common burdock by the end of the second season after treatment (97%). Common burdock by 15 MAT was regrowing from seed with all metsulfuron treatments.

The fourth experiment was established to evaluate absinth wormwood control with metsulfuron. The experiment was established in a very dense absinth wormwood stand near Jamestown, ND, on June 4, 2003. Herbicides were applied as previously described when absinth wormwood was beginning to bolt and 12 to 24 inches tall. The plots were 10 by 30 feet, and treatments were replicated four times in a randomized complete block design. Metsulfuron did not control absinth wormwood regardless of rate (Table 4). The standard treatment of picloram at 2 to 4 oz/A provided complete absinth wormwood control for 12 MAT.

In summary, metsulfuron alone controlled perennial sowthistle for several seasons and would be a very cost-effective treatment in pasture, rangeland, and cropland. Metsulfuron provided good common burdock control for 1 yr, but would need to be reapplied to control seedlings. Metsulfuron provided relatively short-term Canada thistle control but did not control absinth wormwood.

Table 1. Control of perennial sowthistle and Canada thistle by metsulfuron alone and with other herbicides applied in June 2002, at Fargo, ND.

		Time after treatment/weed species								
		1 MAT[1]		12 MAT		15 MAT		24 MAT		27 MAT
Treatment[2]	Rate	PEST[1]	CT[1]	PEST	CT	PEST	CT	PEST	CT	PEST
	oz /A	% control								
Metsulfuron	0.06	100	87	99	84	98	80	96	40	93
Metsulfuron	0.075	94	83	97	71	99	74	95	39	93
Metsulfuron	0.15	98	91	97	81	95	75	97	33	86
Metsulfuron	0.3	100	94	96	85	99	78	96	38	96
Metsulfuron + thifensulfuron/ tribenuron[3]	0.03 + 0.075 + 0.037	97	85	96	80	92	70	95	35	86
Metsulfuron + thifensulfuron/ tribenuron[3]	0.06 + 0.15 + 0.074	99	81	98	68	99	68	95	28	89
Clopyralid /2,4-D[4]	1.52 + 8	96	76	94	73	65	43	73	30	66
Glyphosate	6	65	24	55	10	43	0	82	8	79
LSD (0.05)		9	12	10	18	34	28	21	NS	17[5]

[1] Abbreviations: MAT = months after treatment; PEST = perennial sowthistle; CT = Canada thistle.
[2] Surfactant X-77 at 0.25% was applied with all treatments, Loveland Industries, Greeley, CO.
[3] Thifensulfuron + tribenuron - commercial formulation - Harmony Extra by DuPont, Wilmington, DE.
[4] Commercial formulation - Curtail by Dow AgroSciences, Indianapolis, IN.
[5] LSD = 0.10.

Table 2. Control of perennial sowthistle and Canada thistle by metsulfuron applied in June 2003.

		2 MAT[1]		3 MAT		12 MAT	
Treatment[2]	Rate	CT[1]	PEST[1]	CT	PEST	CT	PEST
	—— oz/A ——	—————— % control ——————					
Metsulfuron + X-77	0.3 + 0.25%	99	99	60	93	23	83
Metsulfuron + X-77	0.45 + 0.25%	99	99	61	99	3	100
Metsulfuron + X-77	0.6 + 0.25%	99	99	80	99	16	80
Metsulfuron + X-77	0.9 + 0.25%	99	99	91	100	8	100
Metsulfuron + X-77	1.2 + 0.25%	100	100	98	100	46	99
Metsulfuron + X-77	1.8 + 0.25%	99	99	99	100	50	100
Clopyralid/2,4-D[3]	3 + 16	96	98	63	95	83	80
LSD (0.10)		NS	NS	NS	NS	47	NS

[1] Abbreviations: MAT = months after treatment; PEST = perennial sowthistle; CT = Canada thistle.
[2] Surfactant X-77 at 0.25% was applied with all treatments, Loveland Industries, Greeley, CO.
[3] Commercial formulation - Curtail by Dow AgroSciences, Indianapolis, IN.

Table 3. Common burdock control with metsulfuron applied in June 2003 in a

		Time after treatment			
Treatment[1]	Rate	1 MAT[2]	3 MAT	12 MAT	15 MAT
	—— oz/A ——	———— % control ————			
Metsulfuron	0.3	62	88	100	50
Metsulfuron	0.45	58	91	100	3
Metsulfuron	0.6	76	98	97	48
Metsulfuron	0.9	63	97	100	32
Metsulfuron	1.2	70	91	100	49
Metsulfuron	1.8	72	95	100	36
Clopyralid/2,4-D[3]	3 + 16	53	88	100	97
LSD (0.05)		NS	NS	NS	52

[1] Surfactant X-77 at 0.25% was applied with all metsulfuron treatments, Loveland Industries, Greeley, CO.
[2] Abbreviation: MAT = months after treatment.
[3] Commercial formulation - Curtail by Dow AgroSciences, Indianapolis, IN.

Table 4. Absinth wormwood control with metsulfuron applied in June 2003 near Jamestown, ND.

Treatment	Rate	Time after treatment		
		1 MAT[1]	3 MAT	12 MAT
	—— oz/A ——	% injury	—— % control ——	
Metsulfuron + X-77[2]	0.6 + 0.25%	18	0	0
Metsulfuron + X-77	0.9 + 0.25%	23	8	0
Metsulfuron + X-77	1.2 + 0.25%	21	0	0
Metsulfuron + X-77	1.8 + 0.25%	29	0	0
Picloram	2	86	99	100
Picloram	4	96	99	100
LSD (0.05)		1	3	1

[1] Abbreviation: MAT = months after treatment.
[2] X-77 - Loveland Industries, Greeley, CO.

Table beet tolerance to S-metolachlor and dimethenamid-p. Ed Peachey (Horticulture Dept, Oregon State University, Corvallis, OR 97331) The objective of this study was to evaluate table beet tolerance to soil-applied herbicides under wet soil conditions. The soil at this site was a silt loam with an OM content of 4.91% and a CEC of 21.5 meq/100g of soil. Granular fertilizer and cycolate herbicide (4 pts/A) were broadcast on May 12 and incorporated with a vertical tine tiller. Table beets (Detroit Dark Red) were planted on May 17 with a Gaspardo vacuum precision planter into plots with spacing of 1.5 feet between rows. Pyrazon herbicide was applied to all plots to reduce weed competition. Preemergence herbicide treatments were applied on May 19 to very wet soil. Irrigation was applied on May 20 to incorporate the PES[1] herbicides. The plots were kept relatively wet through the early season to maximize potential effects of S-metolachlor on beet growth. Another 1.2 inches of irrigation water was applied on June 3 following application of the EPOST herbicides on June 1, and 1 inch of rain fell from June 6 to June 10. Stand counts were made on June 14 and growth reduction estimates due to herbicides were made on June 11 and 23. Beets were harvested on July 30 from 8.2 feet of one middle row in each plot.

Stunting of beet growth from S-metolachlor was significant at rates of 0.064 lbs ai/A or above through June 11, but only at 0.95 lbs ai/A on June 23. The effect of S-metolachlor on beet growth was much less when the herbicide was applied EPOST. Stunting was severe with all rates and timings of dimethenamid-p. Crop yield averaged 22.4 t/A in the check plots. Hand weeding was not needed in any of the plots because cycloate and pyramin controlled weeds exceptionally well. Crop yields with S-metolahclor applied PES at 0.32 to 0.96 lbs ai/A were statistically equivalent to the untreated check. However, the application of S-metolachlor at 0.094 lbs ai/A reduced the percentage of beets in the combined size classes of 1 and 2 from 80 to 60 %, an indication of fewer but larger beets. The cause for the lower than expected yield of 19.1 t/A in Tr. 1 is unclear. A yield reduction was not expected, even at this very low rate of herbicide (0.032 lbs ai/A) because few in any weeds survived the cycloate and pyrazon applications.

Table 1. Table beet tolerance to herbicides.

						Crop injury assessment					
					Stand	11-Jun-04		23-Jun-04		Harvest	
	Herbicide	Timing	Rate	Obs.	count	Stunting	Phyto	Stunting	Phyto	Yield	Grade
			lbs ai/A		no/3 ft of row	%	1-10	%	1-10	t/A	% 1-2
1	S-metolachlor	PES	0.32	4	32	3	0	3	0.3	19.1	88
2	S-metolachlor	PES	0.64	4	33	14	0	8	0	21.1	83
3	S-metolachlor	PES	0.95	4	28	33	3	30	0	21.4	60
4	S-metolachlor	EPOST	0.32	4	33	0	0	0	0	20.2	82
5	S-metolachlor	EPOST	0.64	4	32	10	0	8	0.8	21.3	86
6	S-metolachlor	EPOST	0.95	4	36	14	0	10	0	21.8	79
7	Dimethenamid-p	PES	0.54	4	28	58	1	48	0	20.2	58
8	Dimethenamid-p	PES	1.08	4	12	94	2	86	0	14.0	38
9	Dimethenamid-p	EPOST	0.54	4	31	23	1	15	0	20.1	82
10	Dimethenamid-p	EPOST	1.08	4	36	38	2	25	0	19.8	79
11	Check	-	0	8	36	0	0	0	0	22.4	80
	$FPLSD_{(0.05)}$				8	12	ns	13	ns	4.1	11

[1] Preemergence surface

Table 2. Soil and herbicide application data.

Site and plot characteristics			
Plot size/Exp. design	6.5 by 32 ft	4 reps	RCBD
Previous crop	Broccoli		
Soil test	OM 4.91% (LOI)	CEC 21.5 meq/100 g soil	
Herbicide application data			
Date	May 19, 2004		June 1, 2004
Crop stage	Planted on May 17		Cotyledon, first true leaves visible
Application timing	PES (preemergence surface)		EPOST
Start/end time	6:30-8:30 A		6:30-7A
Air temp/soil temp (2")/surface	58/58/62		54/56/53
Wind direction/velocity	E 0-1		0
Cloud cover	100		0
Soil moisture	Very wet, rain 0.5" on 5-18		Dry
Sprayer/PSI	Backpack 30 PSI		Backpack 30 PSI
Gallons H20/acre	20 GPA		20 GPA
Nozzle type	8002		8002
Nozzle spacing and height	20/18		20/18
Soil inc. method/implement	Irrigation		-

Weed control with S-metolachlor in table beets. Ed Peachey (Horticulture Dept, Oregon State University, Corvallis, OR 97330) The objective of this experiment was to determine the potential of using s-metolachlor herbicide for weed control in table beets. Predominant weeds at the field site were common lambsquarters, Powel amaranth, and hairy nightshade. PPI herbicides were applied on April 27 and incorporated within 2 minutes with a 16 inch disk. Table beets were planted on 18 inch rows on April 29 and PES[1] treatments applied the next day. Herbicides were incorporated with irrigation water shortly after planting. POST treatments were applied as the first true leaves of the table beets emerged. Crop injury was evaluated at 4 and 5 WAP, and weed control at harvest. Beets were harvested on August 12 from one 2.5 m section of each row in the middle of the plot, graded, and weighed.

Weed control estimates at harvest accounted for approximately 60% of the yield variability. S-metolachlor PES alone did not provide adequate control, even though crop yield was significantly greater than the check treatment. S-metolachlor applied PES with cycloate or cycloate + pyrazon treatments significantly improved weed control and yield compared to either cycloate or Pyrazon applied singly. Crop growth was reduced in the POST s-metolahclor treatments at the June 29 evaluation because of poor weed control.

Table. Effect of s-metolachlor on weeds and table beet growth and yield.

				Crop response						Weed control		
				20-May	30-May		4-Jun		29-Jun			
	Herbicide	Timing	Rate	Emer.	Phyto	Stunting	Phyto	Stunting	Stunting	at harvest	Yield	Grade
			lbs ai/A	no/3ft	0-10	%	0-10	%	%	%	t/A	% # 1
1	Cycloate	PPI	3.00	47	0	5	1	3	11	15	11.6	29
2	Cycloate Pyrazon	PPI PES	3.00 3.25	36	0	6	0	6	3	69	15.6	21
3	S-metolachlor	PES	0.64	40	0	3	0	3	8	28	13.9	24
4	S-metolachlor S-metolachlor	PES POST	0.32 0.32	37	0	10	0	8	13	8	7.3	38
5	Pyrazon S-metolachlor	PES PES	3.25 0.32	43	0	4	0	6	15	33	17.0	19
6	Pyrazon S-metolachlor	PES PES	3.25 0.64	41	0	13	0	9	10	53	19.1	17
7	Pyrazon S-metolachlor	PES PES	3.25 0.96	40	0	18	0	15	5	59	17.7	21
8	Pyrazon S-metolachlor	PES PES	3.25 1.28	45	0	15	0	13	3	58	16.6	19
9	Cycloate Pyrazon S-metolachlor	PPI PES PES	3.00 3.25 0.64	38	0	29	0	23	10	90	18.0	16
10	Cycloate Pyrazon S-metolachlor	PPI PES POST	3.00 3.25 0.64	37	0	13	0	10	5	88	19.1	17
11	Pyrazon S-metolachlor	PES POST	3.25 0.32	47	0	8	0	13	23	0	5.5	44
12	Pyrazon S-metolachlor	PES POST	3.25 0.64	36	0	1	0	6	21	0	8.5	37
13	Pyrazon S-metolachlor	PES POST	3.25 0.96	45	0	4	0	4	18	13	8.0	35
14	Pyrazon S-metolachlor	PES POST	3.25 1.28	46	0	13	0	13	13	28	12.5	31
15	Unweeded	-	-	50	0	0	6	0	15	0	5.9	44
16	Weeded Check	-	-	-	0	0	0	0	0	-	16.1	29
	FPLSD (0.05)			ns	0.5	12	1	12	10	19	6	11

[1] Preemergence surface

Purple nutsedge control in turfgrass with various timings and combinations of herbicides. Kai Umeda and Gabriel Towers. (University of Arizona Cooperative Extension, 4341 E. Broadway Rd., Phoenix, AZ 85040) At the Riverview Golf Course in Sun City, AZ, the plots measured 5 ft by 20 ft in length and each treatment was replicated four times and arranged in a randomized complete block design. Herbicides were applied either as a single application, three monthly applications, or as needed multiple applications. The first application of all treatments was made on 08 July 2004 with the air temperature at 90°F, clear sky, no wind, and humidity increasing. The CYPRO was 2 to 3 inches tall and the turf was not mowed until the following day. The common bermudagrass turf was regularly cut at 0.5 inch height. The second application date was 22 July for as needed applications of halosulfuron and imazaquin treatments. The approximate temperature at the time of application was 80°F. The third application date was 04 August when the second monthly treatments were sprayed with temperature at 86°F, calm wind, and slightly cloudy conditions. The fourth application for an MSMA application was on 19 August with temperature at 84°F, 95% overcast, and calm. The fifth application date for the treatment as needed was 24 August when temperature was 82°F and overcast. The sixth application date for the third monthly application was 03 September with temperature at 82°F, clear, and a slight wind. All applications were made using a backpack CO_2 sprayer with a hand-held boom equipped with three flat fan 8002 nozzles spaced 20 inches apart. All sprays were applied in 30 gpa water pressurized to 30 psi and included a non-ionic surfactant, Latron CS-7 at 0.25% v/v.

The highest degree of CYPRO control was observed for trifloxysulfuron with two timely applications, three monthly applications, or when combined with MSMA. Imazaquin and halosulfuron applied in three monthly applications alone or with MSMA also controlled CYPRO. Sulfosulfuron and flazasulfuron applied only once controlled CYPRO for one month.

Table. Purple nutsedge control with multiple applications and combinations of herbicides at Riverview Golf Course, Sun City, AZ in 2004.

Treatment	Rate	Total number applications (Application dates)	CYPRO control 22-Jul	4-Aug	19-Aug	21-Sep	01-Oct
	lb a.i./A		%				
untreated check			0	0	0	0	0
halosulfuron	0.062	4 (07 Jul, 22 Jul, 04 Aug, 24 Aug)	85	70	95	74	71
halosulfuron	0.062	3 (07 Jul, 04 Aug, 03 Sep)	90	83	94	97	88
trifloxysulfuron	0.026	2 (07 Jul, 24 Aug)	88	91	68	97	94
trifloxysulfuron	0.026	3 (07 Jul, 04 Aug, 03 Sep)	84	91	98	97	95
imazaquin	0.5	3 (07 Jul, 22 Jul, 24 Aug)	64	92	69	89	90
sulfosulfuron	0.094	1 (07 Jul)	86	96	83	59	74
flazasulfuron	0.047	1 (07 Jul)	91	91	68	73	75
MSMA	3.0	4 (07 Jul, 22 Jul, 04 Aug, 19 Aug)	55	59	69	48	63
MSMA + halosulfuron	3.0 0.062	4 (07 Jul, 22 Jul, 04 Aug, 24 Aug)	88	76	91	71	74
MSMA + trifloxysulfuron	3.0 0.026	2 (07 Jul, 24 Aug)	84	89	69	97	95
MSMA + imazaquin	3.0 0.5	3 (07 Jul, 22 Jul, 24 Aug)	76	99	88	95	91
LSD (p=0.05)			14.4	14.9	11.1	14.9	12.1

Evaluation of new herbicides for use in blackberries. Diane Kaufman and Judy Kowalski. North Willamette Research and Extension Center, Oregon State University, Aurora, OR 97002) The study was conducted in a two year old planting of 'Marion' Blackberry established on a Quatama silt loam soil with 4% organic matter at the North Willamette Research and Extension Center. Plots 10 feet wide by 30 feet long (5 plants per plot) were arranged in a randomized complete block design with 4 replications. Herbicides were applied over plots of untrained 'Marion' blackberry canes on October 6, 2003 and March 23, 2004, using a CO_2 pressurized backpack sprayer with a 3-nozzle boom (TeeJet 8002, flat fan) set at 40 psi and a rate of 20 gallons of water per acre.

Table 1. Treatments and herbicide rates.

Treatments: October 26, 2003	Rates (lb ai/A)	Treatments: March 23, 2004	Rates (lb ai/A)
Metolachlor	1.25	Metolachlor	1.25
Isoxaben + Dimethenamid-P	0.75 + 0.30	Flumioxazin	0.075
Dimethenamid-P	0.75	Dimethenamid-P	0.75
Pendimethalin	2.00	Pendimethalin	2.00
Simazine	1.33	Simazine	1.33
Sulfentrazone + Dimethenamid-P	0.225 + 0.25	Sulfentrazone + Dimethenamid-P	0.225 + 0.25
Oryzalin	2.00	Oryzalin	2.00
Thiazopyr	0.50	Thiazopyr	0.50

Quality of weed control from the fall herbicide application was evaluated on March 10, 2004. Quality of weed control from the spring herbicide application was evaluated April 14 and July 30, 2004.

Table 2. Quality of weed control, expressed as percent control compared to weedy control areas between plots.

Treatment	Overall weed control from fall application March 10 (156 DAT)	Overall weed control from spring application April 14 (21 DAT)	Overall weed control from spring application June 30 (129 DAT)
	%	%	%
Metolachlor	53.8	80.0	66.9
Isoxaben + Dimethenamid-P	52.5	-----	-----
Flumioxazin	-----	83.2	75.6
Dimethenamid-P	68.8	73.0	59.4
Pendimethalin	66.2	83.2	76.2
Simazine	87.5	76.2	60.6
Sulfentrazone+Dimeth-P	91.2	88.8	70.0
Oryzalin	67.5	74.8	55.0
Thiazopyr	94.0	93.8	85.0
LSD (0.05)	16.8	11.1	NS

Thiazopyr, sulfentrazone + dimethenamid-P, and simazine provided the best weed control of the fall-applied herbicides. The main weeds present over winter were common chickweed, annual bluegrass, common groundsel, annual sowthistle, shepherdspurse, white clover, and vetch. Of these, clover was the only weed that survived in plots treated with thiazopyr. Weed control 21 days after the spring herbicide application was excellent (90-100%) in plots treated with thiazopyr, good (80-89%) in plots treated with sulfentrazone + dimethenamid-P, pendimethalin, flumioxazin, and metolachlor, and fair (70-79%) in plots treated with simazine, oryzalin, and dimethenamid-P. Quality of weed control from the spring herbicide application deteriorated as the summer progressed. By 129 days after treatment, thiazopyr provided good weed control, while flumioxazin and pendimethalin provided fair weed control. The main weeds present during spring and summer were crabgrass, redroot pigweed, annual sowthistle, common groundsel, and clover.

Temperatures in early spring, 2004 were warmer than usual, resulting in early emergence of new primocanes. Because some new primocanes were present at the time of the spring herbicide application, we were able to observe the effect of experimental herbicides on primocane burn and growth.

Table 3. Effect of spring applied herbicides on primocane growth, 2004.

Treatment	Primocane damage rating[1] March 30 (7 DAT)	Primocane growth rating[2] April 21 (21 DAT)
	%	%
Metolachlor	0	4.0
Flumioxazin	2.6	1.6
Dimethnamid-P	0.1	3.2
Pendimethalin	1.2	2.6
Simazine	0.2	3.6
Sulfentrazone +Dimethenamid-P	3.0	1.5
Oryzalin	0	3.5
Thiazopyr	0.2	2.2
LSD (0.05)	0.4	0.8

[1]Damage rating: 0 = no damage; 1 = leaf margins burned; 2 = leaves and cane tips burned; 3 = primocane burned back to the ground.
[2]Regrowth rating: 1 = poor (5 to 10 inches high); 2 = fair (10 to 15 inches high); 3 = good (15 to 19 inches high); 4 = very good (20 or more inches high).

Metolachlor, dimethenamid-P, simazine, oryzalin, and thiazopyr (0.5 lb ai) did not damage newly emerged primocanes. In a previous trial by this researcher, thiazopyr burned back recently emerged primocanes in 'Meeker' red raspberry when applied at rates of 0.75 and 1.0 lb ai/A (WSWS Research Progress Report 2001). Pendimethalin resulted in some marginal burn and curling of primocane leaves. Both flumioxazin and sulfentrazone + dimethenamid-P burned new primocanes back completely. Two weeks later, primocanes were growing well in plots treated with metolachlor, simazine, oryzalin, and dimethenamid-P. Primocane growth was intermediate in plots treated with thiazopyr and pendimethalin. New primocane leaves in plots treated with pendimethalin continued to be somewhat curled. Primocane growth was greatly reduced in plots treated with flumioxazin and sulfentrazone + dimethenamid-P.

The effect of the various herbicides on 'Marion' blackberry plant vigor was assessed by measuring primocane number, diameter, and height of two plants per plot during the first week of August, 2004. Although primocane growth in plots treated with flumioxazin and sulfentrazone + dimethenamid-P lagged behing most other treatments during the spring, there were no significant differences among treatments in mean primocane number per plant, cane diameter, or total cane growth measured in early August (data not shown).

Screening of low rate pre- and postemergence herbicides in broccoli, lettuce and spinach. Steven A. Fennimore and John S. Rachuy. (Department of Plant Sciences, University of California-Davis, Salinas, CA, 93905).

The search for new herbicide options for cool-season vegetables is necessary because of limited weed control options for those crops. The objective of this study was to identify new potential herbicides for broccoli, lettuce and spinach. Iceberg lettuce 'Sharp Shooter', romaine lettuce 'Green Towers', Broccoli 'Marathon', and spinach 'Whale' were screened in the field (sandy loam soil, with pH of 7.0 and 2.1% organic matter) for tolerance to low-rate herbicides at the University of California/USDA Agricultural Research Station, Salinas, California. In addition, two broadleaf weed species, redroot pigweed (*amaranthus retroflexus L.*) and shepherds-purse (*Capsella bursa-pastoris (L.) Medik.*), were seeded and tested for their susceptibility to the low-rate herbicides. Preemergence herbicides (Pre) and rates tested (in lb ai/A) were: bispyribac sodium at 0.018 and 0.036, bensulfuron at 0.029 and 0.037, V-10146 at 0.1, DCPA at 7.5, pronamide at 1.2, and cycloate at 3.0. Postemergence herbicides (Post) (tested at rates of lb ai/A; except where noted) included: bispyribac sodium at 0.018 and 0.036, flucarbazone at 0.014 and 0.027, floransulam at 0.002 and 0.004, bensulfuron at 0.029 and 0.037, V-10146 at 0.1, and pelargonic acid at 3 and 5 (% v/v). Non-ionic surfactant (NIS) was added at 0.25% v/v to all post treatments, except for pelargonic acid. All pre and post treatments were applied as a water-based spray solution at a target rate of 40 gpa; with the exception of the pelargonic acid treatments, which were applied undiluted at 75 gpa. The planting date for both crops and weeds was June 2, 2004. Preemergence treatments were applied on June 3, 2004. Postemergence treatments were applied on June 22, when most crop species were at two to five true leaves. Crop phytotoxicity ratings were recorded on June 18 and 30, at 15 days after preemergence treatment (DAT), and 8 days after postemergence treatment, respectively. Resident (non-planted) weed density counts were made on June 29 (26DAT). Crop stand counts were measured July 8 (35 DAT) for spinach, July 13 (40 DAT) for broccoli, July 19 (46 DAT) for romaine lettuce, and July 26 (53 DAT) for iceberg lettuce. Crop and weed species fresh biomass samples were collected on July 8 (35 DAT) for spinach, July 13 (40 DAT) for broccoli, July 19 (46 DAT) for romaine lettuce, July 26 (53 DAT) for iceberg lettuce and redroot pigweed, and August 2 (60 DAT) for shepherd's-purse. Dry weights were determined for all crops and weeds. Mean separation was performed using LSD (P=0.05).

The criteria for acceptable crop injury was a mean phytotoxicity rating of < 2.0 (0 = no injury, 10 = plant death). Preemergence applications of pronamide at 1.2 lb ai/A and V-10146 at 0.1 lb ai/A were the only safe treatments on iceberg and romaine lettuce (Table 1). The preemergence application of cycloate at 3 lb ai/A was the only safe treatment on either broccoli or spinach (Table 2). All treatments not previously mentioned resulted in unacceptable crop injury.

Preemergence applications of bensulfuron at .029 lb ai/A and V-10146 at 0.1 lb ai/A produced iceberg lettuce biomasses comparable to the pronamide standard. The preemergence application of V-10146 at 0.1 lb ai/A was the only treatment to produce a romaine lettuce biomass comparable to the pronamide standard (Table 1). None of the pre or post-emergence treatments produced broccoli or spinach biomasses comparable to the cycloate standard (Table 2).

The level of weed control by each treatment was evaluated by measuring densities of resident weeds and dry weights of seeded weed species. For either method, the criterion for acceptable weed control was an efficiency of > 80% (based on the treatment mean, with the untreated check used as comparison). When analyzing resident weed counts, the herbicides that provided acceptable control by weed species (where rates in lb. a.i. /A are identified in parenthesis) were: Shepherd's-purse; preemergence treatments of bispyribac sodium (0.018, 0.036), bensulfuron (0.029, 0.037), V-10146 (0.1), DCPA (7.5), and cycloate (3.0), and post-emergence treatments of bispyribac sodium (0.018, 0.036), floransulam (0.002, 0.004), bensulfuron (0.029, 0.037), V-10146 (0.1), and pelargonic acid (at 3 and 5% v/v). Burning nettle; preemergence treatments of bensulfuron (0.029, 0.037) and DCPA (7.5), and post-emergence treatments of bispyribac sodium (0.018, 0.036), floransulam (0.002, 0.004), bensulfuron (0.029, 0.037) and pelargonic acid (at 3 and 5% v/v) (Table 3). Herbicide treatments that were found to provide acceptable levels of control of seeded redroot pigweed were: preemergence applications of bispyribac sodium (0.036), bensulfuron (0.029, 0.037), V-10146 (0.1), DCPA (7.5), and cycloate (3.0), and post-emergence applications of bispyribac sodium (0.018, 0.036), flucarbazone (0.014, 0.027), floransulam (0.004) and V-10146 (0.1). Treatments that controlled seeded shepherd's-purse were preemergence applications of bispyribac sodium (0.018, 0.036), bensulfuron (0.029, 0.037), V-10146 (0.1), DCPA (7.5), and cycloate (3.0), and post-emergence applications of bispyribac sodium (0.018, 0.036), flucarbazone (0.014, 0.027), floransulam (0.002, 0.004), bensulfuron (0.029, 0.037), V-10146 (0.1) and pelargonic acid (at 5% v/v) (Table 4).

All treatments not previously mentioned resulted in unacceptable weed control.

Table 1. Phytotoxicity, stand count and crop biomass for iceberg and romaine lettuce.

			Iceberg Lettuce				Romaine Lettuce			
			Phytotoxicity[1]				Phytotoxicity[1]			
Herbicide	Stage	Rate	6/18	6/30	Stand	Biomass[2]	6/18	6/30	Stand	Biomass[2]
		lb ai A^{-1}			# $3ft^{-1}$	g $3ft^{-1}$			# $3ft^{-1}$	g $3ft^{-1}$
Bispyribac sodium	Pre	0.018	6.3	8.5	18.0	37.4	6.6	8.5	21.0	12.7
Bispyribac sodium	Pre	0.036	6.9	8.9	15.8	15.6	7.1	8.8	16.8	8.1
Bispyribac sodium + NIS	Post	0.018	---	6.0	21.5	63.3	---	6.3	17.0	13.8
Bispyribac sodium + NIS	Post	0.036	---	6.9	15.8	30.7	---	7.0	15.8	8.6
Flucarbazone + NIS	Post	0.014	---	5.1	22.3	87.5	---	5.8	20.5	50.3
Flucarbazone + NIS	Post	0.027	---	6.1	24.5	82.6	---	6.6	18.8	19.6
Floransulam + NIS	Post	0.002	---	7.8	0	0	---	7.8	0.8	0.2
Floransulam + NIS	Post	0.004	---	8.8	0	0	---	9.0	0	0
Bensulfuron	Pre	0.029	4.8	5.3	18.3	116.1	6.0	6.4	15.5	49.3
Bensulfuron	Pre	0.037	5.1	6.1	16.8	88.4	6.0	6.0	14.3	63.8
Bensulfuron + NIS	Post	0.029	---	6.8	19.3	34.4	---	7.4	18.3	10.9
Bensulfuron + NIS	Post	0.037	---	6.9	18.5	16.1	---	7.3	14.0	5.9
V- 10146	Pre	0.100	1.6	0.9	23.5	128.0	1.8	1.0	20.5	106.8
V- 10146 + NIS	Post	0.100	---	7.3	10.8	14.9	---	7.3	14.0	12.2
Pelargonic acid	Post	3.00[3]	---	9.6	2.0	19.0	---	9.5	1.8	6.9
Pelargonic acid	Post	5.00[3]	---	9.8	1.5	12.9	---	9.6	1.8	5.9
DCPA	Pre	7.500	4.8	10.0	0.3	3.8	5.1	9.9	0	0
Pronamide	Pre	1.200	0.3	0.1	22.8	126.2	1.1	0.3	23.3	108.9
Cycloate	Pre	3.000	6.8	7.1	14.5	92.5	7.6	8.4	11.0	41.5
Hand-Weeded Check	-	-	0.0	0.0	22.8	138.5	0.0	0.0	24.0	117.2
Untreated Check	-	-	0.0	0.0	21.8	130.6	0.0	0.0	23.3	102.9
LSD (0.05)			1.0	0.9	5.9	21.5	1.0	1.0	5.2	16.2
Days after preemergence treatment			18	27	53	53	18	27	46	46
Days after postemergence treatment			---	8	34	34	---	8	27	27

[1] Crop phytotoxicity (0 = no injury, commercially acceptable < 2.0, 10 = death)
[2] Crop biomass (dry weight)
[3] Rate in % V/V.

Table 2. Phytotoxicity, stand count and crop biomass for broccoli and spinach.

Herbicide	Stage	Rate	Broccoli Phytotoxicity[1] 6/18	Broccoli Phytotoxicity[1] 6/30	Broccoli Stand	Broccoli Biomass[2]	Spinach Phytotoxicity[1] 6/18	Spinach Phytotoxicity[1] 6/30	Spinach Stand	Spinach Biomass[2]
		lb ai A^{-1}			# $3ft^{-1}$	g $3ft^{-1}$			# $3ft^{-1}$	g $3ft^{-1}$
Bispyribac sodium	Pre	0.018	6.3	9.4	0	0	6.0	8.4	0.8	0.5
Bispyribac sodium	Pre	0.036	7.9	9.6	0	0	7.2	8.9	0	0
Bispyribac sodium + NIS	Post	0.018	---	8.4	0	0	---	8.4	0	0
Bispyribac sodium + NIS	Post	0.036	---	9.1	0	0	---	8.1	0	0
Flucarbazone + NIS	Post	0.014	---	6.8	0	0	---	6.4	4.5	11.6
Flucarbazone + NIS	Post	0.027	---	7.0	0	0	---	7.1	0.8	1.6
Floransulam + NIS	Post	0.002	---	7.9	0	0	---	8.0	1.8	1.5
Floransulam + NIS	Post	0.004	---	8.4	0	0	---	8.3	0	0
Bensulfuron	Pre	0.029	7.0	8.7	3.0	4.5	7.1	8.1	5.0	8.5
Bensulfuron	Pre	0.037	7.6	9.1	0	0	7.3	8.5	4.0	7.1
Bensulfuron + NIS	Post	0.029	---	7.3	0	0	---	6.3	9.8	18.1
Bensulfuron + NIS	Post	0.037	---	8.0	0	0	---	7.4	4.5	7.5
V- 10146	Pre	0.100	6.3	8.3	6.3	6.3	7.3	8.5	0	0
V- 10146 + NIS	Post	0.100	---	8.1	0	0	---	8.1	0	0
Pelargonic acid	Post	3.000[3]	---	9.7	0	0	---	8.3	5.8	17.3
Pelargonic acid	Post	5.000[3]	---	9.8	0.8	0.1	---	9.0	3.8	5.4
DCPA	Pre	7.500	1.8	4.6	14.3	62.0	3.3	8.1	4.5	12.4
Pronamide	Pre	1.200	3.6	5.5	12.5	55.2	6.6	7.1	7.0	27.6
Cycloate	Pre	3.000	0.5	1.4	13.5	97.2	0.5	0.7	14.0	59.9
Hand-Weeded Check	-	-	0	0.4	13.0	85.4	0	0.3	17.0	88.5
Untreated Check	-	-	0	0	14.0	94.0	0	0	12.5	58.6
LSD (0.05)			1.1	0.8	2.3	11.6	1.4	1.2	5.1	19.1
Days after preemergence treatment			18	27	40	40	18	27	35	35
Days after postemergence treatment			---	8	21	21	---	8	16	16

[1] Crop phytotoxicity (0 = no injury, commercially acceptable < 2.0, 10 = death)
[2] Crop biomass (dry weight)
[3] Rate in % V/V.

Table 3. Weed counts and % control for resident weeds.

Herbicide	Stage	Rate	Shepherd's-purse Count	Shepherd's-purse Control[1]	Burning nettle Count	Burning nettle Control[1]
		lb ai A^{-1}	# $0.25m^{-1}$	%	# $0.25m^{-1}$	%
Bispyribac sodium	Pre	0.018	0.1	82.7	4.9	40.0
Bispyribac sodium	Pre	0.036	0	100.0	2.3	72.3
Bispyribac sodium + NIS	Post	0.018	0	100.0	0	100.0
Bispyribac sodium + NIS	Post	0.036	0.1	82.7	0	100.0
Flucarbazone + NIS	Post	0.014	0.8	0.0	5.8	29.3
Flucarbazone + NIS	Post	0.027	0.5	33.3	3.6	55.4
Floransulam + NIS	Post	0.002	0	100.0	0.5	93.8
Floransulam + NIS	Post	0.004	0	100.0	0.8	90.8
Bensulfuron	Pre	0.029	0.1	82.7	0	100.0
Bensulfuron	Pre	0.037	0	100.0	0	100.0
Bensulfuron + NIS	Post	0.029	0.1	82.7	0.9	89.2
Bensulfuron + NIS	Post	0.037	0	100.0	0.5	93.8
V- 10146	Pre	0.100	0	100.0	2.8	66.2
V- 10146 + NIS	Post	0.100	0.1	82.7	8.3	-1.5
Pelargonic acid	Post	3.000[2]	0.1	82.7	1.1	86.1
Pelargonic acid	Post	5.000[2]	0.1	82.7	0	100.0
DCPA	Pre	7.500	0	100.0	0.3	96.9
Pronamide	Pre	1.200	0.3	66.7	2.0	75.4
Cycloate	Pre	3.000	0	100.0	1.8	78.5
Hand-Weeded Check	-	-	0.3	66.7	3.3	60.0
Untreated Check (UTC)	-	-	0.8	0.0	8.1	0.0
LSD (0.05)			0.5		3.5	
Days after preemergence treatment			26		26	
Days after postemergence			7		7	

[1] Weed Control, based on weed count data, where % Control = ((UTC-Trt)/UTC) X 100)
[2] Rate in % V/V.

Table 4. Weed biomass and % control for seeded redroot pigweed and shepherd's-purse.

Herbicide	Stage	Rate	Redroot pigweed		Shepherd's-purse	
			Biomass[1]	Control[2]	Biomass[1]	Control[2]
		lb ai A^{-1}	g $3ft^{-1}$	%	g $3ft^{-1}$	%
Bispyribac sodium	Pre	0.018	105.0	73.3	5.3	95.7
Bispyribac sodium	Pre	0.036	28.2	92.8	0.1	99.9
Bispyribac sodium + NIS	Post	0.018	7.7	98.0	0	100.0
Bispyribac sodium + NIS	Post	0.036	1.9	99.5	0	100.0
Flucarbazone + NIS	Post	0.014	14.4	96.3	0.4	99.7
Flucarbazone + NIS	Post	0.027	10.8	97.3	0	100.0
Floransulam + NIS	Post	0.002	105.0	73.3	0	100.0
Floransulam + NIS	Post	0.004	41.1	89.6	0	100.0
Bensulfuron	Pre	0.029	44.1	88.8	0	100.0
Bensulfuron	Pre	0.037	2.6	99.3	0	100.0
Bensulfuron + NIS	Post	0.029	367.5	6.7	0.4	99.7
Bensulfuron + NIS	Post	0.037	298.8	24.1	0	100.0
V- 10146	Pre	0.100	0.6	99.8	0	100.0
V- 10146 + NIS	Post	0.100	48.3	87.7	0	100.0
Pelargonic acid	Post	3.000[2]	193.8	50.8	35.6	71.1
Pelargonic acid	Post	5.000[2]	136.2	65.4	21.7	82.4
DCPA	Pre	7.500	59.0	85.0	5.7	95.4
Pronamide	Pre	1.200	386.3	1.9	80.0	35.1
Cycloate	Pre	3.000	62.6	84.1	9.8	92.0
Hand-Weeded Check	-	-	386.3	1.9	98.3	20.2
Untreated Check (UTC)	-	-	393.8	0	123.2	0
LSD (0.05)			87.6		25.1	
Days after preemergence treatment			53		60	
Days after postemergence			34		41	

[1] Weed biomass (dry weight)

[2] Weed Control, based on biomass data, where % Control = ((UTC-Trt)/UTC) X 100)

[3] Rate in % V/V.

Herbicides for weed control in cabbage seed crops. Timothy W. Miller and Robert K. Peterson. (Washington State University Northwestern Washington Research and Extension Center, 16650 State Route 536, Mount Vernon, WA 98273) Cabbage is a biennial plant that is transplanted in late August or early September, grown through the winter, bolts in April through May, and seed is harvested in July and August. Weed control is especially important during the first few months (September through March) because cabbage plants are not particularly competitive until after bolting occurs. Given mild winter temperatures and high precipitation in this production region, however, many herbicides applied at transplanting fail to provide season-long weed control. In effort to extend herbicidal control of weeds through cabbage bolting, split-applications of herbicides are being investigated.

Cabbage seedlings (2- to 3-leaf) were transplanted September 9, 2003; pre-transplant (PRETR) and post-transplant (POSTR) treatments were applied September 8 and 9, 2003, respectively. Plots measured 3.5 by 80 ft. Split-plot, postemergence (POST) herbicides were applied October 13, 2003; split-plots measured 3.5 by 8 ft. All these treatments were made using a ATV-mounted sprayer delivering 20 gpa at 15 psi. A commercial blend of acetic acid + citric acid (Ground Force = "vinegar") was applied POSTR September 9, and POST October 10 and November 12, 2003. Vinegar treatments were applied using a backpack sprayer with a shielded nozzle delivering 20 gpa at 12 psi. An additional POST treatment was flaming both sides of the cabbage row October 13, 2003 and again January 21, 2004 using a backpack, propane-fired, infrared flamer. Crop injury and weed control (0 = no injury or control, 100 = dead plants) were estimated October 24, 2003 and March 29, 2004. Predominant weeds included shepherd's-purse, pale smartweed, henbit, and common chickweed. Four cabbage plants were selected at early flowering (April 1, 2004), cut at the soil surface, and fresh weight determined. The statistical design for this trial was a split-block randomized complete block design with three replicates. Means were separated using Fisher's Protected LSD (P = 0.05). Application data are presented in Table 1 and results in Table 2.

Table 1. Herbicide application data.

Application #1	Application #2
2:00 p.m., September 8, 2003	11:00 a.m., September 9, 2003
Broadcast, PRETR	Broadcast and directed, POSTR
100% cloud cover	100% cloud cover
Winds 3 to 5 mph, from S	Winds 1 to 3 mph, from N
Air temp. = 66 F; soil temp (4") = 63 F	Air temp. = 68 F; soil temp (4") = 62 F
Relative humidity = 61%	Relative humidity = 52%
Soil surface was moist	Soil surface was moist
Few cotyledon weeds	Few cotyledon weeds
Application #3	**Application #4**
2:00 p.m., October 10, 2003	3:00 p.m., October 13, 2003
Directed, POST	Broadcast, POST
50% cloud cover	50% cloud cover
Winds 1 to 3 mph, from SW	Winds 2 to 4 mph, from NW
Air temp. = 58 F; soil temp (4") = 57 F	Air temp. = 56 F; soil temp (4") = 56 F
Relative humidity = 72%	Relative humidity = 64%
Soil surface was moist	Soil surface was moist
Weeds 1 to 2 inches	Weeds 1 to 2 inches
Application #5	**Application #6**
1:00 p.m., November 12, 2003	3:00 p.m., January 21, 2004
Directed, POST	Directed, POST
50% cloud cover	80% cloud cover
Winds 1 to 3 mph, from W	Winds 1 to 3 mph, from NE
Air temp. = 47 F; soil temp (4") = 40 F	Air temp. = 51 F; soil temp (4") = 42 F
Relative humidity = 45%	Relative humidity = 69%
Soil surface was wet	Soil surface was wet
Weeds 4 to 6 inches	Weeds 4 to 6 inches

Nearly all PRETR or POSTR products gave very effective weed control (87 to 99%) by October 24. Except for dimethenamid-p, clomazone, and simazine, however, control from these single treatments had declined to unacceptably low levels by March 29, 2004. Sulfentrazone applied POST in October caused 27 to 40% injury to cabbage, but no significant injury when applied immediately POSTR. Several combinations of September and October treatments improved the level of weed control through March, especially oxyfluorfen, sulfentrazone, s-metolachlor, dimethenamid-p, clomazone, or simazine followed by clomazone or simazine, simazine followed by clopyralid, and dimethenamid-p or clomazone followed by napropamide, clopyralid, or flaming twice. Flaming with or without residual herbicide provided 82 to 100% weed control in October. Weed control after two flamings had fallen to 38% by March 29, but still ranged from 82 to 99% when used with residual herbicides. Vinegar applied three times caused about 10% injury to cabbage plants, but weed control was generally poor at both evaluations (0 to 80%), except for vinegar followed by clomazone or simazine (90 and 82%) by March 29.

Fresh weight of cabbage treated with sulfentrazone POST was reduced regardless of residual herbicide used, indicating that damage from the October application was excessive. Compared to hand weeded cabbage plants, simazine applied twice reduced cabbage fresh weight, although weed control remained at 100%. Vinegar treatments followed by sulfentrazone, flame, or clopyralid and napropamide or flame used after hand weeding resulted in low cabbage weight, probably due primarily to poor weed control.

Table 6. Crop injury and weed control from split-applications of several herbicides in cabbage seed (planted September 9, 2003).

PRETR or POSTR treatment[1]	POST treatment[2]	Rate	Crop injury 10/24/03	Weed control 10/24/03	Weed control 3/29/04	Fresh weight 4/01/04
		lb ai/A	%	%	%	lb/plant
Oxyfluorfen (PRETR)		0.75	0	97	72	0.43
	Sulfentrazone	0.2	35	100	93	0.19
	Napropamide	0.0	0	95	81	0.38
	Flame	---	0	98	86	0.38
	Clopyralid	0.125	0	96	78	0.39
	Simazine	0.8	0	98	100	0.30
	Clomazone	0.25	0	95	100	0.49
Sulfentrazone (POSTR)		0.25	0	95	57	0.47
	Sulfentrazone	0.2	28	100	93	0.18
	Napropamide	0.0	0	92	80	0.42
	Flame	---	0	93	83	0.48
	Clopyralid	0.125	0	93	63	0.39
	Simazine	0.8	0	97	100	0.40
	Clomazone	0.25	0	90	100	0.44
S-metolachlor (POSTR)		1.25	0	87	58	0.42
	Sulfentrazone	0.2	28	99	96	0.22
	Napropamide	0.0	0	92	68	0.42
	Flame	---	0	90	82	0.32
	Clopyralid	0.125	0	90	73	0.39
	Simazine	0.8	0	90	98	0.38
	Clomazone	0.25	0	88	95	0.37
Dimethenamid-p (POSTR)		0.95	0	95	95	0.36
	Sulfentrazone	0.2	27	100	99	0.23
	Napropamide	0.0	0	96	95	0.35
	Flame	---	0	93	99	0.34
	Clopyralid	0.125	0	95	95	0.32
	Simazine	0.8	0	95	100	0.31
	Clomazone	0.25	0	94	100	0.38
Clomazone (POSTR)		0.25	0	99	99	0.40
	Sulfentrazone	0.2	32	100	99	0.24
	Napropamide	0.0	0	98	100	0.46
	Flame	---	0	100	99	0.42
	Clopyralid	0.125	0	99	100	0.40
	Simazine	0.8	0	99	100	0.33
	Clomazone	0.25	0	99	100	0.40
Simazine (POSTR)		0.38	0	98	98	0.37
	Sulfentrazone	0.2	28	100	99	0.17
	Napropamide	0.0	0	95	88	0.43
	Flame	---	0	100	99	0.45
	Clopyralid	0.125	0	98	96	0.44
	Simazine	0.8	0	99	100	0.24
	Clomazone	0.25	0	97	100	0.44
Hand weeded		---	0	38	0	0.30
	Sulfentrazone	0.2	33	77	28	0.17
	Napropamide	0.0	0	13	0	0.22
	Flame	---	0	82	38	0.24
	Clopyralid	0.125	0	40	0	0.31
	Simazine	0.8	0	45	53	0.30
	Clomazone	0.25	0	50	63	0.33
Vinegar (POSTR)		20 gpa	10	38	0	0.39
	Sulfentrazone	0.2	40	80	70	0.15
	Napropamide	0.0	15	38	0	0.34
	Flame	---	0	85	45	0.28
	Clopyralid	0.125	0	55	23	0.27
	Simazine	0.8	10	55	82	0.33
	Clomazone	0.25	5	75	90	0.29

[1]PRETR = pre-transplant, applied September 8; POSTR = post-transplant, applied September 9, 2003.
[2]POST = postemergence, applied about 5 weeks after transplanting (October 13, 2003); flame applied October 13, 2003 and January 21, 2004; acetic acid + citric acid applied September 9, October 10, and November 12, 2003.

Weed control and potato tuber yields with various rates of metribuzin, flufenacet and low rates of sulfentrazone applied preemergence alone or in tank mixtures. Pamela J.S. Hutchinson, Brent R. Beutler, and Daniel M. Hancock. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). This experiment was designed to evaluate the efficacy of various rates of metribuzin, sulfentrazone, and flufenacet applied preemergence (PRE) alone or in tank mixtures in potatoes. A weedy check and a weed-free control were included in the trial. The trial area was infested with 80 redroot pigweed (AMARE), 100 common lambsquarters (CHEAL), 10 kochia (KCHSC), 20 hairy nightshade (SOLSA), and 30 green foxtail (SETVI)/m^2.

The experimental area was fertilized with 140 lb N, 60 lb P_2O_5, 20 lb K_2O, 20 S and 3 lb Zn/A before planting 'Russet Burbank' potatoes on May 12, 2003. Potatoes were planted 5 inches deep at 12-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.4% organic matter and pH 8.0 at the Aberdeen Research and Extension Center, ID. The experimental design was a randomized complete block with three replications. Plot size was 12 by 30 feet.

Potatoes were hilled and 0.27 lb/A imidacloprid was applied on May 30, 2003, just prior to potato emergence. Herbicide treatments were applied June 2, 2003 with a CO_2-pressurized backpack sprayer that delivered 17.5 gpa at 35 psi. Herbicides were incorporated by 0.70-inch sprinkler irrigation immediately after application. No potato or weed plants were exposed at time of application.

Potatoes were sprinkler irrigated as needed throughout the growing season, and received additional N and P_2O_5, based on petiole test results, through the irrigation system. Potato vines were desiccated with 0.375 lb/A diquat September 15, 2003. Tubers were harvested from 20 feet of each of the two center rows in each plot using a single-row mechanical harvester on Oct. 7, 2003, and graded according to USDA standards.

All treatments of metribuzin or sulfentrazone applied alone, or all metribuzin + sulfentrazone tank mixture treatments controlled AMARE and CHEAL $\geq$90% regardless of rates (Table). Sulfentrazone at 0.094 lb/A tank-mixed with flufenacet at 0.525 or 0.6 lb/A controlled AMARE $\geq$90%. Either rate of flufenacet + sulfentrazone (0.047 or 0.094 lb/A) or metribuzin controlled CHEAL $\geq$90%. Sulfentrazone alone at 0.094 lb/A, or the same rate applied with 0.5 lb/A metribuzin were the only treatments controlling SOLSA $\geq$90% (Table). KCHSC control was $\geq$90% only with sulfentrazone alone or sulfentrazone + metribuzin tank mixtures, regardless of rates, or sulfentrazone and flufenacet applied together at the highest respective rates used in this trial (Table). Sulfentrazone alone did not control SETVI whereas all other treatments controlled SETVI $\geq$80% (Table).

All treatments resulted in U.S. No. 1 tuber yields greater than the weedy check except flufenacet alone at 0.6 lb/A (Table). The only treatments resulting in total tuber yields greater than the weedy check were metribuzin (0.5 lb/A + flufenacet or the highest rate of sulfentrazone.

Table. Late-season weed control and potato crop yields with metribuzin, sulfentrazone, and flufenacet applied preemergence at Aberdeen, ID.

		Weed control[1]					Crop response	
		AMARE	CHEAL	KCHSC	SOLSA	SETVI		
Treatment	Rate	9/14	9/14	9/14	9/14	9/14	U.S. No. 1	Total tuber
	lb/A	-----	-----	-----%-----	-----	-----	-----cwt/A-----	
Weedy check		-	-	-	-	-	67	13
Weed-free control		-	-	-	-	-	186	99
Metribuzin	0.375	93	95	68	10	82	219	133
Metribuzin	0.5	95	95	72	20	80	188	95
Sulfentrazone	0.047	80	90	96	78	0	164	100
Sulfentrazone	0.07	92	95	95	80	0	211	102
Sulfentrazone	0.094	95	98	99	90	0	212	113
Metribuzin + sulfentrazone	0.375 + 0.047	93	91	93	77	82	225	87
Metribuzin + sulfentrazone	0.375 + 0.07	90	90	96	85	82	206	79
Metribuzin + sulfentrazone	0.375 + 0.094	93	98	96	85	80	231	128
Metribuzin + sulfentrazone	0.5 + 0.047	94	95	98	73	88	222	112
Metribuzin + sulfentrazone	0.5 + 0.07	92	93	96	77	85	240	132
Metribuzin + sulfentrazone	0.5 + 0.094	93	98	99	95	87	267	134
Flufenacet	0.525	0	0	0	0	85	175	91
Flufenacet	0.6	0	0	0	0	90	135	59
Flufenacet + sulfentrazone	0.525 + 0.0235	53	63	53	27	87	188	108
Flufenacet + sulfentrazone	0.525 + 0.047	81	95	77	47	88	204	116
Flufenacet + sulfentrazone	0.525 + 0.094	90	98	88	72	90	223	120
Flufenacet + sulfentrazone	0.6 + 0.0235	77	83	72	47	88	241	124
Flufenacet + sulfentrazone	0.6 + 0.047	75	90	80	72	92	235	114
Flufenacet + sulfentrazone	0.6 + 0.094	95	96	95	82	92	231	126
Metribuzin + flufenacet	0.5 + 5.25	93	93	83	30	95	250	146
LSD (0.05)	-	15	11	16	25	5	70	65

[1]AMARE redroot pigweed; CHEAL common lambsquarters; KCHSC kochia; SOLSA hairy nightshade; SETVI green foxtail.

Potato leaf and stem desiccation with various single and sequential application desiccation treatments. Pamela J.S. Hutchinson, Brent R. Beutler, and Daniel M. Hancock. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this trial was to determine the effectiveness of several potato desiccants alone or in combination with other desiccants in single or sequential applications (see Table) on potato leaf and stem desiccation in a field trial at the Aberdeen Research and Extension Center in Aberdeen, Idaho.

The trial areas were fertilized with 120 lb N, 20 lb S, and 3 lb Zn/A based on soil tests, before planting. 'Russet Burbank' potato were planted 5 inches deep at 12-inch intervals in rows spaced 36 inches apart on May 13, 2003. The soil was a Declo loam soil with 1.3% organic matter and pH 7.9. Experimental design was a randomized complete block with three replications, and 12 by 30 foot plots.

Potatoes were hilled and 0.27 lb/A imidacloprid was applied on May 30, 2003, just prior to potato emergence. The trial area was treated with a postemergence application of pendimethalin to limit weed population. Desiccant treatments were applied August 22 and August 29, 2003 with a tractor-mounted CO_2-pressurized sprayer that delivered 30 gpa at 40 psi. Potato vines and leaves were visually rated for desiccation one week after the first application, just prior to the second application, and again one week after the second application (2 wk after the first application). Potatoes were sprinkler irrigated as needed throughout the growing season and received additional N and P_2O_5, based on petiole test results, through the irrigation system.

At one week after the first application, a single application of paraquat + nonionic surfactant (NIS) resulted in 98% potato leaf and 82% stem desiccation (Table). Other single application treatments providing >90% control at 1 WAT were sulfuric acid (30 gal/A), 100% v/v sulfuric acid-Cheltec formulation, 0.375 lb/A glufosinate-ammonium + 1% v/v AMS Plus, 0.375 lb/A glufosinate-ammonium + 0.0083 lb/A carfentrazone + 1% v/v AMS Plus, 0.05 lb/A carfentrazone + 0.25 lb/A diquat + 1 qt/A methylated seed oil (MSO), or 0.0375 or 0.05 lb/A carfentrazone + 0.5 lb/A endothall + 1 qt/A MSO. At one week after the second application, all single and sequential application treatments except endothall + MSO applied 2 weeks earlier were providing ≥90% potato leaf desiccation.

Carfentrazone + Silwet resulted in less initial leaf and stem desiccation 1 WAT compared with the same rate of carfentrazone applied with MSO (Table). Carfentrazone at 0.0375 lb/A or at 0.05 lb/A tank mixed with either diquat or endothall and MSO provided greater desiccation compared with the same rates of carfentrazone applied without diquat or endothall and with MSO at 1 WAT.

Glufosinate-ammonium applied alone at the first application provided 83 and 60% leaf and stem desiccation 1 WAT, and 90 and 73% leaf and stem desiccation 2 WAT (Table). Glufosinate-ammonium applied alone at the first application followed by (fb) sulfuric acid at the second application timing provided 99% leaf and stem desiccation 1 wk after the sulfuric acid was applied/2 wk after the glufosinate-ammonium was applied. Sulfuric acid applied only at the second application timing provided similar leaf and stem desiccation as the glufosinate fb sulfuric acid treatment 1 WAT at 99 and 96%, respectively. Glufosinate-ammonium applied without any surfactant or tank mix partner provided less potato leaf and stem desiccation than glufosinate-ammonium + AMS Plus or glufosinate-ammonium + carfentrazone + AMS Plus 1 or 2 WAT.

Table. Potato leaf and stem desiccation 7 and 13 days after desiccation treatments were applied alone or sequentially at Aberdeen, ID in 2003.

			Potato desiccation			
			Leaf		Stem	
Treatment	Rate	Timing[1]	8/29[2]	9/4	8/29	9/4
	lb/A		%			
Untreated control	-	-	17	0	30	13
Diquat[3]	0.375	A	83	95	60	82
Diquat[3]	0.5	A	88	95	67	82
Diquat[3]	0.25+	A				
+diquat	0.25	B	80	98	60	93
Diquat-CT 301[4]	0.375	A	88	92	70	82
Paraquat[3]	0.47	A	98	99	82	93
Sulfuric Acid (CT-311)[5]	30%	A	82	95	60	90
Sulfuric Acid (CT-311)[5]	100%	A	93	95	70	90
Sulfuric Acid	100%	A	95	99	82	99
Sulfuric Acid	100%	B		99		96
Glufosinate	0.375+	A				
+sulfuric acid	100%	B	85	99	70	99
Glufosinate	0.375	A	83	90	60	73
Glufosinate	0.375+	A				
+AMS Plus	1% v/v		95	99	70	85
Glufosinate	0.375+	A				
+carfentrazone	0.0083+					
+AMS Plus	1% v/v		95	96	80	87
Endothall[6]	0.5	A	23	53	0	43
Carfentrazone[6]	0.05	A	82	95	60	90
Carfentrazone[6]	0.0375+	A				
+carfentrazone	0.0375	B	80	99	53	98
Carfentrazone[6]	0.05+	A				
+carfentrazone	0.05	B	83	99	60	99
Carfentrazone[6]	0.075+	A				
+carfentrazone	0.075	B	90	100	67	100
Carfentrazone[7]	0.05+	A				
+carfentrazone	0.05	B	67	95	40	90
Carfentrazone[6]	0.0375+	A				
+diquat	0.25+					
+carfentrazone	0.0375+	B				
+diquat	0.25		90	100	80	100
Carfentrazone[6]	0.05+	A				
+diquat	0.25+					
+carfentrazone	0.05+	B				
+diquat	0.25		93	100	80	100
Carfentrazone[6]	0.0375+	A				
+endothal	0.5+					
+carfentrazone	0.0375+	B				
+endothall	0.5		93	100	77	100
Carfentrazone[6]	0.05+	A				
+endothall	0.5+					
+carfentrazone	0.05+	B				
+endothall	0.5		95	100	80	100
LSD (0.05)	-	-	4	3	4	4

[1] Timing 'A' and 'B' applications were applied August 27 and September 3, 2002, respectively.
[2] 9/3/02 ratings were conducted the same day as Application B
[3] Treatment included non-ionic surfactant at 0.25% v/v.
[4] Diquat-CT301 is an experimental formulation sulfuric acid with diquat, property of Cheltec, Inc.
[5] CT-311 is an experimental formulation of sulfuric acid, property of Cheltec, Inc.
[6] Treatment included methylated seed oil at 1qt/A.
[7] Treatment included Silwet L-77 (organo-silicone surfactant) at 0.125% v/v.

Weed control in potatoes with preemergence herbicides: two- and three-way tank mixtures. Pamela J.S. Hutchinson, Brent R. Beutler, and Daniel M. Hancock. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this trial was to compare standard preemergence two- and three-way tank mixtures including dimethenamid-p, EPTC, ethalfluralin, metribuzin, pendimethalin, rimsulfuron, and s-metolachlor. The trial area was infested with 130 redroot pigweed (AMARE), 20 common lambsquarters (CHEAL), 10 kochia (KCHSC), 20 hairy nightshade (SOLSA), 25 green foxtail (SETVI), and 10 volunteer oat (AVESA)/m^2.

The experimental area was fertilized with 120 lb N, 20 lb S, and 3 lb Zn/A, based on soil tests, before planting. 'Russet Burbank' potatoes were planted 5 inches deep at 12-inch intervals in rows spaced 36 inches apart on May 1, 2003 in a Declo loam soil with 1.4% organic matter and pH 8.0. The experimental design was a randomized complete block with three replications. Plot size was 12 by 30 feet.

Potatoes were hilled, and 0.27 lb/A imidacloprid was applied on May 20, 2003. Herbicide treatments were applied after hilling and just prior to potato emergence on May 22, 2003, with a CO_2-pressurized backpack sprayer that delivered 17.5 gpa at 35 psi. Herbicides were incorporated by 0.70-inch sprinkler irrigation immediately after application. No potato or weed plants were exposed at time of application.

Potatoes were sprinkler irrigated as needed throughout the growing season, and received additional N and P_2O_5, based on petiole test results through the irrigation system. Potato vines were desiccated with 0.375 lb/A diquat August 30, 2003. 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, 2003 and graded according to USDA standards.

When comparing the two-way tank mixtures, any treatment including metribuzin or rimsulfuron controlled AMARE, CHEAL, AVESA, or SETVI $\geq$90% season-long (Table 1). Two-way tank mixtures including rimsulfuron provided greater SOLSA control than any other two-way tank mixtures. Other than the pendimethalin + rimsulfuron mixture, any two-way mixture including metribuzin controlled KCHSC better than any other two-way mixture. Control of all weeds present with any three-way tank mixture was similar except for SOLSA control. Three-way tank mixtures including rimsulfuron or dimethenamid-p controlled SOLSA greater than three-way mixtures without rimsulfuron or dimethenamid-p.

All three-way mixtures, with the exception of pendimethalin + s-metolachlor + EPTC, provided greater season-long AMARE control compared with the two-way mixtures of EPTC + pendimethalin, s-metolachlor, or ethalfluralin (Table 1). CHEAL control was greater with all three-way mixtures than with EPTC + s-metolachlor or ethalfluralin. Any three-way mixture including rimsulfuron and metribuzin, or dimethenamid-p and pendimethalin controlled SOLSA greater than any two-way mixture not including rimsulfuron. Two-way tank mixtures including rimsulfuron provided similar SOLSA control compared with most of the three-way mixtures. The two- and three-way mixtures including metribuzin controlled KCHSC better than any of the other treatments. In general, grass control with any herbicide combination, with the exception of two-way mixtures of EPTC and pendimethalin, s-metolachlor, or ethalfluralin, was similar and >90%.

Two- and three-way tank mixtures providing good season-long weed control usually resulted in U.S. No. 1 and total tuber yields that were greater than the weedy check and comparable to the weed-free control yields (Table 2). All three-way tank mixtures, as well as two-way mixtures including metribuzin resulted in U.S. No. 1 tuber yields that were similar to the weed-free control yields and greater than the weedy check yields. Rimsulfuron + pendimethalin or s-metolachlor also resulted in U.S. No. 1 tuber yields that were comparable to the weed-free control yields and greater than the weedy check yields. All two- and three-way mixtures, except EPTC + pendimethalin, s-metolachlor, or ethalfluralin resulted in greater total tuber yields than the weedy check yield.

Table 1. Season-long weed control with preemergence two- and three-way tank mixtures in 2003 at Aberdeen, ID.

		Weed control[1]					
		AMARE	CHEAL	KCHSC	SOLSA	SETVI	AVESA
Treatment	Rate	9/1	9/1	9/1	9/1	9/1	9/1
	lb/A	-------	-------	-------	%-------	-------	-------
Metribuzin							
+ rimsulfuron	0.5 + 0.023	96.3	96.3	97.7	91.7	96.3	97.7
+ pendimethalin	0.5 + 1	95	97.7	99	66.7	96.3	95
+ s-metolachlor	0.5 + 1.34	95	97.7	99	63.3	97.7	95
+ ethalfluralin	0.5 + 0.94	95	97.7	95	66.7	96.3	95
+ EPTC	0.5 + 3	93.3	95	93.3	70	95	93.3
Rimsulfuron							
+ pendimethalin	0.023 + 1	95	93.3	93.3	88.3	96.3	93.3
+ s-metolachlor	0.023 + 1.34	95	91.7	60	90	95	91.7
+ ethalfluralin	0.023 + 0.94	95	93.3	66.7	90	96.3	95
+ EPTC	0.023 + 3	93.3	90	80	88.3	96.3	93.3
EPTC							
+ pendimethalin	3 + 1	85	88.3	76.7	66.7	88.3	83.3
+ s-metolachlor	3 + 1.34	85	80	66.7	70	81.7	76.7
+ ethalfluralin	3 + 0.94	85	83.3	66.7	70	83.3	81.7
Metribuzin + Rimsulfuron							
+ pendimethalin	0.5 + 0.023 + 0.75	99	97.7	99	96.3	97.7	94.7
+ s-metolachlor	0.5 + 0.023 + 1	99.3	97.7	99	97.7	97.7	95
+ ethalfluralin	0.5 + 0.023 + 0.94	99.3	96.3	99	97.7	97.7	96.3
+ EPTC	0.5 + 0.023 + 3	99.3	97.7	99	95	96.3	96.3
Metribuzin + EPTC							
+ pendimethalin	0.5 + 3 + 0.75	97.7	97.7	97.7	81.7	95	96.3
+ s-metolachlor	0.5 + 3 + 1	96.3	97.7	97.7	81.7	95	93.3
+ ethalfluralin	0.5 + 3 + 0.94	96.3	97.7	97.7	81.7	95	91.7
Pendimethalin+ S-metolachlor							
+ metribuzin	0.75 + 1 + 0.5	96.3	99	97.7	81.7	93.3	95
+ rimsulfuron	0.75 + 1 + 0.023	96.3	93.3	88.3	91.7	95	95
+ EPTC	0.75 + 1 + 3	88.3	90	83.3	83.3	95	90
Pendimethalin+ Dimethenamid-p							
+metribuzin	0.75 + 0.64 + 0.5	99	95	97.7	99	96.3	95
+EPTC	0.75 + 0.64 + 3	99	95	93.3	97.7	96.3	95
S-metolachlor+EPTC	1.67 + 3	80	76.7	63.3	83.3	83.3	83.3
EPTC +s-metolachlor	3.9 + 13.4	85	73.3	70	86.7	86.7	86.7
LSD (0.05)	-	2.49	4.35	5.09	5.98	3.56	4.45

[1]AMARE redroot pigweed; CHEAL common lambsquarters; KCHSC kochia; SOLSA hairy nightshade; SETVI green foxtail; AVESA tame oat.

Table 2. Potato tuber yields with preemergence two- and three-way tank mixtures in 2003 at Aberdeen, ID.

Treatment	Rate	U.S. No. 1	Total Tuber
	lb/A	-------------cwt/A-----------	
Weedy check	-	31	101
Weed-free control	-	180	279
Metribuzin			
+ rimsulfuron	0.5 + 0.023	245	336
+ pendimethalin	0.5 + 1	165	282
+ s-metolachlor	0.5 + 1.34	169	274
+ ethalfluralin	0.5 + 0.94	232	334
+ EPTC	0.5 + 3	190	312
Rimsulfuron			
+ pendimethalin	0.023 + 1	219	341
+ s-metolachlor	0.023 + 1.34	176	271
+ ethalfluralin	0.023 + 0.94	141	240
+ EPTC	0.023 + 3	141	235
EPTC			
+ pendimethalin	3 + 1	85	161
+ s-metolachlor	3+ 1.34	124	211
+ ethalfluralin	3 + 0.94	68	149
Metribuzin + Rimsulfuron			
+ pendimethalin	0.5 + 0.023 + 0.75	200	322
+ s-metolachlor	0.5 + 0.023 + 1	242	346
+ ethalfluralin	0.5 + 0.023 + 0.94	194	293
+ EPTC	0.5 + 0.023 + 3	223	364
Metribuzin + EPTC			
+ pendimethalin	0.5 + 3 + 0.75	178	297
+ s-metolachlor	0.5 + 3 + 1	224	343
+ ethalfluralin	0.5 + 3 + 0.94	187	291
Pendimethalin + S-metolachlor			
+ metribuzin	0.75 + 1 + 0.5	255	366
+ rimsulfuron	0.75 + 1 + 0.023	207	329
+ EPTC	0.75 + 1 + 3	116	212
Pendimethalin + Dimethenamid-p			
+metribuzin	0.75 + 0.64 + 0.5	247	380
+EPTC	0.75 + 0.64 + 3	177	281
S-metolachlor+EPTC	1.67 + 3	121	220
EPTC +s-metolachlor	3.9 + 13.4		
		58	131
LSD (0.05)	-	76	81

Efficacy of standard and new preemergence herbicides: alone, in tank mixtures, and applied preemergence followed by postemergence rimsulfuron. Pamela J.S. Hutchinson, Brent R. Beutler, and Daniel M. Hancock. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this trial was to compare weed control with dimethenamid-p, flumioxazin, sulfentrazone, and their tank mixtures with standard potato herbicides. The Aberdeen Research and Extension trial area was infested with 11 hairy nightshade (SOLSA), 5 common lambsquarters (CHEAL), 80 redroot pigweed (AMARE), 3 volunteer oat (AVESA), and 1 kochia (KCHSC)/m^2.

The experimental area was fertilized with 120 lb N, 20 lb sulfur, 3 lb zinc, based on soil tests, before planting 'Russet Burbank' potatoes on April 30, 2003. Potatoes were planted 5 inches deep at 12-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.4% organic matter and pH 8.0. The experimental design was a randomized complete block with three replications and 12 by 30 foot plots.

Potatoes were hilled and 0.27 lb/A imidacloprid was applied on May 20, 2003, just prior to potato emergence. Preemergence (PRE) herbicide treatments were applied May 22, 2003 and postemergence (POST) treatments June 11, 2003, with a CO_2-pressurized backpack sprayer that delivered 17.5 gpa at 35 psi. PRE treatments were incorporated by 0.7-inch sprinkler irrigation immediately after application. No potato or weed plants were exposed at time of the PRE application.

Potatoes were sprinkler irrigated as needed throughout the growing season and received additional N and P_2O_5, based on petiole test results, through the irrigation system. Potato vines were desiccated with 0.375 lb/A diquat August 30, 2003. 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, 2003, and graded according to USDA standards.

At the mid-season rating time conducted just prior to complete row closure, AMARE, CHEAL, and KCHSC control by PRE tank mixtures was generally improved compared with control by herbicides applied alone, except metribuzin or sulfentrazone (Table 1). Rimsulfuron applied alone controlled AMARE similar to any tank mixture including rimsulfuron, however, CHEAL and KCHSC control by rimsulfuron applied alone was less than control with any PRE tank mixture. SOLSA control by tank mixtures also was greater than control by herbicides applied alone except rimsulfuron, (92%) dimethenamid-p (93%), or sulfentrazone (95 to 100%) (Table 1). AVESA control by tank mixtures was greater than herbicides applied alone except flufenacet (95%) (Table 1). At approximately 1 month after the POST rimsulfuron treatments were made, metribuzin + rimsulfuron applied in a PRE tank mixture was providing similar AMARE, CHEAL, KCHSC, SOLSA, or AVESA control compared to metribuzin applied PRE + rimsulfuron applied POST and control by either treatment was $\geq$90% regardless of weed species (Table 1). Weed control with dimethenamid-p, flumioxazin, or sulfentrazone applied in a PRE tank mixture with metribuzin also was similar to control with those herbicides applied PRE followed by (fb) rimsulfuron POST.

AMARE control at the end of the season was still greater with tank mixtures compared to any herbicide applied alone except metribuzin, rimsulfuron, or sulfentrazone at 0.094 or 0.125 lb/A (Table 1). Tank mixtures also improved CHEAL control compared with any herbicide applied alone except metribuzin or sulfentrazone (Table 1). Although rimsulfuron + dimethenamid-p controlled CHEAL greater than either herbicide applied alone, that tank mixture provided less control than any other tank mixture except dimethenamid-p + EPTC. Dimethenamid-p + EPTC provided similar KCHSC control compared with dimethenamid-p alone at 87and 85%, respectively (Table 1). Otherwise, with the exception of metribuzin or sulfentrazone applied alone, all other tank mixtures controlled KCHSC greater than any herbicide applied alone. In general, SOLSA control by tank mixtures was greater than any herbicide applied alone except sulfentrazone at 0.094 or 0.125 lb/A (Table 1). AVESA control by all tank mixtures was greater than any herbicide applied alone except, metribuzin, rimsulfuron, or flufenacet (Table 1). Rimsulfuron, dimethenamid-p, flumioxazin, or sulfentrazone applied in a PRE tank mixture controlled all weeds as well as each of those herbicides applied PRE fb rimsulfuron POST (Table 1).

Rimsulfuron or sulfentrazone applied alone; flumioxazin + metribuzin, rimsulfuron, or dimethenamid-p; any tank mixture including sulfentrazone; or metribuzin, dimethenamid-p, flumioxazin, or sulfentrazone applied PRE fb rimsulfuron POST resulted in U.S. No. 1 and total tuber yields that were greater than the weedy check yields (Table 2). Metribuzin applied alone also resulted in greater total tuber yields than the weedy check. All other treatments did not yield differently than the weedy check.

Table 1. Season-long weed control with preemergence applications of dimethenamid-p, flumioxazin, or sulfentrazone alone, preemergence followed by postemergence rimsulfuron, or in preemergence tank mixtures with standard potato herbicides at Aberdeen, ID in 2003.

			Weed control[1]									
		Appl	AMARE		CHEAL		KCHSC		SOLSA		AVESA	
Treatment	Rate	Timing[2]	7/14	9/1	7/14	9/1	7/14	9/1	7/14	9/1	7/14	9/1
	lb/A		%									
Metribuzin + rimsulfuron	0.5 +0.023	PRE PRE	96	95	99	98	92	98	96	96	96	96
Metribuzin + rimsulfuron	0.5 +0.023	PRE POST	98	98	99	98	90	99	95	98	96	95
Metribuzin	0.5	PRE	96	93	95	95	93	98	60	53	90	92
Rimsulfuron	0.023	PRE	96	93	85	82	67	77	92	88	88	90
EPTC	3	PRE	83	68	80	77	53	60	87	73	73	80
EPTC	3.9	PRE	87	78	87	82	80	73	92	85	88	83
Flufenacet	0.6	PRE	30	0	13	0	0	0	0	0	95	95
S-metolachlor	1.34	PRE	73	63	47	83	47	53	53	63	83	85
Pendimethalin	1	PRE	43	47	83	87	88	83	30	27	82	83
Pendimethalin H_2O	1	PRE	47	40	83	88	88	85	30	27	82	85
Dimethenamid-p	0.64	PRE	87	82	82	82	87	85	93	88	87	87
Dimethenamid-p		PRE										
+ metribuzin	0.64 + 0.5	PRE	99	95	99	99	99	99	98	99	96	96
+ rimsulfuron	0.64 + 0.023	PRE	98	93	96	87	95	92	96	98	95	95
+ EPTC	0.64 + 3	PRE	96	92	92	88	95	87	95	96	92	93
+ flufenacet	0.64 + 0.6	PRE	95	90	92	96	92	90	92	98	96	96
+ pendimethalin	0.64 + 1	PRE	98	92	98	99	98	96	93	98	95	93
+pendimethalin H_2O	0.64 + 0.094	PRE	96	93	99	99	98	95	95	98	95	93
+ flumioxazin	0.64 + 0.094	PRE	99	96	99	99	98	96	96	99	95	95
+ sulfentrazone	0.64 + 0.094	PRE	99	99	100	99	99	99	99	99	92	92
+ rimsulfuron	0.64 + 0.023	POST	99	98	99	96	98	98	98	99	95	96
Flumioxazin	0.078	PRE	53	27	77	53	73	80	82	70	63	53
Flumioxazin	0.094	PRE	60	37	80	67	77	83	87	77	72	63
Flumioxazin	0.125	PRE	60	40	82	80	90	85	90	82	73	67
Flumioxazin		PRE										
+ metribuzin	0.094 + 0.5	PRE	96	96	99	99	99	99	98	99	95	95
+ rimsulfuron	0.094 + 0.023	PRE	96	95	99	96	96	98	98	99	95	92
+ EPTC	0.094 + 3	PRE	90	92	99	95	95	98	99	96	92	90
+ flufenacet	0.094 + 0.6	PRE	88	92	98	93	92	96	98	96	95	96
+ s-metolachlor	0.094 + 1.34	PRE	96	93	99	96	98	96	98	95	95	92
+ pendimethalin	0.094 + 1	PRE	95	92	99	99	99	99	95	96	92	88
+ rimsulfuron	0.094 + 0.023	POST	98	93	98	98	96	98	99	99	95	93
Sulfentrazone	0.063	PRE	95	88	98	96	96	96	95	93	67	67
Sulfentrazone	0.094	PRE	98	95	99	98	98	99	99	99	72	70
Sulfentrazone	0.125	PRE	99	98	99	99	100	99	100	99	77	78
Sulfentrazone		PRE										
+ metribuzin	0.094 + 0.5	PRE	99	98	99	99	100	99	100	99	96	96
+ rimsulfuron	0.094 + 0.023	PRE	99	98	99	99	99	99	100	99	93	95
+ EPTC	0.094 + 3	PRE	99	98	99	98	98	99	98	98	92	93
+ flufenacet	0.094 + 0.6	PRE	99	96	98	99	96	99	98	98	96	96
+ s-metolachlor	0.094 + 1.34	PRE	99	99	99	99	96	99	99	99	88	90
+ pendimethalin	0.094 + 1	PRE	99	98	99	99	99	99	99	99	88	92
+ rimsulfuron	0.094 + 0.023	POST	99	99	99	99	99	99	99	99	95	96
LSD (0.05)	-	-	5	5	4	6	5	6	5	6	5	6

[1]AMARE redroot pigweed; CHEAL common lambsquarters; KCHSC kochia; SOLSA hairy nightshade; AVESA tame oat.
[2]Post-applied treatments included MSO at 1% v/v.

Table 2. Potato tuber yields with preemergence applications of dimethenamid-p, flumioxazin, or sulfentrazone alone, preemergence followed by postemergence rimsulfuron, or in preemergence tank mixtures with standard potato herbicides at Aberdeen, ID in 2003.

Treatment	Rate	Application timing[1]	U.S. No. 1	Total Tuber
	lb/A		-------------cwt/A------------	
Weedy Check	-	-	33	136
Weed-free Control	-	-	182	290
Metribuzin + rimsulfuron	0.5 +0.023	PRE PRE	169	300
Metribuzin + rimsulfuron	0.5 +0.023	PRE POST	305	408
Metribuzin	0.5	PRE	225	336
Rimsulfuron	0.023	PRE	271	388
EPTC	3	PRE	146	249
EPTC	3.9	PRE	127	232
Flufenacet	0.6	PRE	150	265
S-metolachlor	1.34	PRE	109	209
Pendimethalin	1	PRE	75	162
Pendimethalin H_20	1	PRE	76	187
Dimethenamid-p	0.64	PRE	155	259
Dimethenamid-p		PRE		
+ metribuzin	0.64 + 0.5	PRE	206	310
+ rimsulfuron	0.64 + 0.023	PRE	206	332
+ EPTC	0.64 + 3	PRE	188	289
+ flufenacet	0.64 + 0.6	PRE	184	295
+ pendimethalin	0.64 + 1	PRE	214	320
+pendimethalin H_20	0.64 + 0.094	PRE	195	298
+ flumioxazin	0.64 + 0.094	PRE	300	402
+ sulfentrazone	0.64 + 0.094	PRE	244	349
+ rimsulfuron	0.64 + 0.023	POST	261	368
Flumioxazin	0.078	PRE	188	300
Flumioxazin	0.094	PRE	87	189
Flumioxazin	0.125	PRE	132	225
Flumioxazin		PRE		
+ metribuzin	0.094 + 0.5	PRE	258	359
+ rimsulfuron	0.094 + 0.023	PRE	251	358
+ EPTC	0.094 + 3	PRE	176	284
+ flufenacet	0.094 + 0.6	PRE	207	308
+ s-metolachlor	0.094 + 1.34	PRE	168	273
+ pendimethalin	0.094 + 1	PRE	127	235
+ rimsulfuron	0.094 + 0.023	POST	252	349
Sulfentrazone	0.063	PRE	243	356
Sulfentrazone	0.094	PRE	297	398
Sulfentrazone	0.125	PRE	293	401
Sulfentrazone		PRE		
+ metribuzin	0.094 + 0.5	PRE	310	399
+ rimsulfuron	0.094 + 0.023	PRE	270	368
+ EPTC	0.094 + 3	PRE	285	388
+ flufenacet	0.094 + 0.6	PRE	299	391
+ s-metolachlor	0.094 + 1.34	PRE	329	434
+ pendimethalin	0.094 + 1	PRE	269	390
+ rimsulfuron	0.094 + 0.023	POST	231	341
LSD (0.05)	-	-	105	107

[1] Post-applied treatments included MSO at 1% v/v.

Evaluation of mesotrione and diflufenzopyr+dicamba for volunteer potato control. Pamela J.S. Hutchinson, Brent R. Beutler, and Daniel M. Hancock. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this trial was to compare volunteer potato control with mesotrione and a pre-mix of diflufenzopyr and dicamba. Potatoes were planted in the spring with in- and between-row spacing similar to commercial potato production planting, and were grown without the presence of a rotation crop.

The experimental area was fertilized with 120 lb N, 20 lb sulfur, 3 lb zinc, based on soil tests, before planting 'Russet Burbank' potatoes on May 01, 2003. Potatoes were planted 5 inches deep at 12-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.4% organic matter and pH 8.0. The experimental design was a randomized complete block with three replications and 12 by 30 foot plots.

Potatoes were hilled and 0.27 lb/A imidacloprid was applied on May 20, 2003, just prior to potato emergence. Herbicide treatments of diflufenzapyr + dicamba at 0.18 or 0.26 lb/A + 0.25% v/v nonionic surfactant (NIS) and 5 lb/100 gal spray mix ammonium sulfate (AMS), or mesotrione at 0.094 lb/A + 1% v/v crop oil concentrate (COC) and 8.5 lb/100 gal spray mix AMS were applied postemergence (POST) June 04, 2003, with a CO_2-pressurized backpack sprayer that delivered 17.5 gpa at 35 psi. An untreated, weed-free control was included in the trial. Potatoes were 1 to 3 in tall with rosette size at 3 to 5 in diameter at application time.

Plots were kept weed-free during the growing season. Potatoes were sprinkler irrigated as needed throughout the growing season and received additional N and P_2O_5, based on petiole test results, through the irrigation system. Potato vines were desiccated with 0.375 lb/A diquat August 30, 2003. 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, 2003, and graded according to USDA standards.

At approximately 2 wk after treatment (WAT), all treatments were providing similar potato control ranging from 72 to 83% (Table 1). At 5 WAT, control with mesotrione (78%) was greater than control with the lowest rate of diflufenzapyr + dicamba (65%), and similar to control with the highest diflufenzapyr + dicamba rate (73%). Mesotrione resulted in severe chlorosis and bleaching of the foliage as well as stunting. Diflufenzapyr + dicamba caused epinastic growth and stunting.

All three treatments resulted in reduced U.S. No. 1 and total tuber yields compared with the untreated control. Diflufenzapyr + dicamba reduced total tuber yield approximately 67%, regardless of rate, and the mesotrione treatment reduced total yield 75%. All treatments reduced U.S. No. 1 tuber yield by $\geq$92%. Tubers harvested from these plots will be planted to determine germination and viability of daughter tubers from treated plants, and symptoms expressed in plants growing from the daughter tubers.

Table 1. Volunteer potato control with postemergence herbicide application of mesotrione or diflufenzopyr+dicamba Aberdeen, ID in 2003.

Treatment	Rate	Application timing	Volunteer potato control[1] SOLTU 6/16	7/12
	lb/A		---------------%---------------	
Untreated Check	-	-		
diflufenzopyr+ dicamba [2]	0.18	POST	72	65
diflufenzopyr+dicamba [2]	0.26	POST	83	73
mesotrione[3]	0.094	POST	83	78
LSD (0.05)	-	-	13	10

[1] SOLTU volunteer potatoes – potato plants were 1 to 3 in height at application time.
[2]Treatments of diflufenzopyr+dicamba included NIS at 25% v/v and AMS at 5 lb/gal.
[3]Treatments of mesotrione included COC at 1% v/v and AMS at 8.5 lb/100gal.

Table 2. U.S. No. 1 and total tuber yields of volunteer potato treated with postemergence applied mesotrione or diflufenzopyr+dicamba at Aberdeen, ID in 2003.

Treatment	Rate	Application timing	U.S. No. 1	Total Tuber
	lb/A		------------cwt/A------------	
Untreated Check	-	-	167	317
diflufenzopyr+dicamba[2]	0.18	POST	6	104
diflufenzopyr+dicamba[2]	0.26	POST	13	116
mesotrione[3]	0.094	POST	7	82
LSD (0.05)	-	-	80	43

[1] SOLTU volunteer potatoes
[2]Treatments of diflufenzopyr+dicamba included NIS at 25% v/v and AMS at 5 lb/gal.
[3]Treatments of mesotrione included COC at 1% v/v and AMS at 8.5 lb/100gal.

Evaluation of herbicides for use in rhubarb. Gina Koskela and Robert McReynolds. (North Willamette Research & Extension Center, Oregon State University, Aurora, OR 97002) Due to the diminishing effectiveness of the herbicides currently labeled for use in rhubarb, this trial was initiated to evaluate the efficacy and phytotoxicity of other herbicides. The trial was conducted in a newly established field at the North Willamette Research & Extension Center, in Aurora, OR. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of a single row 20 ft by 5.5 ft, containing ten rhubarb plants. Untreated weedy plots, untreated weeded plots, and the currently registered combination of pronamide + napropamide, were included for comparison. All treatments were applied using a CO_2 pressurized backpack sprayer equipped with a 3-nozzle (TeeJet 8002 flat fan) boom delivering 40 gals water/A at 30 psi. Dichlobenil was applied by hand using a shaker can. Treatments were applied on Jan. 22, 2004 when rhubarb plants were dormant, with tips just showing, and no leaves present. At the time of application, there was no wind and sky was overcast; air temperature was 44°F, humidity was 66%, and soil was moist. Phytotoxicity and efficacy evaluations were made at 42, 56, 72 and 86 DAT. Yield data were collected on May 12 (113 DAT) by pulling petioles from plant, removing leaf, then weighing petiole. Weeds present in the plots included annual bluegrass, common groundsel, common chickweed, dandelion, clover, common vetch, and deadnettle.

There were no statistically significant differences in yield between treatments (Table 1). Because the planting was newly established, plant growth was erratic throughout the field, resulting in some plots with missing plants. Therefore, yield data is expressed as yield per plant rather than as yield per plot. On all evaluation dates there were statistically significant differences in phytotoxicity and efficacy between treatments (Table 2).

Table 1. Yield of rhubarb petioles treated with herbicides before leaf emergence.

Treatments	Rate	Yield
	lbs ai/A	lb/plant
Dimethenamid-p	0.75	6.26
Oxyfluorfen	2.00	5.93
Clomazone	1.50	7.72
Linuron	3.00	7.58
S-metolachlor	2.00	4.34
Pronamide + napropamide	2.00 + 2.00	5.95
Prometryn	2.00	6.77
Pendimethalin	1.59	7.54
Halosulfuron + sulfentrazone	0.94 + 0.25	9.08
Dichlobenil	2.00	6.88
Untreated weeded		5.97
Untreated weedy		7.58
Significance ($P \leq 0.05$)		ns

Table 2. Phytotoxicity and efficacy ratings of rhubarb.

	Phytotoxicity [a]				Efficacy [b]			
Treatments	42 DAT [c]	56 DAT	72 DAT	86 DAT	42 DAT	56 DAT	72 DAT	86 DAT
Dimethenamid-p	0.00	0.00	0.25	1.00	8.25	8.25	8.00	8.00
Oxyfluorfen	2.25	1.12	2.25	2.75	9.25	9.50	9.00	8.75
Clomazone	1.50	2.75	1.75	2.25	9.00	9.00	8.25	8.75
Linuron	0.50	0.00	0.00	0.00	9.00	9.50	9.00	8.00
S-metolachlor	0.00	0.50	2.25	3.00	9.00	8.75	8.75	8.25
Pronamide + napropamide	0.50	0.25	0.00	0.25	8.50	8.50	9.00	7.50
Prometryn	0.75	0.00	0.25	1.25	8.00	8.25	8.50	8.50
Pendimethalin	0.50	0.00	0.25	0.25	8.25	7.75	8.50	8.25
Halosulfuron + sulfentrazone	1.25	0.00	0.25	0.75	8.75	6.75	8.50	8.75
Dichlobenil	0.25	0.25	1.00	2.50	7.25	8.25	7.5	8.25
Untreated weeded	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00
Untreated weedy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Significance ($P \leq 0.05$)	0.85	0.66	1.02	1.43	1.19	2.12	1.00	0.94

[a] Phytotoxicity: 0 = no injury; 10 = all plants dead

[b] Efficacy: 0 = no control (plots weedy); 10 = good control (no weeds)

Evaluation of bispyribac-sodium for *Poa annua* control in turfgrass. Kai Umeda. (University of Arizona Cooperative Extension, 4341 E. Broadway Rd., Phoenix, AZ 85040) Two small plot field trials were conducted at the Peoria Sports Complex, Peoria, AZ and at the Cave Creek Golf Course, Phoenix, AZ. Perennial ryegrass (cv. not known) was overseeded over common bermudagrass turf during the fall of 2003 and maintained at one-half to one inch height. POAAN at the flowering stage infested a landscaped common area at Peoria and the tee area of the driving range at Cave Creek. Experimental units for each treatment were plots measuring 5ft by 25ft replicated three times in a randomized complete block design. Herbicides were applied using a backpack CO_2 sprayer consisting of a hand-held boom equipped with three 8002LP flat fan nozzles spaced 20 inches apart. Each treatment was applied in 25 gpa water pressurized to 30 psi. Both field trials were initiated on 17 February 2004 and subsequent applications were made at both sites on 05 and 16 March. On 17 February, the weather conditions at Peoria were a clear sky, no wind, and air temperature of 64°F. At Cave Creek, the temperature was 80°F with high thin clouds with 50% sunshine, and no wind. The second application date was 05 March at 17 days after the first applications and there was rainfall at both sites during the night before. At Peoria, the temperature was 52°F, cloudy, and there was a very slight breeze at less than 5 mph. The temperature at Cave Creek was 56°F, cloudy, and a slight breeze at 5 mph. The last application date was 16 March which was 11 days after the second application for bispyribac that was applied three times and also 28 days after the second of only two applications. At Peoria, the sky was clear with no wind and temperature at 68°F. At Cave Creek, the temperature was 75°F, clear, and no wind. The turf was maintained per typical cultural practices at each location with routine mowing, fertilization, and irrigation. The POAAN control and turf color were evaluated at intervals after applications.

Two or three applications of bispyribac at 30 g ai/A controlled POAAN 63 to 82% in two field experiments. Multiple applications of bispyribac at 17 day intervals provided a higher degree of POAAN control compared to applications made at 28 day intervals. Perennial ryegrass exhibited chlorosis at two weeks after applications and appeared to recover at one month

Table. Evaluation of bispyribac-sodium for *Poa annua* control in turfgrass in 2004.

			LOLPE color[4]						POAAN control	
			05 Mar		16 Mar		30 Mar		30 Mar	
Treatment	Rate	Timing interval	CC	Peoria	CC	Peoria	CC	Peoria	CC	Peoria
	g a.i./A								-------- % --------	
untreated check			9.0 a	9.0 a	9.0 a	9.0 a	8.0 a	7.0 a	0 c	0 c
bispyribac	30[1] + 30[2]	17 day	7.0 b	8.3 b	7.0 b	8.3 a	8.0 a	7.0 a	63 ab	75 a
bispyribac	45[1] + 45[3]	28 day	7.0 b	8.2 b	9.0 a	8.7 a	6.3 b	7.0 a	50 b	57 b
bispyribac	60[1] + 60[3]	28 day	6.0 c	7.3 c	9.0 a	8.0 a	6.7 b	7.0 a	57 b	57 b
bispyribac	30[1] + 30[2] + 30[3]	17/11 day	7.0 b	7.8 bc	6.7 b	8.3 a	7.0 b	7.0 a	73 a	82 a

Treatments applied on [1]17 February 2004, [2]05 March, [3]16 March at CC (Cave Creek Golf Course) and Peoria Sports Complex, AZ
[4]LOLPE color scale - 9=green, healthy; 1=brown, dying
Mean ratings followed by the same letter are not significantly different (P=0.05, SNK)

Evaluation of promising weed control strategies in strawberries. Diane Kaufman, Ed Peachey, and Judy Kowalski. (North Willamette Research and Extension Center, Oregon State University, Aurora, OR 97002). The study was conducted in a planting of 'Totem' strawberry established on raised beds in May, 2003 at the North Willamette Research and Extension Center. The soil is a Quatama silt loam with 4% organic matter. Plots 4 rows wide (13.33 feet) by 25 feet long were arranged in a randomized complete block design with four replications. Herbicides were applied over the top of strawberry plants on October 3, 2003 (fall application) and January 20, 2004 (winter dormancy application) using a CO_2 pressurized backpack sprayer with a 4-nozzle boom (TeeJet 8002, flat fan) set at 40 psi and a rate of 20 gallons of spray per acre. As in previous years, runners were not managed in most of the plots and were allowed to grow and fill in the space between berry rows in order to evaluate their contribution to weed control over winter. In the organically managed plots, barkdust (4 to 6 inches deep) was applied between strawberry rows on October 4, 2003.

Table 1. Treatments and herbicide rates.

Treatments: October 3, 2003	Rates (lb ai/A)	Treatments:January 20, 2004	Rates (lb ai/A)
Simazine (grower standard)	1.00	Metolachlor	1.00
Simazine	1.00	Dimethenamid-P	0.84
Simazine	1.00	Dimethenamid-P	1.00
Metolachlor	1.00	Sulfentrazone[1] (grower standard)	0.20
Metolachlor	1.00	Sulfentrazone[1]	0.20
Hand weeded control	-----	-----	-----
Weedy control	-----	-----	-----
Simazine	1.00	Imazapic[2]	0.062
Simazine	1.00	Rimsulfuron[2]	0.25
Simazine	1.00	Sulfentrazone+Dimethenamid-P[2]	0.20 + 0.30
Organically managed[3]	Bark mulch	-----	-----

[1] Two identical sets of plots were established for sulfentrazone with the intention of dividing these plots into two different cultural practices (runners removed/tucked into the berry row or runners allowed to fill in the area between rows) later in the experiment.

[2] Plots treated with imazapic, rimsulfuron, or sulfentrazone+dimethenamid-P were blocked separately beside the other herbicide treatments.

[3] Rows managed organically were beside experimental plots and, therefore, not within the experimental design.

Quality of weed control from the winter herbicide application was evaluated on March 10 (48 DAT) and April 28, 2004 (98 DAT).

Table 2. Quality of weed control, expressed as percent control compared to the weedy control or number of dandelion plants.

Treatment	Annual bluegrass control 48 DAT	Dandelions 48 DAT	Overall control 48 DAT	Dandelions 98 DAT	Overall control 98 DAT
	%	#	%	#	%
Metolachlor	97.5	0	97.0	0.2	91.2
Dimethenamid-P 0.84	98.0	0.2	96.5	0.5	85.8
Dimethenamid-P 1.00	99.0	0.8	97.0	0.5	86.2
Sulfentrazone + runners	97.5	1.5	95.5	0.2	96.5
Sulfentrazone – runners	85.0	16.8	74.5	29.5	62.5
Hand weeded	-----	3.5	-----	3.0	-----
Weedy	-----	7.8	-----	3.8	-----
LSD (0.05)	6.8	5.3	10.0	7.9	9.4
Imazapic	99.5	0	99.8	0	98.2
Rimsulfuron	100	0	99.5	0.5	98.7
Sulfentrazone+ Dimethenamid-P	100	0	100	0	100
LDS (0.05)	NS	NS	NS	NS	NS
Organic	82.5	0.8	85.2	0.2	96.0

Weed control on March 10, 2004 was excellent (90% or higher) in all herbicide treatments in which the runners were allowed to cover the area between rows. The sulfentrazone plots were duplicated so that the quality of weed control from a winter herbicide application could be compared with and without runners between the rows. Because strawberry growers in Oregon traditionally remove excess runners in fall, this treatments would demonstrate the potential contribution of unsuppressed runners to weed control over winter. Weed control was significantly reduced in sulfentrazone plots without the presence of runners. This supports observations made by this researcher from weed trials conducted in strawberries over the last 4 years. When strawberry runners are allowed to cover the ground in fall and winter, they serve as an effective cover crop for weed suppression. Weed control in the organically managed plots, which had few runners due to the thick barkdust mulch, was good (80-89%) in March, 2004. Weeds were hand removed from all plots following the March 10 weed evaluation. By the end of April, the difference in quality of weed control in sulfentrazone plots with and without runners was more pronounced, to the extent that overall weed control was poor (60-69%) in sulfentrazone plots without runners. Metolachlor, imazapic, rimsulfuron, sulfentrazone + dimethenamid-P, sulfentrazone + runners, and the barkdust mulch provided excellent weed control through harvest. The main weeds present over winter were annual bluegrass, common groundsel, hairy vetch, black medic, and white clover.

Winter-applied herbicides were also evaluated for their effect on spring strawberry plant growth and bloom. Strawberry plant growth was normal in all plots, with the exception of those treated with imazapic, in which plants were severely stunted and new growth was yellowish-green in color (data not shown). Bloom was slightly delayed in plots treated with imazapic or rimsulfuron, and in the organically managed plots.

All plots, with the exception of the organically managed treatment, were cultivated during the first week of May to remove enough runners to have an 8 to 16 inch clear space between rows to facilitate picking. Plants were vigorous, with the exception of plots treated with imazapic, and the crop was 2 weeks early, due to abnormally warm weather. The first pick was scheduled for May 25. However, by May 20, the early ripening fruit had begun to turn brownish in color and dry up. The unexpected deterioration of the early fruit spread quickly through the entire planting, with the exception of the organically managed rows. On the day of the first pick, it was apparent that the organic, rimsulfuron, and imazapic treatments were 1 to 2 weeks behind the other treatments in fruit development. There was also a striking difference in the amount of fruit rot in all plots treated with herbicide versus the organically managed plots. Whereas only 30% of the first pick was marketable in the herbicide-treated plots and hand-weeded and weedy controls, 90% of the first pick fruit was marketable from the organic plots (data not shown). Fruit samples from the first pick which were sent to the OSU Plant Disease Clinic tested positive for leather rot (*Phytophthora cactorum*). Although leather rot is a common disease of strawberries grown in the Midwest, it is extremely rare in Oregon. In the Midwest, leather rot is a very serious disease, and causes even normal looking berries to taste bitter and be unmarketable. Fortunately, the disease performed differently here and fruit quality improved over time. Fruit was picked from a 5-foot length of row per plot.

Table 3. First year yield data from four picks.

Treatment	Total yield	Marketable yield	Marketable yield	Adjusted berry size
	grams	grams	%	grams
Metolachlor	1,962	1,016	44.6	11.9
Dimethenamid-P 0.84	2,801	1,860	62.2	12.1
Dimethenamid-P 1.00	2,089	1,364	58.7	12.3
Sulfentrazone + runners	2,179	1,239	58.8	12.6
Sulfentrazone – Runners	3,918	3,064	77.2	13.3
Hand weeded	2,905	1,874	62.6	12.5
Weedy	3,022	2,066	65.8	12.8
LSD (0.05)	NS	NS	NS	NS
Imazapic	542	424	81.6	6.9
Rimsulfuron	2,253	1,823	80.1	11.9
Sulfentrazone + Dinethenamid-P	2,158	1,379	63.9	12.3
LSD (0.05)	651	596	NS	0.4
Organic	4,785	3,997	83.4	16.2

Imazapic applied during winter resulted in significantly lower yields than any other treatment. Based on our results, it appears that strawberry plants have little tolerance for imazapic when applied either at planting (resulted in plant death; data appears in WSWS Research Progress Reports, 2004) or in winter. Although rimsulfuron has a similar mode of action and resulted in some leaf yellowing when applied to strawberries at planting (WSWS Research Progress Reports, 2000), yields in established strawberries treated with rimsulfuron in winter were similar to those with other herbicides.

Among plots treated with herbicide and the hand weeded or weedy controls, there was a trend for higher total marketable yield in plots treated with sulfentrazone in which runners had been removed. Eventhough the presence of runners between rows significantly reduced the number of weeds, it also appears to have resulted in lower yields. Because this researcher has been maintaining runners between rows over winter in previous weed control trials with no negative effect on yield, it appears as if leather rot was a crucial factor in this trial. Although the presence of a mound of runners between rows would suppress weeds, it would also reduce air flow and cause the soil to remain wetter for longer periods of time. Increased soil moisture enhances sporulation of *P. cactorum* and facilitates infection by splashing of spores on to developing fruit.

Fruit from the organically managed plots was virtually free of leather rot. In these plots, losses in marketable yield were due primarily to Botrytis fruit rot, which became worse as the pickings progressed. Research conducted in Ohio has shown that the presence of a mulch is as effective at reducing leather rot as the application of a phosphorus acid-based fungicide (eg. Aliette, Fosphite, etc.). The mulch forms a barrier between the soil and the fruit, thereby protecting the fruit from infection by splashing soil. Eventhough the 4 to 6 inch thick layer of barkdust had been applied between organically managed rows for the purpose of weed suppression, it also provided the benefit of leather rot control.

Because of the unusual circumstances of this trial, treatments will be maintained for another year.

Post-bloom herbicide applications in tulip. Timothy W. Miller and Robert K. Peterson. (Washington State University Northwestern Washington Research and Extension Center, Mount Vernon, WA 98273) Tulip bulb production in northwestern Washington is made more difficult by the inability of dormant-season herbicides, usually applied in October or November, to maintain weed control through the July bulb harvest. Postemergence herbicides are not currently available for over-the-top use due to injury potential to bulb foliage. If postemergence products could be applied using a shielded sprayer, however, perhaps weed control could be accomplished in mid-spring with minimal crop injury. A trial was conducted to test the efficacy and safety of post-bloom herbicide treatments applied to tulip in northwestern Washington.

'Negrita' and 'Preludium' tulip bulbs were planted in October, 2003, and plots were treated preemergence (PRE) with isoxaben, pendimethalin, diuron, oryzalin, s-metolachlor, or dimethenamid-p plus glyphosate November 3, 2003 using a tractor-mounted sprayer delivering 20 gpa at 15 psi. Plots measured 3.5 by 260 ft. Ten postemergence (POST) herbicides were then applied post-bloom April 28, 2004 using a backpack sprayer with a shielded nozzle delivering 20 gpa at 12 psi. Herbicides were applied in bands 1.5 ft wide by 10 ft long on either side of the tulip row. Post-bloom products were glufosinate, flumioxazin, oxyfluorfen, pyraflufen, pelargonic acid, chloransulam, bentazon, carfentrazone, sulfentrazone, and glyphosate. Bentazon was applied with crop oil concentrate at 1% (v/v), while flumioxazin, chloransulam, glufosinate, carfentrazone, and sulfentrazone were applied with nonionic surfactant at 0.25% (v/v). An eleventh post-bloom treatment was flaming the sides of the row using a backpack, propane-fired, infrared flamer. Flower height and number were recorded April 13 and 14 (prior to post-bloom treatments). Crop injury and weed control 2003 (0 = no injury or control, 100 = dead plants) were rated April 12 (prior to post-bloom treatments) and May 8 (10 days after post-bloom treatments). Major weeds in the plots were pale smartweed, shepherd's-purse, and Italian ryegrass. Bulbs were harvested in July, then washed, sorted, and weighed. The statistical design for this trial was a split-block randomized complete block design with four replicates. Means were separated using Fisher's Protected LSD (P = 0.05). Application data are presented in Table 1 and results in Tables 2 and 3. Since there was no difference in response between 'Negrita' and 'Preludium', data were averaged across both tulip varieties. Interaction between PRE and POST applications were not statistically significant, so only main effect data are presented.

Table 1. Herbicide application data.

2:00 p.m., November 3, 2003	3:00 p.m., April 28, 2004
Broadcast, PRE	Directed beneath foliage, POST
0% cloud cover	25% cloud cover
Winds 1 to 3 mph, from W	Winds 5 to 7 mph, from NW
Air temp. = 47 F; soil temp (4") = 40 F	Air temp. = 66 F; soil temp (4") = 53 F
Relative humidity = 45%	Relative humidity = 37%
Soil surface was moist	Soil surface was dry, no dew present
No weeds present	Weeds 4 to 6 inches

Preemergence products. Weed control from residual herbicides plus glyphosate applied in November ranged from 73% (s-metolachlor) to 99% (diuron and oryzalin) through flowering (Table 1). Weed control from either s-metolachlor or dimethenamid-p plus glyphosate was excellent through flowering (85 and 97, respectively). Flower number did not differ significantly between treatments, and while flower height did differ, all heights were commercially acceptable (from 17.1 to 17.9 inches tall). Oryazalin-treated plots yielded the greatest bulb weight, but number and average bulb weight were not different from non-treated plots. Diuron treatment resulted in the greatest number of bulbs, but total and average bulb weights were similar to non-treated tulips. Isoxaben and dimethenamid-p, however, reduced total and average bulb weight compared to non-treated bulbs.

Postemergence products. Tulip foliage was not severely injured by any herbicide at 10 days after treatment (DAT, Table 2). The highest level of foliar burn resulted from pelargonic acid (10%). Weed control resulting from most treatments was generally very good, with carfentrazone, sulfentrazone, flaming, glyphosate, and oxyfluorfen providing the best weed control at 10 DAT. Glyphosate treatment, however, reduced total and average bulb weight compared to non-treated bulbs, while flaming reduced average bulb weight significantly. Glufosinate also significantly reduced total bulb weight, although bulb number and average weight were similar to non-treated tulips. While sulfentrazone treatments increased total bulb weight and flumioxazin increased total bulb number, other bulb parameters were not affected.

Table 2. Weed control, injury, and bulb yield after preemergence herbicide applications to tulip[1].

Treatment	Rate	Foliar injury[2]	Weed control[3] 4/12	Weed control[3] 5/8	Flower height	Flower number	Bulb yield total wt.	Bulb yield total no.	Bulb yield avg. wt.
	lb ai/A	%	%	%	inches	no./plot	g/plot	no./plot	g/bulb
Isoxaben	0.5	3	91	90	17.4	36	1177	95	13.2
Pendimethalin	2.0	3	80	86	17.7	36	1291	93	14.0
Diuron	3.2	3	99	98	17.8	36	1294	99	13.6
Oryzalin	1.5	3	99	97	17.9	36	1325	97	13.7
S-metolachlor	2.5	3	73	83	17.5	36	1224	90	13.7
Dimethenamid-p	2.0	3	80	87	17.1	36	1194	93	13.1
$LSD_{0.05}$	---	ns	4	1	0.4	ns	56	7	0.6

[1]Data averaged across both tulip varieties.

[2]Foliar injury rated May 8, 2003.

[3]Weed control April 12 was prior to post-bloom treatments; weed control May 8 was averaged across post-bloom treatments.

Table 3. Tulip[1] foliar injury and weed control after directed postemergence applications of various herbicides.

Treatment[2]	Rate	Foliar injury[3]	Weed control[3]	Bulb yield total wt.	Bulb yield total no.	Bulb yield avg. wt.
	lb ai/A	%	%	g/plot	no./plot	g/bulb
Glufosinate	0.5	6	94	1165	89	13.2
Flumioxazin	0.07	4	88	1191	102	13.0
Oxyfluorfen	0.5	0	90	1329	98	13.7
Pyraflufen	0.0045	0	88	1282	98	13.2
Flame	---	5	93	1214	101	12.9
Pelargonic acid	5%	10	87	1334	97	13.9
Chloransulam	0.032	0	89	1272	87	14.7
Bentazon	0.75	0	89	1252	93	13.6
Carfentrazone	0.075	8	97	1262	95	13.3
Sulfentrazone	0.25	4	94	1350	96	14.1
Glyphosate	0.5	0	92	1094	86	12.8
None	---	0	82	1265	92	13.9
$LSD_{0.05}$	---	1	2	80	10	0.8

[1]Data averaged across both tulip varieties.

[2]Bentazon was applied with crop oil concentrate at 1% (v/v); flumioxazin, chloransulam, glufosinate, carfentrazone, and sulfentrazone were applied with nonionic surfactant at 0.25% (v/v).

[3]Foliar injury and weed control were averaged across residual herbicide treatments (applied November 3-4, 2003) at 10 days after post-bloom treatments (applied April 28, 2004).

Postemergence herbicide screening trial for winter weed control in glyphosate resistant alfalfa. Mick Canevari and Donald Colbert. (Cooperative Extension, University of California, Stockton, CA 95205). An experiment was conducted near Stockton, CA to screen postemergence herbicides for winter weed control in glyphosate resistant alfalfa. Alfalfa was seeded in the fall of 2001 and POST treatments were applied on January 6, 2004. Plots were 10 by 15 ft arranged in a randomized complete block design with three replications. All herbicide treatments were applied using a CO_2 backpack sprayer calibrated to deliver 20 gpa at 35 psi. Environmental conditions at application were as follows: air 52F, relative humidity 43%, wind speed 1 mph, 100% cloud cover and dew present. Non-dormant alfalfa was 4-6 inch height. Weed size prior to application: common chickweed 4-10 leaf/2-6 inch and annual bluegrass 1-3 leaf/1-3 inch. Visual evaluations on crop injury and weed control were made 16 and 69 DAT.

All treatments with imazamox, imazethapyr, hexazinone and glyphosate showed no alfalfa injury. Carfentrazone treatments 16 and 69 DAT resulted in significant alfalfa injury (stunting). Paraquat alone and tank mixes with sulfentrazone gave some early alfalfa necrosis but 69 DAT there was no crop injury. Flumioxazin plus paraquat treatments resulted in some early alfalfa necrosis with alfalfa stunting in the 8-23% range 69 DAT. The only postemergence treatments 16 DAT to give 85-94% control of STEME and POAAN were tank mix combinations of flumioxazin + paraquat. At 69 DAT glyphosate tank mixed with either imazamox or imazethapyr were more effective in controlling both STEME and POAAN (78-89%) than either herbicide applied alone (7-47%). Carfentrazone had no activity on either weed species. Flumioxazin plus paraquat combinations were the most effective treatments for controlling STEME (85-97%) and POANN (90-98%). Glyphosate alone controlled 82% STEME and 83% of the POAAN. Hexazinone at 0.5 lb ai/A controlled STEME and POAAN 63 and 84%, respectively. Paraquat gave 55% control of STEME and 60% on POAAN.

Table 1. Weed control and alfalfa injury with postemergence herbicides near Stockton, California in 2004.

Treatment	Rate	Crop injury		Weed control			
				16 DAT		69 DAT	
		16 DAT	69 DAT	STEME	POAAN	STEME	POAAN
	Lb ai/A	%	%	--------------------	%	--------------------	
Untreated check	0	0	0	0	0	0	0
Imazamox + NIS + UN32	0.032	0	0	17	18	43	43
Imazamox + glyphosate + NIS + UN32	0.032 0.75	0	0	57	60	78	87
Imazethapyr + NIS + UN32	0.063	0	0	17	3	47	7
Imazethapyr + glyphosate + NIS + UN32	0.063 0.75	0	0	62	62	85	89
Glyphosate + NIS	0.75	0	0	0	0	82	83
Carfentrazone + COC	0.02	60	20	0	0	0	0
Carfentrazone + COC	0.03	63	22	0	0	0	0
Sulfentrazone + paraquat + NIS	0.25 0.47	45	0	75	75	55	89
Sulfentrazone + paraquat + NIS	0.375 0.47	58	2	77	80	60	92
Flumioxazin + paraquat + NIS	0.188 0.47	68	8	93	85	85	90
Flumioxazin + paraquat + NIS	0.25 0.47	68	13	94	90	89	93
Flumioxazin + paraquat + NIS	0.375 0.47	70	23	93	90	97	98
Hexazinone	0.5	0	0	33	40	63	84
Paraquat + NIS	0.47	47	0	77	77	55	60

UN32 = urea ammonium nitrate 32% applied at 1.25% V/V.
COC = herbimax applied at 1.25% V/V.
NIS = unifilm 707 applied at 0.25% V/V.

Postemergence applications of glyphosate alone and tank mix combinations for winter weed control in glyphosate resistant alfalfa. Mick Canevari, Donald Colbert and Scott Whiteley. (Cooperative Extension, University of California, Stockton, CA 95205). An experiment was conducted near Stockton, CA to evaluate postemergence herbicides for weed control and crop response in glyphosate resistant alfalfa. Alfalfa was seeded in the fall of 2001 and POST treatments were applied on January 6, 2004. Plots were 10 by 50 ft arranged in a randomized complete block design with three replications. All herbicide treatments were applied using a $C0_2$ pressurized backpack sprayer calibrated to deliver 20 gpa at 35 psi. Environmental conditions at application were as follows: air 52F, relative humidity 43%, wind speed 1 mph, 100% cloud cover and dew present. Non-dormant alfalfa was 4-6 inch height. Weed size prior to application: common chickweed 4-10 leaf/2-6inch, annual bluegrass 1-3 leaf/1-3inch, annual sowthistle 3-6 leaf/2-4 inch, shepherdspurse 4-8 leaf/2-6inch and burning nettle 4-6 leaf/1-2inch. Visual evaluations on crop injury were made 16 and 69 DAT. Weed control was evaluated visually 39 and 69 DAT.

All treatments of glyphosate alone showed no alfalfa injury. Tank mixtures of glyphosate + hexazinone and paraquat + hexazinone showed some early alfalfa necrosis, 15 and 37% respectively. Both treatments, showed no alfalfa injury 69 DAT. Visual weed control evaluations 39 DAT showed postemergence applications of glyphosate alone gave excellent control (97-100%) of STEME, CAPBP, SONOL and POAAN with 37-88% control of URTUR. Combination treatments of glyphosate + hexazinone and paraquat + hexazinone gave complete control (99-100%) of the weed species present, data not included in table. All treatments 69 DAT gave excellent (90-100%) control of POAAN and CAPBP. All glyphosate alone treatments resulted in poor control of URTUR (0-43%) and SONOL (0-33%) with average activity of STEME (77-83%). Poor SONOL control with glyphosate alone was due to a second flush of sowthistle occurring around March 1. For overall weed control, the best treatments were the tank mixtures of glyphosate (91-100%) + hexazinone and paraquat + hexazinone (96-100%).

Table 1. Weed control and alfalfa injury with postemergence herbicides near Stockton, California in 2004.

		Crop injury		Weed control 69 DAT				
Treatments	Rate	16 DAT	69 DAT	POAAN	URTUR	SONOL	STEME	CAPBP
	Lb ai/A	%	%	---%				
Untreated check	0	0	0	0	0	0	0	0
Glyphosate	0.5	0	0	92	0	0	78	100
Glyphosate	1.0	0	0	90	7	17	77	100
Glyphosate	2.0	0	0	93	43	33	83	100
Glyphosate + hexazinone	1.0 0.5	15	0	100	91	92	95	100
Paraquat + hexazinone + unifilm 707	0.375 0.5	37	0	100	98	100	96	100

Unifilm 707 = 0.25% V/V

Cover crops in spring seeded alfalfa. Dennis Merrick and Ralph E. Whitesides. (Department of Plants,Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820). Conventional weed control methods using cover crops in newly seeded alfalfa usually consists of a quick germinating non-legume crop, which provides adequate weed control at the expense of the alfalfa. Although a higher yield results in the first cutting, sequential cuttings suffer in total yield and allow weed regrowth reducing hay quality. This research project provides a way to maintain season long high yield while providing adequate weed control using low seeding rates of oats as a cover crop in spring seeded alfalfa. Each seeding rate was compared to a control and herbicide treatments.

Treatments were randomized using simple randomization with four replications. Treatments included: control, *Avena sativa* L. cu. 'Powell' oats seeded at the standard seeding rate of 40 lbs/acre, half rate of 20 lbs/acre, and a light rate of 10 lbs/acre, and a herbicide treatment of 2,4-DB @ 2 qts/acre and Clethodim @ 7 oz/acre. Herbicide treatment was applied at the four trifoliate leaf stage of the alfalfa. Treatments were applied to 10 by 30 ft plots with a CO_2 backpack sprayer using flatfan Turbojet 015 nozzles calibrated to deliver 25 gpa at 39 psi. Alfalfa was seeded at 18 lbs/acre on top of the already seeded oats.

Weeds present included: Green foxtail (SETVI), Common lambsquarters (CHEAL), Redroot pigweed (AMARE), Kochia (KCHSC), and Velvetleaf (ABUTH).

Table 1. Dry matter yield.

	Dry Matter Yield lbs/Acre						
		Alfalfa			**Weeds**		
Treatment	**Oats**	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
Control	0	3154	2206	2611	1571	154	180
2,4-DB&Clethodim	0	3286	2624	2887	0	0	0
10 lbs/acre oats	3716	2159	1923	2269	265	97	175
20 lbs/acre oats	5024	1439	1598	2665	172	16	13
40 lbs/acre oats	5820	1050	1616	2197	178	46	91

Table 2. Seasonal dry matter yield.

	Season Total Dry Matter Yield lbs/acre			
	Field Sample data	***Sub-sample data***		
Treatment	**Total biomass**	**Oats**	**Alfalfa**	**Weeds**
Control	10078	0 (0%)	7971 (81%)	1905 (19%)
2,4-DB&Clethodim	9615	0 (0%)	8797 (100%)	0 (0%)
10 lbs/acre oats	11011	3716 (35%)	6351 (60%)	537 (5%)
20 lbs/acre oats	10369	5024 (46%)	5703 (52%)	201 (2%)
40 lbs/acre oats	10486	5820 (53%)	4863 (44%)	315 (3%)

At first cutting the traditional 40 pounds of oats/acre surpassed all other treatments in total yield, but had a small percentage of alfalfa as part of the total yield. In subsequent cuttings the 10 pounds of oats/acre produced similar total yields in comparison to both the control and herbicide treatments. The herbicide treatment had 100% weed control throughout the season, but had a reduced yield at first cutting due to the stunting nature of the herbicides, however, this treatment supplied the highest alfalfa yield for the season. The highest season yield total was achieved by the light rate (10 lbs/acre oats) with 5% total weed content for the season and approximately 72% weed control. Both the 40 and 20 pounds/acre oat treatments supplied better weed control and significant season yield total's, however, the higher yields were due to the high oat content at first cutting.

Evaluation of prohexadione calcium effects on barley quality. Don W. Morishita, Robyn C. Walton, and Michael P. Quinn. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Lodging is a severe problem in wheat and barley production. Ethephon is currently the only product registered for reducing lodging in grain. Its main drawback is the narrow application timing window. A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to determine the effect of the plant growth regulator prohexadione calcium on barley growth, yield and quality. 'Moravian 37' was planted April 4, 2004, at 100 lb/A. Experimental design was a three by three factorial randomized complete block with four replications. The three factors were: nitrogen rate (1, 1.5, and 2 times the recommended rate based on soil analysis), prohexadione rate (0.069 and 0.138 lb ai/A), and application timing (1 to 2 node and 3 node to tillering). Individual plots were 10 by 30 ft. Soil type was a Portneuf silt loam (17.9% sand, 61.8% silt, and 20.3% clay) with a pH of 8.0, 1.7% organic matter, and CEC of 21.0-meq/100 g soil. The entire experimental site was sprayed with a tank mixture of bromoxynil & MCPA + fluroxypyr at 0.5 + 0.062 lb ai/A for broadleaf weed control on May 13. Prohexadione was applied with a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 15 gpa. Additional application information and environmental conditions are given in Table 1. Plant height was measured after heading on June 28. Crop lodging was evaluated visually 90 days after treatment (DAT) on September 2. Grain was harvested September 14 with a small-plot combine.

Table 1. Environmental conditions at application and weed species densities.

Application date	March 31	June 1	June 4
Application timing	Pre-plant	2 node	Flag leaf
Air temperature (F)	51	65	69
Soil temperature (F)	-	50	54
Relative humidity (%)	48	34	48
Wind velocity (mph)	9	3.5	5.2
Cloud cover (%)	50	5	30

Prohexadione rate, application timing, or nitrogen rate did not affect barley yield and test weight. However, plant growth and several barley quality parameters were affected (Table 2). Plant height decreased as prohexadione rate increased with 3 node to tillering application timing compared to the 1 to 2-node timing. Similarly, plump kernels increased with increasing prohexadione rate and later application timing. In addition, plump kernels declined as nitrogen rate increased. Barley kernel color is another measure of barley quality. In this study, color index declined as prohexadione rate increased. However, less than 40 is considered the rejection value for color quality. Unfortunately, in this study lodging was not a factor, as it can be in commercial malt barley production. Lodging ratings in this study were inconclusive with regard to the benefit of using prohexadione. As expected, protein content increased as nitrogen rate increased. However, with the 0.137 lb ai/A prohexadione rate, lodging did not increase with increasing nitrogen rate. The results from this study indicate potential benefits from prohexadione on malt barley.

Table 2. Barley growth and quality parameters affected by nitrogen rate, prohexadione rate, and application timing, near Kimberly, ID.

Prohexadione rate	Application timing	Height	Plumps[1]	Color[2]
lb ai/A		inch	%	
0	1 to 2 node	31.3	93.2	57.3
0	3 node to tillering	31.3	93.2	
0.069	1 to 2 node	28.6	91.3	57.9
0.069	3 node to tillering	26.9	94.4	
0.137	1 to 2 node	25.0	91.1	55.8
0.137	3 node to tillering	23.7	94.5	
LSD (0.05)			2.9	
LSD (0.10)		1.2		1.4

Prohexadione rate	Nitrogen rate[3]	Lodging	Protein	Plumps
lb ai/A		----------------------------	%----------------------------	
0	1X	3	10.4	95.1
0	1.5X	10	11.5	92.7
0	2X	5	11.3	91.0
0.069	1X	4	10.5	
0.069	1.5X	9	10.9	
0.069	2X	4	11.2	
0.137	1X	7	10.7	
0.137	1.5X	1	10.6	
0.137	2X	0	10.8	
LSD (0.05)			0.7	1.9
LSD (0.10)		8		

[1]Plumps is the percentage of barley kernels that do not pass through a 0.078 by 0.75 inch screen.
[2]Color is quality identifier used to determine acceptability of the grain for malting. A numerical value >40 is considered acceptable.
[3]Nitrogen rate is based on multiples of the recommended fertilizer based on soil analysis. 1X = 20 lb N/A.

Spring barley and yellow mustard response to imazamox and other grass herbicides persistence. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established near Moscow, Lewiston, and Bonners Ferry, Idaho to examine spring barley and yellow mustard response to imazamox, sulfosulfuron, flucarbazone, and propoxycarbazone persistence. The experimental design at all locations was a randomized split-block with four replications. Main plots were two rotational crops, spring barley and yellow mustard (15 by 144 ft), and subplots were eight herbicide treatments and an untreated check (16 by 30 ft). All herbicide treatments were applied in 2003 using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). The study at Moscow was moldboard plowed in the fall and cultivated in the spring, and at Bonners Ferry, the experiment was cultivated in the spring prior to seeding rotational crops. At Lewiston, all rotational crops were direct-seeded into standing wheat stubble. 'Camas' spring barley and 'IdaGold' yellow mustard were seeded on April 14 and 26, and May 10, 2004 at Moscow, Lewiston, and Bonners Ferry, Idaho, respectively. At Moscow, spring barley was oversprayed with clopyralid/MCPA at 0.7 lb ai/A on May 18, 2004 to control broadleaf weeds. Yellow mustard was oversprayed with clopyralid at 0.19 lb ai/A for broadleaf weed control on May 18 and carbaryl at 0.75 lb ai/A for flea beetle control on May 24, 2004. At Lewiston, spring barley and yellow mustard were oversprayed for wild oat control with tralkoxydim at 0.23 lb ai/A and quizalofop at 0.07 lb ai/A, respectively, on June 2, 2004. At Bonners Ferry on June 15, 2004, spring barley was oversprayed with tralkoxydim at 0.18 lb ai/A and bromoxynil/MCPA at 0.5 lb ai/A for weed control, and yellow mustard was oversprayed with quizalofop at 0.07 lb ai/A for wild oat control and carbaryl at 1 lb ai/A for flea beetle control. Rotational crop injury was evaluated visually, and spring barley and yellow mustard seed was harvested with a small plot combine on August 9 (Moscow) and 16 (Lewiston), and September, 2 (Bonners Ferry), 2004.

Table 1. Application and soil data for Moscow, Lewiston, and Bonners Ferry, Idaho locations.

Location	Moscow, Idaho	Lewiston, Idaho	Bonners Ferry, Idaho
Application date	April 30, 2003	April 28, 2003	June 16, 2003
Wheat variety	F2020	F2020	Fidel
Wheat growth stage	3 to 4 tiller	3 to 4 tiller	3 to 5 tiller
Air temperature (F)	47	59	74
Relative humidity (%)	78	64	50
Wind (mph, direction)	4, W	2, W	2, NW
Cloud cover (%)	100	55	10
Soil moisture	wet	damp	dry
Soil temperature at 2 in (F)	47	47	65
pH	5.2	6.1	7.6
OM (%)	2.6	5.5	4.0
CEC (meq/100g)	18	38	10.5
Texture	silt loam	silt loam	silt loam
Primary tillage	moldboard plow	none (no-till)	field cultivator

At Moscow, spring barley was not injured on May 21 and was injured 2 to 6% on June 11, but did not differ among treatments (Table 2). On May 21, yellow mustard injury ranged from 10 to 69%. This evaluation was confounded by a heavy variable population of broadleaf weeds. Broadleaf weeds were hand-pulled May 24 to 26, 2004. By June 11, all treatments injured yellow mustard 5 to 12% and did not differ among treatments. At Lewiston on May 25, spring barley was injured 14 to 52% but did not differ among treatments. By June 16, propoxycarbazone at 0.08 lb ai/A injured spring barley 31% which was not different from the low rate of sulfosulfuron (20%) or propoxycarbazone (21%). The high rate of propoxycarbazone injured yellow mustard 72 and 64% on May 25 and June 16, respectively, and was not different from the high rate of imazamox on either date (46 and 51%). At Bonners Ferry on June 3, propoxycarbazone at 0.08 lb ai/A injured spring barley 16% and was not different from the high rate of sulfosulfuron (12%). By June 29, sulfosulfuron at 0.062 lb ai/A injured spring barley 42%, while propoxycarbazone at 0.04 lb ai/A injured spring barley 22% and did not differ from the low rate of sulfosulfuron or propoxycarbazone at 0.08 lb ai/A (10 and 19%). On June 3, yellow mustard was injured 10 and 11% by the high rates of sulfosulfuron and propoxycarbazone, respectively, but by June 29 yellow mustard injury did not differ among treatments.

At Moscow, spring barley yield (5127 to 5706 lb/A) and test weight (51.8 to 52.6 lb/bu) and yellow mustard yield (1092 to 1407 lb/A) did not differ among herbicide treatments or from the untreated check (Table 3). At Lewiston, spring barley yield and test weight ranged from 2048 to 2994 lb /A and 47.1 to 49.3 lb/bu, respectively, and did not differ among herbicide treatments or from the untreated check. Imazamox at 0.08 lb ai/A and propoxycarbazone at 0.04 and 0.08 lb ai/A reduced yellow mustard seed yield 22, 49 and 56%, respectively, compared to the untreated check. At Bonners Ferry, sulfosulfuron at 0.062 lb ai/A and propoxycarbazone at 0.04 and 0.08 lb ai/A reduced spring barley yield 52, 30, and 19%, respectively, and test weight 6, 4, and 4%, respectively, compared to the untreated check. Yellow mustard yield ranged from 702 to 947 lb/A and did not differ among treatments.

Table 2. Spring barley and yellow mustard injury near Moscow, Lewiston, and Bonners Ferry, Idaho in 2004.

		Moscow				Lewiston				Bonners Ferry			
		Spring barley		Yellow mustard		Spring barley		Yellow mustard		Spring barley		Yellow mustard	
Treatment[1]	Rate	May 21	June 11	May 21	June 11	May 25	June 16	May 25	June 16	June 3	June 29	June 3	June 29
	lb ai/A	%											
Imazamox	0.04	0	2	17	5	25	4	8	1	0	1	0	1
Imazamox	0.08	0	6	69	10	31	8	46	51	0	4	0	5
Sulfosulfuron	0.031	0	4	19	8	36	20	26	14	6	10	0	5
Sulfosulfuron	0.062	0	4	36	8	39	15	22	19	12	42	10	9
Flucarbazone	0.027	0	4	10	9	14	4	12	5	0	5	0	16
Flucarbazone	0.054	0	4	15	4	40	10	16	2	0	8	0	3
Propoxycarbazone	0.04	0	2	38	12	46	21	34	46	1	22	4	14
Propoxycarbazone	0.08	0	4	41	10	52	31	72	64	16	19	11	16
LSD (0.05)		NS	NS	24	NS	NS	14	26	16	7	13	7	NS

[1]90% nonionic surfactant (R-11) was applied at 0.5% v/v with sulfosulfuron and 0.25% v/v with all other treatments. 32% urea ammonium nitrate was applied at 1 qt/A with all imazamox treatments.

Table 3. Yellow mustard and spring barley yield and spring barley test weight near Moscow, Lewiston, and Bonners Ferry, Idaho in 2004.

		Moscow			Lewiston			Bonners Ferry		
		Spring barley		Y. mustard	Spring barley		Y. mustard	Spring barley		Y. mustard
Treatment[1]	Rate	Yield	Test weight	yield	Yield	Test weight	yield	Yield	Test weight	yield
	lb ai/A	lb/A	lb/bu	lb/A	lb/A	lb/bu	lb/A	lb/A	lb/bu	lb/A
Imazamox	0.04	5706	52.6	1407	2762	47.6	884	4052	47.6	870
Imazamox	0.08	5481	52.3	1350	2572	47.8	770	3420	49.0	702
Sulfosulfuron	0.031	5293	52.4	1290	2846	49.1	938	3306	47.0	771
Sulfosulfuron	0.062	5374	52.7	1290	2570	48.7	823	1726	44.7	805
Flucarbazone	0.027	5127	51.8	1174	2994	48.5	952	3390	47.3	947
Flucarbazone	0.054	5220	52.3	1198	2941	49.3	940	3463	47.6	747
Propoxycarbazone	0.04	5256	52.1	1330	2328	47.9	505	2918	45.8	900
Propoxycarbazone	0.08	5149	51.9	1092	2048	47.1	438	2544	45.8	904
Untreated check	--	5256	52.6	1287	2617	47.8	993	3610	47.6	852
LSD (0.05)		NS	NS	NS	NS	NS	188	674	1.8	NS

[1]90% nonionic surfactant (R-11) was applied at 0.5% v/v with sulfosulfuron and 0.25% v/v with all other treatments. 32% urea ammonium nitrate was applied at 1 qt/A with all imazamox treatments.

Preplant graminicide injury to spring wheat and spring barley. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, Idaho 83844-2339) Two experiments were established near Moscow, Idaho to determine preplant graminicide injury to spring wheat and spring barley. Herbicides were applied 14, 7, and 0 days before planting. Treatments were applied with a CO_2 pressurized backpack sprayer delivering 10 gpa at 3 mph and 32 psi (Table 1). Soil pH, organic matter, CEC, and type were 5.6, 2.8%, 16 cmol/kg, and silt loam, respectively. 'Zak' wheat and 'Baronesse' barley were seeded on April 27, 2004. The experimental design was a split block with four replications and 8 by 30 ft experimental units. The main plots were time of application and subplots were the herbicide treatment. Crop injury was evaluated visually throughout the season and grain was harvested at maturity.

Table 1. Environmental information at the time of application.

Application date	Apil 7	April 13	April 20
Air temperature (F)	61	71	72
Soil temperature at 2 inch (F)	59	53	55
Relative humidity (%)	55	60	58

Wheat and barley injury was not visible at any time during the growing season and grain yield and test weight did not differ among treatments (Tables 2 and 3).

Table 2. Wheat grain yield and test weight affected by preplant graminicides.

Treatment	Rate	Time of application	Wheat grain yield	Wheat test weight
	lb ai/a	days before planting	lb/a	lb/bu
Quizalofop	0.034	14	2932	52
Quizalofop	0.048	14	3258	52
Quizalofop	0.096	14	2992	52
Fluazifop	0.375	14	3121	52
Sethoxydim	0.75	14	3156	53
Clethodim	0.25	14	3000	52
Untreated	0	14	3018	52
Quizalofop	0.034	7	2994	52
Quizalofop	0.048	7	3019	52
Quizalofop	0.096	7	2939	52
Fluazifop	0.375	7	2830	52
Sethoxydim	0.75	7	2765	51
Clethodim	0.25	7	2809	51
Untreated	0	7	2571	51
Quizalofop	0.034	0	2941	52
Quizalofop	0.048	0	3031	51
Quizalofop	0.096	0	3141	53
Fluazifop	0.375	0	3088	52
Sethoxydim	0.75	0	3168	54
Clethodim	0.25	0	3044	52
Untreated	0	0	3623	53
LSD (0.05)			NS	NS

Table 3. Barley grain yield and test weight affected by preplant graminicides.

Treatment	Rate	Time of application	Barley grain yield	Barley test weight
	lb ai/a	days before planting	lb/a	lb/bu
Quizalofop	0.034	14	4865	46
Quizalofop	0.048	14	4503	46
Quizalofop	0.096	14	5050	46
Fluazifop	0.375	14	4379	44
Sethoxydim	0.75	14	4858	46
Clethodim	0.25	14	4886	46
Untreated	0	14	4752	49
Quizalofop	0.034	7	4428	45
Quizalofop	0.048	7	4774	46
Quizalofop	0.096	7	4876	46
Fluazifop	0.375	7	3911	45
Sethoxydim	0.75	7	4703	46
Clethodim	0.25	7	4367	45
Untreated	0	7	4578	45
Quizalofop	0.034	0	4868	47
Quizalofop	0.048	0	4544	45
Quizalofop	0.096	0	4629	46
Fluazifop	0.375	0	4821	46
Sethoxydim	0.75	0	4525	46
Clethodim	0.25	0	4467	46
Untreated	0	0	4309	45
LSD (0.05)			NS	NS

Preplant quizalofop and glyphosate application time affects spring wheat and barley. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, Idaho 83844-2339) Glyphosate is the major herbicide used to control volunteer wheat and other weeds before planting a spring crop, especially in direct seed systems. An alternate herbicide would be required if herbicide-resistant weeds developed or a glyphosate-resistant crop was planted in a previous season. Crop injury can result when cereal crops are planted before volunteer wheat is completely killed (greenbridge effect). Quizalofop may not kill the plants as rapidly as glyphosate and thus extend the greenbridge. Also, there may be a possibility of wheat or barley injury due to quizalofop residue in the soil. An experiment was established near Moscow, Idaho to determine effects of two application times of preplant quizalofop and glyphosate comparing direct seed with tillage. Herbicides were applied with a CO_2 pressurized backpack sprayer delivering 10 gpa at 3 mph and 32 psi (Table 1). Soil pH, organic matter, CEC and texture were 5.2, 3.1%, 20 cmol/kg, and silt loam, respectively. The experimental design was a randomized complete block, split block with main plots arranged as factorial of herbicide and application timing, and sub plots were direct seed or tillage. Experimental units were 10 by 24 ft and treatments were replicated four times. Tillage treatment was two passes with a field cultivator/harrow on April 29, 2004. "Zak" wheat and "Baronesse" barley were planted with a Haybuster no-till drill on the same day. The entire experiment was treated with glyphosate at 0.5 lb ai/A on April 30, 2004. Wheat and barley injury was evaluated visually throughout the growing season, plant height was measured before harvest, and grain was harvested at maturity.

Table 1. Application weather data and wheat growth stage.

Application date	April 1, 2004 (4 WBP)	April 22, 2004 (1 WBP)
Volunteer wheat growth stage	1 to 3 leaf, 2 to 4 inches tall	1 to 3 leaf, 6 inches tall
Volunteer wheat dry biomass (g/m^2)	200	292
Air temperature (F)	41	59
Soil temperature (F)	44	40
Relative humidity (%)	52	60
Cloud cover (%)	10	90
Soil moisture	dry	high

Barley plants were taller (9.6 vs. 9.2 inch) and barley grain yield was lower (4416 vs. 5391 lb/a) in direct seed compared to tilled treatments (Table 2). Barley was shorter (9.1 vs. 9.7 inch) and barley grain yield was lower (4551 v. 5255 lb/a) when herbicides were applied 1 week before planting (WBP) than 4 WBP (Table 3).

Wheat grain yield was lower (2484 vs. 3002 lb/a) and test weight was higher (55.3 vs. 54.7 lb/bu) in direct seed compared to tilled treatments (Table 4). Wheat plants were shorter (10.8 vs. 12.0 inch) and grain yield was lower (2553 vs. 2934 lb/a) when herbicides were applied 1 WBP than 4 WBP.

Table 2. Spring barley height, grain yield, and test weight in 2004.

Herbicide[1]	Rate	Application timing	Tillage	Barley height Interaction	Barley height Mean	Grain yield Interaction	Grain yield Mean	Test weight Interaction	Test weight Mean
	lb ai/a	WBP		--- inch ---		--- lb/a ---		--- lb/bu ---	
Quizalofop	0.034	4	Direct seed	9.4		4794		49.0	
Quizalofop	0.068	4	Direct seed	9.6		4142		49.3	
Glyphosate	0.75	4	Direct seed	10.7		5313		49.1	
Quizalofop	0.034	1	Direct seed	9.2		4294		48.8	
Quizalofop	0.068	1	Direct seed	9.4		3821		48.5	
Glyphosate	0.75	1	Direct seed	9.2	9.6	4131	4416	49.0	49.0
Quizalofop	0.034	4	Tilled	9.4		4996		48.1	
Quizalofop	0.068	4	Tilled	9.2		5713		48.8	
Glyphosate	0.75	4	Tilled	10.0		5620		18.6	
Quizalofop	0.034	1	Tilled	8.7		5950		48.4	
Quizalofop	0.068	1	Tilled	9.0		5085		48.4	
Glyphosate	0.75	1	Tilled	9.0	9.2	4981	5391	49.0	48.5
P > F				NS	0.01	NS	0.01	NS	0.07

[1] Urea ammonium nitrate at 4 qt/a and crop oil concentrate (Moract) at 1% v/v were added to all quizalofop treatments. Ammonium sulfate (Bronc) at 8.5 lb/100 gal was added to glyphosate treatments.

Table 3. Effect of treatment and application timing on barley height and grain yield in 2004.

Treatment Herbicide[1]	Treatment Rate	Application timing	Barley height Treatment by timing	Barley height Application timing mean	Barley grain yield Treatment by timing	Barley grain yield Application timing mean
	lb ai/a	WBP	----------- inch -----------		-------- lb/a -------	
Quizalofop	0.034	4	9.4		5254	
Quizalofop	0.068	4	9.4		4881	
Glyphosate	0.75	4	10.4	9.7	5631	5255
Quizalofop	0.034	1	9.0		4690	
Quizalofop	0.068	1	9.2		4401	
Glyphosate	0.75	1	9.1	9.1	4564	4551
LSD (0.05)			0.5	0.3	578	340

[1] Urea ammonium nitrate at 4 qt/a and crop oil concentrate (Moract) at 1% v/v were added to all quizalofop treatments. Ammonium sulfate (Bronc) at 8.5 lb/100 gal was added to glyphosate treatments.

Table 4. Spring wheat height, grain yield, and test weight in 2004.

Herbicide[1]	Rate	Application timing	Tillage	Wheat height Interaction	Wheat height Mean	Grain yield Interaction	Grain yield Mean	Test weight Interaction	Test weight Mean
	lb ai/a	WBP		---- inch ----		---- lb/a ----		---- lb/bu ----	
Quizalofop	0.034	4	Direct seed	11.6		2532		54.8	
Quizalofop	0.068	4	Direct seed	11.9		2793		55.5	
Glyphosate	0.75	4	Direct seed	12.5		2814		53.2	
Quizalofop	0.034	1	Direct seed	11.2		2184		56.1	
Quizalofop	0.068	1	Direct seed	11.0		2261		56.0	
Glyphosate	0.75	1	Direct seed	11.2	11.6	2321	2484	56.4	55.3
Quizalofop	0.034	4	Tilled	11.9		3124		54.2	
Quizalofop	0.068	4	Tilled	11.7		2089		54.5	
Glyphosate	0.75	4	Tilled	12.5		3250		53.2	
Quizalofop	0.034	1	Tilled	10.7		2712		55.9	
Quizalofop	0.068	1	Tilled	10.1		2960		55.4	
Glyphosate	0.75	1	Tilled	10.8	11.3	2878	3002	55.0	54.7
P > F				NS	0.09	NS	<0.01	NS	0.04

[1] Urea ammonium nitrate at 4 qt/a and crop oil concentrate (Moract) at 1% v/v were added to all quizalofop treatments. Ammonium sulfate (Bronc) at 8.5 lb/100 gal was added to glyphosate treatments.

Table 5. Effect of treatment and application timing on wheat height and grain yield in 2004.

Treatment: Herbicide[1]	Treatment: Rate	Application timing	Wheat height: Treatment by timing	Wheat height: Application timing mean	Wheat grain yield: Treatment by timing	Wheat grain yield: Application timing mean
	lb ai/a	WBP	----------- inch -----------		-------- lb/a -------	
Quizalofop	0.034	4	11.7		2828	
Quizalofop	0.068	4	11.8		2941	
Glyphosate	0.75	4	12.5	12.0	3032	2934
Quizalofop	0.034	1	10.9		2448	
Quizalofop	0.068	1	10.6		2611	
Glyphosate	0.75	1	11.0	10.8	2599	2553
LSD (0.05)			0.6	0.3	NS	260

[1] Urea ammonium nitrate at 4 qt/a and crop oil concentrate (Moract) at 1% v/v were added to all quizalofop treatments. Ammonium sulfate (Bronc) at 8.5 lb/100 gal was added to glyphosate treatments.

Broadleaf weed control with thifensulfuron plus tribenuron combinations. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, Idaho 83844-2339) Two experiments were established near Moscow, Idaho to determine broadleaf weed control in winter wheat and spring barley with a four to one ratio of thifensulfuron to tribenuron. Treatments were applied with a CO_2 pressurized backpack sprayer delivering 10 gpa at 3 mph and 32 psi (Table 1). The experimental design was a randomized complete block with four replications and 8 by 30 ft experimental units. Weed control was evaluated visually and grain was harvested at maturity.

Table 1. Environmental information at the time of application.

Location	North of Moscow, Idaho	University of Idaho farm, Moscow, Idaho
Application date	April 22, 2003	May 27, 2003
Wheat	10 inch tall, 1 to 3 tillers	-
Prickly lettuce	3 to 5 inch tall, 3 plants/ft^2	-
Mayweed chamomile	1 inch diameter, 4 plants/ft^2	-
Barley 'Camas'	-	10 inch tall, 1 to 2 tillers
Henbit	-	2 to 4 inch, 1 plant/yd^2
Redroot pigweed	-	1 to 2 inch, 1 plant/ft^2
Common lambsquarters	-	1 to 4 inch, 1 plant/ft^2
Air temperature (F)	62	72
Soil temperature at 3 inch (F)	45	63
Relative humidity (%)	62	56
Soil pH	5.4	4.8
Soil organic matter (%)	4.9	2.6
Soil CEC (cmol/kg)	19	14
Soil texture	Silt loam	Loam

Mayweed chamomile control in winter wheat was 92 to 99% with all treatments except bromoxynil/MCPA (Table 2). Prickly lettuce control was 95 to 99% with all treatments. Henbit, redroot pigweed and common lambsquarters control in spring barley was 99% with all treatments (data not shown). Wheat and barley grain yield and test weight did not vary among treatments (Table 2).

Table 2. Mayweed chamomile and prickly lettuce control and wheat and barley yield.

Treatment	Rate[1]	Winter wheat Mayweed chamomile	Winter wheat Prickly lettuce	Winter wheat Yield	Winter wheat Test weight	Spring barley Yield	Spring barley Test weight
	lb ai/a	-------- % -------		lb/a	lb/bu	lb/a	lb/bu
Thifensulfuron+	0.0075	99	99	7413	60	5278	44
tribenuron+	0.0019						
fluroxypyr+	0.094						
2,4-D ester+	0.375						
nonionic surfactant	0.25						
Thifensulfuron+	0.015	99	99	7310	60	5752	44
tribenuron+	0.00375						
fluroxypyr+	0.094						
2,4-D ester+	0.375						
nonionic surfactant	0.25						
Thifensulfuron+	0.03	99	99	7214	59	5014	44
tribenuron+	0.0075						
fluroxypyr+	0.094						
2,4-D ester+	0.375						
nonionic surfactant	0.25						
Thifensulfuron+	0.045	92	97	7294	59	5340	43
tribenuron+	0.0013						
fluroxypyr+	0.094						
2,4-D ester+	0.375						
nonionic surfactant	0.25						
Thifensulfuron+	0.0075	98	98	7336	60	5954	45
tribenuron+	0.0019						
Bromoxynil/MCPA+	0.46						
nonionic surfactant	0.25						
Thifensulfuron+	0.015	99	99	7257	60	5445	44
Tribenuron+	0.00375						
Bromoxynil/MCPA+	0.46						
nonionic surfactant	0.25						
Thifensulfuron+	0.03	99	99	7052	60	5269	43
tribenuron+	0.0075						
bromoxymil/MCPA+	0.46						
nonionic surfactant	0.25						
Thifensulfuron+	0.045	98	99	6905	59	5812	44
tribenuron+	0.0013						
bromoxynil/MCPA+	0.46						
nonionic surfactant	0.25						
Fluroxypyr+	0.094	96	98	7282	60	5684	43
2,4-D ester	0.375						
Bromoxynil/MCPA	0.614	75	95	7001	60	5293	44
Untreated	0	-	-	6820	60	5422	45
LSD (P=0.05)		10	NS	NS	NS	NS	NS

[1] Nonionic surfactant rate is expressed as % v/v.

Downy brome control in winter barley. Sandra M. Frost, Larry H. Bennett, and Daniel A. Ball. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801) A study was established to evaluate crop safety and control of downy brome (*Bromus tectorum*) in winter barley at the Columbia Basin Agricultural Research Center, Pendleton, OR. Winter barley (var. Strider) was seeded on October 20, 2003. Plots were 9 by 30 ft arranged in a randomized complete block design with 4 replications. Soil at the site was a silt loam (27% sand, 60.1% silt, 12.9% clay, 2.5% organic matter, 5.2 pH, and CEC of 14.8 meq/100g). Herbicide treatments were applied using a hand boom sprayer delivering 16 gpa at 30 psi. Preemergence (PRE) treatments were applied October 27, 2003 before weed or crop emergence (Table 1). Early postemergence (EPOST) treatments were applied February 23, 2004 to barley at the 3.5 to 4 leaf stage and downy brome at the 2.5 to 3.5 leaf stage. Late postemergence (LPOST) treatments were applied March 17, 2004 to barley at the 5.5 to 7 leaf stage and downy brome at the 5 to 7 leaf stage. Barley stand was determined by counting the number of plants per meter of row in two locations per plot on November 19, 2003 (Table 2). Crop injury and downy brome control were visually evaluated on April 14 and May 21, 2004. Crop lodging was rated on May 21, 2004 on a 0-5 scale, with 0=no lodging, and 5=complete lodging. The crop was harvested July 15, 2004 with a small plot combine. Harvested samples were cleaned using an Almaco seed cleaner, weighed, and yield converted to bu/a using a test weight of 48 lb/bu.

Table 1. Application conditions.

	Oct 27, 2003	Feb 23, 2004	Mar 17, 2004
Timing	PRE	EPOST	LPOST
Crop (leaf)	--	3.5-4	5.5-7
Rattail fescue (leaf)	--	2.5-3.5	5-7
Air temperature (F)	72	53	63
Relative humidity (%)	32	68	56
Wind (mph)	7	3	4
Soil temperature (F)	60	53	64
Cloud cover (%)	50	25	60

There were no significant differences in plant stand from any treatments. All rates of flufenacet caused significant crop injury in the form of stunting, as did the preemergence application of metribuzin. Injury by flufenacet was dependent on rate, with the higher rates giving more injury than the lower rates. The addition of metribuzin to flufenacet appeared to increase injury slightly. Downy brome control, however, was good to excellent with all of the flufenacet treatments, as well as with the split applications of metribuzin (PRE and EPOST). Metribuzin applied at PRE alone was less effective. Metribuzin applied PRE, chlorsulfuron + metsulfuron-methyl + metribuzin applied EPOST, and metribuzin applied alone at LPOST gave poor control of downy brome (38-55%). The other treatments gave good to excellent control (81-97%). The high rate of flufenacet was very injurious to the barley, causing 63% damage when the last crop injury rating was taken on May 21, 2004. The PRE treatments of flufenacet gave fair to good control of downy brome, with the control being dependent on the rate. The addition of metribuzin either at the same time or EPOST appeared to increase downy brome control. A single application of metribuzin at any of the timings gave poor control of downy brome, whereas sequential applications were more effective. The crop lodging rating showed all of the plots which had flufenacet applied PRE had less lodging that the other treatments. This was probably due to crop injury from flufenacet treatments, which caused stunting of the crop, so it was less susceptible to lodging. Plots were harvested July 15, 2004 using a Wintersteiger plot combine. The highest yield was obtained with a PRE treatment of flufenacet followed by an EPOST application of metribuzin. The high rate of flufenacet which had significant crop injury had the lowest yield. In general, the higher yields were obtained in plots without significant crop injury and with good downy brome control. There were no significant differences in test weight of the barley in the different treatments.

Table 2. Downy brome control in winter barley.

Treatment[1]	Rate	Timing	Crop stand 11/19/04	Crop injury 4/14/04	Crop injury 5/21/04	D. brome control 4/14/04	D.brome control 5/21/04	Crop lodging 7/13/04	Crop yield 7/15/04
	--lb ai / A--		--# / m--	------------------------	-----------%	-----------	------------------------	0 to 5	--bu/A--
Flufenacet	0.337	PRE	29	1	6	81	68	2	126
Flufenacet	0.675	PRE	27	6	21	93	80	1	128
Flufenacet	1.35	PRE	25	38	63	95	89	0	94
Flufenacet + metribuzin	0.337 + 0.187	PRE	26	5	10	83	76	2	124
Metribuzin	0.187	PRE	28	0	0	28	0	4	109
Metribuzin	0.28	PRE	31	0	0	18	0	3	104
Flufenacet / metribuzin + NIS	0.337 / 0.14	PRE / EPOST	24	3	13	91	86	1	142
Metribuzin / metribuzin + NIS	0.187 / 0.14	PRE / EPOST	30	1	0	88	78	3	132
Metribuzin + NIS	0.14	EPOST	24	0	0	78	65	4	131
Chlorsulfuron + metsulfuron-methyl + metribuzin + NIS	0.0156 + 0.0031 + 0.14	EPOST	29	0	0	45	18	4	103
Metribuzin + NIS / metribuzin + NIS	0.14 / 0.28	EPOST / LPOST	24	3	0	88	80	3	135
Metribuzin + NIS	0.28	LPOST	31	0	0	56	33	3	115
Untreated check			30	0	0	0	0	2	103
LSD (0.05)			NS	8	6	17	15	2	17

[1] NIS, a non-ionic surfactant, applied at 0.5% v/v. NS = not significant.

Weed control in glyphosate tolerant sugar beet. Robyn C. Walton, Don W. Morishita, and Michael P. Quinn. (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 treatments for crop injury and weed control on glyphosate tolerant sugar beet. 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% silt, and 8.6% clay) with a pH of 8.1, 1.5% organic matter, and CEC of 17-meq/100 g soil. 'Roundup Ready®' sugar beet was planted April 14, 2004, in 22-inch rows at a rate of 51,840 seed/A. Wild oat (AVEFA), kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), green foxtail (SETVI), and barnyardgrass (ECHCG) were the major weed species present. Herbicides were broadcast-applied 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 visually 29 days after the first herbicide treatments were applied. Crop injury and weed control were evaluated visually 26 days after the last herbicide treatment (DALT) on July 26. The two center rows of each plot were harvested mechanically Month day.

Table 1. Environmental conditions at application and weed species densities.

Application date	May 4	May 13	May 24	June 7	June 16	June 30
Application timing	Cotyledon	2 leaf	4-6 leaf	6 leaf	8 leaf	Row close
Air temperature (F)	67	44	51	65	57	67
Soil temperature (F)	48	45	53	58	50	61
Relative humidity (%)	36	92	51	32	30	62
Wind velocity (mph)	3.5	3	6	2	3.7	4.1
Cloud cover (%)	5	5	65	5	0	20
Weed species (plants/ft^2)						
kochia	0	1	1	1	1	
lambsquarters, common	2	6	6	6	6	
pigweed, redroot	2	8	9	5	7	
oat, wild	6	6	15	9	8	
foxtail, green	4	5	0	2	1	
barnyardgrass	0	0	0	1	5	

Crop injury ranged from 2 to 28%, but because of variability within the study site there were no differences among herbicide treatments for both evaluations (Table 2). All glyphosate treatments controlled kochia (KCHSC) 97 to 100%. Ethofumesate & desmedipham & phenmedipham (efs&dmp&pmp) + triflusulfuron + clopyralid + MSO applied at the micro rate did not control KCHSC. Using the standard rate, efs&dmp&pmp + triflusulfuron + clopyralid controlled KCHSC 90%. Common lambsquarters (CHEAL) control ranged from 94 to 98% with glyphosate + ammonium sulfate applied three times beginning May 13 or 24 and ending at row closure on June 30. One or two glyphosate applications did not control CHEAL better than 80%. Redroot pigweed control was ≥94% with three glyphosate + ammonium sulfate applications, with the last application made at row closure. Wild oat (AVEFA) control with all glyphosate treatments was 99 to 100%. Efs&dmp&pmp + triflusulfuron + clopyralid treatments applied at the micro and standard rates did not control AVEFA >77%. Control of SETVI, and ECHCG ranged from 66% to 100% with no difference among treatments. Root yield ranged from 8 to 27 ton/A with no difference among the herbicide treatments. However, all herbicide treatments yielded higher than the untreated check. Sucrose yield ranged from 4080 to 10263 lb/A with no difference among any of the treatments including the untreated check.

Table 2. Crop injury, weed control, root and extractable sugar yield in glyphosate tolerant sugar beet near Kimberly, Idaho.

Treatment[2]	Application rate[3]	Application dates	Crop injury 6/3	Crop injury 7/26	Weed control[1] KCHSC	CHEAL	AMARE	AVEFA	SETVI	ECHCG	Root yield	Extractable sugar
	lb ae/A		%								ton/A	lb/A
Check	-		-	-	-	-	-	-	-	-	8	4080
Glyphosate + ammonium sulfate	0.75 + 2% w/w	5/13 & 5/24	7	19	100	66	66	99	66	97	21	7208
Glyphosate + ammonium sulfate	0.75 + 2% w/w	5/13 & 6/7	7	6	100	72	72	100	79	100	28	9499
Glyphosate + ammonium sulfate	0.75 + 2% w/w	5/24 & 6/7	10	16	100	79	76	100	88	97	27	9145
Glyphosate + ammonium sulfate	0.75 + 2% w/w	5/13, 5/24 & 6/16	2	4	100	87	94	100	91	99	24	7782
Glyphosate + ammonium sulfate	0.75 + 2% w/w	5/13, 5/24 & 6/30	9	11	100	97	99	100	99	100	24	7897
Glyphosate + ammonium sulfate	0.75 + 2% w/w	5/13, 6/7 & 6/30	8	11	100	98	97	100	95	99	29	10263
Glyphosate + ammonium sulfate	0.75 + 2% w/w	5/24, 6/16 & 6/30	10	15	100	94	96	100	98	99	25	8842
Glyphosate + ammonium sulfate/	0.75 + 2% w/w	5/13	13	18	97	80	81	100	96	100	25	8411
Metolachlor + glyphosate + ammonium sulfate	1.28 + 0.75 + 2% w/w	6/7										
Glyphosate + ammonium sulfate/	0.75 + 2% w/w	5/13	9	28	100	77	77	100	90	100	27	9445
Ethofumesate + glyphosate + ammonium sulfate	1 + 0.75 + 2% w/w	6/7										
Efs&dmp&pmp + triflusulfuron + clopyralid + MSO	0.08 + 0.0104 + 0.03 + 1.5% v/v	5/4, 5/13, 5/24, 6/7 & 6/16	25	14	53	70	86	77	80	100	20	6865
Efs&dmp&pmp + triflusulfuron/	0.337 + 0.0312	5/4	27	13	90	77	76	76	69	89	24	8196
Efs&dmp&pmp + triflusulfuron + clopyralid	0.45 + 0.0312 + 0.187	5/13 & 5/24										
LSD (0.05)			ns	ns	10	17	20	10	ns	ns	11	ns

[1]Weeds evaluated for control were kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), wild oat (AVEFA), green foxtail (SETVI), and barnyardgrass (ECHCG).

[2]Efs&dmp&pmp is a commercial formulation of a 1:1:1 mixture of ethofumesate, desmedipham, and phenmedipham.

[3]All herbicide rates other than glyphosate are listed in pounds active ingredient per acre.

Comparison of ethofumesate, desmedipham, and phenmedipham formulations for crop tolerance and weed control. Robyn C. Walton, Don W. Morishita, and Michael P. Quinn. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Bayer CropScience is introducing new formulations of Betamix® and Progress® herbicides. A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare current and new desmedipham & phenmedipham (dmp&pmp) and ethofumesate & desmedipham & phenmedipham (efs&dmp&pmp) formulations for crop tolerance and weed control. The new formulations are designated as dmp&pmp-β and efs&dmp&pmp-β. 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 (19.0% sand, 61.3% silt, and 19.7% clay) with a pH of 7.6, 1.56% organic matter, and CEC of 15.6-meq/100 g soil. '2985 RZ' sugar beet was planted April 26, 2004, in 22-inch rows at a rate of 51,840 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), hairy nightshade (SOLSA), and redroot pigweed (AMARE) were the major weed species present. Herbicides were broadcast-applied 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 18 days after the last herbicide treatment (DALT) on June 28 and 49 DALT on July 29. The two center rows of each plot were harvested mechanically October 6.

Table 1. Environmental conditions at application and weed species densities.

Application date	May 19	May 25	June 9
Application timing	Cotyledon	2-4 leaf	6 leaf
Air temperature (F)	64	53	62
Soil temperature (F)	55	55	56
Relative humidity (%)	56	42	35
Wind velocity (mph)	3.7	6	6
Cloud cover (%)	50	10	20
Weed species (plants/ft^2)			
kochia	0	1	0
pigweed, redroot	2	2	1
lambsquarters, common	1	2	1
nightshade, hairy	0	1	1

Crop injury ranged from 13 to 48% at the first evaluation and 15 to 31% at the second evaluation (Table 2). However, due to rep-to-rep variability, there were no crop injury differences among the herbicide treatments at either evaluation. KCHSC control at the first evaluation ranged from 74% to 97%. Several treatments controlled KCHSC >90% and did not differ between old and new formulations. KCHSC control at the second evaluation ranged from 54 to 74%, with no difference among treatments. CHEAL control at the first evaluation ranged from 85 to 95% and 51 to 79% at the second evaluation with no differences among treatments at either evaluation. Several treatments controlled AMARE >90% at the first evaluation. Like the other weed species, AMARE control declined by the second evaluation. Efs&dmp&pmp + triflusulfuron at 0.25 + 0.012 lb ai/A followed by efs&dmp&pmp + triflusulfuron + clopyralid at 0.33 + 0.012 + 0.089 lb ai/A applied two times controlled AMARE 80%. No differences in SOLSA or grass control, which ranged from 96 to 100%, were observed among the herbicide treatments. Root yield ranged from 11 to 27 ton/A. Efs&dmp&pmp + triflusulfuron + clopyralid + MSO at 0.08 + 0.004 + 0.03 lb ai/A + 1.5% v/v followed by efs&dmp&pmp + triflusulfuron + clopyralid + MSO at 0.16 + 0.004 + 0.03 lb ai/A + 1.5% v/v was among the highest yielding treatments at 27 ton/A. All herbicide treatments had yields higher than the untreated check.

Table 2. Crop injury, weed control, and yield comparing old and new ethofumesate, desmedipham, and phenmedipham formulations near Kimberly, Idaho.

					Weed control[1]									
		Application	Crop injury		KCHSC		CHEAL		AMARE		SOLSA	Grasses	Root	Extractable
Treatment[2]	Rate	dates	6/28	7/30	6/28	7/30	6/28	7/30	6/28	7/30	6/28	6/28	yield	sugar
	lb ai/A		%										ton/A	lb/A
Check	-		-	-	-	-	-	-	-	-	-	-	11	3015
Efs&dmp&pmp-β/	0.25/	5/19	29	19	74	54	88	61	93	63	97	99	21	5628
Efs&dmp&pmp-β	0.33	5/25 & 6/9												
Efs&dmp&pmp/	0.25/	5/19	28	30	89	59	89	61	95	63	99	100	21	5683
Efs&dmp&pmp	0.33	5/25 & 6/9												
Efs&dmp&pmp-β +	0.25 +	5/19	34	28	97	70	95	66	96	70	100	100	22	5839
triflusulfuron/	0.012/													
Efs&dmp&pmp-β +	0.33 +	5/25 & 6/9												
triflusulfuron +	0.012 +													
clopyralid	0.089													
Efs&dmp&pmp +	0.25 +	5/19	24	20	89	74	95	79	94	80	99	100	24	6369
triflusulfuron/	0.012/													
Efs&dmp&pmp +	0.33 +	5/25 & 6/9												
triflusulfuron +	0.012 +													
clopyralid	0.089													
Efs&dmp&pmp-β +	0.08 +	5/19, 5/25	24	15	80	54	85	51	88	48	98	100	20	5219
triflusulfuron +	0.004 +	& 6/9												
clopyralid +	0.03 +													
MSO	1.5% v/v													
Efs&dmp&pmp +	0.08 +	5/19, 5/25	19	16	87	60	89	59	86	55	99	100	23	6145
triflusulfuron +	0.004 +	& 6/9												
clopyralid +	0.03 +													
MSO	1.5% v/v													
Efs&dmp&pmp-β +	0.08 +	5/19, 5/25	18	28	86	61	94	65	84	51	97	100	24	6368
triflusulfuron +	0.004 +	& 6/9												
clopyralid +	0.03 +													
MSO	1.5% v/v													
Efs&dmp&pmp +	0.08 +	5/19	29	28	89	69	91	64	84	61	96	100	27	7047
triflusulfuron +	0.004 +													
clopyralid +	0.03 +													
MSO	1.5% v/v													
Efs&dmp&pmp +	0.16 +	5/25 & 6/9												
triflusulfuron +	0.004 +													
clopyralid +	0.03 +													
MSO	1.5% v/v													
Dmp&pmp-β/	0.25/	5/19	20	18	85	62	88	61	82	53	97	99	21	5561
Dmp&pmp-β	0.33	5/25 & 6/9												
Dmp&pmp/	0.25/	5/19	13	16	89	55	90	64	76	55	96	100	26	6902
Dmp&pmp	0.33	5/25 & 6/9												

Table 2. Continued

Treatment[2]	Rate	Application dates	Crop injury 6/28	Crop injury 7/30	Weed control[1] KCHSC 6/28	KCHSC 7/30	CHEAL 6/28	CHEAL 7/30	AMARE 6/28	AMARE 7/30	SOLSA 6/28	Grasses 6/28	Root yield	Extractable sugar
	lb ai/A		%										ton/A	lb/A
Dmp&pmp-β +	0.25 +	5/19	48	31	93	59	95	64	88	53	99	99	13	3530
triflusulfuron/	0.004/													
Dmp&pmp-β +	0.33 +	5/25 & 6/9												
triflusulfuron +	0.012 +													
clopyralid	0.089													
Dmp&pmp +	0.25 +	5/19	26	31	96	73	96	70	93	70	100	100	22	5919
triflusulfuron/	0.004/													
Dmp&pmp +	0.33 +	5/25 & 6/9												
triflusulfuron +	0.012 +													
clopyralid	0.089													
Dmp&pmp-β +	0.08 +	5/19, 5/25	25	29	93	64	90	61	93	61	98	100	25	6669
triflusulfuron +	0.004 +	& 6/9												
clopyralid +	0.03 +													
MSO	1.5% v/v													
Dmp&pmp +	0.08 +	5/19, 5/25	18	19	92	63	91	65	84	54	100	100	24	6430
triflusulfuron +	0.004 +	& 6/9												
clopyralid +	0.03 +													
MSO	1.5% v/v													
Dmp&pmp-β +	0.077 +	5/19	29	21	96	70	94	63	92	61	99	98	24	6307
triflusulfuron +	0.004 +													
clopyralid +	0.03 +													
MSO/	1.5% v/v													
Dmp&pmp-β +	0.154 +	5/25 & 6/9												
triflusulfuron +	0.004 +													
clopyralid +	0.03 +													
MSO	1.5% v/v													
Dmp&pmp +	0.08 +	5/19	19	15	92	69	89	70	93	74	99	99	24	6451
triflusulfuron +	0.004 +													
clopyralid +	0.03 +													
MSO/	1.5% v/v													
Dmp&pmp +	0.16 +	5/25 & 6/9												
triflusulfuron +	0.004 +													
clopyralid +	0.03 +													
MSO	1.5% v/v													
LSD (0.05)			ns	ns	11	ns	ns	ns	11	18	ns	ns	7	1842

[1]Weeds evaluated for control were kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), hairy nightshade (SOLSA), and grasses consisting of green foxtail and barnyardgrass.

[2]MSO is methylated seed oil. Efs&dmp&pmp is the commercial formulation of a 1:1:1 mixture of ethofumesate, desmedipham, and phenmedipham sold as Progress. Efs&dmp&pmp-β is the commercial formulation of a 1.56:1:1.28 mixture of ethofumesate, desmedipham, and phenmedipham sold as Progress-β. Dmp&pmp is a commercial formulation of a 1: 1 mixture of desmedipham and phenmedipham sold a Betamix. Dmp&pmp-β is a commercial formulation of a 1: 1 mixture of desmedipham and phenmedipham sold a Betamix-β.

Late season weed control in sugar beet. Don W. Morishita, Robyn C. Walton, and Michael P. Quinn. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Controlling weeds after row closure is usually done by hand weeding. However, labor crew availability to manage late season weeds has become less in recent years. Some growers have tried mowing weeds growing above the crop canopy and others have tried using glyphosate in wiper or wick applicators. Other herbicide combinations would be helpful to control some of the weeds glyphosate does not effectively control. A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare late season control methods on crop injury, weed control, and sugar beet yield. Experimental design was a randomized complete block with four replications. Individual plots were four rows by 45 ft. Soil type was a Portneuf silt loam (19.0% sand, 61.3% silt, and 19.7% clay) with a pH of 15.6, 1.56% organic matter, and CEC of 7.6-meq/100 g soil. '2985 RZ' sugar beet was planted April 26, 2004, in 22-inch rows at a rate of 51,840 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), and redroot pigweed (AMARE) were the major weed species present. Herbicides were applied by spraying broadcast or using a wiper applicator. Sprayed herbicides were applied with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles. The wiper applicator, manufactured by Agriweld, Inc. is a tractor-pulled implement equipped with a hydraulic-driven rotating 4-inch tube, covered with carpet. A concentrated herbicide solution is sprayed onto the carpet surface with flat fan nozzles positioned above the carpet. The carpeted tube rotates against a carpeted backboard, providing friction necessary to create a thick foam. The foam on the carpet-covered tube is pulled over the top of the beets contacting only those plants above the crop canopy. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 17 days after the last herbicide treatment (DALT) on August 13 and 29 DALT on August 26. The two center rows of each plot were harvested mechanically October 6. At harvest, root injury was scored on a 0 to 10 scale where 0 = no injury and 10 = completely dead roots.

Table 1. Environmental conditions at application and weed species densities.

Application date	May 7	June 1	June 9	June 11	July 19	July 27	Aug. 13
Application timing[1]	Pre	4-6 leaf	6 leaf	6 leaf	Mow	Wiper	Mow
Air temperature (F)	75	67	62	56		83	
Soil temperature (F)	72	54	56	54		70	
Relative humidity (%)	15	35	35	50		32	
Wind velocity (mph)	5	4.5	6	6			
Cloud cover (%)	20	5	20	15		20	
Weed species (plants/ft^2)							
kochia	0	0	0	1			
pigweed, redroot	1	3	2	2			
lambsquarters, common	1	3	2	2			
foxtail, green	1	0	0	0			

[1]Mow is the mowing and hand weeding applications made to late postemergence and the wiper is a carpet wiper applied late postemergence.

Crop injury 17 DALT ranged from 14% to 86% (Table 2). Fluroxypyr + mesotrione at 12.5 + 12.5% had the most severe injury (86%). Mowed or hand weeded treatments were injured the least and ranged from 14 to 21%. The second injury evaluation 29 DALT followed the same pattern as the first. Root injury evaluation taken at harvest showed that all roots exhibited some level of injury. Interestingly, the hand weeded and mowed treatments had an injury score of 2, which was the same as the fluroxypyr + mesotrione treatment that had the highest visual injury rating. All glyphosate rates (25, 37.5, and 50%) and combinations with fluroxypyr or mesotrione had the most root injury at harvest, ranging from 5 to 7. The hand weed as needed and late season hand weeded treatments had the best overall weed control ranging from 85 to 100%. Mowing one or two times had the worst overall weed control. Redroot pigweed control averaged 40 and 34% at the 29 DALT evaluation. Root yield for all treatments ranged from 8 to 30 ton/A. The hand weed as needed treatment had the highest yield at 30 ton/A. This was followed by the late hand weed and the standard herbicide treatment consisting of ethofumesate applied preemergence followed by efs&dmp&pmp + triflusulfuron + clopyralid postemergence. Mowing once or twice had the next highest yield even though weed control was rated poorly. All of the late season herbicide applications had lower root yields than the other treatments ranging from 8 to 17 ton/A. These results contrast results in 2003 where the late season herbicide applications did not affect sugar beet yield (see 2004 WSWS Res. Prog. Rep., p. 88.). Extractable sugar yields mirrored the root yield results.

Table 2. Crop injury, weed control, and beet yield using a wiper applicator for weed control in sugar beet near Kimberly, Idaho.

						Weed control[1]									
		Application	Crop injury[2]			KCHSC		CHEAL		AMARE		Grasses		Root	Extractable
Treatment[3]	Rate[4]	dates	8/13	8/26	10/6	8/13	8/26	8/13	8/26	8/13	8/26	8/13	8/26	yield	sugar
	lb ai/A		-------------					%					-------------	ton/A	lb/A
Check	-		-	-	0	-	-	-	-	-	-	-	-	13	3129
Hand weed as needed	-	-	14	13	2	99	100	94	95	86	88	96	97	30	7472
Ethofumesate /	1.25	5/7	16	11	3	68	69	74	80	81	90	98	91	24	5862
Efs&dmp&pmp + triflusulfuron + clopyralid	0.25 + 0.0156 + 0.094	6/1, 6/9													
Glyphosate	25%	7/27	56	29	7	96	97	81	82	76	74	96	99	14	3448
Glyphosate	37.5%	7/27	44	25	6	89	90	83	73	81	71	95	92	17	4173
Glyphosate	50%	7/27	58	64	6	88	90	75	80	83	73	95	90	10	2563
Glyphosate + fluroxypyr	12.5% + 12.5%	7/27	71	65	5	86	94	75	85	69	65	95	93	11	2613
Glyphosate + mesotrione	12.5% + 12.5%	7/27	55	69	5	75	85	68	79	65	75	96	93	10	2411
Fluroxypyr + mesotrione	12.5% + 12.5%	7/27	86	85	2	90	91	89	89	85	81	95	94	8	1908
Mow one time		7/19	15	8	2	54	68	53	71	26	40	91	88	21	5196
Mow two times		7/19 & 8/13	19	16	2	64	79	44	69	33	34	86	79	21	5117
Hand weed (late)		7/19	23	24	2	94	96	86	89	88	90	94	89	24	5913
LSD (0.05)			23	15	2	12	11	18	ns	20	19	ns	ns	2	1612

[1]Weeds evaluated for control were kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), and grasses that consisted of green foxtail and barnyardgrass.
[2]Crop injury rating on October 6 was based on a visual evaluation of the harvested roots from each plot. Injury was rated on a scale of 0 to 10 where 0 = no injury and 10 = completely dead root.
[3]Efs&dmp&pmp is a 1:1:1 commercial formulation of ethofumesate, desmedipham, and phenmedipham. All glyphosate, fluroxypyr, and mesotrione containing treatments as well as the mowing and late hand weeding treatments were preceded by two postemergence efs&dmp&pmp + triflusulfuron + clopyralid at 0.25 + 0.0156 + 0.094 lb ai/A applications.
[4]Ethofumesate, efs&dmp&pmp, triflusulfuron, and clopyralid application rate unit was pounds active ingredient per acre. All other herbicide rates were solution concentration.

Ethofumesate, desmedipham and phenmedipham versus triflusulfuron alone and in combination for sugar beet weed control. Robyn C. Walton, Don W. Morishita, and Michael P. Quinn. (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 weed control with ethofumesate & desmedipham & phenmedipham (efs&dmp&pmp) and triflusulfuron used alone or in combination. 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 (19.0% sand, 61.3% silt, and 19.7% clay) with a pH of 7.6, 1.56% organic matter, and CEC of 15.6-meq/100 g soil. '2984 RZ' sugar beet was planted April 26, 2004, in 22-inch rows at a rate of 51,840 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), and hairy nightshade (SOLSA) were the major weed species present. Herbicides were broadcast-applied 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 32 days after the last herbicide treatment (DALT) on June 28 and 64 DALT on July 30. The two center rows of each plot were harvested mechanically October 6.

Table 1. Environmental conditions at application and weed species densities.

Application date	May 13	May 21	May 25
Application timing	Cotyledon	2-4 leaf	4 leaf
Air temperature (F)	62	52	53
Soil temperature (F)	58	57	55
Relative humidity (%)	28	68	42
Wind velocity (mph)	10.5	7.4	6
Cloud cover (%)	50	60	10
Weed species (plants/ft^2)			
kochia	1		1
pigweed, redroot	1		2
lambsquarters, common	1		2
nightshade, hairy	1		0

Crop injury, at 32 DALT, ranged from 3 to 29% with no differences among treatments. The second crop injury evaluation (64 DALT) ranged from 6 to 15%, again with no differences among treatments (Table 2). KCHSC control ranged from 80 to 100% 32 DALT, but there were no differences among herbicide treatments. No differences in KCHSC control were observed at 64 DALT as well. AMARE control 32 DALT averaged 55% with triflusulfuron applied alone compared to an average 82% for all efs&dmp&pmp treatments. However, redroot pigweed control 64 DALT ranged from 43 to 76% and did not differ among herbicide treatments. Similar results were observed for CHEAL control, where triflusulfuron alone did not satisfactorily control CHEAL (46%). All other herbicide treatments controlled CHEAL 80% or better. Hairy nightshade and grass weed (green foxtail and barnyardgrass) control ranged from 97 to 100% and were not different among herbicide treatments. Root yield ranged from 9 to 27 ton/A. All treatments containing efs&dmp&pmp applied alone or in combination with triflusulfuron had higher yields than the check and triflusulfuron applied alone. Extractable sugar yield followed the same order as root yield.

Table 2. Crop injury, weed control, root and sugar yield with herbicides in sugar beet near Kimberly, Idaho.

Treatment[2]	Rate	Application dates[3]	Crop injury 6/28	Crop injury 7/30	Weed control[1] KCHSC 6/28	KCHSC 7/30	AMARE 6/28	AMARE 7/30	CHEAL 6/28	CHEAL 7/30	SOLSA 6/28	Grasses 6/28	Root yield	Extractable sugar
	lb ai/A		--------%--------		---------------------%---------------------								ton/A	lb/A
Check	-		-	-	-	-	-	-	-	-	-	-	9	2552
Efs&dmp&pmp + triflusulfuron/	0.25 + 0.0156/	5/13	19	9	92	81	80	76	80	71	99	99	27	7384
Efs&dmp&pmp + triflusulfuron/	0.337 + 0.0234/	5/21												
Efs&dmp&pmp + triflusulfuron	0.42 + 0.0312	5/25												
Triflusulfuron/	0.0156/	5/13	13	6	80	58	55	43	46	27	97	100	14	3848
Triflusulfuron/	0.0234/	5/21												
Triflusulfuron	0.0312	5/25												
Efs&dmp&pmp/	0.25/	5/13	28	14	97	73	91	63	82	64	100	99	22	6006
Efs&dmp&pmp/	0.337/	5/21												
Efs&dmp&pmp	0.42	5/25												
Efs&dmp&pmp/	0.337/	5/13	25	8	99	63	86	61	83	61	100	100	25	6858
Efs&dmp&pmp/	0.42/	5/21												
Efs&dmp&pmp	0.73	5/25												
Efs&dmp&pmp/	0.253/	5/13	16	9	89	76	86	61	85	63	99	100	22	5967
Efs&dmp&pmp/	0.337/	150 GDD												
Efs&dmp&pmp	0.42	150 GDD												
Efs&dmp&pmp/	0.337/	5/13	29	15	100	75	88	58	89	61	100	100	21	5881
Efs&dmp&pmp/	0.42/	150 GDD												
Efs&dmp&pmp	0.73	150 GDD												
LSD (0.05)			ns	ns	ns	ns	19	ns	11	15	ns	ns	7	1942

[1]Weeds evaluated for control were kochia (KCHSC), redroot pigweed (AMARE), common lambsquarters (CHEAL), hairy nightshade (SOLSA), and a small mixture of grass weeds (green foxtail and barnyardgrass).

[2]Efs&dmp&pmp is a 1:1:1 commercial formulation of ethofumesate, desmedipham, and phenmedipham.

[3]Application date interval corresponds to calendar date and 150 growing degree days. However, 150 GDD was equivalent to the same calendar dates used for the other treatments.

Comparison of different adjuvants used with micro rates in southern Idaho. Robyn C. Walton, Don W. Morishita, and Michael P. Quinn. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Micro herbicide rates have been used in Idaho for the past four years with mixed success. Inconsistency with these lowers rates is not clearly understood. Drier conditions, including lower relative humidity than the Red River Valley of North Dakota and Minnesota are thought to be a factor. A field experiment was initiated at the University of Idaho Research and Extension Center near Kimberly, Idaho to evaluate different adjuvants used with the micro rate as well as the half rate in Idaho's drier climate. Experimental design was a randomized complete block with three replications. Individual plots were four rows by 30 ft. Soil type was a Portneuf silt loam (20.4% sand, 71% silt, and 8.6% clay) with a pH of 8.1, 1.5% organic matter, and CEC of 17.0-meq/100 g soil. '2984 RZ' sugar beet was planted April 14, 2004, in 22-inch rows at a rate of 51,840 seed/A. Wild oat (AVEFA), kochia (KCHSC), common lambsquarters (CHEAL), and redroot pigweed (AMARE) were the major weed species present. Herbicides were broadcast-applied with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles. Additional application information and environmental data are given in Table 1. Crop injury was evaluated visually on June 3. Crop injury and weed control were evaluated visually 23 and 52 days after the last herbicide treatment (DALT) was applied on June 30 and July 29, respectively. The two center rows of each plot were harvested mechanically October 4.

Table 1. Environmental conditions at application and weed species densities.

Application date	May 4	May 13	May 24	June 7
Application timing	Cotyledon	2 leaf	4-6 leaf	8 leaf
Air temperature (F)	72	57	53	67
Soil temperature (F)	58	50	52	59
Relative humidity (%)	32	70	62	31
Wind velocity (mph)	3.5	8	6	1.5
Cloud cover (%)	0	15	90	0
Weed species (plants/ft^2)				
kochia	0	0	1	1
pigweed, redroot	1	2	2	2
lambsquarters, common	1	3	3	3
oat, wild	7	8	8	9

Crop injury ranged from 7 to 32% on June 3 (Table 2). Ethofumesate & desmedipham & phenmedipham (Efs&dmp&pmp) applied at the half rate (0.125 lb ai/A) + clopyralid + triflusulfuron + Destiny® + Interlock® had the most severe injury at each evaluation averaging 32, 11, and 17% on June 3, 30, and July 29, respectively. The second and third injury evaluations ranged from 0 to 17% with no differences among treatments for either evaluation. No herbicide treatment effectively controlled wild oat. The best wild oat control averaged only 60%. Kochia control ranged from 70 to 93%. Due to a variable kochia population, no differences in control were observed among herbicide treatments. At the 23 DALT evaluation, common lambsquarters (CHEAL) control averaged 92% or better among all herbicide treatments, except the micro rate treatment with methylated seed oil (MSO) as the adjuvant, which averaged 53%. Adding Bronc® (ammonium sulfate and proprietary ingredients) or sucrose improved CHEAL control to at least 93%. By the 52 DALT evaluation, CHEAL control ranged from 35 to 88%. Common lambsquarters control was best with the half rate plus MSO or the micro rate plus Destiny® and Interlock®. Redroot pigweed control ranged from 95 to 100% with no differences among herbicide treatments. Root yield ranged from 9 to 28 ton/A. All of the herbicide treatments had higher root and extractable sugar yields than the untreated check. All other micro rate treatments, except the micro rate with Rivet® + Interlock®, had higher root and extractable sugar yields than the standard micro rate with MSO. All half rate treatments, except the half rate with Destiny® + Interlock®, also had higher root and extractable sugar yields than the standard micro rate with MSO. Efs&dmp&pmp + triflusulfuron at 0.125 + 0.0312 lb ai/A with MSO at 1.5% v/v followed by efs&dmp&pmp + triflusulfuron + clopyralid at 0.25 + 0.047 + 0.0312 lb ai/A with MSO at 1.5% v/v had the highest root yield at 28 ton/A and the highest extractable sugar yield at 7678 lb/A. However, several other treatments were statistically equal. Based on injury evaluations, weed control, and yield, other adjuvants need to be investigated for use in micro and half rate applications in southern Idaho.

Table 2. Crop injury, weed control, root and extractable sugar yield with micro rates applied with different adjuvants in sugar beet near Kimberly, Idaho.

						Weed control[1]								
		Application	Crop injury			AVEFA		KCHSC		CHEAL		AMARE	Root	Extractable
Treatment[2]	Rate	date	6/3	6/30	7/29	6/30	7/29	6/30	7/29	6/30	7/29	6/30	yield	sugar
	lb ai/A		%										ton/A	lb/A
Check	-		-	-	-	-	-	-	-	-	-	-	<1	137
Efs&dmp&pmp +	0.0833 +	5/4	20	3	5	47	17	82	53	53	35	100	9	2464
triflusulfuron +	0.0104 +													
clopyralid +	0.0313 +													
MSO/	1.5% v/v													
Efs&dmp&pmp +	0.123 +	5/14, 5/24												
triflusulfuron +	0.0104 +	& 6/7												
clopyralid +	0.0313 +													
MSO	1.5% v/v													
Efs&dmp&pmp +	0.0833 +	5/4	17	2	5	55	25	93	72	96	87	100	24	6648
triflusulfuron +	0.0104 +													
clopyralid +	0.0313 +													
Destiny +	1.5% v/v +													
Interlock/	4 fl oz/A													
Efs&dmp&pmp +	0.123 +	5/14, 5/24												
triflusulfuron +	0.0104 +	& 6/7												
clopyralid +	0.0313 +													
Destiny +	1.5% v/v +													
Interlock	4 fl oz/A													
Efs&dmp&pmp +	0.0833 +	5/4	13	1	5	50	20	78	57	95	65	100	15	4118
triflusulfuron +	0.0104 +													
clopyralid +	0.0313 +													
Rivet +	1.25% v/v +													
Interlock/	4 fl oz/A													
Efs&dmp&pmp +	0.123 +	5/14, 5/24												
triflusulfuron +	0.0104 +	& 6/7												
clopyralid +	0.0313 +													
Rivet +	1.25% v/v +													
Interlock/	4 fl oz/A													
Efs&dmp&pmp +	0.125 +	5/4	20	3	8	60	60	92	83	98	88	99	28	7678
triflusulfuron +	0.0312 +													
MSO	1.5% v/v													
Efs&dmp&pmp +	0.25 +	5/14, 5/24												
triflusulfuron +	0.0312 +	& 6/7												
clopyralid +	0.047 +													
MSO	1.5% v/v													

Table 2. Continued.

						Weed control[1]								
		Application	Crop injury			AVEFA		KCHSC		CHEAL		AMARE	Root	Extractable
Treatment[2]	Rate	date	6/3	6/30	7/29	6/30	7/29	6/30	7/29	6/30	7/29	6/30	yield	sugar
	lb ai/A		----------					%				----------	ton/A	lb/A
Efs&dmp&pmp +	0.125 +	5/4	32	11	17	60	58	83	68	96	83	100	17	4856
triflusulfuron +	0.0312 +													
Destiny +	1.5% v/v +													
Interlock/	4 fl oz/A													
Efs&dmp&pmp +	0.25 +	5/14, 5/24												
triflusulfuron +	0.0312 +	& 6/7												
clopyralid +	0.047 +													
Destiny +	1.5% v/v +													
Interlock	4 fl oz/A													
Efs&dmp&pmp +	0.0833 +	5/4	12	1	0	60	57	70	50	95	75	95	22	6190
triflusulfuron +	0.0104 +													
clopyralid +	0.0313 +													
MSO +	1.5% v/v +													
Bronc/	0.85/													
Efs&dmp&pmp +	0.123 +	5/14, 5/24												
triflusulfuron +	0.0104 +	& 6/7												
clopyralid +	0.0313 +													
MSO +	1.5% v/v +													
Bronc	0.85													
Efs&dmp&pmp +	0.0833 +	5/4	8	2	5	55	42	75	57	93	73	100	20	5633
triflusulfuron +	0.0104 +													
clopyralid +	0.0313 +													
MSO +	1.5% v/v +													
sucrose/	0.5/													
Efs&dmp&pmp +	0.123 +	5/14, 5/24												
triflusulfuron +	0.0104 +	& 6/7												
clopyralid +	0.0313 +													
MSO +	1.5% v/v +													
sucrose	0.5													

Table 2. Continued.

Treatment[2]	Rate	Application date	Crop injury			Weed control[1] AVEFA		KCHSC		CHEAL		AMARE	Root yield	Extractable sugar
			6/3	6/30	7/29	6/30	7/29	6/30	7/29	6/30	7/29	6/30		
	lb ai/A		%										ton/A	lb/A
Efs&dmp&pmp +	0.0833 +	5/4	7	0	5	48	27	88	58	92	57	100	19	5383
triflusulfuron +	0.0104 +													
clopyralid +	0.0313 +													
Renegade +	24 fl oz/A +													
In-Place/	1.8 fl oz/A													
Efs&dmp&pmp +	0.123 +	5/14, 5/24												
triflusulfuron +	0.0104 +	& 6/7												
clopyralid +	0.0313 +													
Renegade +	24 fl oz/A +													
In-Place	2.6 fl oz/A													
Efs&dmp&pmp +	0.0833 +	5/4	12	1	8	48	18	93	63	93	67	99	19	5236
triflusulfuron +	0.0104 +													
clopyralid +	0.0313 +													
Renegade +	32 fl oz/A +													
In-Place/	1.8 fl oz/A													
Efs&dmp&pmp +	0.123 +	5/14, 5/24												
triflusulfuron +	0.0104 +	& 6/7												
clopyralid +	0.0313 +													
Renegade +	32 fl oz/A +													
In-Place	2.6 fl oz/A													
LSD (0.05)			14	ns	ns	8	19	ns	ns	21	27	ns	9	2621

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

[2]Efs&dmp&pmp is a 1:1:1 commercial formulation of ethofumesate, desmedipham, and phenmedipham. MSO is methylated seed oil. Destiny is methylated soybean oil. Interlock is a deposition and drift reducing agent. Rivet is a methylated soybean oil. Bronc is a 38% solution of ammonium sulfate. Sucrose is granulated table sugar. Renegade is a modified seed oil, ammonia solution, nonionic surfactant, and alkali buffer. In-Place is a deposition and retention agent.

Weed control in sugar beet with metolachlor and dimethenamid-P. Robyn C. Walton, Don W. Morishita, and Michael P. Quinn. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Soil active herbicides can aid growers obtain longer lasting and/or more effective weed control in sugar beets. A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to evaluate the effectiveness of metolachlor and dimethenamid-p compared to ethofumesate for weed control in sugar beet. Experimental design was a randomized complete block with three 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 8.1, 1.5% organic matter, and CEC of 17.0-meq/100 g soil. '2984 RZ' sugar beet was planted April 14, 2004, in 22-inch rows at a rate of 51,840 seed/A. Wild oat (AVEFA), kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), and hairy nightshade (SOLSA) were the major weed species present. Herbicides were broadcast-applied with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles. Trifluralin was incorporated by hand raking immediately after application. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 9, 36, and 65 days after the last herbicide treatment (DALT) on June 3, 30, and July 29, respectively. The two center rows of each plot were harvested mechanically October 5.

Table 1. Environmental conditions at application and weed species densities.

Application date	April 26	May 4	May 13	May 24
Application timing	Pre	Cotyledon	2 leaf	4 leaf
Air temperature (F)	80	72	49	51
Soil temperature (F)	62	58	49	52
Relative humidity (%)	18	32	68	58
Wind velocity (mph)	1	4	8	5
Cloud cover (%)	0	0	10	75
Weed species (plants/ft^2)				
kochia		1	1	1
pigweed, redroot		4	12	9
lambsquarters, common		7	8	8
nightshade, hairy		15	23	25
oat, wild		5	5	12

Crop injury at the first evaluation (9 DALT) ranged from 0 to 18% (Table 2). Dimethenamid-P applied at the 2 or 4 leaf stage at 0.85 lb ai/A; metolachlor applied at the 2 leaf stage at 0.96 lb ai/A; and dimethenamid-P + trifluralin applied at the 2 leaf stage at 0.85 + 0.5 lb ai/A injured the crop most (12 to 18%). Crop injury at 36 and 65 DALT ranged from 2 to 12% with no difference among herbicide treatments. Wild oat (AVEFA) control 36 and 65 DALT was unacceptable (≤63%). Kochia (KCHSC) control 36 DALT ranged from 75 to 100%. The poorest performing treatment was ethofumesate & desmedipham & phenmedipham + triflusulfuron + clopyralid + MSO applied at the micro rate. By 65 DALT, there was no difference among herbicide treatments for KCHSC control. Common lambsquarters (CHEAL) control 36 DALT was similar to KCHSC control and ranged from 72 to 100%. The two poorest performing treatments were the micro rate treatments with and without ethofumesate applied preemergence. At 65 DALT, CHEAL control with the same two treatments had declined to 37 and 57% while control with all other herbicide treatments averaged 82% or higher. No differences in redroot pigweed control were observed among the herbicide treatments at either evaluation date. Also, no differences in hairy nightshade control were observed, but the control was more variable ranging from 83 to 99%. All herbicide treatments had root and extractable sugar yields greater than the untreated check. However, due to variability in sugar beet yield, there were no differences among herbicide treatments.

Table 2. Crop injury, weed control, root, and extractable sugar yield with metolachlor and dimethenamid-P for weed control in sugar beet near Kimberly, Idaho.

						Weed control[1]										
		Application	Crop injury			AVEFA		KCHSC		CHEAL		AMARE		SOLSA	Root	Extractable
Treatment[2]	Rate	date	6/3	6/30	7/29	6/30	7/29	6/30	7/29	6/30	7/29	6/30	7/29	6/30	yield	sugar
	lb ai/A		%												ton/A	lb/A
Check	-		-	-	-	-	-	-	-	-	-	-	-	-	2	560
Ethofumesate/	1.5/	4/26	8	3	5	52	42	100	96	95	95	100	100	96	26	6559
Efs&dmp&pmp +	0.33 +	5/13 &														
triflusulfuron +	0.0312 +	5/24														
clopyralid	0.094															
Metolachlor/	0.96/	4/26	8	7	3	45	48	90	78	96	90	99	100	98	24	6187
Efs&dmp&pmp +	0.33 +	5/13														
triflusulfuron +	0.0312 +															
clopyralid/	0.094/															
Metolachlor +	0.96 +	5/24														
efs&dmp&pmp +	0.33 +															
triflusulfuron +	0.0312 +															
clopyralid	0.094															
Metolachlor +	0.96 +	5/4	8	7	2	50	35	98	87	95	97	100	100	98	26	6659
efs&dmp&pmp +	0.25 +															
triflusulfuron /	0.0312/															
Metolachlor +	0.96 +	5/13														
efs&dmp&pmp +	0.33 +															
triflusulfuron +	0.0312 +															
clopyralid/	0.094/															
Efs&dmp&pmp +	0.33 +	5/24														
triflusulfuron +	0.0312 +															
clopyralid	0.094															
Efs&dmp&pmp +	0.25 +	5/4	7	2	2	43	43	95	91	93	93	100	100	95	21	5398
triflusulfuron/	0.0312/															
Metolachlor +	0.96 +	5/13														
efs&dmp&pmp +	0.33 +															
triflusulfuron +	0.0312 +															
clopyralid/	0.094/															
Efs&dmp&pmp +	0.33 +	5/24														
triflusulfuron +	0.0312 +															
clopyralid	0.094															
Efs&dmp&pmp +	0.25 +	5/4	15	8	3	47	42	96	84	98	90	100	100	98	19	4989
triflusulfuron/	0.0312/															
Metolachlor +	0.96 +	5/13 &														
efs&dmp&pmp +	0.33 +	5/24														
triflusulfuron +	0.0312 +															
clopyralid	0.094															
Efs&dmp&pmp +	0.25 +	5/4	15	12	2	48	42	100	99	96	88	100	100	99	27	6936
triflusulfuron/	0.0312/															
Dimethenamid-P +	0.85 +	5/13 &														
efs&dmp&pmp +	0.33 +	5/24														
triflusulfuron +	0.0312 +															
clopyralid	0.094															

Table 2. Continued.

Treatment[2]	Rate	Application date	Crop injury			Weed control[1]									Root yield	Extractable sugar
						AVEFA		KCHSC		CHEAL		AMARE		SOLSA		
			6/3	6/30	7/29	6/30	7/29	6/30	7/29	6/30	7/29	6/30	7/29	6/30		
	lb ai/A		---%											---	ton/A	lb/A
Efs&dmp&pmp +	0.25 +	5/4	12	7	5	53	63	98	87	100	92	100	100	97	27	7002
triflusulfuron/	0.0312/															
Dimethenamid-P +	0.85 +	5/13														
trifluralin +	0.5 +															
efs&dmp&pmp +	0.33 +															
triflusulfuron +	0.0312 +															
clopyralid/	0.094/															
Efs&dmp&pmp +	0.33 +	5/24														
triflusulfuron +	0.0312 +															
clopyralid	0.094															
Efs&dmp&pmp +	0.25 +	5/4	18	10	5	48	45	95	90	96	93	100	100	95	23	5927
triflusulfuron/	0.0312/															
Efs&dmp&pmp +	0.33 +	5/13														
triflusulfuron +	0.0312 +															
clopyralid/	0.094/															
Dimethenamid-P +	0.85 +	5/24														
efs&dmp&pmp +	0.33 +															
triflusulfuron +	0.0312 +															
clopyralid	0.094															
Ethofumesate/	1.5/	4/26	0	8	10	37	33	93	74	72	57	93	99	83	24	6229
Efs&dmp&pmp +	0.123 +	5/13 &														
triflusulfuron +	0.0104 +	5/24														
clopyralid +	0.0313 +															
MSO	1.5 % v/v															
Efs&dmp&pmp +	0.083 +	5/4	2	5	3	40	5	75	70	72	37	95	100	87	18	4533
triflusulfuron +	0.0104 +															
clopyralid +	0.0313 +															
MSO/	1.5 % v/v															
Efs&dmp&pmp +	0.123 +	5/13 &														
triflusulfuron +	0.0104 +	5/24														
clopyralid +	0.0313 +															
MSO	1.5 % v/v															
Efs&dmp&pmp +	0.25 +	5/4	7	7	8	50	40	88	70	95	82	95	99	95	22	5747
triflusulfuron/	0.0312/															
Efs&dmp&pmp +	0.33 +	5/13 &														
triflusulfuron +	0.0312 +	5/24														
clopyralid	0.094															
LSD (0.05)			9	ns	ns	ns	27	10	ns	14	21	ns	ns	ns	9	2291

[1]Weeds evaluated for control were wild oat (AVEFA), kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), and hairy nightshade (SOLSA).
[2]Efs&dmp&pmp is a commercial formulation of a 1:1:1 mixture of ethofumesate, desmedipham, and phenmedipham.

Effect of irrigation amount on the activation and crop injury potential of four soil-applied herbicides. Don W. Morishita, Robyn C. Walton, and Michael P. Quinn. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Many sugar beet growers rely on soil-active herbicides applied preplant or preemergence, followed by at least two postemergence herbicide applications for weed control. In sprinkler-irrigated fields, it is common to apply a light irrigation (<1-inch) to initiate weed seed germination and make soil-applied herbicides available for uptake. Occasionally, a rain storm can add more water to the soil surface than what is desired to activate these herbicides. In some cases, growers report crop injury problems presumably because of the herbicide moving down to the germinating sugar beet seed. If cold temperatures follow the wetting of the soil, germinating beet can be injured by the soil-active herbicide. A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to examine irrigation amount on the activation and crop injury potential on soil applied herbicides. Experimental design was a four by four factorial split plot randomized complete block with four replications. Main plots were irrigation amount, labeled as standard (0.75 inch), super-standard (1.5 inch), sub-standard (0.375 inch), and sub-sub-standard (0.1 inch). Sub-plots were the herbicides ethofumesate, pyrazon, ethofumesate + pyrazon, and cycloate. Individual sub-plots were four rows by 36 ft. A sprinkler irrigation system constructed with PVC pipe and lawn sprinkler nozzles enabled precise irrigation applications within a main plot. Soil type was a Portneuf silt loam (20.4% sand, 71.0% silt, and 8.6% clay) with a pH of 8.1, 1.5% organic matter, and CEC of 17-meq/100 g soil. '2985 RZ' sugar beet was planted April 14, 2004, in 22-inch rows at a rate of 51,840 seed/A. Wild oat (AVEFA), kochia (KCHSC), common lambsquarters (CHEAL), and redroot pigweed (AMARE) were the major weed species present. Herbicides were broadcast-applied 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 visually May 17, which was 21 days after the first herbicide application. Crop injury and weed control were evaluated visually 43 and 67 days after the last herbicide treatment (DALT) on July 6 and 30, respectively. The two center rows of each plot were harvested mechanically October 4.

Table 1. Environmental conditions at application and weed species densities.

Application date	April 26	May 13	May 24
Application timing	Pre	2 leaf	4 leaf
Air temperature (F)	80	48	51
Soil temperature (F)	62	47	53
Relative humidity (%)	18	68	51
Wind velocity (mph)	1.4	6	6
Cloud cover (%)	0	5	65
Weed species (plants/ft^2)			
kochia		1	
pigweed, redroot		1	
lambsquarters, common		4	
nightshade, hairy		1	
oat, wild		12	

In the data analysis, only irrigation amount and herbicide treatment main effects were significant. There was no interaction between irrigation amount and herbicide treatment for any variable measured. Crop injury 21 days after the soil-active herbicide application ranged from 52 to 57% within the irrigation amounts (Table 2) and 53 to 54% across all herbicide treatments (Table 3). There were no injury differences within the main effects. Average crop injury levels at 43 and 67 DALT in the irrigation treatments and the herbicide treatments were not different within an evaluation date and ranged from 5 to 12%. There were no differences in weed control among the irrigation treatments, with the exception of common lambsquarters at 43 DALT. However, the difference was between 98 and 96% control, which is not biologically significant. Comparing the herbicide treatments, differences in control were observed with the 67 DALT kochia evaluation and the 43 and 67 DALT wild oat and common lambsquarters evaluations. Kochia control at 67 DALT was lower with pyrazon and cycloate, averaging 76%, compared to ethofumesate and ethofumesate + pyrazon, which averaged 85% control. This is not surprising since pyrazon and cycloate have little activity on kochia. Pyrazon controlled wild oat best averaging 76% for each evaluation date. None of the other herbicides controlled wild oat >70%. Common lambsquarters and redroot pigweed control ranged from 92 to 100% control. Even though there were significant control differences among herbicide treatments, it is believed that they are not biologically different. No difference in root or extractable sugar yield was observed among irrigation treatments. A small difference at the P=0.1 probability level was observed in root and extractable sugar yield among the herbicide treatments. Cycloate had the lowest root yield at 28 ton/A and sucrose yield at 6,907 lb/A. The ethofumesate + pyrazon tank mixture had the highest root and sugar yields at 32 ton/A and 7,838 lb/A, respectively.

Table 2. Crop injury, weed control, and root yield effect from irrigation amount on the activation of soil applied herbicide treatments near, Kimberly, Idaho.

					Weed control[1]									
Irrigation		Crop injury			KCHSC		AVEFA		CHEAL		AMARE	Grasses	Root	Extractable
treatment	Rate	5/17	7/6	7/30	7/6	7/30	7/6	7/30	7/6	7/30	7/6	7/6	yield	sugar
	inches	%			%								ton/A	lb/A
Standard	0.75	53	6	8	90	78	62	65	97	98	98	93	30	7543
Sub-standard	0.375	52	7	9	91	81	70	66	96	98	98	95	29	7248
Super-standard	1.5	57	8	7	87	79	68	68	96	98	99	93	31	7627
Sub-sub standard	0.1	52	7	12	94	84	52	44	98	96	99	93	29	7130
LSD (0.05)		ns	ns	ns	ns	ns	ns	ns	2	ns	ns	ns	ns	ns

[1]Weeds evaluated for control were kochia (KCHSC), wild oat (AVEFA), common lambsquarters (CHEAL), redroot pigweed (AMARE), and grasses consisting of green foxtail and barnyardgrass.

Table 3. Crop injury, weed control, and root yield effect from irrigation amount on the activation of soil applied herbicide treatments near, Kimberly, Idaho.

						Weed control[1]									
		Application	Crop injury			KCHSC		AVEFA		CHEAL		AMARE	Grasses	Root	Extractable
Treatment[2]	Rate	dates	5/17	7/6	7/30	7/6	7/30	7/6	7/30	7/6	7/30	7/6	7/6	yield	sugar
	lb ai/A		%			%								ton/A	lb/A
Ethofumesate	1.5	4/26	54	5	10	90	84	58	53	94	97	96	95	29	7234
Pyrazon	3	4/26	54	7	7	88	77	76	77	99	100	100	94	30	7569
Ethofumesate + pyrazon	1.0 + 1.5	4/26	53	8	9	95	86	63	64	99	98	99	94	32	7838
Cycloate	3	4/26	53	7	10	89	75	54	50	92	93	97	91	28	6907
LSD (0.05)			ns	ns	ns	ns	9	7	8	6	6	6	ns	2[3]	603[3]

[1]Weeds evaluated for control were kochia (KCHSC), wild oat (AVEFA), common lambsquarters (CHEAL), redroot pigweed (AMARE), broadleaf weeds consisting of hairy nightshade, common mallow, and Flixweed, and grasses consisting of green foxtail and barnyardgrass.

[2]A combination of ethofumesate & desmedipham & phenmedipham and triflusulfuron and clopyralid at 0.33 + 0.012 + 0.094 lb ai/A applications were made at the sugar beet cotyledon stage and nine days later for weed control in the sugar beet crop. Efs&dmp&pmp is a commercial formulation of a 1:1:1 mixture of ethofumesate, desmedipham, and phenmedipham.

[3]Calculated at a 90% confidence level.

Ethofumesate carryover potential in sugar beet. Robyn C. Walton, Don W. Morishita, and Michael P. Quinn. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Ethofumesate is widely used for weed control in sugar beet. It can be applied preplant, preemergence, or postemergence at rates up 3 lb ai/A. According to the label, growers cannot plant wheat or barley for 12 months following an ethofumesate application. A few growers however, have reported no apparent carryover problems when they have planted small grain cereals within the 12 month plant-back interval. The first year of a two year field experiment was initiated at the University of Idaho Research and Extension Center near Kimberly, Idaho to: 1) evaluate several ethofumesate rates applied preemergence and postemergence for weed control in sugar beet and 2) determine potential carryover from ethofumesate applications in sugar beet to wheat and barley. Experimental design was a randomized complete block with four replications. Individual plots were six rows by 30 ft. Soil type was a Portneuf silt loam (20.4% sand, 71% silt, and 8.6% clay) with a pH of 8.1, 1.5% organic matter, and CEC of 17.0-meq/100 g soil. '2984 RZ' sugar beet was planted April 14, 2004, in 22-inch rows at a rate of 51,840 seed/A. Wild oat (AVEFA), kochia (KCHSC), common lambsquarters (CHEAL), and redroot pigweed (AMARE) were the major weed species present. Herbicides were applied broadcast or in an 11-inch band with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 10 or 15 gpa, respectively. Broadcast applications used 8001 flat fan nozzles and band applications used 8002 even fan nozzles. Additional environmental and application information is given in Table 1. Crop injury was evaluated visually 10 days after the second postemergence herbicide application on June 3. Crop injury and weed control were evaluated visually 23 and 56 days after the last herbicide treatment (DALT) on July 3 and August 2, respectively. The two center rows of each plot were harvested mechanically October 4.

Table 1. Environmental conditions at application and weed species densities.

Application date	April 26	May 4	May 13	May 24	June 7
Application timing	Pre	Cotyledon	2 leaf	4 leaf	6 leaf
Air temperature (F)	80	72	55	53	67
Soil temperature (F)	62	58	51	50	59
Relative humidity (%)	18	32	60	62	31
Wind velocity (mph)	1	4	5	6	2
Cloud cover (%)	0	0	50	80	5
Weed species (plants/ft^2)					
kochia		1	2	2	1
lambsquarters, common		5	8	6	5
pigweed, redroot		1	6	5	4
oat, wild		14	12	12	9

Crop injury on the first evaluation ranged from 5 to 10% (Table 2). Crop injury averaged 5% with ethofumesate applied preemergence as a broadcast or band application at 3.0 lb ai/A, which was the highest rate used. Crop injury averaged 8% when no ethofumesate was applied other than the amount in the pre-formulated ethofumesate & desmedipham & phenmedipham mixture applied with all herbicide treatments. By the second and third evaluations crop injury ranged from 0 to 3% with no differences among any of the treatments. Kochia, common lambsquarters, and redroot pigweed control ranged from 74 to 100% over both evaluations with no difference between any herbicide treatments. Wild oat control was unacceptable (≤50%) with all treatments. Broadcast applied ethofumesate at 2.25 and 3.0 lb ai/a controlled wild oat 49 and 50%, respectively. Redroot pigweed control averaged 100% with all herbicide treatments. All herbicide treatments had higher yields than the untreated check, which averaged only 2 ton/A. Ethofumesate applied preemergence broadcast at 2.25 lb ai/A, and applied preemergence band or broadcast at 3.0 lb ai/a were among the highest yielding treatments ranging from 28 to 30 ton/A. These treatments also had the highest extractable sugar yield ranging from 6889 to 7428 lb/A. Wheat and barley will be planted spring 2005 to determine injury potential of the ethofumesate applications.

Table 2. Crop injury, weed control, root, and extractable sugar yield in sugar beet treated with ethofumesate near Kimberly, Idaho.

						Weed control[1]								
		Application	Crop Injury			KCHSC		CHEAL		AVEFA		AMARE	Root	Extractable
Treatment[2]	Rate	date	6/3	6/30	8/2	6/30	8/2	6/30	8/2	6/30	8/2	6/30	yield	sugar
	lb ai/A		%										ton/A	lb/A
Check	-		-	-	-	-	-	-	-	-	-	-	2	436
Ethofumesate/	1.5/	4/26	9	1	3	94	71	98	91	13	2	100	20	5048
Efs&dmp&pmp (band) +	0.33+	5/13, 5/24												
triflusulfuron +	0.0312+	& 6/7												
clopyralid	0.094													
Ethofumesate/	1.5/	4/26	8	3	3	95	78	97	96	23	1	100	21	5106
Efs&dmp&pmp (broadcast) +	0.33+	5/13, 5/24												
triflusulfuron +	0.0312+	& 6/7												
clopyralid	0.094													
Ethofumesate/	2.25/	4/26	5	0	2	99	74	98	98	32	11	100	24	6069
Efs&dmp&pmp (band) +	0.33+	5/13, 5/24												
triflusulfuron +	0.0312+	& 6/7												
clopyralid	0.094													
Ethofumesate/	2.25/	4/26	6	0	0	99	91	99	100	49	33	100	30	7416
Efs&dmp&pmp (broadcast) +	0.33+	5/13, 5/24												
triflusulfuron +	0.0312+	& 6/7												
clopyralid	0.094													
Ethofumesate/	3.0/	4/26	5	0	1	94	80	100	100	34	21	100	28	6890
Efs&dmp&pmp (band) +	0.33+	5/13, 5/24												
triflusulfuron +	0.0312+	& 6/7												
clopyralid	0.094													
Ethofumesate/	3.0/	4/26	5	0	0	96	79	100	97	50	47	100	28	6889
Efs&dmp&pmp (broadcast) +	0.33+	5/13, 5/24												
triflusulfuron +	0.0312+	& 6/7												
clopyralid	0.094													
Efs&dmp&pmp (band) +	0.25	5/4	10	0	1	95	88	99	99	22	3	100	19	4826
triflusulfuron/	0.0312/													
Efs&dmp&pmp (band) +	0.25+	5/13												
triflusulfuron +	0.0312+													
clopyralid +	0.094+													
ethofumesate/	0.75/													
Efs&dmp&pmp (band) +	0.25+	5/24 & 6/7												
triflusulfuron +	0.0312+													
clopyralid +	0.094+													
ethofumesate	1.375													

Table 2. Continued.

						Weed control[1]								
		Application	Crop Injury			KCHSC		CHEAL		AVEFA		AMARE	Root	Extractable
Treatment[2]	Rate	date	6/3	6/30	8/2	6/30	8/2	6/30	8/2	6/30	8/2	6/30	yield	sugar
	lb ai/A		%										ton/A	lb/A
Efs&dmp&pmp (broadcast) +	0.25+	5/4	10	0	1	99	95	97	97	19	4	100	19	4719
triflusulfuron/	0.0312/													
Efs&dmp&pmp (broadcast) +	0.33+	5/13												
triflusulfuron +	0.0312+													
clopyralid +	0.094+													
ethofumesate/	0.75/													
Efs&dmp&pmp (broadcast) +	0.33+	5/24 & 6/7												
triflusulfuron +	0.0312+													
clopyralid +	0.094+													
ethofumesate	1.375													
Efs&dmp&pmp (broadcast) +	0.25	5/4	8	0	0	98	79	95	88	6	0	100	18	4399
triflusulfuron/	0.0312/													
Efs&dmp&pmp (broadcast) +	0.33+	5/13, 5/24												
triflusulfuron +	0.0312+	& 6/7												
clopyralid	0.094													
LSD (0.05)			3	ns	ns	ns	ns	ns	ns	9	13	ns	6	1509

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

[2]Efs&dmp&pmp is a commercial formulation of a 1:1:1 mixture of ethofumesate, desmedipham, and phenmedipham. Band applications were 11-inches wide and applied with 8002 even fan nozzles. Broadcast applications were made with 11001 flat fan nozzles.

Wild oat control in seedling Kentucky bluegrass grown for seed production. Sandra M. Frost, Larry H. Bennett, and Daniel A. Ball. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801). A study was conducted at the Hermiston Agricultural Research and Experiment Station, OR to evaluate wild oat (*Avena fatua*) control in seedling Kentucky bluegrass grown for seed production. Kentucky bluegrass (var. Brilliant) was planted August 29, 2003. Oats were seeded with a hand rotary seeder on September 17, 2003. Early post-emergence (EPOST) treatments were applied October 9, 2003 to Kentucky bluegrass at 5-6 leaf stage and to oats at the 2-3 leaf stage. Late post-emergence (LPOST) treatments were applied on October 17, 2003 to Kentucky bluegrass at the 7-8 leaf stage and oats at the 4-8 leaf stage. Spring treatments were applied April 6, 2004 to Kentucky bluegrass at the prejoint, 3 to 5 inch stage and to oats at the 4 to 7 leaf stage. Spring applications were repeated, all at one time, to the fall treatments. All treatments were made with a hand-held CO_2 sprayer delivering 16 gpa at 30 psi. Plots were 6 ft by 35 ft in size, in an RCB arrangement, with 4 replications. Soil at the site was a sandy loam (65.6% sand, 30.5% silt, 3.9% clay, 1.0% organic matter, 6.7 pH, and CEC of 8.7 meq/100g). Evaluations of crop injury were made on October 31, 2003 and February 18 and April 29, 2004. Visual estimates of wild oat control were made on October 31, 2003 and April 29, 2004 (Table 2). Kentucky bluegrass was swathed on June 17, 2004 with a small plot swather and combined on June 29, 2004. Harvested seed was cleaned with a 'Clipper' cleaner, weighed, and yield converted to lbs/A.

Table 1. Application conditions.

	Oct 9, 2003	Oct 17, 2003	Apr 6, 2004
Kentucky bluegrass (lf)	5-6	7-8	pre-joint
Timing	EPOST	LPOST	SPRING
Air temp (F)	48	64	64
Relative humidity (%)	72	50	51
Wind velocity (mph)	3	5	2
Soil temp 1 inch (F)	44	48	70

Crop injury ratings taken on October 31, 2004 showed injury mainly from the imazamethabenz-methyl and difenzoquat + imazamethabenz-methyl EPOST applications. The LPOST applications showed less crop injury. Crop injury ratings in February again showed injury from the EPOST treatments of imazamethabenz-methyl and imazamethabenz-methyl + difenzoquat. The LPOST treatment of imazamethabenz-methyl + difenzoquat also caused some crop injury. Wild oat control ratings, taken October 31, 2004, showed fair to good control with all EPOST treatments. The LPOST treatments were less effective. The last wild oat ratings were taken 23 days after the plots were treated in the spring. At this time all of the plots were treated with the same application timing. Oat control with the spring timing was good with flucarbazone-sodium at both rates (86-91%). Difenzoquat gave very poor control (15-23%), while imazamethabenz-methyl and imazamethabenz-methyl + difenzoquat gave fair control (59-74%). Kentucky bluegrass seed yields in the treated plots were highest in the flucarbazone-sodium plots which had good oat control as well as very little crop injury. The imazamethabenz-methyl treated plots gave only partial oat control but caused significant crop injury as yields were significantly reduced in these plots. Imazamethabenz-methyl + difenzoquat plots also had reduced seed yields. Crop injury appeared to be the cause of yield reduction more than the control or lack of control of oats, due to the untreated control having no oat control but still having good seed yield. Results indicate that flucarbazone-sodium applied EPOST to oats in seedling KBG gives good control of the oats with little or no injury to the crop.

Table 2. Herbicide treatment effects on wild oat control in seedling Kentucky bluegrass.

Treatment[1]	Rate	Timing	KBG Injury 10/31/03	KBG Injury 2/18/04	KBG Injury 4/29/04	Oats Control 10/31/03	Oats Control 4/29/04	KBG Yield 6/29/04
	--lb ai / A--		-------------	-------------	%-------------	-------------	-------------	-lb/A-
Flucarbazone / flucarbazone	0.018 / 0.018	EPOST/ SPRING	2	0	1	79	91	398
Flucarbazone / flucarbazone	0.026 / 0.026	EPOST/ SPRING	2	0	4	85	87	365
Imazamethabenz / imazamethabenz	0.47 / 0.47	EPOST/ SPRING	11	13	50	75	65	28
Difenzoquat / difenzoquat	0.5 / 0.5	EPOST/ SPRING	1	1	0	80	15	288
Imazamethabenz + difenzoquat / Imazamethabenz + difenzoquat	0.234 + 0.5 / 0.234 + 0.5	EPOST/ SPRING	9	8	15	81	63	239
Flucarbazone / flucarbazone	0.018 / 0.018	LPOST/ SPRING	0	0	1	48	89	331
Flucarbazone / flucarbazone	0.026 / 0.026	LPOST/ SPRING	3	0	5	66	86	334
Imazamethabenz / imazamethabenz	0.47 / 0.47	LPOST/ SPRING	0	3	23	49	74	122
Difenzoquat / difenzoquat	0.5 / 0.5	LPOST/ SPRING	1	0	1	44	23	291
Imazamethabenz + difenzoquat / Imazamethabenz + difenzoquat	0.234 + 0.5 / 0.234 + 0.5	LPOST/ SPRING	6	8	13	61	59	220
Untreated control			0	0	0	0	0	339
LSD (0.05)			6	5	6	21	2	74

[1] All treatments contained NIS at 0.25% v/v.

Broadleaf weed control in dry beans with preemergence herbicides followed by sequential postemergence herbicides. Richard N. Arnold, Michael K. O'Neill and Dan Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 27, 2004 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of dry beans (var. Bill Z) and annual broadleaf weeds to preemergence followed by sequential postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with four replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Dry beans were planted with flexi-planters equipped with disk openers on May 27. Preemergence treatments were applied on May 27 and immediately incorporated with 0.75 in of sprinkler-applied water. Postemergence treatments were applied on June 30 when dry beans were in the 3rd to 4th trifoliate leaf stage and weeds were small. All postemergence treatments had a crop oil concentrate and 32-0-0 added at 0.5 and 1.0 percent v/v. Black nightshade, prostrate and redroot pigweed and common lambsquarters infestations were heavy and Russian thistle infestations were light throughout the experimental area. Treatments were evaluated on July 29.

Common lambsquarters, black nightshade redroot and prostrate pigweed control were excellent with all treatments except the check. Dimethenamid-p alone or in combination with pendimethalin at 0.56 plus 0.8 lb ai/A gave poor control of Russian thistle. Flumioxazin alone at 0.05 lb ai/A gave excellent control of all weeds. Yields were 3770 to 2231 lb/A higher in the herbicide treated plots as compared to the check.

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

Treatments[1]	Rate	Crop injury	Weed control					Yield
			CHEAL	SOLNI	AMARE	AMABL	SASKR	
	lb ai/A	---%---			%			lb/A
Flumioxazin	0.05	0	99	98	94	98	98	4001
Dimethenamid-p	0.56	0	96	89	90	97	30	2924
Flumioxazin + pendimethalin	0.05+0.8	0	100	97	95	99	99	3846
Dimethenamid-p + pendimethalin	0.56+0.8	0	97	93	92	96	39	3078
Flumioxazin/imazamox + bentazon	0.05/0.032+0.25	0	100	99	99	100	99	4463
Dimethenamid-p/imazamox + bentazon	0.056/0.032+0.25	0	99	99	99	99	91	4001
Dimethenamid-p + Pendimethalin/imazamox + bentazon	0.056+0.8/ 0.032+0.25	0	99	99	100	99	92	4463
Flumioxazin + pendimethalin/imazamox + bentazon	0.05+0.8/ 0.032 + 0.25	0	99	99	97	100	98	4155
Weedy check		0	0	0	0	0	0	693
LSD (0.05)			2	2	3	2	5	1092

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

Weed control in Kentucky bluegrass with flucarbazone. Janice M. Reed and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were conducted near Nezperce, ID in 'Classic' Kentucky bluegrass and near Tekoa, WA in 'Alene' Kentucky bluegrass. At Nezperce, the weed control study had a poor stand of bluegrass and the crop response study had a non-uniform stand of weeds. Three studies evaluated the effect of flucarbazone in combination with adjuvants for weed control, crop injury, and crop yield. Plots were arranged in a randomized complete block design with four replications and included an untreated check. Treatments in all studies were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Weed control and Kentucky bluegrass injury were visually evaluated. The crop injury and yield study was swathed on July 19 and harvested on August 4, 2004. The weed control studies at both sites were not harvested.

Table 1. Application and soil data.

Study location	Nezperce, ID	Tekoa, WA
Study type	Weed control, crop response	Weed control
Application date	April 26	April 30
Bluegrass growth stage	2 to 4 inch	3 to 5 inch
Ventenata	1 to 3 inch	--
Downy brome	4 inch	--
Windgrass	--	2 to 4 inch
Quackgrass	--	4 to 6 inch
Air Temperature (F)	67	69
Relative humidity (%)	62	52
Wind (mph, direction)	3, NW	0
Cloud cover (%)	0	0
Soil temperature at 2 inch (F)	58	60
pH	5.2	--
OM (%)	5.6	--
CEC	28	--
Texture	Silt loam	Silt loam

At Nezperce, all treatments stunted ventenata and downy brome compared to the untreated check, but did not prevent seed production (Table 2). On both evaluation dates, ventenata was stunted the most (78 and 58 %) with the high rate of flucarbazone + MSO and least with primsulfuron (40 and 21 %). Downy brome control was best with primsulfuron compared to all flucarbazone treatments. At Tekoa, windgrass control was best with the high rate of flucarbazone + MSO (84%). Quackgrass control was best with primsulfuron (81%).

Kentucky bluegrass injury at Nezperce was highest with primsulfuron (28%) and injury from flucarbazone treatments was greater at the high rate compared to the low rate (Table 3). The type of adjuvant used did not affect injury or yield. Bluegrass seed yield was not statistically different among treatments.

Table 2. Weed control with flucarbazone near Nezperce, ID and Tekoa, WA in 2004.

		Nezperce, ID				Tekoa, WA	
		Ventenata[1]		Downy brome[1]		Windgrass	Quackgrass
Treatment[2]	Rate	May 19	July 1	May 19	July 1	May 26	June 21
	lb ai/A	%					
Untreated check	--	--	--	--	--	--	--
Flucarbazone + NIS	0.0178 + 0.25 % v/v	63	30	31	16	63	33
Flucarbazone + NIS	0.0267 + 0.25 % v/v	74	42	48	24	73	38
Flucarbazone + MSO	0.0178 + 0.25 % v/v	65	38	45	20	69	33
Flucarbazone + MSO	0.0267 + 0.25 % v/v	78	58	53	29	84	40
Primsulfuron + NIS	0.0356 + 0.25 % v/v	40	21	79	52	55	81
LSD (0.05)		7	8	10	6	9	12

[1] Ventenata and downy brome visual control was rated as stunting compared to the untreated check.
[2] All flucarbazone treatments applied with 8.5 lb ai/100 gal of liquid ammonium sulfate. NIS is non-ionic surfactant (R-11) and MSO is modified seed oil.

Table 3. Kentucky bluegrass injury and seed yield with flucarbazone near Nezperce, ID in 2004.

		Kentucky bluegrass	
Treatment[1]	Rate	Injury[2]	Yield
	lb ai/A	%	lb/A
Untreated check	---	---	80
Flucarbazone + NIS	0.0178 + 0.25 % v/v	8	70
Flucarbazone + NIS	0.0267 + 0.25 % v/v	15	91
Flucarbazone + MSO	0.0178 + 0.25 % v/v	10	85
Flucarbazone + MSO	0.0267 + 0.25 % v/v	16	119
Primsulfuron + NIS	0.0356 + 0.25 % v/v	28	73
LSD (0.05)		5	NS

[1] All flucarbazone treatments applied with 8.5 lb ai/100 gal of liquid ammonium sulfate. NIS is non-ionic surfactant (R-11) and MSO is modified seed oil.
[2] Kentucky bluegrass visual injury was rated as a combination of stunting and panicle density.

Weed control in Kentucky bluegrass with carfentrazone and MCPA. Janice M. Reed and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was conducted near Nezperce, ID to determine the effect of carfentrazone and MCPA on broadleaf weed control in Kentucky bluegrass. The experiment was conducted in a one year old stand of 'Awesome' Kentucky bluegrass. Plots were arranged in a randomized complete block design with four replications and included an untreated check. Treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Weed control and Kentucky bluegrass injury were visually evaluated. Plots were swathed on July 19 and harvested on August 4, 2004.

Table 1. Application and soil data.

Application date	April 29, 2004
Growth stages:	
Kentucky bluegrass	2 to 4 inch
Prickly lettuce (LACSE)	4 to 5 inch
Common mallow (MALNE)	4 to 5 inch
Mayweed chamomile (ANTCO)	1 to 3 inch
Air temperature (F)	59
Relative humidity (%)	55
Wind (mph, direction)	2, NW
Cloud cover (%)	0
Soil temperature at 2 in (F)	57
pH	5.0
OM	6.5
CEC (meq/100g)	29
Texture	Silt loam

Bluegrass injury on May 3 was 4 to 7% with carfentrazone treatments and was highest with carfentrazone + dicamba (Table 2). By the June 14 evaluation date, no injury was visible. Carfentrazone alone did not control any weed species at either evaluation date (6 to 29%). When evaluated on July 1, the addition of 2,4-D or dicamba to carfentrazone increased weed control 72 and 74% for LACSE, 63 and 68% for ANTCO, and 66 and 69% for MALNE, compared to the untreated control. At both evaluation dates, LACSE and MALNE control did not differ among MCPA treatments. ANTCO control was lower (24 and 60 %) with MCPA + dicamba compared to MCPA ester + bromoxynil (45 and 92 %) and MCPA/bromoxynil (43 and 83 %). Weed populations were variable throughout the trial. Bluegrass seed yield did not differ among treatments.

Table 2. Weed control and Kentucky bluegrass injury and seed yield with carfentrazone and MCPA near Nezperce, ID in 2004.

Treatment[1]	Rate	Bluegrass Injury[2]	LACSE control 6/14/04	LACSE control 7/1/04	MALNE control 6/14/04	MALNE control 7/1/04	ANTCO control 6/14/04	ANTCO control 7/1/04	Bluegrass Seed yield
	lb ai/A	%							lb/A
Untreated control	---	---	---	---	---	---	---	---	314
Carfentrazone	0.016	4	9	26	12	29	6	26	288
Carfentrazone + 2,4-D amine	0.016 + 0.25	5	64	92	60	84	31	71	285
Carfentrazone + dicamba	0.016 + 0.25	7	83	99	73	94	35	81	271
MCPA ester + bromoxynil	0.487 + 0.375	0	78	96	56	90	45	92	203
MCPA + dicamba	0.5 + 0.125	0	86	98	60	76	24	60	281
MCPA/bromoxynil	0.75	0	78	97	53	82	43	83	203
LSD (0.05)		1	15	8	29	17	14	19	NS
Plants/ft^2			2		2		3		

[1] Carfentrazone was applied in the 2 EC formulation; all carfentrazone treatments applied with non-ionic surfactant (R-11) at 0.25% v/v. MCPA + bromoxynil is Sword + Buctril; MCPA is Wild Card. MCPA/bromoxynil is Wild Card Extra.
[2] Bluegrass injury rated May 3, 2004.

Interrupted windgrass control in established Kentucky bluegrass grown for seed production. Larry H. Bennett, Sandra M. Frost, and Daniel A. Ball. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801) A study was conducted in a commercial field of established Kentucky bluegrass (KBG) var. 'SR2100', planted in April of 2001 near Imbler, OR in Union County to evaluate flucarbazone-sodium, a potential herbicide for control of interrupted windgrass (*Apera interrupta*). Herbicide treatments were made on April 6, 2004 to KBG in the prejoint stage, about 3-5 inches in height, and windgrass in the 4 to 6 leaf stage. Treatments were applied with a hand-held CO_2 sprayer delivering 16 GPA at 30 psi. Weather conditions at time of application are summarized in Table 1. Plots were 9 ft by 25 ft, in an RCB arrangement, with 3 replications. Soil was a sandy loam (68.6% sand, 19.2% silt, 12.2% clay, 5.4 pH, 2.6% organic matter, with CEC of 15.4 meq/100g). Visual evaluation of crop injury and windgrass control were made on April 29 and May 26, 2004.

Table 1. Application conditions.

	Apr 6, 2004
Crop (inches)	3-5
Windgrass (leaf)	4-6
Air temp (°F)	45
Relative humidity (%)	86
Wind velocity (mph)	4
Soil temp 1 inch (°F)	44

Flucarbazone-sodium appeared to be very safe on the Kentucky bluegrass, as were difenzoquat and imazamethabenz. All rates of flucarabazone-sodium gave excellent control of windgrass regardless of the adjuvant system. Control was poor with difenzoquat alone or in combination with imazamethabenz. Seed yields were not taken in this trial due to uneven stands in the plot area which were present prior to applications of the materials. The plot area was chosen because of the high population of windgrass which tends to be more of a problem in areas with uneven crop stands.

Table 2. Windgrass control in established Kentucky bluegrass, Imbler, OR.

Treatment [1]	Rate	KBG injury 4-29-04	KBG injury 5-26-04	Windgrass control 4-29-04	Windgrass control 5-26-04
	lb ai / A	%			
Untreated check		0	0	0	0
Flucarbazone-sodium + NIS	0.018	0	0	55	92
Flucarbazone-sodium + NIS	0.026	0	0	57	94
Flucarbazone-sodium + AMS + NIS	0.018	0	0	62	94
Flucarbazone-sodium + AMS + NIS	0.026	0	0	75	96
Flucarbazone-sodium + MSO	0.018	0	0	70	96
Flucarbazone-sodium + MSO	0.026	0	0	77	98
Difenzoquat + NIS	0.5	0	0	48	20
Imazamethabenz-methyl + difenzoquat + NIS	0.234 + 0.5	0	0	30	27
LSD (.05)		NS	NS	30	18

[1] NIS = non-ionic surfactant at 0.25% v/v. AMS = ammonium sulfate at 17 lb/A.
MSO = methylated seed oil at 1.5 pt/A. NS = not significant.

Seedling emergence of roundup ready field corn following preemergence herbicides. Richard N. Arnold, Michael K. O'Neill and Dan Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 17, 2004 at the Agricultural Science Center, Farmington, New Mexico to evaluate the emergence of field corn (Dekalb 60-19RR) following 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 three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Field corn was planted with flexi-planters equipped with disk openers on May 17. Treatments were applied on May 18 and immediately incorporated with 0.75 in of sprinkler-applied water. Treatments were evaluated for seedling emergence on May 25, 27 and 29 by counting individual seedlings per 10 ft of the center two rows.

Atrazine plus acetochlor at 1.35 lb ai/A had significantly more seedlings emerged by May 25 than did any other treatments. By May 27 and 29, there no significant differences in seedling emergence from any of the treatments.

Table. Seedling emergence of roundup ready field corn following preemergence herbicides.

Treatments[1]	Rate	5-25-04	Seedling emergence 5-27-04	5-29-04
	lb ai/a		no	
Atrazine + s-metolachlor + mesotrione (pm)	2.47	6.7	35.5	38.0
Atrazine + s-metolachlor (pm)	1.65	8.7	38.5	40.7
Atrazine + acetochlor	2.7	5.2	36.5	41.2
Atrazine + acetochlor	1.35	16.5	38.7	41.0
Atrazine + dimethenamid-p	1.9	3.2	38.7	41.2
Check		10.2	38.0	40.5
LSD 0.05		3.5	ns	ns

[1] pm equal packaged mix.

Broadleaf weed control in field corn with preemergence followed by sequential postemergence herbicides. Richard N. Arnold, Michael K. O'Neill and Dan Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 17, 2004 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Pioneer 34N42) and annual broadleaf weeds to preemergence followed by sequential postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with 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 17. Preemergence treatments were applied on May 18 and immediately incorporated with 0.75 in of sprinkler-applied water. Postemergence treatments were applied on June 10 when corn was in the 4th leaf stage and weeds were small. Treatments with diflufenzopyr plus dicamba had a nonionic surfactant and 32-0-0 added at 0.25 and 0.5 percent v/v. Black nightshade, prostrate and redroot pigweed, and common lambsquarters infestations were heavy and Russian thistle infestations were light throughout the experimental area. Treatments were evaluated on July 12.

Dimethenamid-p and s-metolachlor alone at 0.75 and 1.25 lb ai/A, respectively, gave poor control of Russian thistle. However, when dimethenamid-p and s-metolachlor at 0.75 and 1.25 lb ai/A were combined with diflufenzopyr plus dicamba at 0.25 lb ai/A, Russian thistle control increased approximately 56 and 92 percent. Common lambsquarters, redroot and prostrate pigweed and black nightshade control was greater than 90% in all treatments as compared to the weedy check.

Table. Broadleaf weed control in field corn with preemergence followed by sequential postemergence herbicides.

Treatments[1]	Rate	Crop injury	Weed control CHEAL	SOLNI	AMARE	AMABL	SASKR
	lb ai/A	—%—			%		
Dimethenamid-p + atrazine (pm)	0.85	0	100	93	93	94	94
Dimethenamid-p + atrazine (pm)	1.9	0	100	99	99	99	99
S-metolachlor + atrazine (pm)	0.83	0	100	94	96	97	93
S-metolachlor + atrazine (pm)	1.65	0	100	99	99	100	96
Dimethenamid-p	0.75	0	100	94	93	92	64
S-metolachlor	1.25	0	100	95	94	92	52
Dimethenamid-p/diflufenzopyr + dicamba (pm)	0.75/0.25	0	100	99	100	100	100
S-metolachlor/diflufenzopyr + dicamba (pm)	1.25/0.25	0	100	100	100	100	100
Weedy check			0	0	0	0	0
LSD (0.05)			ns	3	2	2	3

[1] pm equal packaged mix with first treatment being applied preemergence then a slash, followed by a sequential postemergence treatment.

Evaluation of postemergence herbicides for control of bristly foxtail and common lambsquarters in field corn. Ralph E. Whitesides and Dennis Merrick (Department of Plants, Soils and Biometeorology, Utah State University, Logan, Utah 84322-4820). A study was conducted at the Scott Jensen Farm in Amalga, UT to determine the influence of several postemergence herbicides on bristly foxtail (SETVE). Glyphosate-resistant corn hybird DK662 was planted at 35,000 seeds/A on May 4, 2004. Postemergence treatments were applied June 15, in a randomized block design, using three replications. Treatments were applied to 10 by 30 ft plots with a CO_2 backpack sprayer using flatfan Turbojet 015 nozzles calibrated to deliver 25 gpa at 39 psi. The soil was a Lewiston fine sandy loam with 7.7 pH and O.M. content of 4%. Corn was 5 to 7 inches tall at application time and was in the 4-5 leaf stage. Bristly foxtail was 1-2 inches high and at a density of 8-15 plants per ft^2.

No crop injury occurred with any herbicide treatment. Formasulfuron provided good control of bristly foxtail initially but was weak on common lambsquarters (CHEAL). By the middle of the crop season control was excellent for both weeds. All treatments showed some re-growth of weeds by harvest. Adjuvants and tank mixes with other herbicides did not increase control of bristly foxtail in the earlier stages of the crop but did reduce broadleaf weeds. Yields were not significantly different for any treatment.

Table. Bristly foxtail weed control in silage corn.

		Crop			Weed control					
		Injury		Yield	SETVE			CHEAL		
Treatment	Rate	5/28	7/16	9/8	5/28	7/16	9/8	5/28	7/16	9/8
	lb ai/A	--------- %	---------	T/A		--------- %	---------			
Untreated		0	0	22.9	0	0	0	0	0	0
Formasulfuron[a]	0.033	0	0	25.7	63	99	85	12	98	72
Formasulfuron[b]	0.033	0	0	29.5	50	99	92	13	98	87
Formasulfuron[c] + Quest®[d]	0.033+0.2	0	0	26.2	60	98	93	12	98	80
Formasulfuron + Quest®[d] + Dyne-Amic®[e]	0.033+0.2 +0.4	0	0	27.8	47	96	87	12	87	62
DPX-79406[f]	0.022	0	0	27.2	57	99	90	10	93	70
Formasulfuron[a] + diflufenzopyr	0.033+0.175	0	0	20.0	47	99	83	50	100	88
DPX-79406[f] + diflufenzopyr	0.022+0.175	0	0	22.9	43	98	90	57	100	92
Formasulfuron[a] + mesotrione	0.033+0.063	0	0	24.3	33	97	85	75	100	83
Formasulfuron[a] + dicamba	0.033+0.5	0	0	24.2	47	97	87	53	100	85
LSD (0.05)				NS	15	2	8	15	4	19

[a] MSO at .75 qt/A plus 28% N at 1.5 qt/A added.
[b] AMS at 3 lb/A plus 28% N at 1.5 qt/A added.
c MSO at .75 qt/A.
[d] Hydroxy carboxylic, phosphoric, polyacrylic acids and ammonium sulfate.
[e] Proprietary blend of polyalkylene oxide modified polydimethysiloxane, monicruic emulsifiers, and methylesters of C16-C18 fattyacids
[f] NIS at 0.5 % V/V plus N at 2.5%V/Vadded.

Russian thistle control in chemical fallow. Sandra M. Frost, Larry H. Bennett, and Daniel A. Ball. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801) A study was established to evaluate different herbicide strategies for control of Russian thistle in chemical fallow in Morrow County, OR. Plots were 18 by 60 ft arranged in a randomized complete block design with 3 replications. Soil at the site was a silt loam (25% sand, 65.2% silt, 9.8% clay, 1.3% organic matter, 6.8 pH, and CEC of 15.1 meq/100g). Herbicide treatments were applied using a tractor mounted plot sprayer delivering 10 gpa at 20 psi. Early postemergence (EPOST) treatments were applied February 24, 2004 before Russian thistle (SASKR) emergence but at the 2 to 4 leaf stage of downy brome (BROTE) (Table 1). Early mid-postemergence (EMPOST) treatments were applied March 23, 2004 before Russian thistle emergence, but at the 4 to 7 leaf stage of downy brome. Mid-postemergence (MPOST) treatments were applied May 3, 2004 to Russian thistle at the 0.5 to 1 inch stage and downy brome at the boot stage. Late postemergence (LPOST) treatments were applied June 4, 2004 to Russian thistle at the 4 to 12 inch stage and to downy brome at the head stage. Russian thistle control was visually evaluated May 24, June 17 and July 8, 2004 (Table 2). Control of downy brome was visually evaluated on May 24 and July 8, 2004.

Table 1. Application conditions.

	Feb 24, 2004	Mar 23, 2004	May 3, 2004	Jun 4, 2004
Timing	EPOST	EMPOST	MPOST	LPOST
Russian thistle (inch)	pre	pre	0.5-1	4-12
Downy brome (leaf)	2-4	4-7	boot	headed
Air temperature (F)	48	55	66	68
Relative humidity (%)	80	66	56	52
Wind (mph)	5	5	6	4
Soil temperature (F)	44	52	62	62
Cloud cover (%)	90	15	70	0

Plots that received sulfentrazone applications had very good Russian thistle control regardless of the timing. Glyphosate applications alone were not effective at controlling Russian thistle. All treatments gave good control of downy brome. Paraquat + diuron or the addition of 2,4-D to glyphosate at the last application increased Russian thistle control significantly.

Table 2. Russian thistle control in chemical fallow.

Treatment[1]	Rate[2]	Timing	BROTE control 5/24/04	BROTE control 7/8/04	SASKR control 5/24/04	SASKR control 6/17/04	SASKR control 7/8/04
	--lb ai/A--		---------------	---------------	%	---------------	---------------
Sulfentrazone + glyphosate / glyphosate	0.127 + 0.376 / 0.376	EPOST / MPOST	100	82	100	96	93
Sulfentrazone + glyphosate / glyphosate	0.187 + 0.376 / 0.376	EPOST / MPOST	100	85	100	98	96
Sulfentrazone + glyphosate / glyphosate	0.248 + 0.376 / 0.376	EPOST / MPOST	100	88	100	99	97
Sulfentrazone + glyphosate / glyphosate	0.127 + 0.376 / 0.376	EMPOST / MPOST	100	83	100	98	87
Sulfentrazone + glyphosate / glyphosate	0.187 + 0.376 / 0.376	EMPOST / MPOST	99	80	100	99	91
Sulfentrazone + glyphosate / glyphosate	0.248 + 0.376 / 0.376	EMPOST / MPOST	98	77	100	92	82
Sulfentrazone + glyphosate / glyphosate	0.127 + 0.376 / 0.376	EPOST / MPOST	100	73	100	93	87
Sulfentrazone + glyphosate / glyphosate	0.248 + 0.376 / 0.376	EPOST / MPOST	99	82	100	100	93
Glyphosate / glyphosate / glyphosate	0.376 / 0.376 / 0.376	EPOST / EMPOST / LPOST	98	93	0	0	0
Glyphosate / glyphosate / glyphosate	0.376 / 0.376 / 0.376	EPOST / MPOST / LPOST	99	80	0	27	0
Glyphosate / glyphosate / glyphosate	0.376 / 0.376 / 0.376	EMPOST / MPOST / LPOST	100	95	0	30	0
Glyphosate / glyphosate / glyphosate / glyphosate	0.376 / 0.376 / 0.376 / 0.376	EPOST / EMPOST / MPOST / LPOST	95	95	0	0	0
Glyphosate / glyphosate / glyphosate / glyphosate + 2, 4-D	0.376 / 0.376 / 0.376 / 0.376 + 0.475	EPOST / EMPOST / MPOST / LPOST	98	87	0	73	77
Glyphosate / glyphosate / glyphosate / paraquat + diuron	0.376 / 0.376 / 0.376 / 0.374 + 0.186	EPOST / EMPOST / MPOST / LPOST	96	88	0	99	88
Untreated check			0	0	0	0	0
LSD (0.05)			3	13	0	4	10

[1] Paraquat + diuron = Surefire® ; glyphosate = Roundup Ultramax®.

[2] Glyphosate rates are expressed in lb. ae/A.

Rattail fescue control in chemical fallow. Larry H. Bennett, Sandra M. Frost, and Daniel A. Ball. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton OR 97801). A study was established in winter wheat stubble to be chemical fallowed to evaluate control of rattail fescue. Treatments consisted of different glyphosate (Roundup Ultramax®) or paraquat + diuron (Surefire®) application rates and timings. The study was conducted at the Columbia Basin Agricultural Research Center, Pendleton, OR. Plots were 9 by 30 ft arranged in a randomized complete block design with 4 replications. Rattail fescue seed was surface broadcast to the plot area on November 4, 2003. Soil at the site was a Walla Walla silt loam (25% sand, 61% silt, 14% clay, 2.3% organic matter, 5.7 pH, and CEC of 16.7 meq/100g). Herbicide treatments were applied using a 9 ft hand-held boom, CO_2 pressured sprayer delivering 10 gpa at 20 psi. Early postemergence (EPOST) treatments were applied March 29, 2004. Rattail fescue was at the 3 to 5 leaf stage of growth (Table 1). Late postemergence (LPOST) treatments were applied on April 30, 2004, when rattail fescue was at the 5 to 6 leaf stage of growth. Control of rattail fescue was visually evaluated on April 12, April 20, April 30, May 21, and June 4, 2004 (Table 2). Panicles were collected from a $1m^2$ area and counted on July 9, 2004.

Table 1. Application conditions.

	3/29/04	4/30/04
Timing	EPOST	LPOST
Rattail fescue (leaf)	3-5	5-6
Air temperature (F)	72	71
Relative Humidity (%)	28	36
Wind speed (mph)	6	3
Soil temperature (F at 1 inch)	74	82
Cloud cover (%)	5	0

Results indicated that glyphosate or paraquat + diuron applied EPOST gave little or no control of rattail fescue at the end of the evaluation period. Glyphosate and paraquat + diuron treatments applied LPOST resulted in higher levels of control than the EPOST treatments, while split applications resulted in the highest levels of rattail fescue control and greatest reduction in rattail fescue panicles. Glyphosate (Roundup Ultramax) gave more effective control than paraquat + diuron.

Table 2. Rattail fescue control in chemical fallow at Pendleton, OR.

Treatment[1]	Rate	Timing[2]	Rattail fescue control 4/12/04	Rattail fescue control 4/20/04	Rattail fescue control 4/30/04	Rattail fescue control 5/21/04	Rattail fescue control 6/3/04	R.fescue panicle counts 7/9/04
	lb ae / gal		----------------------------	---------------------------%	----------------------------	----------------------------	----------------------------	--# / m^2 --
Untreated check	--	--	0	0	0	0	0	2730
Glyphosate	0.375	EPOST	65	59	66	48	33	3160
Glyphosate	0.562	EPOST	74	71	79	48	30	3750
Glyphosate	0.75	EPOST	84	83	85	61	40	2970
Glyphosate	0.937	EPOST	88	89	93	76	55	2060
Paraquat + diuron	0.75	EPOST	83	88	84	58	28	2040
Glyphosate	0.375	LPOST	--	--	--	76	85	1370
Glyphosate	0.562	LPOST	--	--	--	83	90	400
Glyphosate	0.75	LPOST	--	--	--	90	94	200
Glyphosate	0.937	LPOST	--	--	--	95	97	160
Paraquat + diuron	0.5 + 0.25	LPOST	--	--	--	80	70	2120
Glyphosate / glyphosate	0.375 / 0.375	EPOST/LPOST	65	61	73	94	89	760
Glyphosate / glyphosate	0.562 / 0.375	EPOST/LPOST	80	80	86	98	95	120
Glyphosate / glyphosate	0.375 / 0.562	EPOST/LPOST	65	69	79	99	98	150
Glyphosate / glyphosate	0.562 / 0.562	EPOST/LPOST	80	83	84	100	99	80
Glyphosate / glyphosate	0.562 / 0.75	EPOST/LPOST	84	83	84	100	99	20
Glyphosate / paraquat + diuron	0.375 / 0.5 + 0.25	EPOST/LPOST	73	70	79	94	86	970
Paraquat + diuron / glyphosate	0.5 + 0.25 / 0.375	EPOST/LPOST	84	81	81	94	89	770
LSD (0.05)			8	9	7	7	6	630

[1] Glyphosate (Roundup Ultramax®) treatments received AMS at 8.5 lb/100 gal. Paraquat + diuron (Surefire®) treatments received R-11 @ 0.25% v/v.

[2] EPOST= 3-5 leaf rattail fescue, LPOST= 5-6 leaf rattail fescue.

Table 2. Rattail fescue response to herbicide treatments in chemical fallow at Genesee and Moscow, ID.

			Genesee			Moscow		
			Rattail fescue					
			Control		Panicle density	Control		Panicle density
Treatment[1]	Rate[2]	Application timing[3]	6/14/2004	7/12/2004	7/14/2004	6/14/2004	7/12/2004	7/21/2004
	lb ae/A		-----------%-----------		no./yd^2	-----------%-----------		no./yd^2
Untreated check	--	--	--	--	1425	--	--	615
Glyphosate	0.375	EPOST	81	80	254	53	59	375
Glyphosate	0.562	EPOST	89	90	26	87	85	125
Glyphosate	0.750	EPOST	93	93	17	96	96	2
Glyphosate	0.937	EPOST	93	93	22	93	93	17
Paraquat/diuron	0.750	EPOST	83	83	166	87	89	27
Glyphosate	0.375	LPOST	29	31	594	84	85	16
Glyphosate	0.562	LPOST	59	60	352	78	79	74
Glyphosate	0.750	LPOST	53	54	717	91	92	3
Glyphosate	0.937	LPOST	70	70	167	94	91	2
Paraquat/diuron	0.750	LPOST	75	78	503	95	95	3
Glyphosate + glyphosate	0.375 0.375	EPOST LPOST	89	89	13	92	92	3
Glyphosate + glyphosate	0.562 0.375	EPOST LPOST	94	94	5	96	95	4
Glyphosate + glyphosate	0.375 0.562	EPOST LPOST	95	95	6	97	96	1
Glyphosate + glyphosate	0.562 0.562	EPOST LPOST	95	95	8	98	97	1
Glyphosate + glyphosate	0.562 0.750	EPOST LPOST	96	96	3	98	97	1
Glyphosate + paraquat/diuron	0.375 0.750	EPOST LPOST	96	96	3	84	84	11
Paraquat/diuron + glyphosate	0.750 0.375	EPOST LPOST	90	89	43	98	98	2
LSD (0.05)			17	17	518	19	18	206

[1]Glyphosate treatments contained ammonium sulfate (Bronc) at 8.5 lb/100 gal. Paraquat/diuron treatments contained non-ionic surfactant (R-11) at 0.25% v/v.
[2]Paraquat/diuron rates are lb ai/A.
[3]Application timing based on rattail fescue growth stage.

Rattail fescue control with glyphosate in chemical fallow. Eric D. Jemmett, Traci A. Rauch, and Donald C. Thill (Plant Science Division, University of Idaho, Moscow, ID 83844-2339). Two studies were established in summer fallow to investigate response of rattail fescue (VLPMY) to different timings and herbicide combinations with glyphosate at Genesee and Moscow, ID. Plots were 8 by 30 ft arranged in a randomized complete block design with four replications. Rattail fescue was seeded at 16 lb/A using a cone seeder. Herbicide treatments were applied using a backpack sprayer delivering 10 gpa at 34 psi and 3 mph (Table 1). Control of rattail fescue was visually evaluated June 14 and July 12, 2004. Rattail fescue panicles were counted and biomass taken July 14 and 21, 2004 at Genesee and Moscow, respectively.

Table 1. Application conditions.

	Genesee, Idaho		Moscow, Idaho	
Application date	4/29/04	5/10/04	4/22/04	5/03/04
Timing	EPOST	LPOST	EPOST	LPOST
Rattail fescue growth stage	2 to 5 tiller	7 to 10 tiller	1 to 3 tiller	3 to 5 tiller
Air temperature (F)	54	49	60	65
Relative humidity (%)	48	64	50	46
Wind (mph)	3	5	4	5
Cloud cover (%)	0	100	80	40
Soil temperature (F)	45	57	55	60
pH	5.2		5.6	
OM%	3.3		2.8	
CEC (meg/100g)	19		16	
Texture	silt loam		silt loam	

At Genesee on June 14 and July 12, glyphosate or paraquat/diuron applied EPOST or EPOST + LPOST controlled rattail fescue 81 to 96 % and 80 to 96%, respectively, while LPOST applications of glyphosate or paraquat/diuron only controlled rattail fescue 29 to 75% and 31 to 78%, respectively (Table 2). All treatments reduced rattail fescue panicle density compared to the untreated control. Panicle density was reduced most in all EPOST + LPOST treatments and the three highest rates of glyphosate applied EPOST.

At Moscow on June 14 and July 12, all treatments of glyphosate and paraquat/diuron controlled rattail fescue 84 to 98%, except glyphosate applied EPOST at the low rate and LPOST at 0.56 lb ae/A. All treatments reduced rattail fescue panicle density compared to the untreated control. Compared to the untreated control, panicle density was equally reduced by all treatments, except glyphosate applied EPOST at the lowest rate.

Erect knotweed and volunteer wheat control with glyphosate plus adjuvants. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, Idaho 83844-2339) An experiment was established near Moscow, Idaho to determine the effect of adjuvants plus glyphosate on weed control in fallow. Treatments were applied May 13, 2004 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 3 mph and 32 psi. Wheat was 12 in. tall with 2 to 3 tillers and erect knotweed was 3 to 6 in. tall. Air and soil temperature, and relative humidity were 63 F, 49 F, 55%, respectively. Soil pH, organic matter, CEC and texture were 4.8, 5.8%, 40 cmol/kg, and loam, respectively. The experimental design was a randomized complete block with four replications and 8 by 30 ft experimental units. Weed control was evaluated visually and data are shown as percent control compared to the untreated check.

Glyphosate activity was slow due to wet cool weather 2.5 weeks after application (Table). By June 11, weed control with all treatments containing adjuvants was better than glyphosate alone. Wheat and erect knotweed control on June 24, was highest with Bronc Plus Dry EDT+glyphosate and lowest with Bronc Max+glyphosate+Super Spread MSO among treatments containing adjuvants, although these treatments were not statistically different from many of the other glyphosate plus adjuvant treatments.

Table. Volunteer wheat and erect knotweed control in fallow with glyphosate plus adjuvants near Moscow, Idaho.

			Volunteer wheat			Erect knotweed	
Treatment[1]	Rate		May 31	June 11	June 24	June 11	June 24
			%				
Glyphosate	0.125	lb ai/a	31	30	39	13	25
Bronc Max +	0.500	% v/v	63	79	79	58	84
glyphosate +	0.125	lb ai/a					
R-11	0.25	% v/v					
Bronc Max/EDT +	0.5	% v/v	58	81	75	61	78
glyphosate +	0.125	lb ai/a					
R-11	0.25	% v/v					
Bronc Max +	0.5	% v/v	53	78	80	56	81
glyphosate +	0.125	lb ai/a					
WECO 11-1	0.25	% v/v					
WECO – CPAK +	0.75	% v/v	38	60	64	43	65
glyphosate	0.125	lb ai/a					
Bronc Plus Dry EDT +	10	lb ai/100 gal	55	80	84	63	90
glyphosate	0.125	lb ai/a					
WECO 11-2A (BT) +	0.75	% v/v	48	63	68	45	76
glyphosate	0.125	lb ai/a					
Bronc +	2.5	% v/v	53	76	76	61	88
glyphosate +	0.125	lb ai/a					
R-11	0.25	% v/v					
Bronc Max +	0.5	% v/v	40	54	68	43	68
glyphosate +	0.125	lb ai/a					
Hasten	1.25	% v/v					
Bronc Max +	0.5	% v/v	40	53	58	40	58
glyphosate +	0.125	lb ai/a					
Super Spread MSO	1.25	% v/v					
Bronc Max +	0.5	% v/v	50	68	75	49	74
glyphosate +	0.125	lb ai/a					
WE 04COM	1.25	% v/v					
Untreated			-	-	-	-	-
LSD (0.05)			16	15	17	12	18

[1]Chemicals used are as follows: Glyphosate is Buccaneer; Bronc Max is ammonium sulfate(AMS)/citric acid; R-11 and WECO 11-1 are nonionic surfactants (NIS); Bronc Max EDT is citric acid/Enhanced Deposition Technology; BroncPlusDry-EDT is AMS/NIS/Enhanced Deposition Technology; Bronc is AMS; Super Spread MSO, WE04COM, and Hasten are modified vegetable oil/NIS blends; WECO C-PAK and WECO 11-2A are NIS/AMS blends.

Fenoxaprop tank-mixes for wild oat control. Kirk A. Howatt, Ronald F. Roach, and Janet D. Harrington. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105) An experiment was established to determine whether broadleaf herbicides affect the control of wild oat with fenoxaprop. The experiment was established in a wild oat infested field without a crop because weather conditions prevented wild oat emergence in the area that was seeded to wheat. Treatments were applied to 3- to 5-leaf wild oat on June 14 with 56 F air temperature, 80% relative humidity, 100% cloud cover, 2 to 4 mph north wind, and 62 F soil temperature at 4 inches. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through TT 11001 flat-fan nozzles to an area 7 ft wide and the length of 10- by 30-ft plots. The experiment had a randomized complete-block design with four replicates. Wild oat population was estimated to be 100 to 300 plants per ft^2.

The experiment provided a unique perspective on antagonism of fenoxaprop activity because results were not confounded by the effect of crop competition. Fenoxaprop gave 73% control of wild oat on June 24. The fenoxaprop tank-mixes that gave less control than fenoxaprop alone on June 24 each included bromoxynil and MCPA. Fenoxaprop plus thifensulfuron plus fluroxypyr provided 73% control on June 24, the same as with fenoxaprop alone. However, thifensulfuron or fluroxypyr each tended to reduce wild oat control when included with fenoxaprop plus bromoxynil and MCPA, giving 63% and 64% control respectively, as compared with 68% with fenoxaprop plus bromoxynil and MCPA. Only fenoxaprop plus thifensulfuron plus fluroxypyr, 95%, provided control similar to fenoxaprop alone, 97%, on July 19. The herbicide treatment giving the least wild oat control on July 19 was fenoxaprop plus bromoxynil and MCPA at 77%. Better control of wild oat with fenoxaprop plus bromoxynil and MCPA occurred when less bromoxynil and MCPA was included in the tank-mix and fluroxypyr or thifensulfuron was added to supplement broadleaf weed control, but control with these combinations did not exceed 84%. The result of adding thifensulfuron or fluroxypyr with fenoxaprop plus bromoxynil and MCPA was different at each evaluation. On June 24, thifensulfuron or fluroxypyr decreased wild oat control with the bromoxynil treatments, while on July 19, thifensulfuron or fluroxypyr gave increased control. Thifensulfuron and fluroxypyr may have slowed initial injury expression of wild oat, but the same effect was not observed with other treatments containing these herbicides. The control ratings on July 19 seem to be caused solely by antagonism from bromoxynil and MCPA, since the greater rate of bromoxynil and MCPA corresponded to greater antagonism and less control of wild oat. Clodinafop plus thifensulfuron plus fluroxypyr gave wild oat control similar to fenoxaprop plus thifensulfuron plus fluroxypyr at both evaluations.

Table. Wild oat control with fenoxaprop tank-mixes near Fargo, ND, in 2004.

		June 24	July 19
Treatment	Rate[1]	Wild oat	Wild oat
	oz ai/A	%	%
Fenoxaprop	1.32	73	97
Fenoxaprop + bromoxynil/MCPA	1.32 + 8	68	77
Fenoxaprop + bromoxynil/MCPA + fluroxypyr	1.32 + 6 + 1	63	84
Fenoxaprop + bromoxynil/MCPA + thifensulfuron	1.32 + 6 + 0.1	64	81
Fenoxaprop + thifensulfuron + fluroxypyr	1.32 + 0.3 + 1	73	95
Fenoxaprop + clopyralid/MCPA + fluroxypyr	1.32 + 9.6 + 1.5	69	91
Fenoxaprop + clopyralid + fluroxypyr + thifensulfuron	1.32 + 1.5 + 1.5 + 0.22	75	93
Clodinafop + thifensulfuron + fluroxypyr	0.8 + 0.3 + 1	75	92
Untreated	0	0	0
CV		5	3
LSD (P=0.05)		5	4

[1] Fluroxypyr, clopyralid, and MCPA rates expressed in ae.

Yellow mustard response to imazamox persistence. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established near Lewiston and Moscow, Idaho to evaluate injury and yield of three imidazolinone-resistant winter wheat varieties in 2003 and yellow mustard response in 2004 to imazamox. The experimental design was a randomized complete block, complete factorial with four replications. Main plots were three wheat varieties (25 by 48 ft), subplots were two application times (24 by 25 ft), and sub-subplots were two imazamox rates and an untreated check (8 by 25 ft). Imazamox treatments were applied in 2003 using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The study at Moscow was cultivated in the fall 2003 and spring 2004, and the study at Lewiston was moldboard plowed and cultivated in the spring 2004. 'IdaGold' yellow mustard was seeded on April 12 and 23, 2004 at Moscow and Lewiston, respectively. At Moscow, the study was oversprayed on May 24, 2004 with carbaryl at 1 lb ai/A for flea beetle control and on June 3, 2004 with quizalofop at 0.07 lb ai/A for grass weed control. Yellow mustard injury was evaluated visually, and plant biomass was harvested from a 2.7 ft^2 area in each plot on June 15 and 18, 2004 at Lewiston and Moscow, respectively. At both locations, yellow mustard seed was not harvested due to poor seed production likely caused by herbicide persistence.

Table 1. Application and soil data.

	Lewiston		Moscow	
Application date	2/27/2003	3/27/2003	3/24/2003	4/23/2003
Wheat growth stage	3 to 4 tiller	6 to 7 tiller	2 to 3 tiller	4 to 5 tiller
Air temperature (F)	45	45	45	45
Relative humidity (%)	65	68	55	55
Wind (mph, direction)	1, W	3, SW	0	3, W
Cloud cover (%)	20	50	10	100
Soil moisture	wet	wet	wet	wet
Soil temperature at 2 in (F)	37	43	46	47
pH	5.4		5.2	
OM (%)	3.5		3.0	
CEC (meq/100g)	20		21	
Texture	silt loam		silt loam	
Primary tillage	moldboard plow		field cultivator	

At Lewiston, yellow mustard injury (stand reduction and vigor) was greater with imazamox at 0.094 lb ai/A (89%) than imazamox at 0.047 lb ai/A (66%) [LSD (0.05) = 6] and greater at the 6 to 7 tiller (54%) than the 3 to 4 tiller application time (50%) [LSD (0.05) = 4]. Compared to the untreated check, imazamox at 0.047 and 0.094 lb ai/A reduced yellow mustard biomass 64% and 82%, respectively (Table 2). At both application times, biomass decreased with imazamox rate (Table 3).

At Moscow, imazamox at 0.047 and 0.094 lb ai/A injured yellow mustard 17 and 65% [LSD (0.05) = 8]. At both application times, injury increased with imazamox rate (Table 4). Yellow mustard biomass, when compared to the untreated check, was reduced 46% with imazamox at 0.094 lb ai/A. (Table 2).

Table 2. Yellow mustard biomass averaged over wheat variety and application time at Lewiston and Moscow, Idaho in 2004.

	Yellow mustard biomass	
Imazamox rate[1]	Lewiston	Moscow
lb ai/A	oz/yd^2	
0	18.1	18.2
0.047	6.6	17.8
0.094	3.2	9.9
LSD (0.05)	2.2	2.8

[1]Imazamox treatments were applied with 90% nonionic surfactant (R-11) at 0.25% v/v and 32% urea ammonium nitrate at 1 qt/A.

Table 3. Yellow mustard biomass at Lewiston, Idaho averaged over wheat variety in 2004.

Application time	Imazamox rate[1]	Yellow mustard biomass
	lb ai/A	oz/yd²
3 to 4 tiller	0	15.8
	0.047	6.0
	0.094	4.1
6 to 7 tiller	0	20.4
	0.047	7.1
	0.094	2.4
LSD (0.05)		3.2

[1]Imazamox treatments were applied with 90% nonionic surfactant (R-11) at 0.25% v/v and 32% urea ammonium nitrate at 1 qt/A.

Table 4. Yellow mustard injury at Moscow, Idaho averaged over wheat variety in 2004.

Application time	Imazamox rate[1]	Yellow mustard injury[2]
	lb ai/A	%
2 to 3 tiller	0.047	16
	0.094	72
4 to 5 tiller	0.047	19
	0.094	57
LSD (0.05)		12

[1]Imazamox treatments were applied with 90% nonionic surfactant (R-11) at 0.25% v/v and 32% urea ammonium nitrate at 1 qt/A.
[2]June 15, 2004 evaluation.

Weed control with soil- and POST-applied herbicides in field pea. Gregory J. Endres and Blaine G. Schatz. (Carrington Research Extension Center, North Dakota State University, Carrington, ND 58421) Weed control and field pea response to selected soil- and POST-applied herbicides were evaluated in a randomized complete-block design with three replicates. The experiment was conducted on a Heimdahl loam soil with 8.0 pH and 3.3% organic matter at the NDSU Carrington Research Extension Center. The trial area was tilled with a disk followed by two passes with a Melroe culti-harrow on October 20, 2003. Herbicide treatments were applied to 5- by 25-ft plots with a pressurized hand-held plot sprayer at 18 gal/A and 30 psi through 8002 flat-fan nozzles. Fall sulfentrazone treatments were applied October 28 to a dry soil surface with 39 F, 66% RH, 25% clear sky, and 2 mph wind. Snowfall occurred 1 d following herbicide application. PPI treatments were applied on April 29 with 54 F, 86% RH, and 95% clear sky and immediately incorporated to a 2.5- to 3-inch depth using a roto-tiller. The trial area was cultivated twice on May 7 with a Melroe culti-harrow at a 2-inch depth prior to seeding, except fall treatments which were harrowed once at a 0.5- to 1-inch depth. On May 7, inoculated 'Integra' field pea was seeded in 7-inch rows at a pure live seed rate of 300,000 seeds/A. PRE treatments were applied to a dry soil surface on May 8 with 61 F, 49% RH, 20% clear sky, and 13 mph wind. Rainfall totaled 1.04 inches 1 wk following PRE application. POST treatments were applied on June 9 with 54 F, 63% RH, 35% clear sky, and 12 mph wind to 4- to 5-inch tall field pea, 2- to 3-leaf green and yellow foxtail, 0.5- to 2-inch tall common lambsquarters, 2-leaf (0.5- to 1-inch tall) hairy and eastern black nightshade, cotyledon- to 2-leaf (0.5-inch tall) prostrate and redroot pigweed, and 1-inch tall annual smartweed. Average plant density in untreated plots was estimated: field pea = 8 plants/ft^2, foxtail = 36 plants/ft^2, common lambsquarters = 3 plants/ft^2, nightshade = 6 plants/ft^2 and annual smartweed = 2 plants/ft^2. The trial was harvested with a plot combine on August 19.

Fall-applied sulfentrazone generally provided less broadleaf weed control compared to spring-applied sulfentrazone (Table 1). Fall-applied sulfentrazone at 0.25 lb/A did not improve broadleaf weed control compared to the lower rate. PRE sulfentrazone+imazethapyr provided excellent broadleaf weed control of 98-99%, while foxtail was suppressed at 65-72% and pea yield was less compared to the other sulfentrazone treatments (Table 2). Weed control was good to excellent with PPI pendimethalin followed by POST bentazon+sethoxydim+imazamox, 86-99%, and PPI pendimethalin&imazethapyr followed by POST bentazon+sethoxydim, 80-99%. PRE imzaethapyr+glyphosate provided 66-97% weed control, while PRE imazethapyr+pendimethalin provided at least 92% control of all weeds on August 13. Broadleaf weed control ranged from 32-76% with PRE thifesulfuron+glyphosate followed by POST sethoxydim. Imazamox at 0.023 lb/A provided similar weed control and pea yield compared to 0.031 lb/A. All POST imazamox+bentazon+sethoxydim treatments generally provided greater than 90% control of weeds except for common lambsquarters and resulted in similar yield. However, imazamox at 0.016 lb/A +bentazon at 1 lb/A +sethoxydim at 0.2 lb/A +MSO+UAN injured pea 12-18%. Fomesafen+sethoxydim suppressed broadleaf weeds, but severely injured pea 48-68% and reduced yield.

Table 1. Weed control in field pea, Carrington, 2004.

Treatment[1]	Application timing	Rate	7/9 Fox-tail spp.[2]	7/9 Common lambs-quarters	7/9 Night-shade spp.[2]	7/9 Pig-weed spp.[2]	7/9 Annual smart-weed	8/13 Fox-tail spp.	8/13 Common lambs-quarters	8/13 Night-shade spp.	8/13 Pig-weed spp.	8/13 Annual smart-weed
		lb ai/A	%									
Sulfentrazone/Sethoxydim+MSO	Fall/POST	0.188/0.2+2pt	98	92	77	81	68	96	89	73	77	68
Sulfentrazone/Sethoxydim+MSO	Fall/POST	0.25/0.2+2pt	97	85	87	80	53	96	80	73	82	68
Pendimethalin/Bentazon+ sethoxydim+imazamox+ MSO+UAN	PPI/ POST	1.5/ 1+0.2+0.16+1% v/v+2pt	98	96	99	96	93	98	89	95	97	86
Imazethapyr/Bentazon+ sethoxydim+MSO+UAN	PPI/ POST	0.031/ 1+0.2+2pt+2pt	98	76	96	85	96	88	73	75	86	91
Pendimethalin&imazethapyr/ Bentazon+sethoxydim+MSO+ UAN	PPI/ POST	0.5&0.033/ 1+0.2 +2pt+2pt	98	86	95	88	99	98	83	80	97	96
Imazethapyr+sulfentrazone	PRE	0.031+0.188	72	99	98	99	99	65	99	99	99	99
Imazethapyr+glyphosate	PRE	0.031+0.75(ae)	66	85	97	83	94	68	72	88	89	89
Imazethapyr+pendimethalin	PRE	0.031+1.5	91	96	98	94	81	92	96	93	96	95
Sulfentrazone/Sethoxydim+MSO	PRE/POST	0.188/0.2+2pt	96	98	98	96	83	96	99	83	96	84
Thifensulfuron+glyphosate+NIS/ Sethoxydim+MSO	PRE/ POST	0.008+0.75(ae)+0.25 %v/v / 0.2+2pt	96	47	67	60	32	97	48	65	68	40
Thifensulfuron+glyphosate+NIS/ Sethoxydim+MSO	PRE/ POST	0.014+0.75(ae)+0.25 %v/v / 0.2+2pt	97	47	68	58	48	97	40	69	76	47
Bentazon+sethoxydim+MSO+ UAN	POST	1+0.2+2pt+2pt	96	83	69	68	86	96	72	71	72	83
Imazethapyr+NIS	POST	0.031+0.25%	80	75	99	93	89	86	73	85	98	87
Imazamox+NIS	POST	0.031+0.25%	83	72	99	96	80	78	74	96	96	91
Imazamox+NIS	POST	0.023+0.25%	81	73	99	96	98	78	70	98	99	99
Imazamox+bentazon+sethoxydim +NIS+UAN	POST	0.031+0.188+0.038+ 0.25%v/v+2pt	94	86	99	99	89	91	81	99	98	99
Imazamox+bentazon+sethoxydim + MSO+UAN	POST	0.016+1+0.2+1%v/v +2pt	91	91	99	99	89	93	92	99	98	96
Imazamox+bentazon+sethoxydim +MSO+UAN	POST	0.016+0.5+0.1+1% v/v+2pt	90	89	96	96	89	91	87	98	97	86
Fomesafen+sethoxydim+COC	POST	0.19+0.2+0.5%v/v	99	68	97	83	63	94	40	78	83	61
Untreated	x	x	0	0	0	0	0	0	0	0	0	0
LSD (0.05)			4	12	17	4	24	8	14	11	10	14

[1]MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN; Pendimethalin=ProwlH$_2$0, BASF; UAN=urea ammonium nitrate; Pendimethalin&imazethapyr=Pursuit Plus, BASF; NIS=Preference, a nonionic surfactant from Agriliance; glyphosate=Roundup UltaMax (3.7 lb ae/gal), Monsanto; COC=Hi-Per-Oil, a petroleum-based oil from Agriliance.

[2]Foxtail spp.=Yellow and green; Nightshade spp.=hairy and eastern black; Pigweed spp.=Redroot and prostrate.

Table 2. Field pea response to herbicide treatments, Carrington, 2004.

Treatment[1]	Application timing	Rate	Stand	Crop injury 6/23	Crop injury 7/9	Seed yield
		lb ai/A	plants/A	-------- % --------		bu/A
Sulfentrazone/Sethoxydim+MSO	Fall/POST	0.188/0.2+2pt	285847	0	0	73.2
Sulfentrazone/Sethoxydim+MSO	Fall/POST	0.25/0.2+2pt	264345	0	0	76.1
Pendimethalin/ Bentazon+sethoxydim+imazamox+MSO+UAN	PPI/ POST	1.5/1+0.2+0.16+1%v/v+2pt	241578	0	0	76.9
Imazethapyr/Bentazon+sethoxydim+MSO+UAN	PPI/POST	0.031/1+0.2+2pt+2pt	221341	2	6	76.3
Pendimethalin&imazethapyr/ Bentazon+sethoxydim+MSO+UAN	PPI/ POST	0.5&0.033/1+0.2+2pt+2pt	244108	0	0	77.2
Imazethapyr+sulfentrazone	PRE	0.031+0.188	250432	0	0	57.3
Imazethapyr+glyphosate	PRE	0.031+0.75(ae)	254226	0	0	81.4
Imazethapyr+pendimethalin	PRE	0.031+1.5	250432	0	0	77.4
Sulfentrazone/Sethoxydim+MSO	PRE/POST	0.188/0.2+2pt	247902	0	0	78.2
Thifensulfuron+glyphosate+NIS/ Sethoxydim+MSO	PRE/ POST	0.008+0.75(ae)+0.25%v/v/ 0.2+2pt	217547	0	0	77.5
Thifensulfuron+glyphosate+NIS/ Sethoxydim+MSO	PRE/ POST	0.014+0.75(ae)+0.25%v/v/ 0.2+2pt	258021	0	0	75.6
Bentazon+sethoxydim+MSO+UAN	POST	1+0.2+2pt+2pt	266875	2	0	77.8
Imazethapyr+NIS	POST	0.031+0.25%	246638	0	0	85.1
Imazamox+NIS	POST	0.031+0.25%	268139	0	0	77.5
Imazamox+NIS	POST	0.023+0.25%	255491	0	0	69.0
Imazamox+bentazon+sethoxydim+NIS+UAN	POST	0.031+0.188+0.038+0.25%v/v+2pt	294700	0	0	72.6
Imazamox+bentazon+sethoxydim+MSO+UAN	POST	0.016+1+0.2+1%v/v+2pt	274463	18	12	68.4
Imazamox+bentazon+sethoxydim+MSO+UAN	POST	0.016+0.5+0.1+1%v/v+2pt	276993	7	8	72.7
Fomesafen+sethoxydim+COC	POST	0.19+0.2+0.5%v/v	254226	68	48	54.9
Untreated	x	x	264345	0	0	69.6
LSD (0.05)			NS	2	3	13.0

[1]MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN; Pendimethalin=ProwlH_2O, BASF; UAN=urea ammonium nitrate; Pendimethalin&imazethapyr=Pursuit Plus, BASF; NIS=Preference, a nonionic surfactant from Agriliance; glyphosate=Roundup UltaMax (3.7 lb ae/gal), Monsanto; COC=Hi-Per-Oil, a petroleum-based oil from Agriliance.

Tolerance of peppermint to granular and fertilizer impregnated herbicides. Richard Affeldt, Chuck Cole, Jed Colquhoun, and Carol Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR, 97331-3002) Applying a herbicide impregnated on a solid fertilizer can place the herbicide below a peppermint canopy and reduce crop injury. A trial was conducted in a grower's field to evaluate crop safety from granular flumioxazin applied at four timings and to compare it to herbicides impregnated on fertilizer. Plots were 8 by 25 ft with three replications arranged as randomized complete blocks. One flumioxazin treatment was sprayed in 20 gpa water and 20 psi at 3 mph. The granular and fertilizer treatments were applied with a hand spreader. The granular formulation was 0.17% flumioxazin and the fertilizer treatments were applied on 200 lb/A of 33-0-0. Application conditions and crop stages are presented in Table 1. Peppermint fresh weight was obtained by hand-harvesting three 1-sq yd quadrats of peppermint in each plot on August 9. Samples were air dried and oil yield was obtained through steam distillation.

Table 1. Herbicide application information in Linn County, Oregon, 2004.

Location	Millersburg, Oregon			
Application date	March 4	April 6	May 13	June 3
Peppermint height	0.5 inch	4 inch	10 inch	20 inch
Air temperature (F)	53	67	79	86
Relative humidity (%)	65	53	38	65
Wind velocity (mph)	5	0	0	0
Dew present	no	no	no	no
Soil temperature (F)	50	61	70	72
Soil moisture	slightly muddy	dry	dry	moist
Soil texture	silty clay loam			
Soil pH	5.8			
Soil OM (%)	3.4			

Granular flumioxazin applied in March was less injurious than flumioxazin sprayed with water as a carrier (Table 2). Peppermint crop safety was greater with impregnated fertilizer than with granular flumioxazin applied in May. Sulfentrazone impregnated on fertilizer also was very safe. There was no treatment effect on peppermint hay fresh weight or oil yield.

Table 2. Peppermint injury, fresh hay weight, and oil yield in western Oregon, 2004.

			Peppermint Injury						
Treatment	Rate	Application timing	April 2	May 21	June 3	June 11	July 16	Fresh wt	Oil yield
	lb ai/A		% injury					lb/3 sq yd	lb/A
Untreated check	0	---	0	0	0	0	0	19	69
Flumioxazin spray	0.125	March	27	0	0	0	0	22	79
Flumioxazin granule	0.125	March	2	0	0	0	0	25	95
Flumioxazin granule	0.125	April	---	17	0	0	0	21	79
Flumioxazin granule	0.125	May	---	33	15	0	0	21	94
Flumioxazin fertilizer	0.125	May	---	23	3	0	0	21	88
Sulfentrazone fertilizer	0.25	May	---	20	0	0	0	20	82
Oxyfluorfen fertilizer	0.25	May	---	17	0	0	0	20	80
Flumioxazin granule	0.125	June	---	---	---	15	0	19	78
LSD (0.05)			8	11	5	NS	NS	NS	NS

Weed management strategies in imidazolinone-resistant sunflower. Gregory J. Endres and Blaine G. Schatz. (Carrington Research Extension Center, North Dakota State University, Carrington, ND 58421) Weed control and crop response were investigated with selected PRE and POST herbicides in imidazolinone-resistant (Clearfield^{TM}) sunflower. The trial had a randomized complete block design with three replicates. The experiment was conducted on a loam soil with 8.0 pH and 3.3% organic matter at the NDSU Carrington Research Extension Center. The trial area was tilled with a disk followed by two passes with a Melroe culti-harrow on October 20, 2003. Herbicide treatments were applied to 10 by 25 ft plots with a CO_2 pressurized hand-held plot sprayer. Fall sulfentrazone treatments were applied October 28 at 18 gal/A and 30 psi through 8002 flat fan nozzles on a dry soil surface with 39 F, 66% RH, 25% clear sky, and 2 mph wind. Snowfall occurred 1 d following herbicide application. Seeds 2000 'Viper' was planted in 30-inch rows without any prior spring tillage on May 28, 2004 and hand-thinned to 20,000 plants/A on June 25. Growing-season herbicide treatments were applied at 10 gal/A and 30 psi through 8001 flat fan nozzles. PRE treatments were applied on a dry soil surface on May 28 with 73 F, 44% RH, 75% clear sky, and 16 mph wind. Glyphosate at 0.75 ae/A was applied across the trial on May 28. Rainfall totaled 2.27 inches during May 29 to 30. POST treatments were applied on July 3 with 69 F, 82% RH, 100% cloudy sky, and 7 mph wind to V6- to V8-stage sunflower, tillering green and yellow foxtail, and 2- to 12-inch tall common lambsquarters, 1- to 3-inch tall hairy and Eastern black nightshade, 1- to 3-inch tall prostrate and redroot pigweed, and 1- to 10-inch tall annual smartweed. Late POST treatments were applied on July 9 with 59 F, 90% RH, clear sky, and 8 mph wind to V8-stage sunflower, 6-inch tall green and yellow foxtail, and 6- to 12-inch tall common lambsquarters, 2- to 4-inch tall hairy and Eastern black nightshade, 2- to 8-inch tall prostrate and redroot pigweed, and 6- to 12-inch tall annual smartweed. Weed densities on July 8 were: foxtail = 46 plants/ft^2, common lambsquarters = 1 plant/ft^2, nightshade = 4 plants/ft^2, and annual smartweed = 14 plants/ft^2. The trial was hand harvested and seeds threshed with a plot combine on November 3.

With the exception of common lambsquarters, broadleaf weed control was poor (0-60%) with fall- or spring-applied sulfentrazone (Table 1) and yield was reduced compared to treatments that included imazamox (Table 2). POST Imazamox following sulfentrazone, pendimethalin, or the combination provided 80 to 99% control of all weeds, except annual smartweed (74-86%). Imazamox + MSO improved control of foxtail and smartweed compared to NIS with the POST but not the LPOST application timing. Weed control tended to improve with the POST vs. LPOST application timing, especially when visually evaluated two wk after application. Height reduction generally occurred with treatments that included imazamox, but the generally adequate weed control contributed to highest yields in the trial.

Table 1. Weed control in imidazolinone-resistant sunflower, Carrington, ND, 2004.

Herbicide[1]			2 wk after POST application					4 wk after POST application				
Treatment	Rate	Timing	fota[2]	colq[3]	nish[4]	piwe[5]	smwe[6]	fota	colq	nish	piwe	smwe
	ai/A		% control									
untreated check	x	x	0	0	0	0	0	0	0	0	0	0
Sulfentrazone/ Sethoxydim+MSO	0.188/0.2	Fall/ POST	74	88	56	40	40	88	81	37	13	0
Sulfentrazone/ Sethoxydim+MSO	0.25/0.2	Fall/ POST	76	87	60	40	42	89	86	50	13	0
Sulfentrazone/ Sethoxydim+MSO	0.188/0.2	PRE/ POST	76	50	60	40	27	88	48	35	13	0
Sulfentrazone/ Imazamox+NIS	0.094/ 0.031	PRE/ POST	80	82	99	99	82	92	85	98	99	80
Pendimethalin/ Imazamox+NIS	1.3/0.031	PRE/ POST	90	83	99	99	74	96	86	99	99	74
Pendimethalin/ Imazamox+MSO	1.3/0.031	PRE/ POST	94	96	99	99	84	98	97	99	99	79
Pendimethalin+ sulfentrazone/ Imazamox+MSO	1.3+0.094/0 .031	PRE/ POST	94	94	99	99	86	97	88	99	99	83
Imazamox+NIS	0.031	POST	77	75	93	99	77	88	74	91	99	72
Imazamox+MSO	0.031	POST	86	85	96	99	91	97	83	99	99	83
Imazamox+NIS	0.031	LPOST	69	72	75	77	73	72	68	76	92	72
Pendimethalin/ Imazamox+NIS	1.3/0.031	PRE/ LPOST	73	73	90	82	70	77	72	93	95	69
Imazamox+MSO	0.031	LPOST	72	71	82	87	72	76	76	86	92	73
Pendimethalin/ Imazamox+MSO	1.3/0.031	PRE/ LPOST	76	77	86	85	70	82	80	95	99	70
LSD (0.05)			7	15	13	6	13	4	14	22	17	10

[1]Treatments: MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN, at 32 fl oz/A with sethoxydim and 1% v/v with imazamox; NIS=Preference, a nonionic surfactant from Agriliance, at 0.25% v/v. All imazamox treatments include UAN at 2.5% v/v. Timing: Fall=October 28, 2003; PRE=May 28, 2004; POST=July 3; LPOST=July 9.

[2]fota=green and yellow foxtail.

[3]colq=commom lambsquarters.

[4]nish=hairy and Eastern black nightshade.

[5]piwe=prostrate and redroot pigweed.

[6]smwe=annual smartweed.

Table 2. Imidazolinone-resistant sunflower response to herbicides, Carrington, ND, 2004.

Herbicide[1]			Plant stunting[2]		Seed
Treatment	Rate	Timing	2 WAA	4 WAA	yield
	ai/A		—— % ——		lb/A
untreated check	x	x	0	0	481
Sulfentrazone/Sethoxydim+MSO	0.188/0.2	Fall/POST	3	0	961
Sulfentrazone/Sethoxydim+MSO	0.25/0.2	Fall/POST	0	0	850
Sulfentrazone/Sethoxydim+MSO	0.188/0.2	PRE/POST	0	0	796
Sulfentrazone/Imazamox+NIS	0.094/0.031	PRE/POST	19	6	1324
Pendimethalin/Imazamox+NIS	1.3/0.031	PRE/POST	18	14	1328
Pendimethalin/Imazamox+MSO	1.3/0.031	PRE/POST	14	16	1451
Pendimethalin+sulfentrazone/Imazamox+MSO	1.3+0.094/0.031	PRE/POST	16	12	1193
Imazamox+NIS	0.031	POST	18	9	1403
Imazamox+MSO	0.031	POST	19	11	1381
Imazamox+NIS	0.031	LPOST	15	3	1315
Pendimethalin/Imazamox+NIS	1.3/0.031	PRE/LPOST	0	0	1398
Imazamox+MSO	0.031	LPOST	17	10	1304
Pendimethalin/Imazamox+MSO	1.3/0.031	PRE/LPOST	0	0	1297
LSD (0.05)			8	10	336

[1]Treatments: MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN, at 32 fl oz/A with sethoxydim and 1% v/v with imazamox; NIS=Preference, a nonionic surfactant from Agriliance, at 0.25% v/v. All imazamox treatments include UAN at 2.5% v/v. Timing: Fall=October 28, 2003; PRE=May 28, 2004; POST=July 3; LPOST=July 9.
[2]WAA= wk after POST application.

Annual bluegrass control in carbon-seeded perennial ryegrass. Chuck Cole, Richard Affeldt, Carol Mallory-Smith, and Jed Colquhoun. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Three trials were conducted to evaluate soil-applied herbicides as diuron supplements for the control of annual bluegrass in carbon-seeded perennial ryegrass. Two sites were in growers' fields located in Tangent and Shedd and were infested with annual bluegrass that was purportedly diuron-resistant. A third site was located at the OSU Hyslop Research Farm near Corvallis and was infested with non-resistant annual bluegrass. Activated carbon was applied over the seed row in a 1-inch-wide band at 300 lb/A during the planting process for each trial. Treatments were applied to 8 ft by 25 ft plots with a single-wheel compressed air sprayer calibrated to deliver 20 gpa. The experimental design was a randomized complete block with four replications. Herbicide application and site conditions are presented in Table 1. Annual bluegrass control and perennial ryegrass injury were evaluated visually. The perennial ryegrass was swathed and then machine-threshed with a small-plot combine. Perennial ryegrass seed was cleaned with an air screen machine prior to weighing and yield calculations.

Table 1. Agronomic, application, and soil data for three trial sites in western Oregon.

	Corvallis	Tangent	Shedd
Planting date	October 2, 2003	October 10, 2003	October 13, 2003
Swathing date	June 30, 2004	July 10, 2004	July 10, 2004
Treatment application			
Application date	October 7, 2003	October 10, 2003	October 15, 2003
Air temperature (F)	68	72	50
Soil temperature (F)	72	62	48
Relative humidity (%)	65	65	100
Cloud cover (%)	50	50	100
Wind speed (mph)	4	4	3
Soil			
pH	5.5	5.7	7.0
Organic matter (%)	2.1	2.4	3.1
Soil series, texture	Woodburn silt loam	Dayton silt loam	Dayton silt loam

Residual annual bluegrass control was improved at the Corvallis and Tangent locations with the addition of sulfentrazone, norflurazon, or pronamide to diuron applied at 1.6 lb ai/A compared to diuron applied alone at 2.4 lb ai/A (Table 2). Flufenacet applied alone provided good annual bluegrass control through January at each location.

Table 2. Annual bluegrass control in perennial ryegrass at three sites in western Oregon.

		Annual bluegrass control					
		Corvallis		Tangent		Shedd	
Treatment	Rate	Oct. 23	Dec. 8	Dec. 9	Jan. 27	Dec. 2	Jan. 16
	lb a.i./A	%					
Untreated check	0	0	0	0	0	0	0
Diuron	2.4	95	96	44	53	99	94
Diuron	1.6	81	63	51	35	99	96
Flufenacet	0.2	94	97	94	95	99	98
Diuron + sulfentrazone	1.6 + 0.5	96	98	92	78	98	97
Diuron + pronamide	1.6 + 0.25	93	95	97	97	99	98
Diuron + norflurazon	1.6 + 1.96	95	98	94	94	99	98
LSD (0.05)		19	18	25	10	1	4

Visible perennial ryegrass injury consisting of moderate chlorosis and stand-thinning in plots treated with diuron plus norflurazon was evident at all three locations (Table 3). Flufenacet applied alone thinned the perennial ryegrass stand at the Tangent location. Sulfentrazone and pronamide applied with diuron were more injurious at Tangent than at Corvallis or Shedd. No treatment resulted in significant clean seed yield losses (data not shown).

Table 3. Perennial ryegrass injury at three sites in western Oregon.

		Perennial ryegrass injury					
		Corvallis		Tangent		Shedd	
Treatment	Rate	Oct. 23	Dec. 8	Dec. 9	Jan. 27	Dec. 2	Jan. 16
	lb a.i./A	%					
Untreated check	0	0	0	0	0	0	0
Diuron	2.4	0	3	8	0	0	0
Diuron	1.6	0	0	5	0	0	0
Flufenacet	0.2	0	4	20	10	0	5
Diuron + sulfentrazone	1.6 + 0.5	0	3	18	20	3	5
Diuron + pronamide	1.6 + 0.25	0	1	23	16	3	0
Diuron + norflurazon	1.6 + 1.96	16	19	33	15	4	13
LSD (0.05)		10	9	10	5	4	5

Imazamox/MCPA plus adjuvants affect spring wheat injury and grain yield. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, Idaho 83844-2339) An experiment was established at the University of Idaho farm near Moscow, Idaho to determine the effect of adjuvants plus imazamox/MCPA on imi-tolerant spring wheat. Treatments were applied with a CO_2 pressurized backpack sprayer delivering 10 gpa at 3 mph and 32 psi (Table 1). Soil pH, organic matter, CEC and texture were 4.8, 2.6%, 14 cmol/kg, and loam, respectively. The experimental design was a randomized complete block with four replications and 8 by 30 ft experimental units. Crop injury was evaluated visually on May 18 and June 7 and wheat grain was harvested at maturity.

Table 1. Environmental conditions at the time of application.

Application date	May 10, 2004	May 18, 2004
Wheat stage	2 to 3 leaves	2 to 3 tillers
Air temperature (F)	40	58
Soil temperature (F)	44	45
Relative humidity (%)	60	85
Wind velocity	0	3 mph, west
Cloud cover (%)	100	100
Soil moisture	Dry	Moist

Wheat injury was more evident on June 7 than May 18 for most treatments (Table 2). On June 7, injury was more severe when applications were made at the 2 to 3 tiller stage (15%) compared to the 2 to 3 leaf stage (6%) of growth when averaged across treatments. Injury was most severe with imazamox+methylated seed oil+UAN (urea ammonium nitrate) (46%) applied at the 2 to 3 leaf stage. All high rates of imazamox and imazamox/MCPA applied with methylated seed oil injured wheat. Wheat was also injured with imazamox/MCPA+nonionic surfactant+UAN (0.844 lb ai/a+0.25%v/v+2.5% v/v) applied at the 2 to 3 tiller stage of growth. Wheat grain yield was reduced compared to the untreated check for all treatments showing visual injury. Wheat test weight was not affected.

Table 2. Imazamox/MCPA plus adjuvants affect spring wheat injury and grain yield.

Treatment	Rate	Application time	Wheat injury		Wheat grain	
			May 18	June 7	Yield	Test weight
			-------- % --------		lb/a	lb/bu
Untreated	-	-	-	-	2019	60
Imazamox/MCPA + nonionic surfactant + urea ammonium nitrate	0.562 lb ai/a 0.25% v/v 2.5% v/v	2 to 3 leaves	1	2	1634	58
Imazamox/MCPA + methylated seed oil + urea ammonium nitrate	0.562 lb ai/a 1 % v/v 2.5% v/v	2 to 3 leaves	1	1	1882	60
Imazamox/MCPA + nonionic surfactant + urea ammonium nitrate	0.844 lb ai/a 0.25% v/v 2.5% v/v	2 to 3 leaves	5	4	1863	59
Imazamox/MCPA + methylated seed oil + urea ammonium nitrate	0.844 lb ai/a 1 % v/v 2.5% v/v	2 to 3 leaves	6	11	1599	59
Imazamox + nonionic surfactant + urea ammonium nitrate	0.0937 lb ai/a 0.25% v/v 2.5% v/v	2 to 3 leaves	2	0	1906	60
Imazamox + methylated seed oil + urea ammonium nitrate	0.0937 lb ai/a 1 % v/v 2.5% v/v	2 to 3 leaves	5	18	1707	60
Imazamox/MCPA + nonionic surfactant + urea ammonium nitrate	0.562 lb ai/a 0.25% v/v 2.5% v/v	2 to 3 tillers	0	2	2042	60
Imazamox/MCPA + methylated seed oil + urea ammonium nitrate	0.562 lb ai/a 1 % v/v 2.5% v/v	2 to 3 tillers	0	0	1751	59
Imazamox/MCPA + nonionic surfactant + urea ammonium nitrate	0.844 lb ai/a 0.25% v/v 2.5% v/v	2 to 3 tillers	0	15	1598	58
Imazamox/MCPA + methylated seed oil + urea ammonium nitrate	0.844 lb ai/a 1 % v/v 2.5% v/v	2 to 3 tillers	0	28	1578	59
Imazamox + nonionic surfactant + urea ammonium nitrate	0.0937 lb ai/a 0.25% v/v 2.5% v/v	2 to 3 tillers	0	1	1909	60
Imazamox + methylated seed oil + urea ammonium nitrate	0.0937 lb ai/a 1 % v/v 2.5% v/v	2 to 3 tillers	15	46	1206	58
LSD (0.05)			NS	10	288	NS

Yellow foxtail control with flucarbazone. Kirk A. Howatt, Ronald F. Roach, Janet D. Harrington. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105-5051) An experiment was established to determine the best adjuvant system to maximize control of yellow foxtail with flucarbazone. 'Alsen' hard red spring wheat was seeded May 4. Treatments were applied to 1- to 2-leaf yellow foxtail on June 10 with 60 F air temperature, 72% relative humidity, 100% cloud cover, 7 mph east wind, and 58 F soil temperature at 4 inches. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through TT 11001 flat-fan nozzles to an area 7 ft wide and the length of 10- by 30-ft plots. The experiment had a randomized complete-block design with four replicates. Yellow foxtail population was estimated to be 75 plants per ft^2.

Flucarbazone or fenoxaprop tank-mixes did not cause observable injury to wheat. Flucarbazone at 0.42 oz/A generally provided greater yellow foxtail control than flucarbazone at 0.28 oz/A during July evaluations. The addition of non-ionic surfactant (NIS) or methylated seed oil (MSO) alone initially increased foxtail control with flucarbazone at 0.28 oz to 58%, which was similar to flucarbazone at 0.42 oz with either of these adjuvants. By July 27, improved foxtail control from the addition of NIS or MSO alone with flucarbazone was not visible. Diammonium sulfate solution (AMS) increased foxtail control with flucarbazone and MSO an average of 33 percentage points on July 27, resulting in 85% foxtail control with 0.42 oz flucarbazone. Bromoxynil and MCPA or 2,4-D formulations likely provided adjuvant properties that resulted in better foxtail control with flucarbazone than flucarbazone alone or with NIS, but control was 75% and 65%, respectively on July 27, which was less than the 85% control with 0.42 oz flucarbazone plus MSO and AMS. Fenoxaprop alone provided greater than 90% yellow foxtail control. Bromoxynil and MCPA or thifensulfuron plus MCPA antagonized control of foxtail with fenoxaprop, resulting in control with fenoxaprop tank-mixes on June 24 of 76% to 79% compared to 91% with fenoxaprop alone. By July 2, fenoxaprop provided 98% control of wild oat, while fenoxaprop tank-mixes gave 83% to 88% control. Only thifensulfuron plus MCPA resulted in antagonism of fenoxaprop on July 27.

Table. Yellow foxtail control with flucarbazone near Fargo, ND, in 2004.

		June 24		July 02	July 27
Treatment[1]	Rate[2]	Wheat	Yellow foxtail	Yellow foxtail	Yellow foxtail
	oz ai/A	%	%	%	%
Flucarbazone	0.28	0	40	45	30
Flucarbazone	0.42	0	50	55	50
Flucarbazone + NIS	0.28 + 0.25%	0	58	50	40
Flucarbazone + NIS	0.42 + 0.25%	0	58	64	48
Flucarbazone + MSO	0.28 + 0.19G	0	58	63	38
Flucarbazone + MSO	0.42 + 0.19G	0	50	63	48
Flucarbazone + NIS + AMS	0.28 + 0.25% + 1G	0	45	38	35
Flucarbazone + NIS + AMS	0.42 + 0.25% + 1G	0	75	80	74
Flucarbazone + MSO + AMS	0.28 + 0.19G + 1G	0	69	75	68
Flucarbazone + MSO + AMS	0.42 + 0.19G + 1G	0	70	80	85
Flucarbazone + bromoxynil/MCPA + NIS	0.42 + 8 + 0.25%	0	80	83	75
Flucarbazone + thifensulfuron + 2,4-D	0.42 + 0.225 + 6	0	68	81	65
Fenoxaprop	0.8	0	91	98	97
Fenoxaprop + bromoxynil/MCPA	0.8 + 8	0	76	83	90
Fenoxaprop + thifensulfuron + MCPA	0.8 + 0.225 + 8	0	79	88	86
Untreated	0	0	0	0	0
CV		0	11	10	13
LSD (P=0.05)		0	10	9	10

[1] NIS = nonionic surfactant, Activator 90 from Loveland Industries, Greeley, CO 80632; MSO = methylated seed oil, Scoil from AGSCO, Grand Forks, ND 58208; and AMS = diammonium sulfate solution from Agriliance LLC, St. Paul, MN 55164.

[2] MCPA and 2,4-D rates expressed in ae; % = % vol/vol; and G = gallons per acre.

Evaluation of herbicides for wild oat control in spring wheat. Ralph E. Whitesides and Ruth Richards. (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820) Rick spring wheat was planted April 12, 2004 on the Don Jeppson farm in Wellsville, UT. Herbicide treatments, including combinations of fenoxaprop, fluroxypyr, tralkoxydim, bromoxynil/MCPA, and mesosulfuron-methyl were applied to evaluate wild oat (AVEFA) control. Individual treatments were applied to 10 by 30 foot plots with a CO_2 sprayer using Turbojet 015 nozzles calibrated to deliver 25 gpa at 40 psi. The soil was a Center Creek silt loam with 7.8 pH and O.M. content of less than 3%. Treatments were applied postemergence May 26, in a randomized block design, with three replications. Wheat ranged in size from 5 to 6 inches tall. Wild oat averaged 2 to 4 inches tall with 2 to 3 leaves. Visual evaluations for crop injury and weed control were completed June 18, and July 16. Plots were harvested September 24, 2004.

There was no injury to wheat with any treatment. Wild oat control was excellent for all treatments except fenoxaprop alone and the talkoxydim tank mix. Fenoxaprop tank mixed with thifensulfuron+fluroxypyr or fluroxypyr+MCPA provided the best control of wild oats in the June evaluation. All treatments but the fenoxaprop alone and the talkoxydim tank mix improved control to nearly 100 percent by July. Yields were not significantly different but the fenoxaprop tank mixed with thifensulfuron + fluroxypyr did give the highest yield.

Table. Evaluation of wild oat control in spring wheat.

		Wheat			Weed control	
		Injury		Yield	AVEFA	
Treatment	Rate	6/18	7/16	9/24	6/18	7/16
	lbai/A	-------%-------		Bu/A	--------%--------	
Untreated		0	0	27	0	0
Fenoxaprop[a]	0.08	0	0	21	77	67
Fenoxaprop + bromoxynil/MCPA[a]	0.08+0.5	0	0	31	78	100
Fenoxaprop + bromoxynil/MCPA[a] + fluroxypyr	0.08+0.375 +0.062	0	0	26	80	100
Fenoxaprop + bromoxynil/MCPA[a] + thifensulfuron	0.08+0.375 +0.0047	0	0	29	73	100
Fenoxaprop + thifensulfuron + fluroxypyr	0.08+0.014 +0.062	0	0	33	88	100
Fenoxaprop + fluroxypyr + MCPA	0.08+0.062+0.347	0	0	27	88	100
Fenoxaprop + MCPA + thifensulfuron	0.08+0.347+0.014	0	0	29	83	100
Fenoxaprop + MCPA + thifensulfuron/tribenuron	0.08+0.347 +0.014	0	0	29	68	100
Fenoxaprop + bromoxynil + thifensulfuron/tribenuron	0.08+0.25 +0.014	0	0	31	81	100
Fenoxaprop + bromoxynil + thifensulfuron	0.08+0.25 +0.014	0	0	28	82	100
Fenoxaprop + bromoxynil/MCPA[a]	0.08+0.375	0	0	29	83	97
Tralkoxydim[b] + bromoxynil/MCPA + fluroxypyr	0.2+0.5 +0.062	0	0	30	80	67
Mesosulfuron-Methyl[c]+ Mesosulfuron	0.009+0.0002	0	0	27	72	100
$LSD_{(0.05)}$				NS	9	18

[a] Bromoxynil+MCPA was a commercial premix Bronate Advanced containing both octanoic and heptanoic formulations of bromoxynil.
[b] Supercharge 0.5% v/v added.
[c] NIS at 0.5 %V/V + N at 2 qt/A added.

Wild oat control in spring wheat. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, Idaho 83844-2339) Two experiments were established near Princeton and Moscow, Idaho to determine wild oat control in spring wheat. Treatments were applied with a CO_2 pressurized backpack sprayer delivering 10 gpa at 3 mph and 32 psi (Table 1). The experimental design was a randomized complete block with four replications and 8 by 30 ft experimental units. Wheat injury and wild oat control were evaluated visually on May 31 and June 29 at Moscow and June 24 and August 3 at Princeton. Wheat grain was harvested at maturity.

Table 1. Environmental information at the time of application.

Location	Princeton, Idaho	University of Idaho farm, Moscow, Idaho
Application date	May 31, 2004	May 25, 2004
Wheat	4 leaves to 1 tiller	2 to 4 leaves
Wild oat	3 leaves to 1 tiller, 7 plants/ft^2	2 to 4 leaves, 9 plants/ft^2
Air temperature (F)	62	71
Soil temperature at 3 inch (F)	51	59
Relative humidity (%)	67	65
Soil pH	4.5	5.2
Soil organic matter (%)	3.5	2.7
Soil CEC (cmol/kg)	15	20
Soil texture	Silt loam	Silt loam

At Princeton, flucarbazone+nonionic surfactant injured wheat 8 and 9%, but wheat injury with flucarbazone+ bromoxynil/MCPA was not statistically different from fenoxyprop (Table 2). By August 3, wheat injury was not evident in some of the replications and wheat injury was not statistically different among treatments. Wild oat control ranged from 97 to 99% on June 24 and control did not vary among treatments. By August 3, the wild oat was fully headed and control was lower with flucarbazone + nonionic surfactant treatments (82 and 85%) compared to the other treatments (91 to 94%). Wheat grain yield was higher than the untreated control with all treatments except flucarbazone + bromoxynil/MCPA (0.0268+0.375 lb ai/a). Test weight did not vary among treatments.

At Moscow, wheat treated with fenoxaprop was chlorotic on May 31, but wheat injury was not evident in any treatments by August 3 (Table 3). Wild oat control ranged from 91 to 98% and control did not differ among treatments. Wheat grain yield was higher with all treatments compared to the untreated check and test weight did not vary among treatments.

Table 2. Wild oat control in spring wheat with flucarbazone near Princeton, Idaho.

		Wheat injury		Wild oat control		Wheat grain	
Treatment	Rate	June 24	August 3	June 24	August 3	Yield	Test weight
		%				lb/a	lb/bu
Untreated	-	-	-	-	-	4092	55
Flucarbazone+ nonionic surfactant	0.0179 lb ai/a 0.25% v/v	8	5	97	82	5367	57
Flucarbazone+ nonionic surfactant	0.0268 lb ai/a 0.25% v/v	9	9	97	85	5069	56
Flucarbazone+ bromoxynil/MCPA	0.0179 lb ai/a 0.375 lb ai/a	1	1	97	91	5174	59
Flucarbazone+ bromoxynil/MCPA	0.0268 lb ai/a 0.375 lb ai/a	4	8	99	94	4720	56
Fenoxaprop/safener+ bromoxynil/MCPA	0.08 lb ai/a 0.375 lb ai/a	0	0	99	94	4991	56
LSD (0.05)		5	NS	NS	5	699	NS

Table 3. Wild oat control with clodinafop in spring wheat near Moscow, Idaho.

Treatment	Rate	Wheat injury	Wild oat control	Wheat grain yield	Wheat test weight
		--------- % --------		lb/a	lb/bu
Untreated		-	-	2539	58
Clodinafop	0.05 lb ai/a	1	96	4181	58
Clodinafop +	0.05 lb ai/a	0	96	3917	58
thifensulfuron/tribenuron +	0.0156 lb ai/a				
nonionic surfactant	0.25%v/v				
Clodinafop	0.062 lb ai/a	0	98	4235	59
Clodinafop +	0.062 lb ai/a	0	94	3822	58
thifensulfuron/tribenuron +	0.0156 lb ai/a				
nonionic surfactant	0.25%v/v				
Fenoxaprop	0.08 lb ai/a	4	97	4039	59
Fenoxaprop +	0.08 lb ai/a	0	98	3967	59
thifensulfuron/tribenuron +	0.0156 lb ai/a				
nonionic surfactant	0.25%v/v				
Flucarbazone +	0.027 lb ai/a	0	91	3701	59
nonionic surfactant	0.25%v/v				
Flucarbazone +	0.027 lb ai/a	1	92	3759	59
thifensulfuron/tribenuron +	0.0156 lb ai/a				
nonionic surfactant	0.25%v/v				
Mesosulfuron +	0.0089 lb ai/a	1	95	3712	61
modified seed oil	1%v/v				
LSD (0.05)		2	NS	365	NS

Wild oat and broadleaf weed control with fenoxaprop tank mixed with broadleaf herbicides. Robyn C. Walton, Don W. Morishita, and Michael P. Quinn. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A study was conducted in Minidoka county, Idaho to evaluate wild oat (AVEFA) and broadleaf weed control with fenoxaprop tank mixed with broadleaf herbicides in spring wheat. 'WB 936R' was planted April 1, 2004, at 100 lb/A. Experimental design was a randomized complete block with four replications and individual plots were 8 by 25 ft. Soil type was a silt loam (29% sand, 60% silt, and 11% clay) with a pH of 8.0, 1.96% organic matter, and CEC of 15.7-meq/100 g soil. Herbicides were applied May 13, using a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 25 psi. Environmental conditions at application were as follows: air temperature 64 F, soil temperature 56 F, relative humidity 36%, wind speed 4 mph, and 75% cloud cover. Crop injury was evaluated visually on May 12, June 3, and July 7, which was 8, 21, and 55 days after treatment (DAT), respectively. Wild oat and broadleaf weed control were evaluated July 7. Grain was harvested August 30 with a small-plot combine.

Crop injury with mesosulfuron ranged from 18 to 23% 8 DAT, and was highest among all herbicide treatments (Table). Fenoxaprop tank mixed with bromoxynil & MCPA + tribenuron, thifensulfuron + MCPA, and thifensulfuron & tribenuron also injured the crop 8 to 9%. Crop injury 21 DAT ranged from 8 to 11% with both mesosulfuron treatments. By 55 DAT, mesosulfuron injury levels had declined to 5 and 6%, but were still higher than any other treatment. All treatments except mesosulfuron-1 + mesosulfuron-2 controlled wild oat 98 to 100%. Broadleaf weed populations in this study consisted of kochia, redroot pigweed, common lambsquarters, and hairy nightshade. Unfortunately, the densities of these weeds were too low to evaluate individually. Thus, broadleaf weed control ratings are based on the overall average. Fenoxaprop + thifensulfuron + MCPA LVE at 0.0825 + 0.014 + 0.347 lb ai/A had the lowest broadleaf weed control at 83%. Other treatments containing fenoxaprop + thifensulfuron or thifensulfuron & tribenuron also had lower broadleaf weed control ratings ranging from 89 to 92%. This reduction in control was not reflected in test weight or grain yield as there were no differences among treatments.

Table. Crop injury, weed control, and grain yield with fenoxaprop and broadleaf herbicides near Paul, Idaho.

Treatment[2]	Application rate	Crop injury			Weed control[1]		Grain	
		5/21	6/3	7/7	AVEFA	broadleaf	test wt.	yield
	lb ai/A	------------------%------------------			-----------%-----------		lb/bu	bu/A
Check	-	-	-	-	-	-	62	132
Fenoxaprop	0.0825	5	0	3	100	100	62	117
Fenoxaprop + bromoxynil & MCPA	0.0825 + 0.5	4	0	1	98	100	62	130
Fenoxaprop + bromoxynil & MCPA + fluroxypyr	0.0825 + 0.375 + 0.062	4	0	0	100	100	61	125
Fenoxaprop + bromoxynil & MCPA + thifensulfuron	0.0825 + 0.375 + 0.0047	8	0	1	100	100	61	126
Fenoxaprop + fluroxypyr + thifensulfuron	0.0825 + 0.062 + 0.014	6	3	1	100	100	61	125
Fenoxaprop + fluroxypyr + MCPA LVE	0.0825 + 0.062 + 0.347	5	0	3	100	99	62	130
Fenoxaprop + thifensulfuron + MCPA LVE	0.0825 + 0.014 + 0.347	9	1	4	100	83	61	124
Fenoxaprop + thifensulfuron & tribenuron + MCPA LVE	0.0825 + 0.014 + 0.347	6	3	5	100	89	61	122
Fenoxaprop + thifensulfuron & tribenuron +	0.0825 + 0.014 +	8	0	1	99	92	62	131
Fenoxaprop + thifensulfuron	0.0825 + 0.014	6	1	1	100	92	62	131
Fenoxaprop + bromoxynil & MCPA	0.0825 + 0.375	5	0	0	99	99	62	121
Tralkoxydim + bromoxynil & MCPA + fluroxypyr + Supercharge + Bronc	0.208 + 0.5 + 0.062 + 0.5% v/v + 1.5	1	1	1	100	100	62	128
Mesosulfuron-1 + mesosulfuron-2 + nonionic surfactant + UAN	0.0045 + 0.00219 + 0.5% v/v + 2 qt/A	18	8	5	88	100	61	126
Mesosulfuron-1 + nonionic surfactant + UAN	0.009 + 0.5% v/v + 2 qt/A	23	11	6	99	100	61	123
LSD (0.05)		4	3	4	6	8	ns	ns

[1]Weeds evaluated for control were wild oat (AVEFA) and broadleaf weeds consisted of kochia, redroot pigweed, common lambsquarters and hairy nightshade.

[2]UAN is a 28% urea ammonium nitrate solution. Supercharge is a proprietary adjuvant. Bronc is a 38% ammonium sulfate solution. Mesosulfuron-1 is Osprey and mesosulfuron-2 is Silverado.

Italian ryegrass control in wheat with imazamox/MCPA. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Four studies were established near Genesee, Idaho in imidazolinone-tolerant wheat to evaluate Italian ryegrass and wheat response with 1) imazamox/MCPA and imazamox in 'Clearfirst' winter wheat, 2) imazamox/MCPA alone or combined with 3) pendimethalin or 4) broadleaf herbicides in Clearfield spring wheat. 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). The winter wheat study was oversprayed with clopyralid/MCPA at 0.60 lb ae/A on May 14, 2004 to control broadleaf weeds. Wheat injury and weed control were evaluated visually. Wheat seed was harvested with a small plot combine at the winter wheat site on August 11 and the spring wheat site on August 30, 2004.

Table 1. Application and soil data.

Study	Imazamox/MCPA in winter wheat		Imazamox/MCPA in spring wheat	Imazamox/MCPA with pendimethalin	Imazamox/MCPA with broadleaf herbicides
Application date	10/9/04	4/28/04	5/13/04	5/13/04	5/13/04
Growth stage					
Winter wheat	preemergence	6 to 10 tiller	--	--	--
Spring wheat	--	--	2 to 3 tiller	2 to 3 tiller	2 to 3 tiller
Italian ryegrass	preemergence	3 to 4 leaf	1 to 4 leaf	1 to 4 leaf	1 to 4 leaf
Air temperature (F)	55	61	61	61	60
Relative humidity (%)	59	36	44	44	38
Wind (mph, direction)	3, SW	2, SW	3, S	3, S	3, S
Cloud cover (%)	60	0	20	20	10
Soil moisture	dry	dry	moist	moist	moist
Soil temperature at 2 in (F)	50	50	55	55	55
pH	5.4		4.9	4.9	4.9
OM (%)	3.4		3.6	3.6	3.6
CEC (meq/100g)	23		21	21	21
Texture	silt loam		silt loam	silt loam	silt loam

In the imazamox/MCPA winter wheat study, flucarbazone injured wheat 5% (Table 2). Flufenacet/metribuzin treatments controlled Italian ryegrass better (76%) than all other treatments (49 to 51%). Wheat seed yield ranged from 7769 to 8220 lb/A and did not differ among treatments.

In the imazamox/MCPA spring wheat study, no treatment significantly injured wheat (0 to 5%) (Table 3). No treatment controlled Italian ryegrass (20 to 48%). Wheat yield was lowest for clodinafop and the untreated check (37 and 34 bu/A). Wheat test weight ranged from 57.0 to 58.0 lb/bu and did not differ among treatments.

In the imazamox/MCPA with pendimethalin study, clodinafop treatments injured wheat 10%, while flucarbazone + pendimethalin at 1.25 lb ai/A injured wheat 2% (Table 4). Italian ryegrass control was best with imazamox/MCPA treatments (74 and 75%). Pendimethalin at any rate or with any treatment did not improve Italian ryegrass control. Wheat seed yield was best with imazamox/MCPA (49 bu/A) but did not differ from imazamox/MCPA + pendimethalin at 0.75 lb ai/A. Imazamox/MCPA + pendimethalin at 0.75 lb ai/A wheat seed test weight was lower (56.6 lb/bu) than the untreated check (57.8 lb/bu).

In the imazamox/MCPA with broadleaf herbicide study, no treatment significantly injured wheat (0 to 9%) (Table 5). Italian ryegrass control was reduced 22 to 40% by the addition of broadleaf herbicides, except fluroxypyr, 2,4-D ester, and dicamba at 0.063 lb ai/A, when compared to imazamox/MCPA at 0.28 lb ai/A. Wheat seed yield ranged from 41 to 52 bu/A and did not differ among treatments but tended to be lowest for the untreated check. Wheat test weight ranged from 54.6 to 58.4 lb/bu and did not differ among treatments but tended to be higher in the untreated check.

Table 2. Italian ryegrass control and wheat response with imazamox/MCPA in winter wheat near Genesee, Idaho in 2004.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	Italian ryegrass control[4]	Wheat yield
	lb ai/A		----------------%	---------------	lb/A
Flufenacet/metribuzin +	0.425	preemergence			
triasulfuron	0.026	preemergence	0	76	8090
Flufenacet/metribuzin +	0.425	preemergence			
imazamox	0.0312	3 to 4 leaf	0	76	8220
Flucarbazone	0.027	3 to 4 leaf	5	49	8044
Imazamox	0.031	3 to 4 leaf	0	51	8005
Imazamox	0.039	3 to 4 leaf	0	49	7769
Imazamox/MCPA	0.28	3 to 4 leaf	0	48	8069
Imazamox/MCPA	0.35	3 to 4 leaf	0	49	7931
Untreated check	--	--	--	--	7861
LSD (0.05)			3	17	NS
Density (plants/ft^2)				7	

[1]A non-ionic surfactant (R-11) at 0.25% v/v was applied with all postemergence (3 to 4 leaf) treatments. 32% urea ammonium nitrate (URAN) was applied with all imazamox treatments at 1 qt/A.
[2]Application timing based on Italian ryegrass growth stage.
[3]June 11, 2004 evaluation date.
[4]July 14, 2004 evaluation date.

Table 3. Italian ryegrass control and wheat response with imazamox/MCPA in spring wheat near Genesee, Idaho in 2004.

Treatment[1]	Rate	Wheat injury[2]	Italian ryegrass control[3]	Wheat	
				Yield	Test weight
	lb ai/A	----------------%	---------------	bu/A	lb/bu
Imazamox	0.0312	0	40	44	57.0
Imazamox/MCPA	0.28	0	48	46	57.1
Flucarbazone	0.027	2	42	42	57.5
Clodinafop	0.0625	5	20	37	57.7
Untreated check	--	--	--	34	58.0
LSD (0.05)		NS	NS	5	NS
Density (plants/ft^2)			50		

[1]A non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments, except clodinafop which was applied with a crop oil concentrate (Score) at 12.8 fl oz/A. 32% urea ammonium nitrate (URAN) was applied with all imazamox treatments at 1 qt/A.
[2]May 20, 2004 evaluation date.
[3]July 14, 2004 evaluation date.

Table 4. Italian ryegrass control and wheat response with imazamox/MCPA plus pendimethalin in spring wheat near Genesee, Idaho in 2004.

Treatment[1]	Rate	Wheat injury[2]	Italian ryegrass control[3]	Yield	Wheat Test weight
	lb ai/A	-------------------%-------------------		bu/A	lb/bu
Imazamox/MCPA	0.28	0	75	49	56.7
Imazamox/MCPA +	0.28				
pendimethalin	0.75	0	75	47	56.6
Imazamox/MCPA +	0.28				
pendimethalin	1.25	0	74	43	57.3
Clodinafop +	0.0625				
MCPA ester	0.375	10	35	36	58.8
Clodinafop +	0.0625				
MCPA ester +	0.375				
pendimethalin	0.75	10	35	38	57.7
Clodinafop +	0.0625				
MCPA ester +	0.375				
pendimethalin	1.25	10	35	33	57.8
Flucarbazone	0.0.27	1	55	42	58.2
Flucarbazone +	0.027				
pendimethalin	0.75	0	55	40	57.2
Flucarbazone +	0.027				
pendimethalin	1.25	2	51	42	57.6
Untreated check	--	--	--	39	57.8
LSD (0.05)		2	16	4	1.2
Density (plants/ft^2)			50		

[1]A non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments, except clodinafop which was applied with a crop oil concentrate (Score) at 12.8 fl oz/A. 32% urea ammonium nitrate (URAN) was applied with all imazamox treatments at 1 qt/A. MCPA ester rate in lb ae/A.

[2]May 20, 2004 evaluation date.

[3]July 14, 2004 evaluation date.

Table 5. Italian ryegrass control and wheat response with imazamox/MCPA plus broadleaf herbicides in spring wheat near Genesee, Idaho in 2004.

Treatment[1]	Rate	Wheat injury[2]	Italian ryegrass control[3]	Wheat	
				Yield	Test weight
	lb ai/A	----------------------	%--------------------	bu/A	lb/bu
Imazamox	0.0312	0	68	49	57.9
Imazamox/MCPA	0.28	0	83	48	56.4
Imazamox/MCPA	0.56	0	94	51	56.2
Imazamox/MCPA +	0.28				
dicamba	0.0.063	0	69	49	57.4
Imazamox/MCPA +	0.28				
dicamba	0.125	9	56	50	56.5
Imazamox/MCPA +	0.28				
fluroxypyr	0.047	0	76	52	57.2
Imazamox/MCPA +	0.28				
fluroxypyr	0.094	0	69	51	56.9
Imazamox/MCPA +	0.28				
bromoxynil/MCPA	0.75	0	59	49	56.4
Imazamox/MCPA +	0.28				
bromoxynil	0.25	0	65	48	57.1
Imazamox/MCPA +	0.28				
carfentrazone	0.008	6	56	44	56.7
Imazamox/MCPA +	0.28				
2,4-D amine	0.25	0	55	50	56.1
Imazamox/MCPA +	0.28				
2,4-D ester	0.25	0	78	47	56.6
Imazamox/MCPA +	0.28				
clopyralid/2,4-D	0.29	0	61	52	56.2
Imazamox/MCPA +	0.28				
clopyralid/2,4-D	0.58	0	50	45	54.6
Imazamox/MCPA +	0.28				
thifensulfuron/tribenuron	0.025	6	64	43	56.3
Untreated check	--	--	--	41	58.4
LSD (0.05)		NS	16	NS	NS
Density (plants/ft^2)			50		

[1]A non-ionic surfactant (R-11) at 0.25% v/v and 32% urea ammonium nitrate (URAN) at 1 qt/A was applied with all treatments. Fluroxypyr, 2,4-D amine, 2,4-D amine, and cloypalid/2,4-D rates are in lb ae/A.
[2]June 11, 2004 evaluation date.
[3]July 14, 2004 evaluation date.

Italian ryegrass control with non-ACCase inhibitor herbicides in spring wheat. Traci A. Rauch, Lydia A. Clayton, and Donald C. Thill (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Populations of ACCase-resistant Italian ryegrass have been identified and are spreading in the Pacific Northwest. A study was established near Genesee, Idaho in 'Wawawai' spring wheat to evaluate control of suspected ACCase-resistant Italian ryegrass (LOLMU) with alternative herbicides. All plots were 8 by 30 ft, 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). Crop injury and Italian ryegrass control were evaluated visually. Spring wheat seed was harvested on August 30, 2004.

Table 1. Application and soil data.

Application date	April 13, 2004	May 6, 2004
Growth stage		
Spring wheat	spike	3 leaf to 2 tiller
Italian ryegrass (LOLMU)	preemergence	2 leaf to 2 tiller
Air temperature (F)	73	55
Relative humidity (%)	34	62
Wind (mph, direction)	0	3, W
Cloud cover (%)	90	100
Soil temperature at 2 in (F)	52	54
Soil moisture	dry	dry
pH	4.9	
OM (%)	3.6	
CEC (meq/100g)	21	
Texture	silt loam	

No treatment significantly injured spring wheat (Table 2). Italian ryegrass control was best with mesosulfuron (85%). All other treatments did not adequately control Italian ryegrass (0 to 21%). Wheat seed yield and test weight ranged from 49 to 62 bu/A and 54.7 to 56.4 lb/bu, respectively, and did not differ among treatments. Two non-selective ACCase herbicides, quizalofop and clethodim, controlled Italian ryegrass 0 and 25%, respectively, and severely injured wheat 100 and 68%, respectively (data not shown).

Italian ryegrass seed was collected and will be tested for ACCase resistance in the greenhouse during winter 2004.

Table 2. Italian ryegrass control and spring wheat response near Genesee, Idaho in 2004.

Treatment[1]	Rate	Application timing[2]	Wheat Injury[3]	Wheat Yield	Wheat Test weight	LOLMU control[3]
	lb ai/A		%	bu/A	lb/bu	%
Triasulfuron	0.026	preemergence	1	62	55.7	8
Diclofop	1	postemergence	1	58	56.4	2
Clodinafop	0.0625	postemergence	0	55	55.5	4
Flucarbazone	0.027	postemergence	0	59	55.2	21
Mesosulfuron	0.0134	postemergence	1	57	54.7	85
Metribuzin	0.25	postemergence	0	49	56.4	0
Untreated check	--	--		53	56.1	--
LSD (0.05)			NS	NS	NS	13
Density (plants/ft^2)						40

[1]90% nonionic surfactant (R-11) was applied at 0.25% v/v with flucarbazone. Modified seed oil at 1.5 pt/A was applied with mesosulfuron.
[2]Application timing based on Italian ryegrass growth stage.
[3]July 20, 2004 evaluation.

Influence of seeding depth and flufenacet timing in winter wheat. Richard Affeldt, Chuck Cole, Jed Colquhoun, and Carol Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR, 97331-3002) Flufenacet is supposed to be applied to wheat that is seeded at least 1 inch deep to prevent crop injury. It has been suggested that flufenacet injury on shallow seeded wheat can be avoided by delaying the timing of flufenacet application. A trial was conducted to evaluate crop injury occurring from flufenacet applied at four growth stages on wheat seeded at two depths. The trial was conducted at Hyslop Research Farm near Corvallis. 'Foote' winter wheat was seeded on October 13, 2003 to a depth of 0.5 inches for shallow seeding and 2 inches for deep seeding. Plots were 8 by 20 ft with four replications arranged as randomized complete blocks. Herbicides were sprayed in 20 gpa and 20 psi at 3 mph. Environmental conditions and crop stages are presented in Table 1. The wheat was harvested with a small-plot combine on July 22, 2004.

Table 1. Herbicide application information at Hyslop Research Farm in 2003.

Location	Corvallis, Oregon			
Wheat growth stage	Preemerge	Emerge	1 leaf	2 leaf
Application date	October 14	October 20	October 22	October 29
Air temperature (F)	50	72	68	56
Relative humidity (%)	77	70	78	65
Wind velocity (mph)	0	5	4	4
Soil temperature (F)	51	68	66	55
Soil texture	silt loam			
Soil pH	5.7			
Soil OM (%)	2.5			

Flufenacet and flufenacet + metribuzin applied preemergence caused 30 and 34% injury, respectively, 20 DAT to shallow seeded wheat (Table 2). Deep seeded wheat was much less injured from preemergence applications. Flufenacet applied to shallow seeded wheat at emergence and 1 leaf timings caused less injury than flufenacet + metribuzin. Metribuzin is only recommended for use preemergence or when wheat has at least two leaves. Injury from flufenacet applied at emergence, 1 leaf, and 2 leaf timings on shallow seeded wheat was not evident until mid-January. Wheat injury was still visible when the wheat was mostly tillered on March 4, but grain yield did not differ from any treatment. Delaying application timing of flufenacet resulted in less injury on shallow seeded wheat. However, deep seeded wheat showed less injury after mid-January than shallow seeded wheat at any application timing.

Table 2. Winter wheat injury and grain yield following herbicide applications at Hyslop Research Farm, Corvallis, Oregon.

			Wheat Injury									
			November 3, 2003		November 24, 2003		January 15, 2004		March 4, 2004		Grain yield	
Treatment	Rate	Application timing	Shallow seed	Deep seed	Shallow seed	Deep seed	Shallow seed	Deep seed	Shallow seed	Deep seed	Shallow seed	Deep seed
	lb ai/A		----------	----------	----------	----------	%	----------	----------	----------	bu/A	
Flufenacet	0.34	Preemerge	30	14	19	0	21	1	25	10	107	113
Flufenacet + metribuzin	0.34 + 0.141	Preemerge	34	9	18	0	20	0	23	9	113	112
Flufenacet	0.34	Emerge	0	5	0	0	11	1	13	0	109	110
Flufenacet + metribuzin	0.34 + 0.141	Emerge	16	14	3	0	11	0	15	3	108	108
Flufenacet	0.34	1 leaf	5	3	0	0	11	11	11	13	107	111
Flufenacet + metribuzin	0.34 + 0.141	1 leaf	15	5	0	0	11	0	15	10	110	106
Flufenacet	0.34	2 leaf	0	0	0	0	13	4	10	4	109	108
Flufenacet + metribuzin	0.34 + 0.141	2 leaf	0	0	0	0	15	0	18	9	109	111
Untreated check	---	---	0	0	0	0	0	0	0	0	110	110
LSD (0.05)			8	6	3	NS	5	3	8	9	NS	NS

Quizalofop-p carryover potential in winter wheat. Robyn C. Walton, Don W. Morishita, and Michael P. Quinn. (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 evaluate the potential carryover of quizalofop applied 1, 7, and 13 days before planting (DBP) winter wheat. 'Brundage' was planted October 28, 2003, at 100 lb/A. Experimental design was a randomized complete block with four replications and individual plots were 10 by 40 ft. Soil type was a Rad silt loam (26.4% sand, 64.0% silt, and 9.6% clay) with a pH of 8.1, 1.6% organic matter, and CEC of 16-meq/100 g soil. Herbicides were applied using a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 15 psi. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 162 days after treatment (DAT) on April 7, 2004, and 244 DAT on June 28. Grain was harvested August 11 with a small-plot combine.

Table 1. Environmental conditions at application.

Application date	10/15/03	10/21/03	10/27/03
Application timing	13 DBP[1]	7 DBP	1 DPB
Air temperature (F)	42	54	66
Soil temperature (F)	38	48	48
Relative humidity (%)	58	38	32
Wind velocity (mph)	6	3	11
Cloud cover (%)	80	20	90

[1]DBP = days before planting.

All quizalofop-p application rates, regardless of application date, showed the highest amount of crop injury ranging from 51 to 93% on the first injury evaluation and 23 to 80% on the second injury evaluation (Table 2). Fluazifop-p-butyl had the next highest crop injury ranging from 21 to 51% on the first evaluation and 15 to 24% injury on the second evaluation. Sethoxydim and clethodim treatments showed less than 11% injury on the first evaluation and less than 15% on the second evaluation. The stand counts for this study were very low due to herbicide injury and poor emergence in the fall. However, grain yield ranged from 13 to 105 bu/A. The highest yielding treatments were from sethoxydim and clethodim applied 13 DBP. Both treatments yielded 95 bu/A. The quizalofop-p treatments had the lowest yields, ranging from 13 to 60 bu/A. The highest quizalofop-p rate (0.096 lb ai/A) at all three application timings had the lowest yield ranging from 16 to 13 bu/A. Soil activity and persistence of quizalofop injured the crop and reduced grain yield as much or more than fluazifop, sethoxydim, and clethodim.

Table 2. Crop injury, stand counts, and grain yield on Quizalofop-p plant-back on fall seeded wheat near Kimberly, Idaho.

Treatment	Application rate	Application timing	Crop injury 4/7	Crop injury 6/28	Stand count	Grain test wt.	Grain yield
	lb ai/A	DBP[1]	-------%-------		plants/2 m	lb/bu	bu/A
Check	-					54	103
Quizalofop-p	0.034	13	51	23	5	46	60
Quizalofop-p	0.048	13	73	34	3	40	43
Quizalofop-p	0.096	13	90	68	1	41	16
Fluazifop-p-butyl	0.375	13	21	10	8	46	79
Sethoxydim	0.75	13	11	15	9	50	95
Clethodim	0.25	13	5	8	8	48	95
Quizalofop-p	0.034	7	76	45	3	47	57
Quizalofop-p	0.048	7	75	40	3	45	43
Quizalofop-p	0.096	7	89	76	1	30	13
Fluazifop-p-butyl	0.375	7	51	15	6	48	71
Sethoxydim	0.75	7	9	6	9	50	105
Clethodim	0.25	7	9	5	10	45	82
Quizalofop-p	0.034	1	58	24	5	45	60
Quizalofop-p	0.048	1	75	51	2	45	45
Quizalofop-p	0.096	1	93	80	1	29	16
Fluazifop-p-butyl	0.375	1	38	24	6	40	67
Sethoxydim	0.75	1	5	6	10	44	76
Clethodim	0.25	1	1	8	13	50	89
LSD (0.05)			19	13	0	12	31

[1]DBP = days before planting.

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 near Lewiston, Idaho in 'Above' imidazolinone-resistant hard red winter wheat. Three studies evaluated weed control and wheat response with 1) propoxycarbazone or mesosulfuron with metribuzin; 2) propoxycarbazone/mesosulfuron rates; and 3) imazamox/MCPA ester with broadleaf herbicide combinations. All plots were 8 by 30 ft, 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). The propoxycarbazone studies were oversprayed with fluroxypyr at 0.0937 lb ae/A to control broadleaf weeds on April 30, 2004. In all experiments, wheat injury and weed control were evaluated visually, and wheat seed was harvested on August 2, 2004.

Table 1. Application and soil data.

Study	Propoxycarbazone or mesosulfuron with metribuzin	Propoxycarbazone /mesosulfuron rates	Imazamox/MCPA with broadleaf herbicides	
Application date	4/7/04	3/29/04	4/1/04	4/22/04
Growth stage				
Wheat	2 to 3 tiller	2 to 3 tiller	2 to 3 tiller	stem elongation
Downy brome (BROTE)	1 to 3 leaf	1 to 3 leaf	1 to 3 leaf	3 to 5 leaf
Wild oat (AVEFA)	preemergence	preemergence	preemergence	1 to 3 leaf
Jointed goatgrass (AEGCY)		--	1 to 2 tiller	2 to 3 tiller
Catchweed bedstraw (GALAP)	--	--	0.5 inch	2 to 4 inch
Air temperature (F)	58	72	53	63
Relative humidity (%)	58	20	39	55
Wind (mph, direction)	1, NW	3, SW	3, E	2, W
Cloud cover (%)	0	0	85	20
Soil moisture	dry	dry	damp	wet
Soil temperature at 2 in (F)	50	50	45	50
pH		5.6		
OM (%)		3.9		
CEC (meq/100g)		22		
Texture		silt loam		

In the propoxycarbazone or mesosulfuron with metribuzin study, all treatments injured wheat 0 to 5% on April 22, 2004 (Table 2). By May 25, no treatment visually injured wheat (data not shown). Downy brome control was better with propoxycarbazone plus metribuzin (84%) than propoxycarbazone alone, mesosulfuron at 0.0089 lb ai/A, and mesosulfuron at 0.0134 lb ai/A plus UAN or metribuzin (42 to 62%). Propoxycarbazone alone and with UAN controlled wild oat better (93%) than all other treatments except sulfosulfuron alone, propoxycarbazone/mesosulfuron, and metribuzin combined with propoxycarbazone or mesosulfuron at 0.0089 lb ai/A. The jointed goatgrass population was light and non-uniform and control generally was lower in the sulfosulfuron treatments. Wheat seed yield was higher with sulfosulfuron alone (50 bu/A) than mesosulfuron at 0.0089 lb ai/A plus UAN or metribuzin and the untreated check (39 to 44 bu/A). Wheat test weight ranged from 60.8 to 62.8 lb/bu and did not differ among treatments.

In the propoxycarbazone/mesosulfuron rate study, no treatment injured wheat (data not shown). Propoxycarbazone alone and propoxycarbazone/mesosulfuron at 0.04 lb ai/A with NIS/MSO controlled downy brome better (69%) than all treatments except sulfosulfuron and propoxycarbazone/mesosulfuron at 0.054 lb ai/A (Table 3). Wild oat control was best with flucarbazone plus chlorsulfuron (95%) but did not differ from propoxycarbazone alone and propoxycarbazone/mesosulfuron at 0.027, 0.0466, and 0.054 lb ai/A. Wheat seed yield was greater with propoxycarbazone alone and propoxycarbazone/mesosulfuron at 0.0466 lb ai/A than propoxycarbazone/mesosulfuron at 0.02 lb ai/A and the untreated check. Wheat test weight ranged from 61.9 to 62.8 lb/bu and tended to lowest in the untreated check (61.9 lb/bu).

In the imazamox/MCPA with broadleaf herbicides study, no treatment injured wheat (data not shown). All imazamox/MCPA treatments, except when combined with dicamba, controlled downy brome 91 to 97% (Table 4). Downy brome control was reduced 8 and 12% with the addition of dicamba compared to imazamox/MCPA alone at the same rate and timing. All treatments controlled wild oat 84 to 98% except the treatments applied at the early timing (18 to 32%), which was before wild oat plants had emerged. Jointed goatgrass control ranged from 97 to

99%. Catchweed bedstraw control was better with imazamox/MCPA at the later timing applied alone or combined with fluroxypyr, 2,4-D ester, cloypalid/2,4-D or dicamba at 0.125 lb ai/A (88 to 94%) than imazamox or imazamox/MCPA applied at the early timing (38 to 61%). Wheat seed yield was greater at the early timing of imazamox alone (48 bu/A) than all imazamox/MCPA + broadleaf herbicide combinations, the late application of imazamox and imazamox/MCPA at 0.422 lb ai/A (28 to 36 bu/A). Yield of the untreated check was inflated by non-imidazolinone tolerant volunteer wheat. Wheat seed test weight was lowest for the untreated check (60.9 lb/bu).

Table 2. Weed control and wheat response with propoxycarbazone or mesosulfuron with metribuzin near Lewiston, Idaho in 2004.

Treatment[1]	Rate	Wheat injury[2]	Weed control BROTE[3]	AVEFA[4]	AEGCY[3]	Wheat Yield[5]	Test weight
	lb ai/A	%				bu/A	lb/bu
Propoxycarbazone +	0.04						
NIS	0.25% v/v	1	62	93	72	49	62.3
Propoxycarbazone +	0.04						
NIS +	0.25% v/v						
UAN	5 gal/A	5	81	93	72	49	62.4
Propoxycarbazone +	0.04						
NIS +	0.25% v/v						
metribuzin	0.1875	0	84	91	82	45	62.8
Mesosulfuron +	0.0089						
NIS +	0.5% v/v						
UAN	2 qt/A	1	50	40	74	41	60.8
Mesosulfuron +	0.0089						
MSO	1.5 pt/A	2	60	62	74	46	62.5
Mesosulfuron +	0.0089						
NIS +	0.5% v/v						
metribuzin	0.1875	1	51	69	71	44	61.7
Mesosulfuron +	0.0134						
NIS +	0.5% v/v						
UAN	2 qt/A	5	58	49	50	45	61.7
Mesosulfuron +	0.0134						
MSO	1.5 pt/A	4	71	51	68	47	61.5
Mesosulfuron +	0.0134						
NIS +	0.5% v/v						
metribuzin	0.1875	2	42	48	61	45	61.4
Sulfosulfuron +	0.0312						
NIS	0.5% v/v	0	65	79	40	50	62.3
Sulfosulfuron +	0.0312						
NIS +	0.5% v/v						
metribuzin	0.1875	1	66	46	39	45	62.2
Propoxycarbazone/mesosulfuron +	0.04						
NIS	0.5% v/v	2	66	73	58	50	62.0
Untreated check	--	--	--	--	--	39	61.0
LSD (0.05)		NS	21	29	NS	6	NS
Density (plants/ft^2)			5	2	1		

[1]NIS is 90% nonionic surfactant (R-11); UAN is urea ammonium nitrate (URAN); and MSO is modified seed oil.
[2]April 24, 2004 evaluation.
[3]June 14, 2004 evaluation.
[4]June 28, 2004 evaluation.
[5]Wheat seed yield LSD significant at the 6% level (P=0.0589).

Table 3. Downy brome and wild oat control and wheat response with propoxycarbazone/mesosulfuron rates near Lewiston, Idaho in 2004.

Treatment[1]	Rate	Weed control		Wheat	
		BROTE[2]	AVEFA[3]	Yield	Test weight
	lb ai/A	----------%---------		bu/A	lb/bu
Sulfosulfuron	0.0312	52	52	52	62.8
Propoxycarbazone	0.04	69	80	55	62.9
Mesosulfuron +	0.0134				
NIS +	0.5% v/v				
UAN	2 qt/A	38	23	48	62.4
Mesosulfuron +	0.0134				
MSO	1.5 pt/A	48	57	52	62.2
Propoxycarbazone/mesosulfuron	0.02	42	43	47	62.5
Propoxycarbazone/mesosulfuron	0.027	38	62	49	62.6
Propoxycarbazone/mesosulfuron	0.0334	41	43	49	62.5
Propoxycarbazone/mesosulfuron	0.04	45	43	51	62.4
Propoxycarbazone/mesosulfuron +	0.04				
NIS/MSO	1.5 pt/A	69	56	53	62.5
Propoxycarbazone/mesosulfuron	0.0466	45	73	54	62.6
Propoxycarbazone/mesosulfuron	0.054	51	74	52	62.7
Flucarbazone +	0.0267				
chlorsulfuron	0.0155	48	95	50	62.7
Untreated check	--	--	--	41	61.9
LSD (0.05)		19	37	7	NS
Density (plants/ft^2)		5	2		

[1]NIS is a 90% non-ionic surfactant (R-11) and was applied at 0.5% v/v with sulfosulfuron, propoxycarbazone, propoxycarbazone/mesosulfuron (except the treatment with NIS/MSO), and flucarbazone + chlorsulfuron. MSO is a modified seed oil. NIS/MSO is a non-ionic surfactant/modified seed oil blend (Hasten).

[2]June 14, 2004 evaluation.

[3]June 28, 2004 evaluation.

Table 4. Weed control and wheat response with imazamox/MCPA combined with broadleaf herbicides near Lewiston, Idaho in 2004.

Treatment[1]	Rate	Application timing[2]	Weed control BROTE[3]	AVEFA[4]	AEGCY[5]	GALAP[6]	Wheat Yield	Test weight
	lb ai/A		------------------------	%	------------------------		bu/A	lb/bu
Imazamox	0.0312	1 to 3 leaf	88	18	97	56	48	62.5
Imazamox/MCPA	0.281	1 to 3 leaf	95	32	99	38	47	62.3
Imazamox/MCPA	0.422	1 to 3 leaf	96	26	99	61	45	62.2
Imazamox	0.0312	3 to 5 leaf	89	98	99	81	33	62.7
Imazamox/MCPA	0.281	3 to 5 leaf	95	97	99	91	39	62.8
Imazamox/MCPA	0.422	3 to 5 leaf	97	96	99	88	36	62.9
Imazamox/MCPA +	0.281							
dicamba	0.063	3 to 5 leaf	87	94	99	77	30	62.4
Imazamox/MCPA +	0.281							
dicamba	0.125	3 to 5 leaf	84	94	99	92	28	62.6
Imazamox/MCPA +	0.281							
fluroxypyr	0.0937	3 to 5 leaf	93	96	99	94	31	62.4
Imazamox/MCPA +	0.281							
bromoxynil	0.25	3 to 5 leaf	97	97	99	83	38	62.7
Imazamox/MCPA +	0.281							
carfentrazone	0.008	3 to 5 leaf	91	93	99	78	34	62.8
Imazamox/MCPA +	0.281							
2,4-D ester	0.25	3 to 5 leaf	96	98	99	91	34	62.9
Imazamox/MCPA +	0.281							
clopyralid/2,4-D	0.583	3 to 5 leaf	92	97	99	90	29	62.6
Untreated check	--	--	--	--	--	--	40	60.9
LSD (0.05)			7	18	NS	8	10	0.7
Density (plants/ft^2)			5	2	1	3		

[1]All treatments were applied with 90% nonionic surfactant (R-11) at 0.25% v/v and 32% urea ammonium nitrate at 1 qt/A. Fluroxypyr, 2,4-D ester, and clopyralid/2,4-D treatments were in lb ae/A.
[2]Application timing based downy brome growth stage.
[3]June 16, 2004 evaluation. Downy brome control LSD significant at the 6% level (P=0.0586).
[4]June 28, 2004 evaluation.
[5]June 16, 2004 evaluation. Only two replications were evaluated due to non-uniform wild oat population.
[6]May 25, 2004 evaluation.

Weed control in winter wheat with imazamox and flucarbazone combined with various adjuvants. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in Clearfield (imidazolinone-resistant) winter wheat to evaluate control of downy brome and catchweed bedstraw near Lewiston, Idaho; wild oat and corn gromwell near Bonners Ferry, Idaho; and Italian ryegrass near Genesee, Idaho with imazamox combined with different adjuvants. In a similar adjuvant study near Moscow, Idaho, Italian ryegrass control in 'Madsen' winter wheat with flucarbazone was evaluated. 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 30 psi and 3 mph (Table 1). The Genesee site was oversprayed with clopyralid/MCPA at 0.60 lb ae/A on May 14, 2004. Wheat injury and weed control were evaluated visually during the growing season. Wheat seed was harvested with a small plot combine on August 2, 11, and 18, 2004 at the Lewiston, Moscow, and Genesee locations, respectively. The Bonners Ferry site was not harvested due to a poor wheat stand.

Table 1. Application and soil data.

Location	Lewiston	Bonners Ferry	Genesee	Moscow
Application date	April 22, 2004	May 6, 2004	April 28, 2004	May 13, 2004
Wheat variety	Above	ID 587	Clearfirst	Madsen
Growth stage				
Wheat	2 to 3 tiller	2 to 3 tiller	6 to 10 tiller	4 to 5 tiller
Downy brome (BROTE)	3 to 5 leaf	--	--	--
Catchweed bedstraw (GALAP)	2 to 5 inches	--	--	--
Wild oat (AVEFA)	1 to 3 leaf	1 to 3 leaf	--	--
Corn gromwell (LITAR)	--	3 to 6 inches	--	--
Italian ryegrass (LOLMU)	--	--	3 to 4 leaf	2 leaf to 4 tiller
Jointed goatgrass (AEGCY)	--	--	--	3 to 4 tiller
Air temperature (F)	63	61	61	57
Relative humidity (%)	57	46	36	54
Wind (mph, direction)	1, W	1, N	2, SW	5, NE
Cloud cover (%)	10	60	0	60
Soil moisture	wet	dry	dry	moist
Soil temperature at 2 in (F)	45	55	50	60
Soil				
pH	5.6	7.6	5.4	5.2
OM (%)	3.9	4.0	3.4	3.0
CEC (meq/100g)	22	31	23	18
texture	silt loam	silt loam	silt loam	silt loam

At the Genesee study, no treatment injured winter wheat (data not shown). Imazamox combined with Hasten suppressed Italian ryegrass more (59%) than any other treatments (32 to 45%) (Table 2). No treatment controlled Italian ryegrass. Wheat seed yield ranged from 108 to 120 bu/A and tended to be greater for all treatments compared to the untreated check. Wheat test weight ranged from 59.3 to 59.5 lb/bu and did not differ among treatments.

At the Moscow study, all treatments injured winter wheat 9 to 13% (Table 3). All treatments controlled Italian ryegrass 99%. Jointed goatgrass control ranged from 65 to 79%. Wheat seed yield ranged from 118 to 122 bu/A. Wheat test weight was lower for all treatments (55.1 to 55.5 lb/bu) compared to the untreated check (56.5 lb/bu).

At the Lewiston study, no treatment injured wheat (data not shown). On May 25 and June 16 2004, all treatments controlled downy brome 90 to 96 and 87 to 97%, respectively (Table 4). Catchweed bedstraw control ranged from 55 to 95%. Wild oat control was 94 to 99%. Catchweed bedstraw and wild oat plant density was light and non-uniform. All imazamox treatments tended to yield less than the untreated check. Wheat yield was poorly correlated with downy brome control due to a heavy non-imidazolinone volunteer winter wheat population. In imazamox treated plots, all volunteer non-imidazolinone resistant wheat was killed and overall wheat stand reduced. Wheat test weight ranged from 62.2 to 63.0 lb/bu and did not differ among treatments.

At the Bonners Ferry study, no treatment injured wheat (data not shown). On June 3, wild oat control ranged from 86 to 96% (Table 4). By June 29, imazamox treatments with adjuvants containing modified seed oil controlled wild oat better (88 to 96%) than all other treatments. Wild oat control was lowest with imazamox +R-11 + Bronc Max + In-Place. Corn gromwell control ranged from 45 to 83% for all treatments but tended to be better with In-Place (75 to 83%).

Table 2. Italian ryegrass control and wheat response with imazamox combined with various adjuvants near Genesee, Idaho in 2004.

Treatment[1]	Rate	Italian ryegrass control[2]	Wheat Yield	Wheat Test weight
	lb ai/A	%	bu/A	lb/bu
Imazamox +	0.031			
R-11 +	0.25% v/v			
Bronc Max +	2 qt/100 gal			
In-Place	0.25 fl oz/A	32	118	59.3
Imazamox +	0.031			
Hasten +	1 pt/A			
Bronc Max +	2 qt/100 gal			
In-Place	0.25 fl oz/A	59	113	59.5
Imazamox +	0.031			
Super Spread MSO +	1 pt/A			
Bronc Max +	2 qt/100 gal			
In-Place	0.25 fl oz/A	40	120	59.3
Imazamox +	0.031			
Renegade +	1 qt/A			
In-Place	0.25 fl oz/A	45	117	59.3
Untreated check	--	--	108	59.4
LSD (0.05)		12	NS	NS
Density (plants/ft^2)		9		

[1]R-11 is 90% nonionic surfactant (NIS); Bronc Max is AMS/citric acid; In-Place is a deposition aid; Hasten and Super Spread MSO are modified vegetable oil/NIS blends; and Renegade is a modified vegetable oil/NIS/NH_4/buffer.

[2]July 14, 2004 evaluation.

Table 3. Italian ryegrass control and wheat injury, yield, and test weight with flucarbazone combined with various adjuvants near Moscow, Idaho in 2004.

Treatment[1]	Rate	Wheat injury[2]	Weed control[2] LOLMU	Weed control[2] AEGCY	Wheat Yield	Wheat Test weight
	lb ai/A		------------%------------		bu/A	lb/bu
Flucarbazone +	0.027					
R-11	0.25 % v/v	9	99	65	119	55.5
Flucarbazone +	0.027					
Renegade	1 qt/A	9	99	75	120	55.1
Flucarbazone +	0.027					
Renegade +	1 qt/A					
In-Place	2 oz/A	13	99	79	118	55.4
Untreated check	--	--	--	--	122	56.5
LSD (0.05)		NS	NS	NS	NS	0.7
Density (plants/ft^2)			5	2		

[1]R-11 is 90% nonionic surfactant (NIS); Renegade is a modified vegetable oil/NIS/NH_4/buffer; and In-Place is a deposition aid.

[2]June 25, 2004 evaluation.

Table 4. Weed control and wheat response with imazamox combined with various adjuvants near Lewiston and Bonners Ferry, Idaho in 2004.

		Lewiston						Bonners Ferry		
		BROTE				Wheat		AVEFA		
Treatment[1]	Rate	5/25/04	6/16/04	GALAP[2]	AVEFA[3]	Yield	Test weight	6/03/04	6/29/04	LITAR[4]
	lb ai/A	%				bu/A	lb/bu	%		
Imazamox +	0.031									
URAN +	2.5% v/v									
R-11	0.25% v/v	92	87	79	99	39	63.0	87	68	45
Imazamox +	0.031									
R-11 +	0.25% v/v									
Bronc Max +	2 qt/100 gal									
In-Place	0.25 fl oz/A	91	91	55	99	40	62.9	86	48	83
Imazamox +	0.031									
Hasten +	1 pt/A									
Bronc Max +	2 qt/100 gal									
In-Place	0.25 fl oz/A	90	98	58	99	38	62.9	96	92	80
Imazamox +	0.031									
Super Spread MSO +	1 pt/A									
Bronc Max +	2 qt/100 gal									
In-Place	0.25 fl oz/A	91	97	95	99	40	62.7	96	96	78
Imazamox +	0.031									
Renegade +	1 qt/A									
In-Place	0.25 fl oz/A	96	92	78	94	35	62.9	92	88	75
Untreated check	--	--	--	--	--	45	62.2	--	--	--
LSD (0.05)		NS	NS	NS	NS	NS	NS	NS	16	NS
Density (plants/ft^2)		25		1	0.5			83		4

[1]URAN is 32% urea ammonium nitrate; R-11 is 90% nonionic surfactant (NIS); Bronc Max is AMS/citric acid; In-Place is a deposition aid; Hasten and Super Spread MSO are modified vegetable oil/NIS blends; and Renegade is a modified vegetable oil/NIS/NH_4/buffer.

[2]June 16, 2004 evaluation.

[3]June 28, 2004 evaluation.

[4]June 3, 2004 evaluation.

Weed control in imidazolinone-resistant winter wheat with imazamox. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in Clearfield (imidazolinone-resistant) winter wheat to evaluate control of downy brome and catchweed bedstraw near Lewiston, Idaho; wild oat and corn gromwell near Bonners Ferry, Idaho; and Italian ryegrass near Genesee, Idaho with imazamox combined with different adjuvants. 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 30 psi and 3 mph (Table 1). The Genesee site was oversprayed with clopyralid/MCPA at 0.60 lb ae/A on May 14, 2004. Wheat injury and weed control were evaluated visually during the growing season. Wheat seed was harvested with a small plot combine on August 2 and 18, 2004 at the Lewiston and Genesee locations, respectively. The Bonners Ferry site was not harvested due to a poor wheat stand.

Table 1. Application and soil data.

Location	Lewiston	Bonners Ferry	Genesee	
Application date	April 22, 2004	May 6, 2004	October 9, 2003	April 28, 2004
Wheat variety	Above	ID 587	Clearfirst	
Growth stage				
Wheat	2 to 3 tiller	2 to 3 tiller	preemergence	6 to 10 tiller
Downy brome (BROTE)	3 to 5 leaf	--	--	--
Catchweed bedstraw (GALAP)	2 to 5 inches	--	--	--
Wild oat (AVEFA)	1 to 3 leaf	1 to 3 leaf	--	--
Corn gromwell (LITAR)	--	3 to 6 inches	--	--
Italian ryegrass (LOLMU)	--	--	preemergence	3 to 4 leaf
Air temperature (F)	63	61	55	61
Relative humidity (%)	57	46	59	36
Wind (mph, direction)	1, W	1, N	3, SW	2, SW
Cloud cover (%)	10	60	60	0
Soil moisture	wet	dry	dry	dry
Soil temperature at 2 in (F)	45	55	50	50
Soil				
pH	5.6	7.6	5.4	
OM (%)	3.9	4.0	3.4	
CEC (meq/100g)	22	31	23	
texture	silt loam	silt loam	silt loam	

At the Lewiston study, no treatment injured wheat (data not shown). On May 25, 2004, imazamox treatments controlled downy brome 92 to 97%, while down brome control with propoxycarbazone was 86 to 89% (Table 2). By June 16, downy brome control was 87 to 96% and did not differ among treatments. All treatments controlled wild oat 92 to 99%. Catchweed bedstraw control tended to be better with imazamox (42 to 79%) versus propoxycarbazone (10 and 24%), but was not significantly different. Wild oat and catchweed bedstraw plant density was light and non-uniform. Wheat yield with propoxycarbazone alone (53 bu/A) was greater than all other treatments except propoxycarbazone + carfentrazone (50 bu/A) and the untreated check (45 bu/A). All imazamox treatments, except imazamox + nitrogen at 30% v/v with or without carfentrazone, yielded less than the untreated check. Wheat yield was poorly correlated with downy brome control due to a heavy non-imidazolinone volunteer winter wheat population. In imazamox treated plots, all volunteer non-imidazolinone resistant wheat was killed and overall wheat stand reduced. Wheat test weight was higher with imazamox + AMS treatments than propoxycarbazone + carfentrazone and the untreated check.

At the Bonners Ferry study, no treatment injured wheat (data not shown). On June 3, fenoxaprop alone and imazamox alone or in combination controlled wild oat better (80 to 94%) than flucarbazone alone and fenoxaprop + bromoxynil/MCPA (66 and 70%)(Table 3). Imazamox + AMS + bromoxynil/MCPA controlled corn gromwell and wild oat on June 29 better than imazamox + nitrogen at 2.5% v/v, fenoxaprop and flucarbazone treatments (except flucarbazone + bromoxynil/MCPA for corn gromwell).

At the Genesee study on May 4, wheat injury ranged 0 to 5% and did not differ among treatments (Table 4). By June 11, no treatment visibly injured wheat (data not shown). Italian ryegrass control was best with flufenacet/metribuzin plus triasulfuron or imazamox and flufenacet + imazamox (69 to 71%) but did not differ from any treatment containing flufenacet (61 to 62%). Imazamox alone suppressed Italian ryegrass 48 to 54%. No treatment adequately controlled Italian ryegrass. Wheat yield and test weight ranged from 122 to 131 bu/A and 59.6 to 60.2 lb/bu, respectively, and did not differ among treatments.

Table 2. Weed control and wheat response with imazamox near Lewiston, Idaho in 2004.

		Weed control				Wheat	
		BROTE					
Treatment[1]	Rate	5/25/04	6/16/04	AVEFA[2]	GALAP[3]	Yield	Test weight
	lb ai/A	%				bu/A	lb/bu
Propoxycarbazone	0.04	89	88	99	24	53	62.8
Imazamox +	0.031						
UAN	2.5% v/v	92	87	99	79	39	63.0
Imazamox +	0.031						
UAN	30% v/v	97	92	99	76	40	62.8
Imazamox +	0.031						
AMS	15 lb /100 gal	92	96	97	65	37	63.3
Propoxycarbazone +	0.04						
carfentrazone	0.008	86	89	99	10	50	62.7
Imazamox +	0.031						
UAN +	2.5% v/v						
carfentrazone	0.008	92	90	92	55	39	63.0
Imazamox +	0.031						
UAN +	30% v/v						
carfentrazone	0.008	93	95	99	42	41	63.2
Imazamox +	0.031						
AMS +	15 lb /100 gal						
carfentrazone	0.008	97	92	99	48	39	63.3
Untreated check	--	--	--	--	--	45	62.2
LSD (0.05)		NS	NS	NS	NS	6	0.5
Density (plants/ft^2)		25		0.5	1		

[1]UAN is 32% urea ammonium nitrate (URAN), AMS is ammonium sulfate (Bronc). A 90% nonionic surfactant (R-11) was applied with all treatments at 0.25% v/v.

[2]June 28, 2004 evaluation.

[3]June 16, 2004 evaluation.

Table 3. Wild oat and corn gromwell control with imazamox near Bonners Ferry, Idaho in 2004.

Treatment[1]	Rate	Wild oat control		Corn gromwell control[2]
		June 3	June 29	
	lb ai/A	---------	%	---------
Flucarbazone	0.027	66	20	0
Fenoxaprop	0.082	90	71	18
Imazamox +	0.031			
UAN	2.5% v/v	87	68	45
Imazamox +	0.031			
UAN	30% v/v	88	78	70
Imazamox +	0.031			
AMS	15 lb/100 gal	90	82	70
Flucarbazone +	0.027			
bromoxynil/MCPA	0.25	80	28	58
Fenoxaprop +	0.082			
bromoxynil/MCPA	0.25	70	45	30
Imazamox +	0.031			
UAN +	2.5% v/v			
bromoxynil/MCPA	0.25	93	88	77
Imazamox +	0.031			
UAN +	30% v/v			
bromoxynil/MCPA	0.25	88	79	61
Imazamox +	0.031			
AMS +	15 lb/100 gal			
bromoxynil/MCPA	0.25	94	92	86
LSD (0.05)		15	21	37
Density (plants/ft^2)		83		4

[1]UAN is 32% urea ammonium nitrate (URAN) and AMS is ammonium sulfate (Bronc). A 90% nonionic surfactant (R-11) was applied with all treatments, except fenoxaprop, at 0.25% v/v.
[2]June 6, 2004 evaluation.

Table 4. Italian ryegrass control and wheat injury, yield, and test weight with imazamox near Genesee, Idaho in 2004.

Treatment[1]	Rate	Application timing	Wheat injury[2]	LOLMU control[3]	Wheat Yield	Wheat Test weight
	lb ai/A		------------%------------		bu/A	lb/bu
Flufenacet/metribuzin	0.425	preemergence	0	62	128	60.0
Flufenacet/metribuzin + triasulfuron	0.425 0.026	preemergence	4	69	129	59.7
Flufenacet	0.34	preemergence	5	61	128	60.2
Flufenacet/metribuzin + imazamox + UAN	0.425 0.031 2.5% v/v	preemergence 3 to 4 leaf	0	71	130	59.8
Flufenacet + imazamox + UAN	0.34 0.031 2.5% v/v	preemergence 3 to 4 leaf	1	70	131	59.8
Imazamox + UAN	0.031 2.5% v/v	3 to 4 leaf	0	48	125	59.9
Imazamox + UAN	0.031 30% v/v	3 to 4 leaf	1	51	124	60.2
Imazamox + AMS	0.031 15 lb/100 gal	3 to 4 leaf	1	54	128	60.1
Untreated check	--		--	--	122	59.6
LSD (0.05)			NS	11	NS	NS
Density (plants/ft^2)				7		

[1]UAN is 32% urea ammonium nitrate and AMS is ammonium sulfate (Bronc). A 90% nonionic surfactant (R-11) was applied with all imazamox treatments at 0.25% v/v.
[2]May 4, 2004 evaluation.
[3]July 14, 2004 evaluation.

Wheat injury and weed control with linuron and diuron herbicide combinations. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, Idaho 83844-2339) An experiment was established near Moscow and Genesee, Idaho, to determine wheat injury and broadleaf weed control in winter wheat with linuron and diuron herbicide combinations. Treatments were applied with a CO_2 pressurized backpack sprayer delivering 10 gpa at 3 mph and 32 psi (Table 1). The experimental design was a randomized complete block with four replications and 8 by 30 ft experimental units. Wheat injury and weed control were evaluated visually and grain was harvested at maturity.

Table 1. Environmental information at the time of application.

Location	University of Idaho farm, Moscow, ID	University of Idaho farm, Genesee, ID
Application date	May 5, 2004	May 14, 2004
Wheat variety 'IDO 587'	8 to 10 inch tall, 2 to3 tillers	15 inch tall, 3 to 4 tillers
Prickly lettuce	-	3 to 5 inch tall, 3 to 6 leaves
Mayweed chamomile	-	1 inch diameter
Catchweed bedstraw	-	3 to 10 inch tall
Air temperature (F)	61	59
Soil temperature at 3 inch (F)	58	41
Relative humidity (%)	60	57
Soil pH	4.8	6.0
Soil organic matter (%)	5.8	4.3
Soil CEC (cmol/kg)	40	20
Soil texture	Loam	Silt loam

Wheat was injured at Moscow with all treatments except Karmex + MCPA ester + R-11, Karmex + MCPA ester + Huntsman, and Karmex + MCPA ester + tribenuron + thifensulfuron + Huntsman (0.6 + 0.015 + 0.00375 + 0.65 lb ai/a + 0.25%v/v) on May 12 (Table 2). By June 11, wheat injury was significantly higher than the untreated only with Karmex + MCPA ester + R-11, Direx + MCPA ester + R-11, linuron + MCPA ester + R-11, and Direx + tribenuron + thifensulfuron + MCPA ester + Huntsman (9, 13, 8, and 8%, respectively). Wheat injury was higher with R-11 than Huntsman in diuron and linuron + MCPA direct comparisons. Many of the treatments that injured wheat in May did not injure wheat in June compared to the untreated check. The visual injury did not correlate to harvest components as wheat grain and test weight did not differ among treatments.

At Genesee, prickly lettuce (LACSE) control was 93 to 97% with all treatments except tribenuron + thifensulfuron + MCPA ester + Huntsman which controlled prickly lettuce 81%. Mayweed chamomile also was controlled least by tribenuron + thifensulfuron + MCPA ester + Huntsman. Catchweed bedstraw populations were variable and control was not statistically different from the untreated check. Visual wheat injury was noticed in only a few plots and was not statistically different from the untreated check. Wheat yield was higher with linuron + MCPA + ester + Huntsman, linuron + tribenuron + thifensulfuron + MCPA ester + Huntsman, and both tribenuron + thifensulfuron + MCPA ester treatments (6023 to 6262 lb/a) compared to the untreated check (5441 lb/a). Wheat test weight from the untreated check (56 lb/bu) was lower than any herbicide treatment (59 to 60 lb/bu).

Table 2. Wheat injury and weed control with linuron and diuron herbicide combinations at Moscow and Genesee, Idaho.

		Moscow				Genesee					
		Wheat injury		Wheat grain		Weed control			Wheat	Wheat grain	
Treatment[1]	Rate[2]	May 12	June 11	Yield	Test wt	LACSE	ANTCO	GALAP	injury	Yield	Test wt
	lb ai/a	------% -----		lb/a	lb/bu	------------------- % ------------------				lb/a	lb/bu
Karmex +	0.8	4	9	2572	60	97	98	85	0	5461	60
MCPA ester +	0.65										
R-11	0.25										
Karmex +	0.8	1	4	3425	59	96	96	90	1	5846	61
MCPA ester +	0.65										
Huntsman	0.125										
Direx +	0.8	5	13	2712	59	97	97	85	0	5459	60
MCPA ester +	0.65										
R-11	0.25										
Direx +	0.8	5	3	2806	59	93	96	85	0	5631	60
MCPA ester +	0.65										
Huntsman	0.125										
Linuron +	0.625	9	8	3209	59	97	96	88	0	5883	61
MCPA ester +	0.65										
R-11	0.25										
Linuron +	0.625	6	4	3287	59	97	97	90	1	6023	60
MCPA ester +	0.65										
Huntsman	0.125										
Karmex +	0.6	2	3	3220	59	97	97	88	1	5957	61
thifensulfuron +	0.015										
tribenuron +	0.00375										
MCPA ester +	0.65										
Huntsman	0.125										
Karmex +	0.8	5	5	3104	59	96	96	85	1	5601	60
thifensulfuron +	0.015										
tribenuron +	0.00375										
MCPA ester +	0.65										
Huntsman	0.125										
Direx +	0.6	5	8	3292	59	94	96	80	0	5582	60
thifensulfuron +	0.015										
tribenuron +	0.00375										
MCPA ester +	0.65										
Huntsman	0.125										
Direx +	0.8	8	5	3014	59	97	97	96	1	5834	61
thifensulfuron +	0.015										
tribenuron +	0.00375										
MCPA ester +	0.65										
Huntsman	0.125										
Linuron +	0.625	5	4	3316	59	95	96	87	1	6033	60
thifensulfuron +	0.015										
tribenuron +	0.00375										
MCPA ester +	0.65										
Huntsman	0.125										
Thifensulfuron +	0.015	6	3	3416	59	95	97	90	0	6262	59
tribenuron +	0.00375										
MCPA ester +	0.65										
R-11	0.25										
Thifensulfuron +	0.015	9	5	3316	60	81	94	60	1	6194	59
tribenuron +	0.00375										
MCPA ester +	0.65										
Huntsman	0.125										
Untreated		-	-	3235	58	-	-	-	-	5441	56
LSD (0.05)		4	6	NS	NS	7	2	NS	NS	564	1

[1]Huntsman is an ethoxylated tallow amine surfactant and R-11 is a nonionic surfactant.

[2]Surfactant rates are expressed as %v/v.

Downy brome control with propoxycarbazone-sodium and mesosulfuron-methyl. Larry H. Bennett, Sandra M. Frost, and Daniel A. Ball. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801) A study was established in winter wheat to investigate control of downy brome (*Bromus tectorum*) in winter wheat at the Columbia Basin Agricultural Research Center, Pendleton, OR. Winter wheat (var. 'Stephens') was planted October 10, 2003. Plots were 9 by 30 ft arranged in a randomized complete block design with 3 replications. Soil at the site was a silt loam (25% sand, 61.1% silt, 13.9% clay, 2.5% organic matter, 5.6 pH, and CEC of 16.0 meq/100g). Herbicide treatments were applied using a hand boom sprayer delivering 16 gpa at 30 psi. Early postemergence (EPOST) treatments were applied February 19, 2004 to wheat at the 3 leaf stage, and downy brome at the 2 to 3 leaf stage (Table 1). Late postemergence (LPOST) treatments were applied March 17, 2004 to wheat at the 6 to 7 leaf stage and downy brome at the 5 to 7 leaf stage. Crop injury was visually evaluated on March 31, 2004 (Table 2). Downy brome control was visually evaluated on March 31, April 14 and May 21, 2004. The crop was harvested July 23, 2004 with a small plot combine.

Table 1. Application conditions.

	Feb 19, 2004	Mar 17, 2004
Timing	EPOST	LPOST
Crop (leaf)	3	6-7
Downy brome (leaf)	2-3	5-7
Air temperature (F)	47	53
Relative humidity (%)	80	68
Wind (mph)	4	2
Soil temperature (F)	47	51
Cloud cover (%)	70	80

Downy brome control was fair to good with all treatments at the first two ratings. Propoxycarbazone + metribuzin, the split application of propoxycarbazone, and sufosulfuron + metribuzin were the only treatments that gave 90% control or better at the April 14 rating. Due to heavy downy brome pressure in this trail, control of downy brome was greatly reduced in all plots when the final ratings were taken on May 21, 2004. The same treatments that gave the highest control at the early ratings still gave the highest control at this rating but averaged only 57-63% control. Wheat yields from the different treatments were correlated to the level of downy brome control. The treatments which had the highest downy brome control also tended to have the highest yields. The untreated check averaged only 35 bushel/A, while the three treatments that had the best downy brome control averaged 82-88 bushels/A, an increase of 134-151%.

Table 2. Downy brome control with propoxycarbazone-sodium and mesosulfuron-methyl.

Treatment[1]	Rate	Timing	Crop injury 3/31/04	D.brome control 3/31/04	D.brome control 4/14/04	D.brome control 5/21/04	Crop yield 7/23/04
	lb ai/A		-------------------------%-------------------------				--bu/A--
Propoxycarbazone + NIS	0.039	EPOST	0	85	78	40	76
Propoxycarbazone + metribuzin + NIS	0.039 + 0.187	EPOST	5	90	92	63	82
Propoxycarbazone + NIS	0.039	LPOST	0	72	83	40	59
Propoxycarbazone + metribuzin + NIS	0.039 + 0.187	LPOST	0	73	87	48	64
Propoxycarbazone + NIS / propoxycarbazone + NIS	0.026 / 0.026	EPOST / LPOST	0	87	90	63	88
Mesosulfuron + Soln 32 + NIS	0.013	EPOST	2	85	83	45	82
Mesosulfuron + metribuzin + NIS	0.013 + 0.187	EPOST	5	88	87	47	78
Mesosulfuron + metribuzin + Soln 32 + NIS	0.009 + 0.187	LPOST	0	72	72	28	41
Mesosulfuron + Soln 32 + NIS	0.013	LPOST	2	72	85	37	59
Mesosulfuron + metribuzin + NIS	0.013 + 0.187	LPOST	0	73	75	28	46
Mesosulfuron + metribuzin + Soln 32 + NIS	0.013 + 0.187	LPOST	2	75	78	30	48
Mesosulfuron + MSO	0.013	LPOST	2	73	85	40	59
Mesosulfuron + metribuzin + MSO	0.013 + 0.187	LPOST	2	73	77	30	52
Sulfosulfuron + NIS	0.031	EPOST	0	82	80	43	77
Sulfosulfuron + metribuzin + NIS	0.031 + 0.187	EPOST	2	88	90	57	87
Sulfosulfuron + NIS	0.031	LPOST	0	70	77	35	49
Sulfosulfuron + metribuzin + NIS	0.031 + 0.187	LPOST	0	75	75	33	55
Untreated check			0	0	0	0	35
LSD (0.05)			NS	5	5	9	12

[1] NIS, a non-ionic surfactant, applied at 0.5% v/v and Solution 32 (UAN in a 32% solution) applied at 2.5% v/v. MSO = methylated seed oil applied at 1.5 pt/A.

NS = not significant.

Rattail fescue control in CLEARFIELD™ winter wheat. Larry H. Bennett, Sandra M. Frost, and Daniel A. Ball. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801) A study was established in winter wheat to investigate the response of rattail fescue (*Vulpia myuros*) to a variety of herbicides and timings at the Columbia Basin Agricultural Research Center, Pendleton, OR. Plots were 9 by 30 ft arranged in a randomized complete block design with 4 replications. Soil at the site was a silt loam (23.5% sand, 62.6% silt, 13.9% clay, 2.4% organic matter, 5.7 pH, and CEC of 15.8 meq/100g). Herbicide treatments were applied using a hand boom sprayer delivering 10 gpa at 20 psi. Winter wheat (var. Clearfirst) was seeded on October 16, 2003. Preemergence (PRE) treatments were applied October 16, 2003 before weed or crop emergence (Table 1). Early postemergence (EPOST) treatments were applied March 29, 2004 to wheat at the 5 to 7 leaf stage, rattail fescue at the 6 to 8 leaf stage and downy brome at the 5 to 7 leaf stage. Wheat stand counts were made on November 18, 2003 (Table 2). Control of rattail fescue and downy brome, as well as crop injury were visually evaluated on April 20 and May 27, 2004. Rattail fescue biomass was sampled June 24, 2004. The crop was harvested July 27, 2004 with a small plot combine

Table 1. Application conditions.

	Oct 16, 2003	Mar 29, 2004
Timing	PRE	EPOST
Crop (leaf)	--	5-7
Rattail fescue (leaf)	--	6-8
Air temperature (F)	62	72
Relative humidity (%)	74	26
Wind (mph)	3	5
Soil temperature (F)	52	74
Cloud cover (%)	90	0

Rattail fescue was controlled by any treatment containing flufenacet applied preemergence. A postemergence application of flufenacet was not effective. Pendimethalin applied preemergence gave fair to good control of rattail fescue, but no control of downy brome. Flufenacet applied preemergence, followed by imazamox applied EPOST gave the most consistent control of both rattail fescue and downy brome. Sulfosulfuron and mesosulfuron-methyl gave only partial control of both weed species when applied without a preemergence treatment preceeding them. Rattail fescue biomass closely followed the visual control ratings. Wheat yields appeared to be correlated with weed control, especially downy brome control. Those treatments with the highest downy brome control gave higher yields than treatments which did not control downy brome. Funding for this project was provided by the USDA-CSREES-STEEP III program.

Table 2. Rattail fescue control in CLEARFIELD™ winter wheat.

Treatment [1]	Rate	Timing	Wheat stand	Rattail fescue control		Downy brome control		Wheat injury		Rat.fes. biomass	Wheat yield
			3/22/04	4/20/04	5/27/04	4/20/04	5/27/04	4/20/04	5/27/04	6/24/04	7/27/04
	--lb ai / A--		plants / m of row	------------------------------------%------------------------------------						--g/m^2--	--bu/A--
Pendimethalin	0.75	PRE	22	68	81	0	0	0	0	6	47
Flufenacet	0.36	PRE	23	100	97	40	18	0	0	1	54
Flufenacet + NIS	0.36	EPOST	20	13	48	0	3	0	0	17	43
Sulfosulfuron + NIS + Soln 32	0.031	EPOST	20	39	35	76	35	4	0	18	59
Mesosulfuron-methyl + NIS + Soln 32	0.013	EPOST	24	44	33	76	10	3	0	19	60
Diuron (80% DF)	1.0	EPOST	21	11	25	0	0	0	0	7	43
Imazamox + NIS + Soln 32	0.047	EPOST	21	65	58	90	78	20	3	15	69
Flufenacet / sulfosulfuron + NIS + Soln 32	0.36 / 0.031	PRE / EPOST	22	100	100	83	68	5	0	0	77
Flufenacet / mesosulfuron-methyl + NIS + Soln 32	0.36 / 0.013	PRE / EPOST	20	100	100	78	35	4	0	1	73
Flufenacet / diuron	0.36 / 1.0	PRE / EPOST	22	99	100	43	10	0	0	0	64
Flufenacet / imazamox + NIS + Soln 32	0.36 / 0.047	PRE / EPOST	23	100	100	93	90	19	3	0	75
Pendimethalin / flufenacet + NIS	0.75 / 0.36	PRE / EPOST	19	78	97	0	0	1	0	0	44
Pendimethalin / sulfosulfuron + NIS +Soln 32	0.75 / 0.031	PRE / EPOST	22	91	96	78	28	1	0	0	68
Pendimethalin / mesosulfuron-methyl+ NIS + Soln 32	0.75 / 0.013	PRE / EPOST	21	86	98	75	10	6	0	2	58
Pendimethalin / diuron	0.75 / 1.0	PRE / EPOST	19	70	93	16	0	1	0	0	49
Pendimethalin / imazamox + NIS + Soln 32	0.75 / 0.047	PRE / EPOST	20	80	81	89	80	24	4	5	66
Untreated check			21	0	0	0	0	0	0	25	44
LSD (0.05)			NS	14	10	14	11	8	NS	12	10

[1]NIS applied at 0.5% v/v and Solution 32 (UAN in a 32% solution) applied at 2.5% v/v. NS = not significant.

Rattail fescue control in imidazolinone-resistant winter wheat. Chuck Cole, Carol Mallory-Smith, Richard Affeldt, and Jed Colquhoun (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002). A trial was established in imidazolinone-resistant winter wheat to test several herbicides for rattail fescue control and crop tolerance. 'Clearfirst' winter wheat was drilled on six-inch rows at 125 lbs/A on October 13, 2003. Plots were 8 by 28 feet arranged as a randomized complete block with five replications. Treatments were applied using a single-wheel compressed air sprayer calibrated to deliver 20 gpa. Herbicides were applied either preemergence and/or at the 2 leaf and 3 tiller stages of growth (Table 1). Rattail fescue control and crop injury were rated visually. Wheat was harvested with a small plot combine on July 22, 2004.

Table 1. Application and soil data for near Corvallis, OR.

Application date	October 14, 2003	October 29, 2003	December 10, 2003
Wheat growth stage	pre	2 leaf	3 tiller
Rattail fescue growth stage	pre	2 leaf	3 tiller
Air temperature (F)	50	56	40
Relative humidity (%)	74	75	86
Soil temperature (F)	51	52	40
Soil pH		5.6	
OM (%)		3.0	
Soil name, texture		Woodburn, silt loam	

Rattail fescue was controlled effectively with applications of flufenacet and diuron applied as either a single preemergence treatment or as part of a sequential treatment (Table 2). Pendimethalin applied as a single preemergence treatment provided 69% rattail fescue control. Plots receiving pendimethalin applied preemergence followed by postemergence applications of flufenacet, sulfosulfuron, mesosulfuron, diuron, or imazamox had good rattail fescue control. Postemergence rattail fescue control at the 2 leaf stage was good with flufenacet, sulfosulfuron, or diuron at the higher rate. Mesosulfuron and the lower rate of diuron provided fair rattail fescue control at the 2 leaf stage. Imazamox applied alone provided 80% rattail fescue control at the 3 tiller stage. Crop safety was generally good with all treatments. Moderate stunting and chlorosis was observed with imazamox when applied at both the 2 leaf and 3 tiller wheat stages. Flufenacet applied preemergence did result in stand thinning, but did not influence yield. Crop safety with flufenacet applied at the 2 leaf stage was excellent while providing 100% rattail fescue control. Wheat yields were improved compared to the untreated check with all treatments. Pendimethalin applied as a single preemergence treatment, the low rate of diuron applied at the 2 leaf stage, and all imazamox treatments did not yield as well as the other herbicide treatments where flufenacet, diuron, sulfosulfuron or mesosulfuron were included.

Table 2. Rattail fescue control, crop injury, and wheat yield near Corvallis, OR.

Treatment[1]	Rate	Rattail fescue stage	Rattail fescue control[2]	Wheat	
				Injury[2]	Yield
	lb ai/A		------------------%------------------		Bu/A
Pendimethalin	0.75	pre	69	2	101
Flufenacet	0.36	pre	100	12	122
Diuron	1.6	pre	91	12	118
Flufenacet/ sulfosulfuron	0.36/ 0.031	pre/ 2 leaf	100	11	120
Flufenacet/ mesosulfuron	0.36/ 0.013	pre/ 2 leaf	100	15	123
Flufenacet/ diuron	0.36/ 1.0	pre/ 2 leaf	100	14	119
Flufenacet/ diuron	0.36/ 1.6	pre/ 2 leaf	100	16	119
Pendimethalin/ flufenacet	0.75/ 0.36	pre/ 2 leaf	100	0	118
Pendimethalin/ sulfosulfuron	0.75/ 0.031	pre/ 2 leaf	100	0	119
Pendimethalin/ mesosulfuron	0.75/ 0.013	pre/ 2 leaf	97	3	117
Pendimethalin/ diuron	0.75/ 1.0	pre/ 2 leaf	91	4	117
Pendimethalin/ diuron	0.75/ 1.6	pre/ 2 leaf	95	2	116
Flufenacet/ imazamox	0.36/ 0.047	pre/ 3 tiller	100	18	111
Pendimethalin/ imazamox	0.75/ 0.047	pre/ 3 tiller	99	4	113
Flufenacet	0.36	2 leaf	100	0	119
Sulfosulfuron	0.031	2 leaf	95	2	117
Mesosulfuron	0.013	2 leaf	85	9	116
Diuron	1.0	2 leaf	76	0	113
Diuron	1.6	2 leaf	92	3	116
Imazamox	0.047	3 tiller	80	16	106
Untreated check	0		0	0	92
LSD (0.05)			7	5	7

[1] Sulfosulfuron and imazamox applied with 90% non-ionic surfactant (R-11) at 0.5% v/v and urea ammonium nitrate (UAN) solution at 2.5% v/v. Mesosulfuron applied with R-11 and UAN at 0.5% v/v. Flufenacet treatment applied at 2 leaf stage with R-11 at 0.5% v/v.

[2] Weed control and crop injury ratings evaluated March 15, 2004.

Rattail fescue control in imazamox-tolerant winter wheat with various herbicides. Eric D. Jemmett, Traci A. Rauch, and Donald C. Thill (Plant Science Division, University of Idaho, Moscow, ID 83844-2339). Two studies were established near Genesee and Moscow, ID in winter wheat to investigate response of rattail fescue (VLPMY) to different formulations and timings of herbicides. 'Clearfirst' winter wheat and rattail fescue were planted October 17 and 20, 2004 at Genesee and Moscow, respectively. Rattail fescue was seeded at 16 lb/A using a cone seeder and wheat at 100 lb/A using a grain box drill. All plots were 8 by 30 ft arranged in a randomized complete block design with four replications. Herbicide treatments were applied using a backpack sprayer delivering 10 gpa at 34 psi and 3 mph (Table 1). Control of rattail fescue was visually evaluated twice during spring 2004. Rattail fescue panicles were counted and biomass was collected June 24 and June 28, 2004 at Genesee and Moscow, respectively. Crop stand was determined April 5 and April 7, 2004 at Moscow and Genesee, respectively. Crop injury was visually evaluated April 27, 2004 for both locations. Crop height was measured and crop heads were counted at both locations June 28, 2004. The crop was harvested at Genesee and Moscow on August 10 and 13, 2004, respectively, with a small plot combine and harvested seed was cleaned.

Table 1. Application conditions.

	Genesee, Idaho		Moscow, Idaho	
Application dates	10/27/03	4/13/04	10/22/03	4/12/04
Timing	PRE	EPOST	PRE	EPOST
Winter wheat growth stage	preemergence	2 to 3 tiller	preemergence	1 to 3 tiller
Rattail fescue growth stage	preemergence	3 to 5 leaf	preemergence	2 to 3 leaf
Air temperature (F)	60	71	80	70
Relative humidity (%)	58	34	34	26
Wind (mph)	0	3	1	4
Cloud cover (%)	100	95	10	5
Soil temperature (F)	50	60	60	58
pH	5.3		5.1	
OM%	3.6		3.1	
CEC (meg/100g)	21		17	
Texture	silt loam		silt loam	

At Genesee, flufenacet in combination with pendimethalin or imazamox, pendimethalin + imazamox, imazamox, and mesosulfuron + NIS injured wheat 9 to 15% (Table 2). There was no difference among treatments for wheat height and heads per yard of row (Table 3). Compared to the untreated control, wheat plants per yard of row were less in plots treated with flufenacet, and greater in plots treated with mesosulfuron + MSO + UAN. Wheat yield was less than the untreated check in plots treated with flufenacet + pendimethalin, flufenacet + diuron, and flufenacet + imazamox. (Table 2). Control of rattail fescue on June 14 and July 12 was 88 to 99% and 90 to 99%, respectively, with flufenacet alone or in combination and pendimethalin combined with flufenacet, sulfosulfuron, imazamox or diuron. Control was least (64 to 66%) with pendimethalin and diuron. All treatments reduced rattail fescue biomass and panicle density equally compared to the untreated control, except biomass in plots treated with diuron.

At Moscow, mesosulfuron treatments, pendimethalin in combination with diuron or imazamox, and flufenacet in combination with mesosulfuron + NIS and imazamox injured wheat 6 to 12% (Table 4). There was no difference among treatments for wheat height and wheat plants per yard of row (Table 5). Compared to untreated control, wheat heads per yard of row were less in plots treated with pendimethalin + diuron. Wheat yield was less in treatments of flufenacet + imazamox, pendimethalin + diuron, and pendimethalin + imazamox (75 bu/A) (Table 4). Control of rattail fescue on June 14 and July 12 was 85 to 99% and 92 to 99%, respectively, with all treatments except for mesosulfuron + NIS + UAN. All treatments equally reduced rattail fescue density compared to the untreated control except mesosulfuron + NIS. All treatments equally reduced rattail fescue biomass compared to the untreated control.

Table 2. Rattail fescue control and winter wheat response to herbicide treatments at Genesee, Idaho in 2004.

Treatment[1]	Rate	Application timing[2]	Wheat Yield	Wheat Injury	Rattail fescue control 6/14/2004	Rattail fescue control 7/12/2004
	lb ai/A		bu/A	%	%	%
Untreated check	--	--	98	--	--	--
Pendimethalin	0.750	PRE	93	0	64	64
Flufenacet	0.360	PRE	91	3	96	96
Flufenacet + pendimethalin	0.360 0.750	PRE	85	10	97	97
Flufenacet + NIS	0.360	EPOST	107	1	92	91
Sulfosulfuron + NIS + UAN	0.031	EPOST	102	0	84	85
Mesosulfuron + NIS + UAN	0.013	EPOST	97	9	69	74
Mesosulfuron + MSO + UAN	0.013	EPOST	105	6	85	84
Diuron	1.000	EPOST	97	3	66	65
Imazamox + NIS + UAN	0.047	EPOST	95	10	85	84
Flufenacet + sulfosulfuron + NIS + UAN	0.360 0.031	PRE EPOST	95	3	95	98
Flufenacet + mesosulfuron + NIS + UAN	0.360 0.013	PRE EPOST	91	6	92	93
Flufenacet + diuron	0.360 1.000	PRE EPOST	84	6	99	99
Flufenacet + imazamox + NIS + UAN	0.360 0.047	PRE EPOST	83	15	99	99
Pendimethalin + flufenacet + NIS	0.750 0.360	PRE EPOST	95	0	98	98
Pendimethalin + sulfosulfuron + NIS + UAN	0.750 0.031	PRE EPOST	100	0	97	97
Pendimethalin + mesosulfuron + NIS + UAN	0.750 0.013	PRE EPOST	95	8	84	83
Pendimethalin + diuron	0.750 1.000	PRE EPOST	93	4	88	90
Pendimethalin + imazamox + NIS + UAN	0.750 0.047	PRE EPOST	93	11	97	96
LSD (0.05)			9	8	13	12

[1]EPOST treatments, except diuron received a non-ionic surfactant (NIS) (R-11) at 0.5 % v/v. Sulfosulfuron, mesosulfuron, and imazamox treatments received urea ammonium nitrate (UAN) at 2.5% v/v (Solution 32). MSO is methylated seed oil.
[2]PRE – preemergence treatments applied after seeding, but before crop and rattail fescue emergence. EPOST – early postemergence applied to rattail fescue in the 3 to 5 leaf stage of growth.

Table 3. Rattail fescue and winter wheat responses to herbicide treatments at Genesee, Idaho in 2004.

Treatment[1]	Rate	Application timing[2]	Wheat[3] Plants	Height	Heads	Rattail fescue[3] Panicle density[4,5]	Biomass[5]
	lb ai/A		no./yd row	inch	no./yd row	no./yd^2	oz/yd^2
Untreated check	--	--	13.0 b-g	36 a	109 a	184.3 a	0.373 a
Pendimethalin	0.750	PRE	11.7 c-h	32 a	102 a	12.5 b	0.074 bc
Flufenacet	0.360	PRE	9.0 h	35 a	118 a	0.0 b	0.000 c
Flufenacet + pendimethalin	0.360 0.750	PRE	10.0 fgh	35 a	94 a	0.0 b	0.000 c
Flufenacet + NIS	0.360	EPOST	15.5 abc	36 a	91 a	1.3 b	0.003 c
Sulfosulfuron + NIS + UAN	0.031	EPOST	12.7 b-h	36 a	104 a	8.8 b	0.020 c
Mesosulfuron + NIS + UAN	0.013	EPOST	10.7 e-h	36 a	117 a	35.0 b	0.133 bc
Mesosulfuron + MSO + UAN	0.013	EPOST	17.0 a	38 a	102 a	1.5 b	0.010 c
Diuron	1.000	EPOST	14.2 a-e	34 a	89 a	37.3 b	0.194 b
Imazamox + NIS + UAN	0.047	EPOST	15.0 a-d	35 a	104 a	3.0 b	0.013 c
Fluefenacet + sulfosulfuron + NIS + UAN	0.360 0.031	PRE EPOST	12.5 b-h	36 a	77 a	0.0 b	0.000 c
Flufenacet + mesosulfuron + NIS + UAN	0.360 0.013	PRE EPOST	11.2 d-h	36 a	90 a	5.3 b	0.025 c
Flufenacet + diuron	0.360 1.000	PRE EPOST	11.5 d-h	33 a	71 a	0.0 b	0.000 c
Flufenacet + imazamox + NIS + UAN	0.360 0.047	PRE EPOST	9.7 gh	33 a	71 a	0.0 b	0.000 c
Pendimethalin + flufenacet + NIS	0.750 0.360	PRE EPOST	13.2 a-g	36 a	92 a	0.0 b	0.000 c
Pendimethalin + sulfosulfuron + NIS + UAN	0.750 0.031	PRE EPOST	14.7 a-d	37 a	109 a	0.3 b	0.000 c
Pendimethalin + mesosulfuron + NIS + UAN	0.750 0.013	PRE EPOST	13.7 a-f	34 a	93 a	2.5 b	0.007 c
Pendimethalin + diuron	0.750 1.000	PRE EPOST	14.25 a-e	35 a	84 a	1.5 b	0.005 c
Pendimethalin + imazamox + NIS + UAN	0.750 0.047	PRE EPOST	15.7 ab	34 a	86 a	0.0 b	0.000 c

[1]EPOST treatments, except diuron received a non-ionic surfactant (NIS) (R-11) at 0.5 % v/v. Sulfosulfuron, mesosulfuron, and imazamox treatments received urea ammonium nitrate (UAN) at 2.5% v/v (Solution 32). MSO is methylated seed oil.

[2]PRE – preemergence treatments applied after seeding, but before crop and rattail fescue emergence. EPOST – early postemergence applied to rattail fescue in the 3 to 5 leaf stage of growth.

[3]Means within a column, followed by the same letter, do not significantly differ at P=0.05.

[4]Rattail panicle density was used due to inability to distinguish between plants for an accurate plant count.

[5]Rattail biomass and panicle density data was analyzed using a square root transformation.

Table 4. Rattail fescue control and winter wheat response to herbicide treatments at Moscow, Idaho in 2004.

Treatment[1]	Rate	Application timing[2]	Wheat Yield	Wheat Injury	Rattail fescue control 6/14/2004	Rattail fescue control 7/12/2004
	lb ai/A		bu/A	%		
Untreated check	--	--	84	--	--	--
Pendimethalin	0.750	PRE	88	0	99	99
Flufenacet	0.360	PRE	87	0	99	99
Flufenacet + pendimethalin	0.360 0.750	PRE	81	1	97	99
Flufenacet + NIS	0.360	EPOST	82	1	98	97
Sulfosulfuron + NIS + UAN	0.031	EPOST	88	0	91	92
Mesosulfuron + NIS + UAN	0.013	EPOST	88	9	78	74
Mesosulfuron + MSO[3] + UAN	0.013	EPOST	88	6	85	95
Diuron	1.000	EPOST	80	3	97	97
Imazamox + NIS + UAN	0.047	EPOST	82	4	98	98
Fluefenacet + sulfosulfuron + NIS + UAN	0.360 0.031	PRE EPOST	84	0	99	99
Flufenacet + mesosulfuron + NIS + UAN	0.360 0.013	PRE EPOST	81	6	99	99
Flufenacet + diuron	0.360 1.000	PRE EPOST	77	1	99	99
Flufenacet + imazamox + NIS + UAN	0.360 0.047	PRE EPOST	75	12	99	99
Pendimethalin + flufenacet + NIS	0.750 0.360	PRE EPOST	80	0	99	99
Pendimethalin + sulfosulfuron + NIS + UAN	0.750 0.031	PRE EPOST	82	4	98	98
Pendimethalin + mesosulfuron + NIS + UAN	0.750 0.013	PRE EPOST	84	3	99	99
Pendimethalin + diuron	0.750 1.000	PRE EPOST	75	8	99	99
Pendimethalin + imazamox + NIS + UAN	0.750 0.047	PRE EPOST	75	8	99	99
LSD (0.05)			8	5	7	8

[1]EPOST treatments, except diuron received a non-ionic surfactant (NIS) (R-11) at 0.5 % v/v. Sulfosulfuron, mesosulfuron, and imazamox treatments received urea ammonium nitrate (UAN) at 2.5% v/v (Solution 32). MSO is methylated seed oil.
[2]PRE – preemergence treatments applied after seeding, but before crop and rattail fescue emergence. EPOST – early postemergence applied to rattail fescue in the 2 to 3 leaf stage of growth.

Table 5. Rattail fescue and winter wheat response to herbicide treatments at Moscow, Idaho in 2004.

Treatment[1]	Rate	Application timing[2]	Wheat[3] Plants	Wheat[3] Height	Wheat[3] Heads	Rattail fescue[3] Panicle density[4]	Rattail fescue[3] Biomass[5]
	lb ai/A		no./yd row	inch	no./yd row	no./yd^2	oz/yd^2
Untreated check	--	--	16 a	36 a	68.8 abc	54.0 a	0.192 a
Pendimethalin	0.750	PRE	17 a	33 a	53.5 cd	0.0 c	0.000 b
Flufenacet	0.360	PRE	18 a	35 a	65.3 a-d	0.0 c	0.000 b
Flufenacet + pendimethalin	0.360 0.750	PRE	15 a	35 a	61.5 bcd	0.0 c	0.000 b
Flufenacet + NIS	0.360	EPOST	13 a	34 a	71.3 abc	0.3 c	0.000 b
Sulfosulfuron + NIS + UAN	0.031	EPOST	14 a	35 a	78.5 ab	2.0 bc	0.005 b
Mesosulfuron + NIS + UAN	0.013	EPOST	18 a	36 a	65.0 a-d	4.3 b	0.006 b
Mesosulfuron + MSO + UAN	0.013	EPOST	13 a	34 a	56.5 cd	0.0 c	0.001 b
Diuron	1.000	EPOST	15 a	33 a	58.5 cd	3.3 bc	0.015 b
Imazamox + NIS + UAN	0.047	EPOST	17 a	34 a	56.3 cd	0.0 c	0.000 b
Fluefenacet + sulfosulfuron + NIS + UAN	0.360 0.031	PRE EPOST	17 a	34 a	68.0 a-d	0.0 c	0.001 b
Flufenacet + mesosulfuron + NIS + UAN	0.360 0.013	PRE EPOST	13 a	33 a	57.0 cd	0.0 c	0.000 b
Flufenacet + diuron	0.360 1.000	PRE EPOST	14 a	34 a	56.5 cd	0.0 c	0.000 b
Flufenacet + imazamox + NIS + UAN	0.360 0.047	PRE EPOST	13 a	32 a	57.5 cd	0.0 c	0.000 b
Pendimethalin + flufenacet + NIS	0.750 0.360	PRE EPOST	11 a	33 a	64.5 a-d	0.0 c	0.000 b
Pendimethalin + sulfosulfuron + NIS + UAN	0.750 0.031	PRE EPOST	16 a	35 a	82.5 a	0.0 c	0.000 b
Pendimethalin + mesosulfuron + NIS + UAN	0.750 0.013	PRE EPOST	14 a	36 a	81.3 a	0.0 c	0.000 b
Pendimethalin + diuron	0.750 1.000	PRE EPOST	17 a	35 a	49.5 d	0.0 c	0.000 b
Pendimethalin + imazamox + NIS + UAN	0.750 0.047	PRE EPOST	14 a	34 a	67.3 a-d	0.0 c	0.000 b

[1]EPOST treatments, except diuron received a non-ionic surfactant (NIS) (R-11) at 0.5 % v/v. Sulfosulfuron, mesosulfuron, and imazamox treatments received urea ammonium nitrate (UAN) at 2.5% v/v (Solution 32). MSO is methylated seed oil.
[2]PRE – preemergence treatments applied after seeding, but before crop and rattail fescue emergence. EPOST – early postemergence applied to rattail fescue in the 3 to 5 leaf stage of growth.
[3]Means within a column, followed by the same letter, do not significantly differ at P=0.05.
[4]Rattail panicle density was used due to inability to distinguish between plants for an accurate plant count.
[5]Rattail biomass and panicle density data was analyzed using a square root transformation.

Italian ryegrass and jointed goatgrass control in winter wheat with flucarbazone. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in 'Madsen' winter wheat near Moscow, Idaho to evaluate Italian ryegrass and jointed goatgrass control with flucarbazone combined with flufenacet/metribuzin or various adjuvants. Plots were 8 by 30 ft, 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 30 psi and 3 mph (Table 1). The studies were oversprayed with clopyralid/MCPA at 0.60 lb ae/A on May 14, 2004 to control broadleaf weeds. Wheat injury and weed control were evaluated visually. Wheat seed was harvested with a small plot combine on August 11, 2004.

Table 1. Application and soil data.

Study	Flucarbazone and flufenacet/metribuzin		Flucarbazone plus adjuvants
Application date	September 24, 2003	May 5, 2004	May 7, 2004
Growth stage			
Wheat	preemergence	2 to 5 tiller	2 to 5 tiller
Italian ryegrass (LOLMU)	preemergence	2 leaf to 3 tiller	2 leaf to 3 tiller
Jointed goatgrass (AECGY)	preemergence	2 to 3 tiller	2 to 3 tiller
Air temperature (F)	78	53	70
Relative humidity (%)	31	58	42
Wind (mph, direction)	0	5, W	2, SW
Cloud cover (%)	0	100	30
Soil moisture	dry	dry	dry
Soil temperature at 2 in (F)	60	55	55
Soil			
pH		5.2	
OM (%)		3.0	
CEC (meq/100g)		18	
texture		silt loam	

In the flucarbazone and flufenacet/metribuzin study, all treatments injured wheat 2 to 11 and 2 to 15% on May 12 and June 25, 2004, respectively (Table 2). All flucarbazone treatments controlled Italian ryegrass better (92 to 99%) than flufenacet/metribuzin alone (66%). Jointed goatgrass plant density was light and non-uniform and control tended to be better with flucarbazone treatments. Wheat seed yield and test weight ranged from 112 to 125 bu/A and 59.1 to 60.8 lb/bu, respectively, and tended to greater in the untreated check.

In the flucarbazone plus adjuvants study, all treatments injured wheat 2 to 16% (Table 3). Italian ryegrass control ranged from 79 to 99% and tended to be greater with flucarbazone treatments containing a modified seed oil. Jointed goatgrass plant density was light and non-uniform. Flucarbazone treatments tended to suppress jointed goatgrass (10 to 32%) more than clodinafop (0%). Wheat seed yield and test weight ranged from 110 to 116 bu/A and 56.5 to 59.0 lb/bu, respectively, and tended to greater in the untreated check.

Table 2. Weed control and wheat response with flucarbazone and flufenacet/metribuzin near Moscow, Idaho in 2004.

Treatment[1]	Rate	Wheat injury 5/12/04	Wheat injury 6/25/04	LOLMU control[2]	ACEGY control[2]	Wheat Yield	Wheat Test weight
	lb ai/A	-----%			-----%	bu/A	lb/bu
Flufenacet/metribuzin	0.34	6	2	66	9	121	60.5
Flucarbazone +	0.026						
NIS	0.25% v/v	2	5	96	31	113	59.6
Flufenacet/metribuzin +	0.34						
flucarbazone +	0.026						
NIS	0.25 % v/v	5	4	95	56	113	59.8
Flucarbazone +	0.026						
NIS +	0.25% v/v						
UAN	4 pt/A	5	10	97	51	113	59.1
Flufenacet/metribuzin +	0.34						
flucarbazone +	0.026						
NIS +	0.25 % v/v						
UAN	4 pt/A	10	13	99	25	114	57.6
Flucarbazone +	0.026						
NIS +	0.25% v/v						
AMS	8.5 lb/100 gal	11	15	97	40	112	59.8
Flufenacet/metribuzin +	0.34						
flucarbazone +	0.026						
NIS +	0.25 % v/v						
AMS	8.5 lb/100 gal	6	4	92	45	118	59.7
Untreated check	--	--	--	--	--	125	60.8
LSD (0.05)		NS	NS	14	NS	NS	NS
Density (plants/ft^2)				5	1		

[1]NIS is 90% non-ionic surfactant (R-11); UAN is 32% urea ammonium nitrate (URAN); and AMS is ammonium sulfate (Bronc).
[2]June 25, 2004 evaluation.

Table 3. Weed control and wheat response with flucarbazone and various adjuvants near Moscow, Idaho in 2004.

Treatment[1]	Rate	Wheat injury[2]	LOLMU control[2]	ACEGY control[2]	Wheat Yield	Wheat Test weight
					bu/A	lb/bu
Flucarbazone +	0.027 lb ai/A					
NIS	0.25% v/v	15	87	32	111	57.8
Flucarbazone +	0.027 lb ai/A					
MSO +	1.8 pt/A					
AMS	10.2 lb/100 gal	2	99	31	114	58.0
Flucarbazone +	0.027 lb ai/A					
MSO/NIS/NH_3/buffer	1 % v/v	9	99	28	112	57.3
Flucarbazone +	0.027 lb ai/A					
MSO/NIS/NH_3/buffer +	1% v/v					
deposition aid	2 fl oz/A	14	97	29	111	57.9
Clodinafop +	0.06 lb ai/A					
COC	12.8 fl oz/A	16	79	0	110	56.9
Untreated check	--	--	--	--	116	59.0
LSD (0.05)		NS	NS	NS	NS	NS
Density (plants/ft^2)			5	1		

[1]NIS is 90% non-ionic surfactant (R-11); MSO is modified seed oil; AMS is ammonium sulfate (Bronc); MSO/NIS/NH_3/buffer is Renegade; deposition aid is In-Place; and COC is crop oil concentrate (Score).
[2]June 25, 2004 evaluation.

Grass weed control in winter wheat with flufenacet combinations. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Three studies were established near Genesee, Moscow, and Viola, Idaho in winter wheat to evaluate Italian ryegrass and jointed goatgrass control and wheat response with flufenacet alone and combined with other grass herbicides. 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 30 psi and 3 mph (Table 1). The studies were oversprayed with clopyralid/MCPA at 0.60 lb ae/A on May 14, 2004 to control broadleaf weeds. Wheat injury and weed control were evaluated visually. Wheat seed was harvested with a small plot combine at the Genesee and Moscow studies on August 11 and the Viola study on August 18, 2004.

Table 1. Application and soil data.

Location	Genesee, Idaho		Moscow, Idaho		Viola, Idaho	
Application date	10/10/03	4/28/04	3/24/03	4/23/03	9/24/03	5/5/04
Growth stage						
Italian ryegrass (LOLMU)	preemergence	3 to 4 leaf	preemergence	4 leaf to 2 tiller	preemergence	2 leaf to 3 tiller
Jointed goatgrass (AGECY)	--	--	--	--	preemergence	2 to 4 tiller
Winter wheat	preemergence	6 to 10 tiller	preemergence	3 to 5 tiller	preemergence	2 to 5 tiller
Air temperature (F)	55	61	74	65	78	50
Relative humidity (%)	55	36	51	54	31	50
Wind (mph, direction)	2, W	2, SW	3, SE	1, SW	2, SW	3, W
Cloud cover (%)	90	0	0	60	0	100
Soil moisture	dry	dry	dry	dry	dry	dry
Soil temperature at 2 in (F)	45	50	50	55	60	55
pH	5.4		5.0		5.2	
OM (%)	3.4		2.6		3.0	
CEC (meq/100g)	23		15		18	
Texture	silt loam		silt loam		silt loam	

Mesosulfuron (9 and 10%) and flucarbazone (8 to 12%) applied alone or in combination with flufenacet injured wheat at Moscow and Genesee, respectively (Table 2). At the Viola study, no treatment significantly injured wheat. At the Genesee study, mesosulfuron controlled Italian ryegrass the best (93 and 96%) while control was poorest with chlorsulfuron/metsulfuron (38%). At the Moscow study, flufenacet + chlorsulfuron/metsulfuron and mesosulfuron and flufenacet/metribuzin treatments controlled Italian ryegrass better (95 to 99%) than flucarbazone and triasulfuron alone (88%). At the Viola study, Italian ryegrass control was best with mesosulfuron and flucarbazone treatments (94 to 99%) but did not differ from triasulfuron combinations and flufenacet + chlorsulfuron/metsulfuron (85 to 90%).

Wheat seed yield did not differ among treatments and ranged from 129 to 134 bu/A at the Genesee study and 103 to 118 bu/A at the Viola study (Table 3). At the Moscow study, wheat seed yield was greater with flufenacet/metribuzin than flufenacet + triasulfuron, chlorsulfuron/metsulfuron alone or in combination and flucarbazone alone or in combination. At all three locations, wheat test weight did not differ among treatments but tended to be equal to or less than the untreated check.

Table 2. Wheat injury and weed control with flufenacet combinations near Genesee, Moscow, and Viola, Idaho in 2004.

			Genesee		Moscow		Viola		
Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	LOLMU[4]	Wheat injury[5]	LOLMU[5]	Wheat injury[5]	LOLMU[5]	AGECY[5]
	lb ai/A								
Flufenacet/metribuzin	0.425	preemergence	4	62	0	95	1	68	35
Flufenacet	0.34	preemergence	0	64	0	94	0	74	13
Triasulfuron	0.026	preemergence	0	62	0	88	0	75	7
Chlorsulfuron/metsulfuron	0.023	preemergence	0	38	0	92	0	70	0
Flufenacet/metribuzin +	0.425	preemergence							
triasulfuron	0.026	preemergence	2	65	0	99	0	85	7
Flufenacet/metribuzin +	0.425								
chlorsulfuron/metsulfuron	0.023	preemergence	0	75	2	96	2	90	30
Flufenacet +	0.34								
triasulfuron	0.026	preemergence	0	71	0	93	3	87	10
Flufenacet +	0.34								
chlorsulfuron/metsulfuron	0.023	preemergence	0	64	0	95	0	76	0
Flucarbazone	0.027	postemergence	0	60	8	88	6	96	65
Mesosulfuron	0.013	postemergence	9	93	1	97	7	94	63
Flufenacet +	0.34	preemergence							
flucarbazone	0.027	postemergence	0	75	12	94	10	98	81
Flufenacet +	0.34	preemergence							
mesosulfuron	0.013	postemergence	10	96	0	99	3	99	97
LSD (0.05)			5	14	2	7	NS	15	52
Density (plants/ft^2)				7		2		4	0.5

[1]A non-ionic surfactant (R-11) at 0.25% v/v and modified seed oil (MSO) at 1.5 pt/A was applied with flucarbazone and mesosulfuron treatments, respectively.
[2]Application timing based on Italian ryegrass growth stage. Postemergence = 3 to 4 leaf for Genesee, 4 leaf to 2 tiller for Moscow, and 2 leaf to 3 tiller for Viola.
[3]June 11, 2004 evaluation date.
[4]July 14, 2004 evaluation date.
[5]June 25, 2004 evaluation date

Table 3. Wheat yield and test weight with flufenacet combinations near Genesee, Moscow, and Viola, Idaho in 2004.

Treatment[1]	Rate	Application timing[2]	Wheat yield			Wheat test weight		
			Genesee	Moscow	Viola	Genesee	Moscow	Viola
	lb ai/A		--------------bu/A--------------			--------------lb/bu--------------		
Flufenacet/metribuzin	0.425	pre	131	115	109	59.8	58.9	55.3
Flufenacet	0.34	pre	130	113	114	59.5	59.1	56.3
Triasulfuron	0.026	pre	129	112	110	59.4	58.6	55.9
Chlorsulfuron/metsulfuron	0.023	pre	131	109	113	59.3	59.2	55.2
Flufenacet/metribuzin +	0.425							
triasulfuron	0.026	pre	133	111	118	58.7	59.2	56.4
Flufenacet/metribuzin +	0.425							
chlorsulfuron/metsulfuron	0.023	pre	134	111	108	59.7	58.6	55.5
Flufenacet +	0.34							
triasulfuron	0.026	pre	133	109	108	59.1	58.9	55.5
Flufenacet +	0.34							
chlorsulfuron/metsulfuron	0.023	pre	131	106	110	59.3	58.8	54.9
Flucarbazone	0.027	post	131	106	104	59.5	57.5	54.1
Mesosulfuron	0.013	post	130	114	104	59.3	58.3	54.1
Flufenacet +	0.34	pre						
flucarbazone	0.027	post	129	104	103	59.6	57.3	54.9
Flufenacet +	0.34	pre						
mesosulfuron	0.013	post	129	111	103	59.6	57.6	53.9
Untreated check	--	--	129	109	107	59.8	59.0	55.5
LSD (0.05)			NS	5	NS	NS	NS	NS

[1]A non-ionic surfactant (R-11) at 0.25% v/v and modified seed oil (MSO) at 1.5 pt/A was applied with flucarbazone and mesosulfuron treatments, respectively.

[2]Application timing based on Italian ryegrass growth stage. Pre= preemergence; Post= postemergence: 3 to 4 leaf for Genesee, 4 leaf to 2 tiller for Moscow, and 2 leaf to 3 tiller for Viola.

Field horsetail and smooth scouringrush control in winter wheat Janice Reed, Traci Rauch, and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were conducted near Moscow and Genesee, ID to evaluate field horsetail and smooth scouringrush control, respectively, in winter wheat with sulfonylurea herbicides. All plots were arranged in a randomized complete block design with four replications and included an untreated check. All herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Weed control and wheat injury were evaluated visually. Plots were harvested at maturity.

Table 1. Application and soil data.

Location	Moscow, Idaho			Genesee, Idaho		
Application timing	preemergence	early post	late post	preemergence	early post	late post
Application date	10/11/32	4/ 9/04	5/3/04	10/9/03	4/22/04	5/14/04
Growth stage						
Wheat	preemergence	2 to 3 tiller	3 to 5 tiller	preemergence	3 to 4 tiller	jointing
Field horsetail						
Reproductive	preemergence	2 to 3 inch	necrosis	--	--	--
Vegetative	preemergence	1 to 2.5 inch	6 inch	--	--	--
Smooth scouringrush	--	--	--	preemergence	1 to 2 inch	4 to 7 inch
Air temperature (F)	77	66	74	54	62	70
Relative humidity (%)	42	52	45	58	58	46
Wind (mph, direction)	0	2-5, SE	0	5, W	2-4, SW	2-5, W
Cloud cover (%)	10	15	75	40	75	50
Soil temperature at 2 in (F)	60	65	68	50	57	65
Soil moisture	dry	dry	dry	dry	wet	damp
pH		6.0			5.5	
OM (%)		3.4			5.0	
CEC (meq/100g)		20			35	
Texture		silt loam			silt loam	

No treatment visibly injured wheat (data not shown). Field horsetail control was best with fluroxypyr + MCPA ester and metsufuron + MCPA ester (1 lb ae/A) applied at the late post timing (Table 2). Control with metsulfuron + MCPA ester at 1 lb ae/A was better when applied at the late post timing (83%) compared to the early post + late post split timing (57%). Field horsetail and winter wheat populations were variable throughout the trial. Winter wheat yield was lowest with chlorsulfuron alone applied preemergence (3432 lb/A) and early post (3461 lb/A) and both treatments did not differ from the untreated control. Wheat test weight did not differ among treatments.

No treatment visibly injured wheat (data not shown). Scouringrush control was best when chlorsulfuron was applied early post emergence (99%) compared to the preemergence application (86%). Tribenuron and metsulfuron + MCPA ester at 1 lb ae/A treatments applied at the late post timing controlled scouringrush better (89 to 95%) than the split application timings (20 to 21%) or fluroxypyr + MCPA ester (10 to 35%). Wheat yield and test weight did not differ among treatments.

Table 2. Field horsetail and scouringrush control, and winter wheat response near Moscow and Genesee, Idaho in 2004.

Treatment[1]	Rate[2]	Timing	Field horsetail control[3]	Winter wheat		Scouringrush control[4]	Winter wheat	
				Yield	Test weight		Yield	Test weight
	lb ai/A		%	lb/A	lb/bu	%	lb/A	lb/bu
Untreated check	---	---	---	3086	60.32	---	8050	60.89
Chlorsulfuron	0.0625	preemergence	18	3432	60.72	86	7131	59.57
Chlorsulfuron	0.0156	early post	40	3461	60.72	99	7647	60.61
Chlorsulfuron +	0.0156 +	early post +	57	4591	61.12	98	8097	60.55
fluroxypyr +	0.134 +	late post +						
MCPA ester	0.536	late post						
Tribenuron +	0.0156 +	early post +	58	4743	60.77	20	7608	59.93
MCPA ester	1	late post						
Metsulfuron +	0.00375 +	early post +	57	4985	60.56	21	7920	60.52
MCPA ester	1	late post						
Tribenuron +	0.0156 +	late post +	32	4567	60.44	89	7928	60.38
MCPA ester	0.5	late post						
Tribenuron +	0.0156 +	late post +	55	4964	60.44	89	7941	60.49
MCPA ester	1	late post						
Metsulfuron +	0.00375 +	late post +	68	4655	60.56	89	7923	60.32
MCPA ester	0.5	late post						
Metsulfuron +	0.00375 +	late post +	83	4661	60.42	95	8036	60.55
MCPA ester	1	late post						
Fluroxypyr +	0.134 +	late post +	80	4904	60.73	10	7399	60.72
MCPA ester	0.536	late post						
Fluroxypyr +	0.244 +	late post +	88	4968	60.70	35	7874	60.76
MCPA ester	0.976	late post						
LSD (0.05)			9	878	NS	11	NS	NS

[1]All postemergence treatments (early and late post) included a 90% non-ionic surfactant (R-11) at 0.25% v/v.
[2]MCPA ester and fluroxypyr rates are in lb ae/A.
[3]July 8, 2004 evaluation. 3 replications were used for statistical analysis of scouringrush control.
[4]August 5, 2004 evaluation.

Evaluation of kochia control in winter wheat. Ralph E. Whitesides and Ruth Richards. (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820) Promontory winter wheat was planted November 10, 2003 on the Utah State University Research Farm at Cache Junction, Utah. Herbicide treatments including individual or combinations of bromoxynil/MCPA, fluroxypyr, tribenuron, and dicamba were applied to evaluate kochia (KCHSC) control. Individual treatments were applied to 10 by 30 foot plots with a CO_2 sprayer using Turbojet 015 nozzles calibrated to deliver 25 gpa at 40 psi. The soil was a Trenton silty clay loam with 7.6 pH and O.M. content of 2 %. Treatments were applied postemergence April 26, 2004 in a randomized block design, with three replications. Wheat ranged in size from 5 to 6 leaves and was just beginning to tiller. Weeds averaged 1 to 2 inches tall with an average density of 5 plants / ft^2. Visual evaluations were completed May 19, June 2, and June 22. Plots were harvested July 27, 2004.

Kochia control was excellent for all treatments. There was a slight reduction in initial weed control for metsulfuron+dicamba. Weed control increased to perfect ratings by the end of June for all treatments. There were no signs of injury to the wheat from any treatment Yields were not significantly different.

Table. Evaluation of Kochia control in wheat.

		Wheat			Weed control		
		Injury		Yield	KCHSC		
Treatment	Rate	5/19	6/02	7/27	5/19	6/02	6/22
	lbai/A	-------%-------		Bu/A	--------%--------		
Untreated		0	0	48	0	0	0
Bromoxynil/MCPA[a]	0.75	0	0	52	92	97	100
Bromoxynil/MCPA[a] + fluroxypyr	0.5+0.062	0	0	59	95	100	100
Bromoxynil/MCPA[a] + fluroxypyr + thifensulfuron[b]	0.5+0.062+ 0.005	0	0	42	93	99	100
Bromoxynil/MCPA[a] + thifensulfuron/tribenuron[b]	0.5 +0.014	0	0	59	97	100	100
Bromoxynil/MCPA[a] + tribenuron[b]	0.5+0.014	0	0	59	99	99	100
Bromoxynil/MCPA[a] + fluroxypyr + thifensulfuron[b]	0.375+0.062+ 0.01	0	0	60	99	100	100
Bromoxynil/MCPA[a] + fluroxypyr + tribenuron[b]	0.375+0.062+ 0.008	0	0	53	98	99	100
Metsulfuron[b] + dicamba	0.005+0.25	0	0	52	80	99	100
$LSD_{(0.05)}$				NS	5	4	NS

[a] Bromoxynil&MCPA was a commercial premix Bronate Advanced containing both octanoic and heptanoic formulation of bromoxynil.

[b] NIS added at 0.25% v/v added.

Wild oat control in winter wheat with clodinafop plus broadleaf herbicides. Joan Campbell and Donn Thill. (Crop and Weed Science Division, University of Idaho, Moscow, Idaho 83844-2339) An experiment was established south of Genesee, Idaho to determine wild oat control with clodinafop in 'Cashup' winter wheat. Treatments were applied on May 5, 2004 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 3 mph and 32 psi. Wheat was 12 in. tall with 4 tillers and wild oat had 1 to 5 leaves. Relative humidity, air and soil temperatures were 58%, 67 and 68 F, respectively. Soil pH, organic matter, CEC and texture were 5.4, 3.3%, 21 cmol/kg, and silt loam, respectively. The experimental design was a randomized complete block with four replications and 8 by 30 ft experimental units. Weed control and crop injury were evaluated visually on June 25 and July 25 and wheat grain was harvested at maturity.

Wild oat control ranged from 91 to 99% (Table). Wild oat control was 91% and 92% with fenoxaprop and mesosulfuron, respectively, on June 25, but control increased to 97 and 98%, respectively by July 25. Wild oat control with clodinafop plus thifensulruon plus MCPA amine and clodinafop plus thifensulfuron plus bomoxynil/MCPA (0.05+0.0234+0.55 lb ai/a) was lower (94 and 95%, respectively) than all other treatments (97 to 99%) on July 25. Wheat grain yield and test weight did not vary among treatments.

Table. Wild oat control and winter wheat yield with clodinafop plus broadleaf herbicides.

		Wild oat control		Winter wheat[1]	
Treatment	Rate	June 25	July 25	Grain yield	Test weight
	lb ai/a	%	%	lb/a	lb/bu
Untreated	-	-	-	5655	61
Clodinafop	0.05	98	99	6076	61
Clodinafop+	0.05	99	99	6342	62
prosulfuron	0.0178				
Clodinafop+	0.05	96	99	5879	61
thifensulfuron	0.0234				
Clodinafop+	0.05	95	97	7986	62
prosulfuron+	0.0178				
bromoxynil/MCPA	0.33				
Clodinafop+	0.05	99	99	7562	62
thifensulfuron+	0.0234				
bromoxynil/MCPA	0.33				
Clodinafop+	0.05	94	97	7684	62
prosulfuron+	0.0178				
MCPA amine	0.375				
Clodinafop+	0.05	93	94	5587	62
thifensulfuron+	0.0234				
MCPA amine	0.375				
Clodinafop+	0.05	94	97	6588	61
prosulfuron+	0.0178				
bromoxynil/MCPA	0.55				
Clodinafop+	0.05	96	95	6070	61
thifensulfuron+	0.0234				
bromoxynil/MCPA	0.55				
Clodinafop	0.0625	95	99	5803	62
Fenoxaprop	0.0825	91	97	7596	62
Mesosulfuron+	0.0134	92	98	6964	61
MSO[2]	1.5[2]				
Clodinafop+	0.05	97	99	7308	62
fluroxypyr/clopyralid	0.1875				
LSD (0.05)		3	2	NS	NS

[1]Three replications were included in wheat analysis due to injury unrelated to the experimental treatments.
[2]MSO is a modified vegetable oil applied at 1.5 pint/acre.

Imazamox and BAS 777 applied with tank mix partners for feral rye control. Robyn C. Walton, Don W. Morishita, and Michael P. Quinn. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A study was conducted in Cassia county, Idaho to evaluate feral rye control in imidazolinone resistant Clearfield™ winter wheat. 'Clearfirst' wheat was planted October 15, 2003, at 100 lb/A. Experimental design was a randomized complete block with four replications and individual plots were 8 by 25 ft. Soil type was a loam (41.2% sand, 33.5% silt, and 25.3% clay) with a pH of 6.6, and 1.96% organic matter. Herbicides were applied using a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa. Additional environmental and application information is given in Table 1. Crop injury and weed species control was evaluated visually 28 days after the last treatment (DALT) on June 3 and 96 DALT on August 10. Grain was harvested August 12 with a small-plot combine.

Table 1. Environmental conditions at application.

Application date	11/10/03	5/6/04
Application timing	3-4 leaf	Jointing
Air temperature (F)	46	76
Soil temperature (F)	35	73
Relative humidity (%)	66	39
Wind velocity (mph)	9	2
Cloud cover (%)	95	50

Injury was observed in all herbicide treatments and ranged from 13 to 23%, but there was no difference among treatments (Table 2). Averaged across all herbicide treatments, fall imazamox and BAS 777 treatments did not control feral rye as well as spring applications (55 to 79%). Typically, imazamox is more effective on feral rye when it is applied in the fall. In this experiment, most of the feral rye emerged after the fall application. Feral rye control with all BAS 777 treatments applied in the spring averaged 80% control compared to 69% control with spring applied imazamox. BAS 777 tank mixed with carfentrazone, dicamba, or 2,4-D controlled feral rye 83 to 91% at the first evaluation. Wheat yield ranged from 117 to 131 bu/A and did not differ among treatments including the check.

Table 2. Crop injury, feral rye control, and grain yield with BAS 777, imazamox, and tank mix partners near Burley, Idaho.

Treatment[2]	Application rate	Application date	Crop injury	SECCE control[1] 6/3/2004	SECCE control[1] 8/10/2004	Grain yield
	lb ai/A		---%	---%	---%	bu/A
Check	-		-	-	-	122
Imazamox +	0.0312 +	5/6/04	13	69	76	125
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.281 +	5/6/04	18	79	79	125
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.281 +	5/6/04	21	75	74	117
dicamba +	0.0625 +					
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.281 +	5/6/04	16	83	85	118
dicamba +	0.125 +					
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.281 +	5/6/04	21	75	86	126
fluroxypyr +	0.0937 +					
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.281 +	5/6/04	23	79	78	120
bromoxynil +	0.25 +					
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.281 +	5/6/04	16	91	90	130
carfentrazone +	0.008 +					
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.281 +	5/6/04	11	85	88	130
2,4-D ester +	0.25 +					
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.281 +	5/6/04	15	76	85	128
clopyralid & 2,4-D +	0.583 +					
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
Imazamox +	0.0312 +	11/10/03	13	55	60	131
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.281 +	11/10/03	15	51	54	122
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
BAS 777 +	0.422 +	11/10/03	18	55	71	126
nonionic surfactant +	0.25% v/v +					
UAN 28%	1% v/v					
LSD (0.05)			ns	11	11	ns

[1]Weed evaluated for control was feral rye (SECCE).

[2] UAN 28% is urea ammonium nitrate in a 28% solution. BAS 777 is a pre-formulated mixture of imazamox & MCPA.

Effect of application timing on Italian ryegrass control wih mesosulfuron-methyl in winter wheat. Chuck Cole, Carol Mallory-Smith, Richard Affeldt, and Jed Colquhoun (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002). A field trial was conducted near Corvallis, OR to estimate the ideal application timing of mesosulfuron-methyl to contol Italian ryegrass. 'Foote' winter wheat was seeded at 125 lb/A along with a separate strip of Italian ryegrass on three dates, September 25, October 13, and October 22, 2003. A single rate of mesosulfuron-methyl plus mefenpyr, a safener, was applied across each planting on six dates with a single-wheel compressed-air sprayer calibrated to deliver 20 gpa (Table 1). An untreated check was included in each planting date for a total of 21 treatments. Plots were 8 by 28 ft arranged as a randomized split-block with 4 replications. Wheat injury and Italian ryegrass control were evaluated visually. Italian ryegrass biomass was measured on a fresh weight basis. Winter wheat was harvested with a small plot combine on July 22, 2004.

Table 1. Climate and soil data for six application dates.

	Nov 3, 2003	Nov 13, 2003	Dec 2, 2003	Dec15, 2003	Jan 13, 2004	Feb 10, 2004
Air temperature (F)	43	53	51	38	46	44
Relative humidity (%)	93	76	84	85	83	88
Soil temperature (F)	42	55	51	39	44	41
Soil pH			5.6			
OM (%)			2.95			
Soil name, texture			Woodburn, silt loam			

Multiple planting dates resulted in unique ryegrass growth stages and climate conditions at each application timing (Table 2). Wheat planting in the Willamette Valley before mid-October is unadvised due to wheat aphid pressure. Label-recommended application timing for Italian ryegrass control with mesosulfuron-methyl is from 4-leaf to 1-tiller. Unseasonably cool weather in December and January limited development of both winter wheat and Italian ryegrass during that period.

Table 2. Wheat and Italian ryegrass stages of growth for three planting and six application dates.

Planting date	Application date	Wheat stage	Italian ryegrass stage
September 25, 2003			
	November 3, 2003	3-4 leaf	3-4 leaf
	November 13, 2003	1-3 tiller	1-2 tiller
	December 2, 2003	2-3 tiller	6-8 inch
	December 15, 2003	2-4 leaf	8-10 inch
	January 13, 2004	6 tiller	10 inch
	February 10, 2004	6-8 inch	16 inch
October 13, 2003			
	November 3, 2003	2 leaf	1-2 leaf
	November 13, 2003	3 leaf	2-3 leaf
	December 2, 2003	1-2 tiller	1-2 tiller
	December 15, 2003	2-3 tiller	3-5 tiller
	January 13, 2004	2-3 tiller	3-5 tiller
	February 10, 2004	2-4 tiller	5-6 inch
October 22, 2003			
	November 3, 2003	Spike	Spike
	November 13, 2003	1 leaf	1 leaf
	December 2, 2003	2-3 leaf	1-2 leaf
	December 15, 2003	3-4 leaf	2-4 leaf
	January 13, 2004	1-2 tiller	3-4 leaf
	February 10, 2004	3 tiller	2-3 tiller

Mesosulfuron-methyl applications to wheat planted October 13th resulted in over 90% Italian ryegrass control in 4 of 6 application dates (Table 3). Italian ryegrass fresh weight was reduced with all application timings. Italian ryegrass control was greatest in wheat planted September 25th with applications on November 3rd and 13th when the Italian ryegrass was at the 3-4 leaf and 1-2 tiller stage of growth, respectively. Mesosulfuron-methyl applications to wheat planted October 22nd resulted in visual Italian ryegrass control greater than 90% at only the December 15th application date when the Italian ryegrass was at the 2-4 leaf stage. Mesosulfuron-methyl provides the most consistent Italian ryegrass control when applied after the 4 leaf stage of growth. Applications prior to that stage do not control plants yet to emerge.

Table 3. Italian ryegrass control, fresh weight, and wheat seed yield as influenced by planting date and mesosulfuron-methyl application timing.

Treatment[1]		Italian ryegrass control[2]	Italian ryegrass fresh weight[3]	Wheat yield
Planting date	Application date			
		%	lbs/sq yd	bu/A
September 25, 2003				
	November 3, 2003	96	1.2	95
	November 13, 2003	96	1.5	93
	December 2, 2003	70	4.2	92
	December 15, 2003	65	3.9	98
	January 13, 2004	55	3.7	95
	February 10, 2004	20	5.1	91
	Untreated check	0	23.2	90
October 13, 2003				
	November 3, 2003	91	2.1	101
	November 13, 2003	91	2.6	105
	December 2, 2003	98	0.3	110
	December 15, 2003	94	0.1	109
	January 13, 2004	75	0.1	109
	February 10, 2004	15	0.6	104
	Untreated check	0	11.9	105
October 22, 2003				
	November 3, 2003	15	11.6	88
	November 13, 2003	43	10.0	88
	December 2, 2003	84	5.0	91
	December 15, 2003	98	0.5	92
	January 13, 2004	75	0.3	93
	February 10, 2004	30	1.5	89
	Untreated check	0	15.5	81
LSD (P=0.05)		12	2.5	11

[1] mesosulfuron-methyl applied at 0.0134 lb ai/A with mefenpyr at 0.0268 lb ai/A plus methylated seed oil at 1.5 pt/A and urea ammonium nitrate solution at 3.8 pt/A.
[2] Italian ryegrass control visual rating, March 2, 2004.
[3] Italian ryegrass fresh weight, April 6, 2004.

Winter wheat yield was not influenced by mesosulfuron application timing. Yield differences were due to planting date. Although Italian ryegrass was controlled at stages beyond 1 tiller, winter wheat yields do not reflect Italian ryegrass competition as wheat was planted separately.

Italian ryegrass and wild oat control in winter wheat with mesosulfuron. Traci A. Rauch and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in 'Madsen' winter wheat at Moscow and 'Hubbard' winter wheat in Bonners Ferry, Idaho to evaluate Italian ryegrass and wild oat control, respectively. Italian ryegrass control was evaluated with mesosulfuron and flucarbazone combined with flufenacet and/or metribuzin. Wild oat control was evaluated with mesosulfuron, propoxycarbazone, and other grass herbicides. Plots were 8 by 30 ft, 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 30 psi and 3 mph (Table 1). The studies were oversprayed to control broadleaf weeds with thifensulfuron/tribenuron at 0.0234 lb/A on May 11, 2004 at Bonners Ferry and clopyralid/MCPA at 0.60 lb ae/A on May 14, 2004 at Moscow. Wheat injury and weed control were evaluated visually. Wheat seed was harvested with a small plot combine on August 11 and September 2, 2004 at Moscow and Bonners Ferry, respectively.

Table 1. Application and soil data.

Location	Moscow, Idaho		Bonners Ferry, Idaho
Application date	September 30, 2003	May 7, 2004	May 6, 2004
Growth stage			
Wheat	preemergence	2 to 5 tiller	2 to 5 tiller
Italian ryegrass (LOLMU)	preemergence	2 leaf to 3 tiller	--
Wild oat (AVEFA)	--	--	1 to 3 leaf
Air temperature (F)	63	72	72
Relative humidity (%)	40	40	30
Wind (mph, direction)	1, E	2, SW	3, S
Cloud cover (%)	0	5	50
Soil moisture	dry	dry	dry
Soil temperature at 2 in (F)	50	58	60
Soil			
pH	5.2		7.3
OM (%)	3.0		11
CEC (meq/100g)	18		17
texture	silt loam		loam

At the Moscow study, all treatments injured wheat 0 to 6% (Table 2). Flufenacet combinations with mesosulfuron or flucarbazone, except flufenacet/metribuzin plus flucarbazone, controlled Italian ryegrass better (98 to 99%) than flufenacet + metribuzin, flufenacet/metribuzin, and flufenacet and flucarbazone alone (67 to 79%). Wheat seed yield and test weight ranged from 103 to 118 bu/A and 54.2 to 56.1 lb/bu, respectively, but did not differ among treatments.

At the Bonners Ferry study, all treatments injured wheat 0 to 10% (Table 3). Wild oat control ranged from 62 to 91% and did not differ among treatments but tended to be best with mesosulfuron (89 and 91%) and poorest with clodinafop (62%). Propoxycarbazone + UAN yielded more grain (96 bu/A) than propoxycarbazone alone (81 bu/A). Wheat seed yield was lowest with the untreated check (66 bu/A). Wheat test weight of the untreated check (56.4 lb/bu) was lower than all other treatments (58.2 to 59.1 lb/bu).

Table 2. Italian ryegrass control and wheat response with mesosulfuron and flucarbazone combined with flufenacet and/or metribuzin near Moscow, Idaho in 2004.

Treatment[1]	Rate	Wheat injury[2]	LOLMU control[2]	Wheat Yield	Wheat Test weight
	lb ai/A	%	%	bu/A	lb/bu
Flufenacet	0.27	4	79	105	55.1
Flufenacet +	0.27				
metribuzin	0.0675	0	67	105	54.6
Flufenacet/metribuzin	0.34	4	79	103	54.6
Triasulfuron	0.34	0	96	107	54.8
Flufenacet/metribuzin +	0.34				
triasulfuron	0.026	0	96	108	55.2
Flufenacet +	0.27				
mesosulfuron +	0.0134				
NIS +	0.5% v/v				
UAN	2 qt/A	0	99	106	55.4
Flufenacet +	0.27				
mesosulfuron +	0.0134				
MSO	1.5 qt/A	6	99	106	54.7
Flufenacet +	0.27				
flucarbazone +	0.027				
NIS	0.25% v/v	2	99	113	55.1
Flufenacet +	0.27				
metribuzin +	0.0675				
mesosulfuron +	0.0134				
NIS +	0.5% v/v				
UAN	2 qt/A	0	99	109	55.2
Flufenacet +	0.27				
metribuzin +	0.0675				
mesosulfuron +	0.0134				
MSO	1.5 qt/A	0	99	116	55.2
Flufenacet +	0.27				
metribuzin +	0.0675				
flucarbazone +	0.027				
NIS	0.25% v/v	0	99	118	55.8
Flufenacet/metribuzin +	0.34				
mesosulfuron +	0.0134				
NIS +	0.5% v/v				
UAN	2 qt/A	2	98	116	56.1
Flufenacet/metribuzin +	0.34				
mesosulfuron +	0.0134				
MSO	1.5 qt/A	6	99	115	55.0
Flufenacet/metribuzin +	0.34				
flucarbazone +	0.027				
NIS	0.25% v/v	4	96	108	54.2
Mesosulfuron +	0.0134				
NIS +	0.5% v/v				
UAN	2 qt/A	0	94	116	55.2
Mesosulfuron +	0.0134				
MSO	1.5 qt/A	1	99	115	55.3
Flucarbazone +	0.027				
NIS	0.25% v/v	0	77	117	55.3
Untreated check	--	--	--	107	55.0
LSD (0.05)		NS	19	NS	NS
Density (plants/ft^2)			5		

[1]NIS is 90%non-ionic surfactant (R-11); UAN is 32% urea ammonium nitrate (URAN); and MSO is modified seed oil.
[2]June 25, 2004 evaluation.

Table 3. Wild oat control and wheat response with mesosulfuron, propoxycarbazone, and other grass herbicides near Bonners Ferry, Idaho in 2004.

Treatment[1]	Rate	Wheat injury[2]	Wild oat control[2]	Wheat Yield	Wheat Test weight
		-------------%	------------	bu/A	lb/bu
	lb ai/A	--			
Propoxycarbazone +	0.04				
NIS	0.25% v/v	10	84	81	58.4
Propoxycarbazone +	0.04				
NIS +	0.25% v/v				
UAN	5 gal/A	3	83	96	58.3
Mesosulfuron +	0.0089				
NIS +	0.5% v/v				
UAN	2 qt/A	2	91	94	59.1
Mesosulfuron +	0.0089				
MSO	1.5 pt/A	0	89	84	58.7
AE 0298618 +	0.04				
NIS	0.5% v/v	4	84	85	58.3
Flucarbazone +	0.027				
NIS	0.25% v/v	2	85	92	58.2
Clodinafop +	0.05				
COC	10.2 fl oz/A	5	62	91	58.6
Fenoxaprop	0.0825	7	70	89	58.2
Untreated check	--	--	--	66	56.4
LSD (0.05)		NS	NS	14	1.1
Density (plants/ft^2)			3		

[1]NIS is 90%non-ionic surfactant (R-11); UAN is 32% urea ammonium nitrate (URAN); MSO is modified seed oil; and COC is a crop oil concentrate (Score).
[2]June 29, 2004 evaluation.

Chickling vetch response to herbicides. Kirk A. Howatt, Ronald F. Roach, and Janet D. Harrington. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105-5051) Chickling vetch is an annual legume that has no herbicides approved for in-crop use in the United States. A study was established near Fargo, ND, to evaluate the response of chickling vetch to several herbicides that are potential registration candidates. The PPI treatment was applied and incorporated with two passes of a field cultivator operating 3 inches deep, chickling vetch was seeded, and PRE treatments were applied on June 22 with 74 F air temperature, 38% relative humidity, 80% cloud cover, and 5 to 6 mph northwest wind. POST treatments were applied to 2- to 4-inch tall chickling vetch on July 16 with 74 F air temperature, 74% relative humidity, 10% cloud cover, and 5 mph northwest wind. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through TT 11001 flat-fan nozzles to an area 7 ft wide and the length of 10- by 35-ft plots. The experiment had a randomized complete-block design with four replicates.

Sulfentrazone resulted in the least amount of injury, 0% to 8%, and presented the best potential for registration. PRE imazethapyr, which is used in other legume crops, gave a minimal 4% injury during the July 23 evaluation. However, stunting and chlorosis, 20% injury, was observed August 13 on chickling vetch in plots treated with PRE imazethapyr. POST imazethapyr resulted in similar late-season injury development. Thifensulfuron, another ALS-inhibiting herbicide, caused 20% to 25% injury as stunting and chlorosis July 23, and injury worsened to 63% to 70% by August 13. Trifluralin, pendimethalin, bentazon, and imazethapyr gave less than 10% injury July 23, but injury on August 13 ranged from 20% to 31%. Metribuzin and bromoxynil produced substantial necrotic injury and stand loss. The herbicide 2,4-DB, which is used in alfalfa, also caused more injury than anticipated. Chickling vetch did not die from 2,4-DB, but leaves and stems expressed moderate epinasty and 43% to 53% injury.

Table. Chickling vetch response to herbicides near Fargo, ND, in 2004.

Treatment[1]	Rate[2]	Timing	July 23 Chickling vetch	August 13 Chickling vetch
	oz ai/A		%	%
Trifluralin	12	PPI	5	31
Pendimethalin	16	PRE	7	30
Sulfentrazone	3	PRE	0	8
Metribuzin	8	PRE	28	45
Imazethapyr	0.75	PRE	4	20
Bromoxynil + clethodim + PO	4 + 1.5 + 0.25G	POST	83	90
Bentazon + clethodim + PO	12 + 1.5 + 0.25G	POST	5	25
2,4-DB + clethodim + PO	8 + 1.5 + 0.25G	POST	53	43
Imazethapyr + clethodim + PO	0.75 + 1.5 + 0.25G	POST	8	28
Thifensulfuron + clethodim + PO	0.25 + 1.5 + 0.25G	POST	20	63
Thifensulfuron + 2,4-DB + clethodim + PO	0.25 + 8 + 1.5 + 0.25G	POST	25	70
Untreated	0		0	0
CV			21	25
LSD (P=0.05)			6	13

[1] PO = petroleum oil concentrate, Herbimax from Loveland Industries, Greeley, CO 80632.
[2] 2,4-DB rates expressed in ae; and G = gallons per acre.

A planning aid for jointed goatgrass management. Randy L. Anderson. (USDA-ARS, Brookings SD 57006). Several cultural practices are available to manage jointed goatgrass in winter wheat, but seldom do one or two practices achieve effective long-term control. Producers recognize that jointed goatgrass management requires a comprehensive systems approach; control tactics are needed in several phases of the jointed goatgrass life cycle to achieve effective population management.

To help producers plan management systems for jointed goatgrass, we developed a visual guide that arranges cultural choices by decision times of the winter wheat production cycle (see Figure). Within each of the four decision times, producers can choose control tactics that either favor winter wheat or suppress jointed goatgrass.

Choices during the interval between winter wheat crops:

During the interval before the next winter wheat crop is planted, producers can reduce seed bank density of jointed goatgrass by including crops with different life cycles in rotation with winter wheat. This practice lengthens the time for natural loss of seed viability in soil to occur. Also, burning crop residue to kill seeds on the soil surface or tilling shallowly to stimulate seed germination will reduce seed bank density. Deep burial of seeds by plowing will minimize jointed goatgrass seedling emergence in the following winter wheat.

Choices before planting winter wheat:

Producers can improve winter wheat competitiveness with jointed goatgrass by favoring winter wheat access to resources such as water, light, or nutrients. For example, increasing seeding rates or growing taller cultivars leads to a denser winter wheat canopy, thus minimizing light penetration to jointed goatgrass. A similar benefit occurs with placing nutrients near the crop seed, planting larger size seeds, or using narrow row spacing.

Choices after planting but before winter wheat jointing:

After winter wheat and jointed goatgrass establishment, producers can control jointed goatgrass in imi-resistant cultivars with imazamox. Efficacy of imazamox is enhanced by cultural practices that strengthen winter wheat competitiveness. If jointed goatgrass is present only in isolated patches, producers can minimize seed production by eliminating those patches with non-selective herbicides such as glyphosate or with tillage. If N fertilizer is applied after the crop emerges, banding the fertilizer by the wheat row will help winter wheat access the fertilizer first.

Choices before harvesting:

After winter wheat begins jointing, producers have options to prevent jointed goatgrass seed production or dispersal in the field. A study with downy brome showed that combine dispersal of weed seeds increases its spread and population growth in a field 16-fold. Thus, harvesting infested patches in a field last will minimize jointed goatgrass dispersal by the combine. Also, eliminating infested patches by either haying or killing plants with non-selective herbicides before grain harvest is another option to prevent seed production and dispersal.

Comprehensive Systems Approach

A key to jointed goatgrass management is to reduce the number of jointed goatgrass seeds in the agroecosystem. Developing comprehensive systems that includes cultural practices from each decision time of the production cycle will be most effective in minimizing both seed production by jointed goatgrass and seed survival in soil. Systems management is effective because synergism occurs among individual practices when used together, enhancing their impact on jointed goatgrass growth.

Our goal with this figure is to provide a framework to facilitate systematic planning for jointed goatgrass control. This approach also will help manage other winter annual grasses such as feral rye or downy brome.

[*Information on performance of individual cultural practices is available at* www.jointedgoatgrass.org]

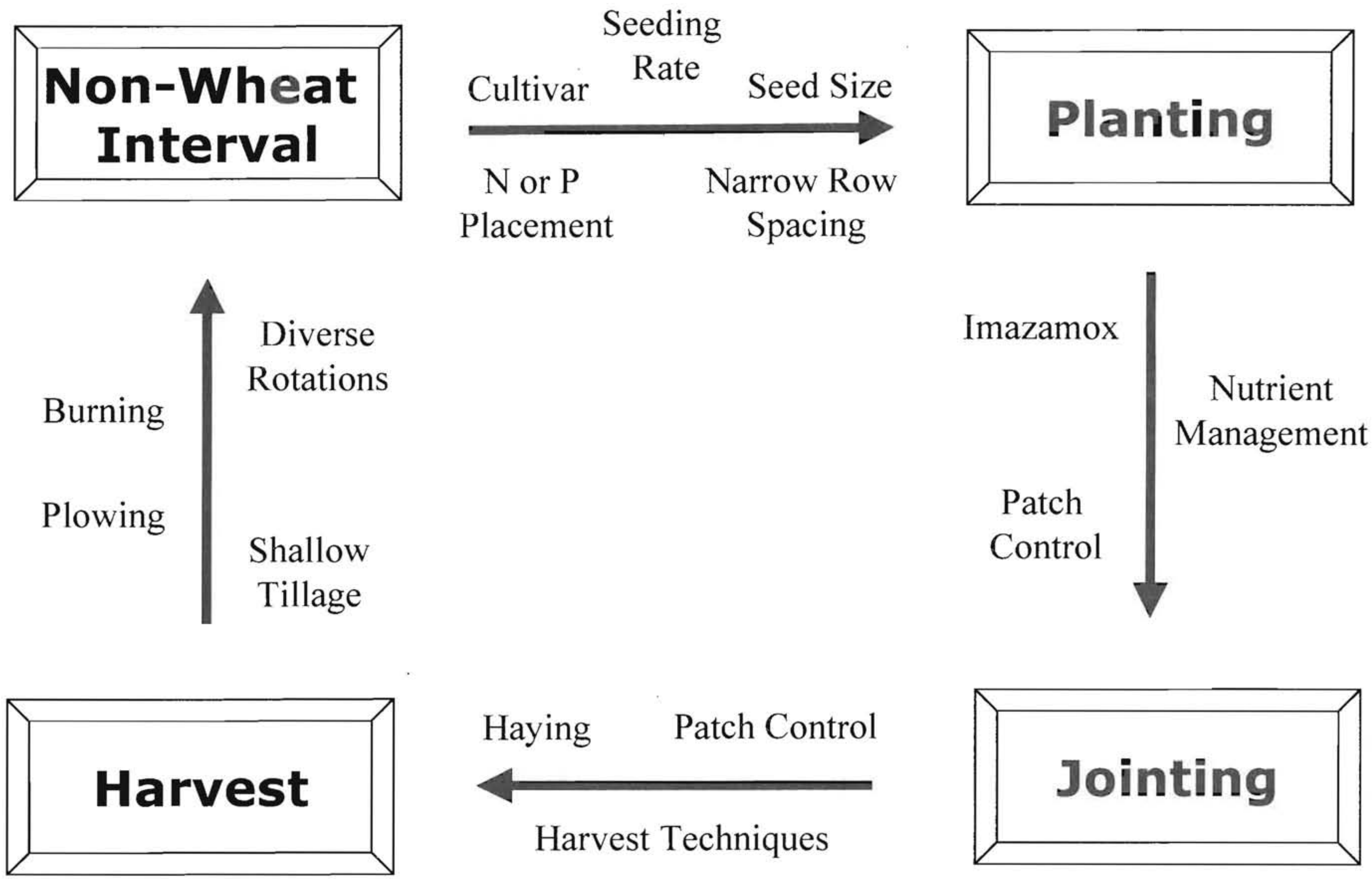

Figure. Planning aid for jointed goatgrass management

Newly reported exotic species in Idaho. Sandra S. Robins and Timothy S. Prather. (Idaho Agricultural Experiment Station, University of Idaho, Moscow, Idaho, 83844-2339). The Lambert C. Erickson Weed Diagnostic Laboratory received 372 specimens for identification in 2004. The utilization of the lab was up from 289 submissions from last year. Seventeen samples were submitted from out of state. Three species reported were new to the state, bristly hawksbeard (*Crepis setosa*), herb bennet (*Geum urbanum)* and bohemian knotweed (*Polygonum xbohemicum).* Two other species were reported for only the second time in the state, lens podded whitetop (*Lepidium draba ssp. chalepensis)* and mountain knapweed (*Centaurea montana)* (see Table 1). A total of 33 counties submitted samples. The lab identified 44 exotic species that were new county records (see Table 2). Species in Table 2 have not previously been reported to the Erickson Weed Diagnostic Laboratory or the Invaders Database System.

Table 1. Identified exotic species new to the state.

County	Family	Scientific Name	Common Name
Nez Perce	Asteraceae	*Crepis setosa*	bristly hawksbeard
Latah	Rosaceae	*Geum urbanum*	herb bennet
Payette	Polygonum	*Polygonum xbohemicum*	bohemian knotweed
Canyon	Brassicaceae	[1]*Lepidium draba ssp.chalepensis*	lens podded whitetop
Idaho	Asteraceae	[1]*Centaurea montana*	mountain knapweed

[1] Second reported occurrence in Idaho

Table 2. Identified exotic species new to a county based on the Invaders database.

County	Family	Scientific Name	Common Name
Bannock	Caryophyllaceae	*Silene conoidea*	cone catchfly
Bingham	Fabaceae	*Oxytropis riparia*	Ruby Valley pointvetch
Blaine	Fabaceae	*Astragalus cicer*	chickpea milkvetch
Canyon	Brassicaceae	*Lepidium draba* ssp. *chalepensis*	lens-podded whitetop
Caribou	Poaceae	*Lolium perenne* ssp. *multiflorum*	perennial ryegrass
Cassia	Brassicaceae	*Brassica kaber*	wild mustard
Cassia	Poaceae	*Poa annua*	annual bluegrass
Clearwater	Poaceae	*Apera interrupta*	interrupted apera
Clearwater	Poaceae	*Bromus japonicus*	Japanese brome
Clearwater	Geraniaceae	*Geranium pusillum*	small flowered geranium
Clearwater	Poaceae	*Vulpia myuros*	rattail fescue
Idaho	Asteraceae	*Centaurea montana*	perennial cornflower
Idaho	Euphorbiaceae	*Euphorbia cyparissias*	cypress spurge
Jefferson	Chenopodiaceae	*Atriplex hortensis*	garden orache
Jerome	Asteraceae	*Carthamus tinctorius*	safflower
Kootenai	Lamiaceae	*Glecoma hederacea*	ground ivy
Kootenai	Asteraceae	*Tragopogon dubius*	western salsify
Latah	Primulaceae	*Anagallis arvensis*	scarlet pimpernel
Latah	Campanulaceae	*Campanula persicifolia*	peachleaf bellflower
Latah	Asteraceae	*Carthamus tinctorius*	safflower
Latah	Fabaceae	*Coronilla varia*	trailing crownvetch
Latah	Rosaceae	*Geum urbanum*	herb bennet
Latah	Scrophulariaceae	*Veronica chamaedrys*	germander speedwell
Lemhi	Tamaricaceae	*Tamarix ramosissima*	saltcedar
Madison	Brassicaceae	*Lepidium draba* ssp. *chalepensis*	lens-podded whitetop
Nez Perce	Asteraceae	*Crepis setosa*	bristly hawksbeard
Nez Perce	Chenopodiaceae	*Kochia scoparia*	kochia
Nez Perce	Fabaceae	*Trifolium aureum*	hop clover
Owyhee	Asteraceae	*Carthamus tinctorius*	safflower
Owyhee	Linaceae	*Linum usitatissimum*	common flax
Payette	Polygonaceae	*Polygonum xbohemicum*	bohemian knotweed

Table 2. continued

County	Family	Scientific Name	Common Name
Power	Asteraceae	*Cirsium vulgare*	bull thistle
Power	Scrophulariaceae	*Linaria dalmatica* ssp. *dalmatica*	Dalmatian toadflax
Teton	Campanulaceae	*Campanula rapunculoides*	creeping bellflower
Twin Falls	Asteraceae	*Carthamus tinctorius*	safflower
Twin Falls	Poaceae	*Poa compressa*	Canada bluegrass

Perennial pepperweed control with herbicides applied at the rosette and flower-bud growth stage. Rob G. Wilson. (University of California Cooperative Extension, 707 Nevada St., Susanville, CA 96130) Perennial pepperweed is a long-lived, root-creeping perennial that thrives in seasonally wet areas or areas with a high watertable. An experiment was established at the Honeylake Wildlife Area near Wendel, CA to evaluate several herbicides applied at the rosette and flower-bud stage for perennial pepperweed control. The experimental site was heavily infested with perennial pepperweed with a large accumulation of standing thatch, so the site was mowed in early March (prior to perennial pepperweed green-up) the year herbicides were applied to break-up thatch and facilitate herbicide application. Tall wheatgrass was intermittent throughout all plots. The experiment was arranged in a randomized complete block with four replications. Plot size was 10 by 30 ft. Herbicides were applied with a CO_2-pressurized backpack sprayer using 11002 LP flat fan nozzles at 20 gal/A. Application and site information is presented in Table 1.

Perennial pepperweed shoot density, perennial pepperweed cover, and tall wheatgrass cover were measured in three 1-m^2 quadrats in each plot to determine herbicide effects on perennial pepperweed and tall wheatgrass. Evaluations were made on June 26, 2002, July 29, 2002, September 19, 2002, June 25, 2003, and May 13, 2004.

Five MAT (months after treatment), chlorsulfuron, 2,4-D, and imazapic applied at the rosette stage reduced perennial pepperweed cover by more than 80% compared to untreated plots, but chlorsulfuron was the only herbicide applied at the rosette stage to maintain acceptable perennial pepperweed control 14 and 25 MAT (Table 2). Glyphosate provided unacceptable control of perennial pepperweed when applied at the rosette stage (Table 2). Thirteen MAT, chlorsulfuron and imazapic at all rates applied at the flower-bud stage reduced perennial pepperweed density and cover by more than 90% compared to untreated plots, and chlorsulfuron at 1.5 oz ai/A and imazapic at 3 oz ai/A maintain the same level of control 24 MAT (Table 3). 2,4-D provided acceptable suppression of perennial pepperweed 5 MAT, but perennial pepperweed density and cover rebounded 13 MAT suggesting yearly 2,4-D applications are needed to maintain control (Table 3). Glyphosate at 3 lb ai/A applied at the flower-bud stage offered acceptable control of perennial pepperweed 13 MAT, but glyphosate eliminated tall wheatgrass cover and encouraged perennial pepperweed seedling establishment 25 MAT (Table 3). All rates of chlorsulfuron, imazapic, and 2,4-D increased tall wheatgrass cover 13 MAT suggesting tall wheatgrass was stimulated by reduced competition from perennial pepperweed.

In summary, herbicides provided better perennial pepperweed control when applied at the flower-bud stage compared to applications to rosettes. Several herbicides offered acceptable perennial pepperweed control the year of application, but herbicides with residual soil activity (chlorsulfuron or imazapic) were needed to maintain acceptable perennial pepperweed control 24 MAT. The rapid increase in perennial pepperweed cover in glyphosate-treated plots between 13 MAT and 25 MAT implies competitive vegetation is imperative to long-term control of perennial pepperweed.

Table 1. Herbicide application information.

Rosette application		Flower-bud application	
Date, time	04/16/02, 8:00 am	Date, time	05/30/02, 10:30 am
Air temperature (F)	44	Air temperature (F)	85
Relative humidity (%)	51	Relative humidity (%)	33
Wind speed (mph)	2 to 5	Wind speed (mph)	1 to 3
Soil type	sodic clay loam	Soil type	sodic clay loam
P. pepperweed growth stage	rosette, 3 to 5 inch	P. pepperweed growth stage	flowerbud, 2 to 4 feet
Tall wheatgrass growth stage	tillering, 4 to 8 inch	Tall wheatgrass growth stage	flowering, 2 to 3 feet

Table 2. The effect of herbicides applied at the rosette stage on perennial pepperweed and tall wheatgrass.

		Perennial pepperweed density		Perennial pepperweed cover			Tall wheatgrass cover		
Herbicide Treatment	Rate	5 MAT[1]	14 MAT	5 MAT	14 MAT	25 MAT	5 MAT	14 MAT	25 MAT
	ai/A	------($shoots/m^2$)-------		------% cover------					
untreated control	-----	19	19	52	49	43	12	16	23
chlorsulfuron + NIS[2]	0.75 oz	2	2	1	5	5	12	33	31
2,4-D ester + NIS	2.0 lb	7	7	9	24	29	10	19	18
imazapic + MSO[3] + AMS[4]	2.0 oz	4	9	5	24	31	9	17	18
imazapic + MSO + AMS	3.0 oz	3	8	5	19	26	16	37	34
glyphosate + AMS	3.0 lb	13	12	22	50	44	0	5	7
$LSD_{(0.05)}$		8	6	9	12	17	14	14	18

[1] MAT= month after treatment
[2] NIS= non-ionic surfactant (R-11) added at 0.25% v/v
[3] MSO= ethylated seed oil and non-ionic surfactant blend (Hasten) added at 1.0 pt/A
[4] AMS= ammonium sulfate added at 10 lb per 100 gallons of spray solution

Table 3. The effect of herbicides applied at the flower-bud stage on perennial pepperweed and tall wheatgrass

		Perennial pepperweed density		Perennial pepperweed cover			Tall wheatgrass cover		
Herbicide Treatment	Rate	4 MAT[1]	13 MAT	4 MAT	13 MAT	24 MAT	4 MAT	13 MAT	24 MAT
	ai/A	------($shoots/m^2$)-------		------% cover------					
untreated control	-----	30	34	61	64	58	5	10	16
2,4-D ester + NIS[2]	1.0 lb	5	14	5	29	29	9	29	30
2,4-D ester + NIS	2.0 lb	1	10	3	24	29	5	24	29
dicamba/diflufenzopr + NIS + AMS[3]	4.0 oz / 1.6 oz	18	25	23	55	42	4	17	28
glyphosate + AMS	3.0 lb	17	4	19	8	37	0	0	4
chlorsulfuron + NIS	0.5 oz	1	3	7	5	7	8	39	35
chlorsulfuron + NIS	0.75 oz	1	2	3	4	9	3	21	21
chlorsulfuron + NIS	1.5 oz	1	0	3	1	2	5	36	34
imazapic + MSO[4] + AMS	2.0 oz	14	4	14	6	8	6	27	24
imazapic + MSO + AMS	3.0 oz	12	2	8	4	3	13	26	23
glyphosate + 2,4-D + AMS	0.4 lb + 0.7 lb	10	7	10	11	34	7	3	10
glyphosate + triclopyr + NIS	0.5 lb + 0.5 lb	23	18	17	32	42	3	11	11
$LSD_{(0.05)}$		4	6	9	15	15	10	11	11

[1] MAT= month after treatment
[2] NIS= non-ionic surfactant (R-11) added at 0.25% v/v
[3] AMS= ammonium sulfate added at 10 lb per 100 gallons of spray solution
[4]MSO= ethylated seed oil and non-ionic surfactant blend (Hasten) added at 1.0 pt/A

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