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FOREWORD

The 2012 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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Research Progress Report Editor
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Table 1. Application data.

Application date	June 1, 2011
Weed growth stage	spring rosette
Air temp (F)	64
Relative humidity (%)	51
Wind (mph, direction)	2 to 4,W
Cloud cover (%)	80
Soil temp at 2 inches (F)	68
Soil type	sandy loam
Delivery rate (gpa)	15.3

Spotted knapweed control was visually evaluated in comparison to the untreated check 1 month after treatment (MAT). Complete control (100%) of knapweed rosettes was observed across all treatments. No treatment differences were observed.

Table 2. Spotted knapweed control following treatments timed to the spring rosette stage.

	Rate	Spotted knapweed	
Treatment [1]	oz ai /A	Cover[2]	Control[2]
		-----------------%	-----------------
Aminocyclopyrachlor + chlorsulfuron	1.00 + 0.40	0	100
Aminocyclopyrachlor + chlorsulfuron	1.78 + 0.70	0	100
Aminocyclopyrachlor + 2,4-D DMA	1.00 + 7.60	0	100
Aminocyclopyrachlor + 2,4-D DMA	2.00 + 15.2	0	100
Aminopyralid	2.00	1	100
Untreated check	--	27	0
Tukey's HSD		17	0

[1] 90% non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments
[2] 1 month after treatment

Evaluation of aminocyclopyrachlor for Russian olive control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminocyclopyrachlor (KJM44-062 or MAT28) has been evaluated for control of wide spread invasive weeds such as leafy spurge and Canada thistle. However, the effect of aminocyclopyrachlor on other invasive or troublesome weeds is largely unknown. The purpose of this research was to evaluate aminocyclopyrachlor efficacy on Russian olive (*Elaeagnus angustifolia* L.) applied as a basal bark treatment.

The study was established near the Sheyenne National Grassland in southeast North Dakota. Russian olive originally had been planted as part of a shelter belt but had spread into an adjacent pasture. The trees were 15 to 25 feet tall and ranged from approximately 10 to over 50 years old. Herbicides were applied in bark oil at concentrations ranging from 5 to 25% v/v on July 8, 2009. The herbicide was applied in an 8-inch band to the bark of uncut Russian olive trees about 12 inches above the soil. If the tree had more than one stem, the largest was chosen for treatment. Each treatment was applied to four trees (reps). Each replicate had similar size trees which ranged from an average circumference of 5 inches in rep one to 13 inches in rep four.

Aminocyclopyrachlor slowly controlled Russian olive when applied as a basal bark treatment (Table). Injury increased from 54 to 75% 6 weeks after treatment (18 Aug 2009) as the aminocyclopyrachlor rate increased from a 5 to 15% solution. Aminocyclopyrachlor at 5% solution killed all but the largest trees and averaged 93% control by July 2011 (24 months after treatment). All Russian olive trees died when aminocyclopyrachlor was applied as a 10 or 15% solution. Control was similar with triclopyr applied alone at 25% or with imazapyr at 20 + 1%, respectively.

All vegetation surrounding the treated tree was also killed and the size of the area increased to over 6 ft in diameter, as the aminocyclopyrachlor rate increased. The largest area of injury was observed when the treatment included imazapyr. No injury was observed when triclopyr was applied alone. Plants gradually reestablished during the course of the study, and no non-target injury was observed by the second season after application.

In summary, aminocyclopyrachlor provided excellent Russian olive control when applied as a basal bark treatment. Previous research had found aminocyclopyrachlor provided 100% control of regrowth when applied as a 2.5% solution in bark oil blue to cut-stumps, but had to be applied at a 10% or more solution to kill well established trees. This study confirmed that to ensure complete kill of all treated Russian olive trees, the aminocyclopyrachlor rate should be 10%, regardless if applied as a basal bark or cut-stump treatment.

Table. Evaluation of aminocyclopyrachlor as a basal bark treatment applied on July 8, 2009 for Russian olive control near McLeod, ND.

		Evaluation				
		2009		2010		2011
Treatment[1]	Rate	22 July	18 Aug	16 June	26 Aug	19 July
	— % by vol. —	— % injury —		— % control —		
Aminocyclopyrachlor	5	30	54	83	90	93
Aminocyclopyrachlor	10	41	79	100	100	100
Aminocyclopyrachlor	15	35	75	100	100	100
Triclopyr ester[2]	25	63	96	99	100	100
Triclopyr ester + imazapyr[3]	20 + 1	46	88	93	99	100
Aminocylopyrachlor + imazapyr	10 + 1	45	68	99	100	100
Untreated	...	0	0	0	0	0
LSD (0.05)		21	25	12	8.5	8

[1]Herbicide treatments applied in Bark Oil Blue LT from UAP Distribution Inc., 7251 West 4th St., Greeley, CO 80634.
[2]Commercial formulation - Garlon 4 from Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.
[3]Commercial formulation - Stalker from BASF Corporation, 100 Campus Drive, Florham Park, NC 07932.

Long-term control of leafy spurge with aminocyclopyrachlor. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminocyclopyrachlor (KJM44-062 or MAT28) is a new herbicide from E. I. DuPont company currently labeled for non-crop and right-of-way weed control. Initial evaluations of this compound for general pasture and invasive weed control was promising on a variety of species. The purpose of this research was to evaluate aminocyclopyrachlor applied twice for both leafy spurge control and possible grass injury.

Aminocyclopyrachlor methyl ester (DPX KJM44-062) was initially applied alone from 1 to 3 oz ai/A in the spring or fall of 2007. The first experiment was established near Walcott, ND in an ungrazed area of pasture with a dense stand of leafy spurge (92 stems/m^2). Treatments were applied June 5, 2007 when leafy spurge was in the true-flower growth stage. All herbicides were reapplied on June 30, 2009 to evaluate long-term control and potential grass injury. The second experiment was established on abandoned cropland near Fargo, ND on September 19, 2007 when leafy spurge was in the fall regrowth stage with a stand density of 30 stems/m^2.

Treatments were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 30 feet and replicated three or four times for the fall and spring study, respectively, in a randomized complete block design. Leafy spurge control was evaluated visually using percent stand reduction compared to the untreated control.

Aminocyclopyrachlor applied at 2 oz/A or higher provided better long-term leafy spurge control than the standard treatments of picloram at 8 oz/A or picloram plus imazapic plus 2,4-D at 4 + 1 + 16 oz/A (Table 1). For instance, aminocyclopyrachlor applied at 2 oz/A provided 90 and 88% leafy spurge control in June and August 2008, respectively, compared to 58 and 45% control, respectively, with picloram at 8 oz/A. Control averaged >80% with aminocyclopyrachlor at 2 to 3 oz/A in June 2009, 24 MAT (months after treatment), but had declined to 48 to 65% with aminocyclopyrachlor applied at 1 to 1.5 oz/A.

Long-term leafy spurge control tended to be higher 15 MAT following a second application compared to a single treatment. For instance, leafy spurge control averaged 89% compared to 55% in August 2010 or August 2008 (15 MAT), respectively, when aminocyclopyrachlor at 1 oz/A was applied twice. Also, the commonly used treatment of picloram plus imazapic plus 2,4-D provided 83% leafy spurge control in August 2010 (15 months after second application) compared to only 56% in August 2008 (15 months after single application). The major grass species present were Kentucky bluegrass and smooth brome and less than 5% grass injury was observed following either the 2007 or 2009 treatment applications (data not shown). Control declined regardless of treatment by 2011 and herbicides would have to be reapplied to maintain leafy spurge control.

Leafy spurge control 11 MAT with aminocyclopyrachlor applied in the fall increased from 89 to 99% as the application rate increased from 1 to 3 oz/A (Table 2). Grass injury was not observed regardless of aminocyclopyrachlor application rate (data not shown). Leafy spurge control averaged over treatments was 93% in June 2010 and 86% in June 2011 (45 MAT). This was much better control than normally observed with the standard treatment of picloram at 16 oz/A. Leafy spurge was still present in the untreated areas, so the reason for such long-term control is unknown. In summary, aminocyclopyrachlor provided better long-term leafy spurge control than commonly used treatments with little grass injury.

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

		Leafy spurge control/evaluation date							
		2007	2008		2009		2010		2011
Treatment	Rate	6 Aug	9 June	19 Aug	10 June	18 Aug	15 June	20 Aug	3 June
	— oz/A —	— % —							
Aminocyclopyrachlor[1]	1	92	79	55	48	92	93	89	53
Aminocyclopyrachlor	1.5	98	87	71	65	95	92	86	46
Aminocyclopyrachlor	2	99	90	88	81	95	98	96	79
Aminocyclopyrachlor	2.5	99	97	92	86	98	99	97	62
Aminocyclopyrachlor	3	99	96	92	87	100	99	95	72
Picloram	8	86	58	45	41	98	76	79	58
Picloram + imazapic + 2,4-D	4 + 1 + 16	97	45	56	38	95	89	83	37
LSD (0.05)		7	31	23	36	NS	15	17	NS

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

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

		Leafy spurge control/evaluation date						
		2008		2009		2010		2011
Treatment	Rate	20 June	20 Aug	12 June	3 Sept	10 July	8 Sept	13 June
	— oz/A —	— % —						
Aminocyclopyrachlor[1]	1	93	89	92	74	90	78	77
Aminocyclopyrachlor	2	99	97	98	85	93	82	84
Aminocyclopyrachlor	3	100	99	98	89	97	95	95
Picloram	16	99	97	98	82	90	88	88
LSD (0.05)		NS	7	4	NS	NS	NS	NS

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

Imazapic applied with saflufenacil for leafy spurge control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Imazapic is primarily used for leafy spurge control as a fall only treatment because spring applications do not provide satisfactory control. Saflufenacil is a pyrimidinedione chemical primarily used for burndown and selective pre-emergence dicot weed control in cropland. Previous research has shown that imazapic applied with saflufenacil in the spring and early summer provided leafy spurge control similar to or better than commonly used treatments. The purpose of this research was to evaluate imazapic applied with a liquid or dry formulation of saflufenacil for leafy spurge control.

The study was established on the Albert Ekre Research Station near Walcott, ND on June 2, 2010. Leafy spurge was in the vegetative to true-flower growth stage and 18 to 24 inches tall. Herbicides were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 30 feet and replicated four times in a randomized complete block design. Leafy spurge control was evaluated visually using percent stand reduction compared to the untreated control. The two formulations of saflufenacil evaluated were BAS80001H, a 70% ai dry flowable, and BAS80004H, a liquid formulated at 342 g ai/L.

All treatments except imazapic alone provided an average 95% leafy spurge top-growth burndown (injury) when evaluated approximately 3 weeks after treatment (28 June 2010) (Table). Leafy spurge control averaged greater than 90% 2 and 3 MAT (months after treatment) with all treatments of imazapic plus saflufenacil and was similar to the standard treatment of imazapic plus picloram plus 2,4-D (North Dakota three-way). Control gradually declined to 33% or less when saflufenacil was applied alone. The best long-term leafy spurge control was achieved when imazapic plus saflufenacil was applied at 1 plus 0.7 oz/A or imazapic at 1.5 oz/A with saflufenacil at 0.35 to 0.7 oz/A and averaged 85% 12 MAT. There was no difference in leafy spurge control when imazapic was applied with the dry or liquid formulation of saflufenacil. No treatment provided satisfactory leafy spurge control 15 MAT. In general, imazapic applied with saflufenacil tended to provide better long-term leafy spurge control than the standard North Dakota three-way treatment.

Table. Evaluation of saflufenacil applied with imazapic for leafy spurge control near Walcott, ND applied 2 June 2010.

		2010						2011	
		28 June		29 July		20 Aug		3 June	8 Sept
Treatment	Rate	LS[1]	Grass	LS	Grass	LS	Grass	Leafy spurge	
	oz/A	% injury	% control						
Imazapic + picloram + 2,4-D amine + MSO[2]	1 + 4 + 13 + 1 qt	91	15	90	18	91	11	55	33
AS80001H[3] + NIS[4] + AMS[5]	0.35 + 0.25 %	87	0	72	0	33	0	15	1
BAS80004H[6] + NIS + AMS	0.35 + 0.25 %	90	0	59	0	29	0	14	0
BAS80001H + NIS + AMS	0.7 + 0.25 %	96	0	70	0	18	1	13	0
Imazapic + NIS + AMS	1 + 0.25 %	5	7	4	6	1	6	4	0
Imazapic + NIS + AMS	1.5 + 0.25 %	6	2	8	3	4	3	5	0
Imazapic + BAS80001H + NIS + AMS	1 + 0.35 + 0.25 %	96	9	94	8	94	1	65	36
Imazapic + BAS80004H + NIS + AMS	1 + 0.35 + 0.25 %	99	9	97	11	95	8	64	45
Imazapic + BAS80001H + NIS + AMS	1 + 0.7 + 0.25 %	99	4	99	6	94	4	82	48
Imazapic + BAS80001H + NIS + AMS	1.5 + 0.35 + 0.25 %	89	14	91	11	94	3	83	25
Imazapic + BAS80001H + NIS + AMS	1.5 + 0.7 + 0.25 %	100	13	100	15	99	5	91	37
Imazapic + BAS80004H + MSO + AMS	1 + 0.35 + 1 qt + 1 %	99	20	96	13	94	0	53	16
LSD(0.05)		11	11	11	10	13	8	34	28

[1]LS = leafy spurge.
[2]MSO = methlated seed oil, [4]NIS is Induce both, Helena Chemical Co., 225 Schilling Blvd., Suite 300, Collierville, TN 38017.
[3]Saflufenacil 70% dry flowable formulation and [6]342 g/L liquid formulation.
[5]AMS is granular ammonium sulfate at 17 lbs/100 gallons of water.

Yellow starthistle control with aminocyclopyrachlor combinations. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Lewiston, ID in canyon grassland to evaluate yellow starthistle (CENSO) control with combinations of aminocyclopyrachlor and chlorsulfuron or 2,4-D timed to spring rosettes and compared to a standard aminopyralid application. Treatments were replicated three times. Plot size was 10 by 30 feet. All treatments were applied with a CO_2-pressurized backpack sprayer (Table 1).

Table 1. Application data.

Application date	May 4, 2011
Weed growth stage	spring rosette
Air temp (F)	83
Relative humidity (%)	14
Wind (mph, direction)	1 to 4, W
Cloud cover (%)	10
Soil temp at 2 inches (F)	56
Soil type	silt loam
Delivery rate (gpa)	16.9

Yellow starthistle control was visually evaluated in comparison to the untreated check 1 and 2 months after treatment (MAT). High levels of yellow starthistle control (>95%) were observed across all treatments at both evaluation dates (Table 2). No treatment differences were detected.

Table 2. Yellow starthistle control following treatments timed to the spring rosette stage.

		Yellow starthistle			
		Density		Control	
Treatment [1]	Rate	PRE[2]	2 MAT[3]	1 MAT	2 MAT
	oz ai /A	-----#plt/m^2-----		-------- % --------	
Aminocyclopyrachlor + chlorsulfuron	0.60 + 0.24	50	4	95	97
Aminocyclopyrachlor + chlorsulfuron	1.00 + 0.40	57	0	98	100
Aminocyclopyrachlor + 2,4-D DMA	0.63 + 4.75	42	0	100	100
Aminocyclopyrachlor + 2,4-D DMA	1.00 + 7.60	56	0	98	100
Aminopyralid	2.00	52	0	100	100
Untreated check	--	63	65	0	0
Tukey's HSD		24	12	7	6

[1] 90% non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments
[2] PRE = pre-treatment data taken May 4, 2011
[3] MAT = months after treatment

Canada thistle control with aminocyclopyrachlor combinations. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Deary, ID in Conservation Reserve Program (CRP) land to evaluate Canada thistle (CIRAR) control with combinations of aminocyclopyrachlor and chlorsulfuron or 2,4-D timed to spring rosettes and compared to a standard aminopyralid application. Treatments were replicated three times. Plot size was 10 by 30 feet. All treatments were applied with a CO_2-pressurized backpack sprayer (Table 1).

Table 1. Application data.

Application date	May 23, 2011
Weed growth stage	spring rosette
Air temp (F)	77
Relative humidity (%)	26
Wind (mph, direction)	2 to 4, SW
Cloud cover (%)	60
Soil temp at 2 inches (F)	60
Soil type	loam
Delivery rate (gpa)	15.7

Canada thistle control was visually evaluated in comparison to the untreated check 1 and 2 months after treatment (MAT). At 1 MAT, high levels of Canada thistle control were observed in aminopyralid (95%) and the high rate of aminocyclopyrachlor + 2,4-D DMA (94%; Table 2). The high rate of aminocyclopyrachlor + 2,4-D DMA resulted in significantly greater control in comparison to the low rate. No differences were detected between the low and high rate of aminocyclopyrachlor + chlorsulfuron. At 1 MAT, herbicide symptoms were observed across treatments, but differences resulted from the number of Canada thistle plants that transitioned to the bolting phenological stage. All herbicide treatments resulted in greater than 90% Canada thistle control at 2 MAT.

Table 2. Canada thistle control following treatments timed to the spring rosette stage.

		Canada thistle		
			Control	
Treatment [1]	Rate	Density[2]	1 MAT[3]	2 MAT
	oz ai /A	plt/m^2	----------- % ----------	
Aminocyclopyrachlor + chlorsulfuron	1.00 + 0.40	48	80	94
Aminocyclopyrachlor + chlorsulfuron	1.78 + 0.70	50	85	97
Aminocyclopyrachlor + 2,4-D DMA	1.00 + 7.60	61	78	93
Aminocyclopyrachlor + 2,4-D DMA	2.00 + 15.2	65	94	100
Aminopyralid	2.00	34	95	92
Untreated check	--	35	--	--
Tukey's HSD		NS	13	18

[1] 90% non-ionic surfactant (R-11) at 0.25% v/v was applied with all treatments
[2] Pre-treatment density data taken May 23, 2011
[3] MAT = months after treatment

Yellow toadflax control with combinations of aminocyclopyrachlor and sulfonylureas at two application timings. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established at Farragut State Park in northern Idaho to evaluate yellow toadflax (LINVU) control using aminocyclopyrachlor in combination with chlorsulfuron or metsulfuron. Treatments were applied as a spring or fall application, and were randomly assigned and replicated four times. Plot size was 10 by 30 feet. All treatments were applied with a CO_2-pressurized (38 psi) backpack sprayer (Table 1). Toadflax plants were approximately 1 to 2 inches tall at the spring application timing. Fall applications were timed to fall precipitation and frosts.

Yellow toadflax density was measured in two 1-m quadrats per plot prior to applications. Toadflax density was variable within the study plots. Plots with low density toadflax were identified as control treatments and toadflax patches outside the study plots were visually inspected for treatment comparisons.

Table 1. Application data.

Application date	June 15, 2010	November 3, 2010
Weed growth stage	1 to 2 inches	dormant
Air temp (F)	68	55
Relative humidity (%)	36	48
Wind (mph, direction)	3 to 9, W	1 to 3, SW
Cloud cover (%)	15	0
Soil temp at 2 inches (F)	69	46
Soil type	sandy loam	sandy loam
Delivery rate (gpa)	16.1	16.9

Yellow toadflax control was evaluated on June 28, 2011, approximately 12 months after treatment (MAT), for spring applications and 7 MAT for fall applications. Control ratings were based on the percent cover of yellow toadflax in comparison to pre-treatment cover estimates.

Spring applications resulted in greater yellow toadflax control (>95%) compared to fall applications (Table 2). No differences were detected between treatments within the spring timing. All treatments that included aminocyclopyrachlor resulted in complete control (100%). Within the fall timing, the high rate of aminocyclopyrachlor + chlorsulfuron and chlorsulfuron alone resulted in 83% control. The low rate of aminocyclopyrachlor + chlorsulfuron and aminocyclopyrachlor + metsulfuron resulted in control that is below the commercial standard (<60%).

Table 2. Yellow toadflax (LINVU) control following spring and fall herbicide applications 12 MAT for spring applications and 7 MAT for fall applications.

Treatment [1]	Rate	Application timing	Yellow toadflax control[2]
	oz ai /A		--- % ---
Aminocyclopyrachlor + chlorsulfuron	0.94 + 0.38	spring	100
Aminocyclopyrachlor + chlorsulfuron	2.5 + 1.0	spring	100
Aminocyclopyrachlor + metsulfuron	2.5 + 0.8	spring	100
Chlorsulfuron	1.0	spring	96
Aminocyclopyrachlor + chlorsulfuron	0.94 + 0.38	fall	58
Aminocyclopyrachlor + chlorsulfuron	2.5 + 1.0	fall	83
Aminocyclopyrachlor + metsulfuron	2.5 + 0.8	fall	50
Chlorsulfuron	1.0	fall	83
Tukey's HSD			30

[1] 90% non-ionic surfactant (R-11) at 0.50% v/v was applied with all treatments

[2] 28 June 2011 evaluation

Response of native grassland forbs and shrubs to various rates of aminocyclopyrachlor. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho, Moscow, ID 83844-2339). An experiment was established near Moscow, ID in Palouse Prairie remnant to evaluate the level of impact of various rates of aminocyclopyrachlor on desirable grassland and rangeland forbs. The experiment was designed as a randomized complete block with three replications and conducted at two sites located within the same remnant. Plot size was 10 by 40 feet. All treatments were applied with a CO_2-pressurized backpack sprayer at 15 gpa (Table 1).

Table 1. Application data.

Application date	May 21, 2009
Target growth stage	actively growing plants
Air temp (F)	68
Relative humidity (%)	32
Wind (mph, direction)	0 to 2, W
Cloud cover (%)	0
Soil temp at 2 inches (F)	60
Soil type	loam

Injury symptoms on desirable forb and shrub species and change in plant cover (%) were evaluated in comparison to the untreated control during the first growing season (2009) in multiple quadrats along a permanent transect in each plot (data not shown). In 2010 and 2011, approximately 13 and 25 months after treatment (MAT), quadrats were re-evaluated to assess changes in canopy cover of desirable forbs and shrubs that were impacted by herbicide treatments. The primary forb and shrub species evaluated were arrowleaf balsamroot (BALSA), fernleaf biscuitroot (LOMDI), snowberry (SYMAL), and wood's rose (ROSWO). Analysis of injury symptoms is pooled across sites.

Significant decline in arrowleaf balsamroot cover was observed between 1 and 13 MAT following aminocyclopyrachlor + chlorsulfuron, and general trends included decreases in arrowleaf balsamroot across herbicide treatments (Table 2). No trends were observed of arrowleaf balsamroot between 13 and 25 MAT. Fernleaf biscuitroot cover significantly declined across all herbicide treatments between 1 and 13 MAT. Small increases in fernleaf biscuitroot were observed across all herbicide treatments between 13 and 25 MAT, but no differences between herbicide treatments were detected, and fernleaf biscuitroot cover was significantly greater in the untreated check 25 MAT compared to each herbicide treatment.

Herbicide treatments had a small effect on native shrub cover between 1 and 13 MAT, with a small decrease in snowberry cover observed (Table 3). At 25 MAT, snowberry cover was no different or greater than 1 MAT. Wood's rose was scarce within study plots. No cover trends were detected. Annual grass increased across all herbicide treatments between 13 and 25 MAT, but did not increase in untreated plots (Table 4). The annual grass increase suggests the perennial forbs may have been important to maintain lower cover of annual grass. Annual forb cover did not differ between 13 and 25 MAT.

Table 2. Native forb cover (%)in Palouse Prairie 1, 13 and 25 months after treatment (MAT).

		Forb Cover					
		BALSA[3]			LOMDI		
Treatment [1]	Rate[2]	1 MAT	13 MAT	25 MAT	1 MAT	13 MAT	25 MAT
	oz ai/A	%					
Aminocyclopyrachlor	0.5	8	8	2	13	3	8
Aminocyclopyrachlor	1	15	8	10	23	1	3
Aminocyclopyrachlor	2	13	3	0	9	0	1
Aminocyclopyrachlor + 2,4-D DMA	1 + 6.2	4	1	1	26	0	1
Aminocyclopyrachlor + chlorsulfuron	1 + 0.15	23	4	8	20	5	8
Untreated check	--	7	23	16	24	16	27
Tukeys HSD		4	16	17	13	10	18

[1] 90% non-ionic surfactant (R-11) at 0.5% v/v was applied with all treatments
[2] 2,4-D DMA expressed as oz ae/A
[3] BALSA = arrowleaf balsamroot, LOMDI = fernleaf biscuitroot

Table 3. Native shrub cover (%) in Palouse Praire 1, 13 and 25 months after treatment (MAT).

		Shrub Cover					
		SYMAL			ROSWO		
Treatment [1]	Rate[2]	1 MAT	13 MAT	25 MAT	1 MAT	13 MAT	25 MAT
	oz ai/A	%					
Aminocyclopyrachlor	0.5	23	24	29	0	2	1
Aminocyclopyrachlor	1	20	13	18	0	4	5
Aminocyclopyrachlor	2	21	13	26	3	1	1
Aminocyclopyrachlor + 2,4-D DMA	1 + 6.2	20	15	20	0	1	1
Aminocyclopyrachlor + chlorsulfuron	1 + 0.15	18	20	20	2	1	0
Untreated check	--	22	14	12	3	1	1
Tukeys HSD		NS	8	NS	2	NS	4

[1] 90% non-ionic surfactant (R-11) at 0.5% v/v was applied with all treatments
[2] 2,4-D DMA expressed as oz ae/A
[3] SYMAL = common snowberry, ROSWO = wood's rose

Table 4. Annual grass and forb cover (%) at 13 and 25 months after treatment (MAT).

		Annual grass cover		Annual forb cover	
Treatment [1]	Rate[2]	13 MAT	25 MAT	13 MAT	25 MAT
	oz ai/A	%		%	
DPX-MAT28	0.5	15	33	17	16
DPX-MAT28	1	22	39	13	12
DPX-MAT28	2	10	37	17	16
DPX-MAT28 + 2,4-D DMA	1 + 6.2	17	41	16	20
DPX-MAT28 + Chlorsulfuron	1 + 0.15	15	35	12	16
Untreated check	--	18	19	15	14
Tukeys HSD		NS	22	NS	NS

[1] 90% non-ionic surfactant (R-11) at 0.5% v/v was applied with all treatments
[2] 2,4-D DMA expressed as oz ae/A

Tolerance of perennial pasture grass seedlings to aminocyclopyrachlor at two growth stages. John Wallace and Tim Prather. (Crop & Weed Science Division, University of Idaho). An experiment was established at Parker and Kambitsch Farms near Moscow, ID in October of 2009 to evaluate the tolerance of Idaho fescue (FEID), bluebunch wheatgrass (PSSP), Sandberg bluegrass (POSE), basin wildrye (LECI) and mountain brome (BRMA) to various rates of aminocyclopyrachlor and surfactants. Grasses were planted on October 13, 2009. Treatments were applied on May 12, 2010 targeting emerged grasses that ranged from 1 to 3 tillers and in May of 2011 in the following growing season targeting established grasses (Table 1).

Table 1. Application data.

Site	Parker	Parker	Kambitsch	Kambitsch
Application date	May 12, 2010	May 13, 2011	May 12, 2010	May 13, 2011
Application timing	1 to 3 tiller	established	1 to 3 tiller	established
Air temp (F)	62	83	64	84
Relative humidity	5	28	5	32
Wind (mph, direction)	3 to 7, W	2 to 5, W	3 to 9, W	2 to 7, W
Soil temp at 2 inches (F)	57	61	58	58
Soil type	loam	loam	loam	loam

Herbicide injury and crop yield effects on targeted grasses within the 2010 growing season has been previously reported in the 2011 WSWS Research Progress Report (pg 36-38). Herbicide injury to established grasses following 2011 applications was evaluated 2 and 6 weeks after treatment (WAT). Biomass was sampled for both application timings on July 15, 2011 (Table 3&4). Five plants per plot were randomly selected, clipped and dried for 64 hrs at 60 C. Biomass estimates are expressed as grams per plant.

Herbicide injury of established perennial grasses was minimal across herbicide treatments 2 and 6 WAT (Table 2). No differences between herbicide rates or surfactant were detected. Injury symptoms were generally confined to the presence of chlorotic leaves. Epinastic symptoms were negligible.

Aminocyclopyrachlor rates and surfactant type did not affect biomass yields, 14 months after treatment (MAT), of perennial grasses sprayed at the seedling stage in 2010 (Table 3). Similarly, no treatment effects were detected on biomass yields of established grasses approximately 2 MAT (Table 4).

Table 2. Herbicide injury on established Idaho fescue (FEID), bluebunch wheatgrass (PSSP), Sandberg bluegrass (POSE), mountain brome (BRMA) and basin wildrye (LECI) 2 and 6 weeks after treatment (WAT).

		Herbicide Injury									
		FEID		PSSP		POSE		BRMA		LECI	
Treatment[1]	Rate	2 WAT	6 WAT	2 WAT	6 WAT	2 WAT	6 WAT	2 WAT	6 WAT	2 WAT	6 WAT
	oz ai/A	---------- % ----------									
Aminocyclopyrachlor + NIS	0.5	0	0	0	1	0	0	2	3	3	2
Aminocyclopyrachlor + MSO	0.5	1	0	0	0	3	1	9	5	4	4
Aminocyclopyrachlor + NIS	1.0	0	0	0	0	0	1	6	4	3	3
Aminocyclopyrachlor + MSO	1.0	0	0	1	0	1	0	6	4	4	2
Aminocyclopyrachlor + NIS	2.0	0	0	4	1	0	1	5	6	0	0
Aminocyclopyrachlor + MSO	2.0	0	0	2	0	1	1	8	7	3	1
Aminocyclopyrachlor + NIS	4.0	0	0	1	2	0	0	14	4	3	2
Aminocyclopyrachlor + MSO	4.0	1	0	0	1	0	1	12	1	8	3
Untreated check		0	0	0	0	0	0	0	0	0	0
Tukey's HSD		8	0	8	9	7	6	14	9	10	8

[1] Non-ionic surfactant (NIS) applied at 0.25% v/v; methylated seed oil (MSO) applied at 1.0% v/v

Table 3. Biomass yield in 2011 growing season following 2010 herbicide treatments to Idaho fescue (FEID), bluebunch wheatgrass (PSSP), Sandberg bluegrass (POSE), mountain brome (BRMA) and basin wildrye (LECI) seedlings.

Treatment[1]	Rate	FEID	PSSP	POSE	BRMA	LECI
	oz ai/A	------------------------------		g/plt		------------------------------
Aminocyclopyrachlor + NIS	0.5	16	33	18	37	39
Aminocyclopyrachlor + MSO	0.5	14	45	13	41	61
Aminocyclopyrachlor + NIS	1.0	22	33	9	27	67
Aminocyclopyrachlor + MSO	1.0	25	52	15	37	88
Aminocyclopyrachlor + NIS	2.0	20	19	12	25	74
Aminocyclopyrachlor + MSO	2.0	19	37	25	36	72
Aminocyclopyrachlor + NIS	4.0	23	26	9	38	65
Aminocyclopyrachlor + MSO	4.0	21	14	9	52	77
Untreated check		18	41	11	41	79
Tukey's HSD		NS	NS	NS	NS	NS

[1] Non-ionic surfactant (NIS) applied at 0.25% v/v; methylated seed oil (MSO) applied at 1.0% v/v

Table 4. Biomass yield of established Idaho fescue (FEID), bluebunch wheatgrass (PSSP), Sandberg bluegrass (POSE), mountain brome (BRMA) and basin wildrye (LECI) approximately 2 months after treatment (MAT).

Treatment[1]	Rate	FEID	PSSP	POSE	BRMA	LECI
	oz ai/A	------------------------------		g/plt		------------------------------
Aminocyclopyrachlor + NIS	0.5	9	17	8	29	49
Aminocyclopyrachlor + MSO	0.5	12	24	5	34	36
Aminocyclopyrachlor + NIS	1.0	7	30	11	26	52
Aminocyclopyrachlor + MSO	1.0	7	17	6	36	43
Aminocyclopyrachlor + NIS	2.0	10	22	6	32	60
Aminocyclopyrachlor + MSO	2.0	10	31	8	30	60
Aminocyclopyrachlor + NIS	4.0	11	21	11	29	40
Aminocyclopyrachlor + MSO	4.0	8	30	4	37	32
Untreated check		13	26	17	42	73
Tukey's HSD		NS	NS	NS	NS	NS

[1] Non-ionic surfactant (NIS) applied at 0.25% v/v; methylated seed oil (MSO) applied at 1.0% v/v

Weed control with penoxsulam/oxyfluorfen for season long weed control in almonds. Joi M. Abit and Bradley D. Hanson. (Plant Sciences, University of California, Davis, CA 95616). A study was conducted near Firebaugh, CA to evaluate dormant-season applications of penoxsulam/oxyfluorfen for season long weed control in almond orchards. Plots were 10 by 22 ft arranged in a randomized complete block design with four replications. Treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 20 gallons per acre with three flat fan XR8002 nozzles spaced 20 inches apart (Table 1). Environmental conditions during applications are presented in table 2. At the time of application, few shepherd's purse and fleabane seedlings were present. Weed control/densities were determined on March 10, April 12, June 3, and July 26, 2011.

Premix of penoxsulam/oxyfluorfen had excellent hairy fleabane (ERIBO) control in all rating dates regardless of herbicide rate, combination, or application timing (Table 2). Yellow nutsedge (CYPES) and grass control was excellent in all penoxsulam/oxyfluorfen treatments up to 3 months after A timing application. Weed density was minimal in all plots one month after B application timing but increased thereafter. Applications of penoxsulam alone in combination with glyphosate or saflufenacil and glyphosate + saflufenacil at C timing, suppressed the germination of grasses but not sedges. However, penoxsulam in combination with saflufenacil did not control junglerice at D timing. Penoxsulam/oxyfluorfen at low and high rates decreased grasses and sedges population 1 month after D application timing. Application of pendemethalin + saflufenacil + glyphosate followed by (fb) saflufenacil + glyphosate and indaziflam + glufosinate fb glufosinate had excellent control on hairy fleabane and grasses but low to moderate control on sedges.

Table 1. Herbicide application information, New Columbia Ranch, Firebaugh CA 2011.

Parameters	A timing	B timing	C timing	D timing
Application date	Jan 12, 2011	Mar 10, 2011	June 3, 2011	July 6, 2011*
Air temperature (F)	56	75	90	96
Soil temperature (F)	50	60	70	77
Relative humidity (%)	70	48	33	32
Wind speed (mph)	0	2.9	0.8	3.9
% cover	80	0	100	0

*July 6, 2011 weather data were obtained from a California Department of Water Resources weather station located within five miles of the experimental site.

Table 2. Weed efficacy with various penoxsulam/oxyfluorfen rates, combinations, and application timings in an almond orchard near Firebaugh CA in Spring 2011.

			3/10/11	4/12/11			6/3/11			7/26/11			
Treatment[1]	Timing[2]	Rate[3]	ERIBO	ERIBO	CYPES	Grass	ERIBO	CYPES	Grass	ERIBO	CYPES	ECHCG	ECHCO
		lb ai/A	%	no. / 10 ft^2									
Untreated		--	0	171	6	0	175	25	7	12	19	28	0
Glyphosate fb glyphosate	A fb B	1.5 fb 1.5	98	5	2	3	10	10	45	4	62	4	0
Glyphosate fb penoxsulam + glyphosate	A fb B	1.5 fb 0.015 + 1.5	98	1	2	0	5	18	5	1	30	1	0
Glyphosate fb penoxsulam + glyphosate	A fb B	1.5 fb 0.03 + 1.5	98	2	2	4	3	8	65	1	33	3	39
Penoxsulam + glyphosate fb penoxsulam + glyphosate	A fb C	0.03 + 1.5 fb 0.015 + 1.5	100	1	3	25	1	13	50	1	7	0	39
Penoxsulam/oxyfluorfen + glyphosate fb glyphosate	A fb C	1.0 + 1.5 fb 1.5	100	1	4	0	0	21	24	0	19	0	0
Penoxsulam/oxyfluorfen + glyphosate fb glyphosate	A fb D	1.5 + 1.5 fb 1.5	100	0	1	0	0	6	5	0	7	0	7
Penoxsulam/oxyfluorfen + glyphosate fb penoxsulam + glyphosate	A fb C	1.0 + 1.5 fb 0.015 + 1.5	100	1	6	4	0	37	29	0	35	5	3
Penoxsulam/oxyfluorfen + glyphosate fb penoxsulam + glyphosate	A fb D	1.5 + 1.5 fb 0.015 + 1.5	100	0	6	2	0	16	94	0	27	0	2
Penoxsulam/oxyfluorfen + glyphosate fb penoxsulam + saflufenacil	A fb C	1.0 + 1.5 fb 0.015 + 0.043	100	1	3	0	2	33	5	1	25	6	0
Penoxsulam/oxyfluorfen + glyphosate fb penoxsulam + saflufenacil	A fb D	1.5 + 1.5 fb 0.015 + 0.043	100	0	7	0	1	20	2	0	12	0	76
Penoxsulam/oxyfluorfen + glyphosate fb saflufenacil + glyphosate	A fb C	1.0 + 1.5 fb 0.043 + 1.5	100	1	3	0	1	10	4	0	59	0	2
Penoxsulam/oxyfluorfen + glyphosate fb saflufenacil + glyphosate	A fb D	1.5 + 1.5 fb 0.043 + 1.5	100	0	3	0	1	18	6	0	7	0	3
Penoxsulam/oxyfluorfen + glyphosate fb penoxsulam /oxyfluorfen + glyphosate	A fb D	1.0 + 1.5 fb 0.5 + 1.5	100	0	3	1	1	22	27	0	8	0	2
Penoxsulam/oxyfluorfen + glyphosate fb penoxsulam /oxyfluorfen + glyphosate	A fb D	1.5 + 1.5 fb 0.5 + 1.5	100	1	2	1	1	14	22	1	1	0	0
Pendimethalin + saflufenacil + glyphosate fb saflufenacil + glyphosate	A fb B	3.8 + 0.043 + 1.5 fb 0.043 + 1.5	100	0	3	0	0	12	5	0	45	0	1
Indaziflam + glufosinate fb glufosinate	A fb B	0.065 + 0.88 fb 0.88	99	1	8	0	1	12	0	0	54	0	0
LSD (0.05)			1	6	7	16	60	32	89	4	36	14	44

[1]Crop oil concentrate (COC) and ammonium sulfate were added to all treatments at 1% v/v and 10 lb/100 gal, respectively. Methylated seed oil was added to saflufenacil instead of COC.
[2]A timing = Jan. 12; B timing = Mar. 10; C timing = June 3; D timing = July 6.
[3]Glyphosate expressed as lb ae/A. Abbreviations: ERIBO, hairy fleabane; CYPES, yellow nutsedge; ECHCG, barnyardgrass; ECHCO, junglerice.

Almond residual herbicide comparison 2010-11. Joi M. Abit and Bradley D. Hanson. (Department of Plant Sciences, University of California, Davis. CA 95616) Premium residual herbicides in combination with burndown materials were compared for control of annual weeds in almonds. The trial, conducted at Nickels Soil Laboratory near Arbuckle, CA, was a randomized complete block design with four replications and 8 ft by 40 ft plots. Herbicides were applied with a CO_2-pressurized backpack sprayer which delivered 25 gallons per acre through XR8002 flat fan nozzles. Treatments were applied on February 23, 2011 with 62 F, 47% RH, 50% cloud cover, 1 mph SE wind, and no dew present. Weed populations were determined 1, 2, and 4 month after treatment (MAT).

Among the twenty treatments evaluated, eight treatments combinations showed excellent weed control in all rating dates. These are saflufenacil + paraquat + pendimethalin, paraquat + simazine, indaziflam (0.0845 lb/A) + glufosinate, indaziflam + glyphosate, penoxsulam /oxyfluorfen + glufosinate, flumioxazin + glyphosate, isoxaben + glufosinate, and glufosinate + oxyfluorfen + pendimethalin. Applications of residual herbicides (pendimethalin, rimsulfuron, indaziflam, and penoxsulam /oxyfluorfen) did not show constant weed control 1 MAT. All herbicide treatments demonstrated excellent fleabane control 2 and 4 MAT. California burclover control was also excellent in all treatments except in plots treated with glyphosate alone 2 MAT. Large crabgrass population was absent or minimal in all treatments except plots treated with glufosinate alone 4 MAT.

Table. Weed control in an almond orchard treated with premium residual herbicides plus burndown materials near Arbuckle, CA in 2011.

Treatment	Rate	1 MAT[1]		2 MAT			4 MAT	
		POAAN	COPDI	COPDI	MEDPO	ERIBO	ERIBO	DIGSA
	lb ai/A[2]	no. 10 ft^{-2}						
Untreated	-	21	217	12	5	16	11	12
Glyphosate	1.5	22	51	5	7	0	3	8
Glufosinate	0.88	30	15	1	0	0	3	17
Saflufenacil + pendimethalin	0.043 + 3.8	59	98	3	0	0	2	1
Saflufenacil + rimsulfuron	0.043 + 0.0625	6	18	2	0	0	1	9
Saflufenacil + pendimethalin + rimsulfuron	0.043 + 3.8 + 0.0625	11	24	1	0	0	0	1
Saflufenacil + paraquat	0.043 + 1.0	3	145	22	2	0	1	5
Saflufenacil + paraquat + pendimethalin	0.043 + 1.0 + 3.8	1	9	7	2	0	1	0
Paraquat + simazine	1.0 + 0.5	1	9	5	1	0	0	3
Indaziflam + glufosinate	0.065 + 0.88	23	9	1	0	1	1	1
Indaziflam + glufosinate	0.0845 + 0.88	6	3	0	0	0	0	0
Indaziflam + glyphosate	0.065 + 1.5	0	1	0	3	0	0	0
Indaziflam + saflufenacil	0.065 + 0.043	44	16	0	1	1	1	1
Indaziflam + paraquat	0.065 + 1.0	2	31	0	2	1	1	2
Penoxsulam/oxyfluorfen	1.5	30	178	58	3	0	1	11
Penoxsulam/oxyfluorfen + glufosinate	1.5 + 0.88	2	0	6	0	0	0	3
Penoxsulam/oxyfluorfen + saflufenacil	1.5 + 0.043	27	55	7	0	1	1	0
Flumioxazin + glyphosate	0.19 + 1.5	4	0	0	0	0	0	1
Isoxaben + glufosinate	1.33 + 0.88	4	0	1	1	0	1	6
Glufosinate + oxyfluorfen + pendimethalin	0.88 + 0.125 + 3.8	2	0	3	0	0	1	1
LSD (0.05)		29	103	14	4	9	5	10

[1] Abbreviations: POAAN, annual bluegrass; COPDI, lesser swinecress; MEDPO, California burclover; ERIBO, hairy fleabane; DIGSA, large crabgrass. MAT, months after treatment. Treatments were applied February 23, 2011.
[2] Glyphosate rates are expressed in lb ae/A.

Walnut and almond residual herbicide comparison. Joi M. Abit, John Roncoroni, Carolyn DeBuse, and Bradley D. Hanson. (Department of Plant Sciences, University of California, Davis, 95616). Field experiments were conducted in almond and walnut orchards in Yolo County California to evaluate residual herbicides plus burndown materials for dormant season application. Several newer materials were compared to grower standards to determine their relative efficacy against hairy fleabane and other winter and summer annual weeds in young almond and walnut orchards. Treatments were applied using a CO_2 backpack sprayer calibrated to deliver 20 gallons per acre on January 11, 2011. For treatments with second applications, treatments were applied on April 21, 2011. The experiments were arranged as randomized complete blocks with 8- by 40-ft (included 3 trees) plots. Treatments were replicated four times. Weed densities were determined on March 18 and May 10, 2011 (2 and 4 months after initial application, respectively).

A total of three and six broadleaf weed species were identified in the almond and walnut experimental sites, respectively. Hairy fleabane was the most common species observed in both sites. On March 18, 2011 at the almond site, hairy fleabane populations were low in all treatments except in plots treated with a sequential glyphosate program (Table 1). However, all treatments reduced weed populations compared to the non-treated plots by the May 10 evaluation. For other broadleaf weeds, weed counts were generally low in all treatments and on May 10, all treatments had weed counts lower than the non-treated.

At the walnut site, 31 and 18 hairy fleabane per 10 ft^2 was observed in plots treated with paraquat + simazine (a low simazine rate) and indaziflam (low rate) + glufosinate, respectively during the March 18 evaluation (Table 2). All other herbicide treatments had fewer than five hairy fleabane plants per 10 ft^2. By May 10, weed counts in plots treated with paraquat + simazine continued to be higher than all other plots. Further, growth of other broadleaf weeds was highest in plots treated with indaziflam (low rate) + glufosinate in March 18 count. Both experiments were terminated after the May evaluation due to high densities of field bindweed and alkali mallow where were not controlled by any of the winter treatments.

Table 1. Weed counts in an almond orchard in Yolo County California treated with premium residual herbicides plus burndown materials January 11, 2011.

Treatment[1]	Rate[3]	18-Mar[4] Hairy fleabane	18-Mar[4] Other broadleaf	10-May[4] Hairy fleabane	10-May[4] Other broadleaf
	lb ai/A	no. 10 ft^{-2}			
Untreated	-	40 a	1 b	55 a	19 a
Glyphosate fb glyphosate[2]	1.5 fb 1.5	35 ab	4 a	4 b	4 b
Glufosinate fb glufosinate[2]	0.88 fb 0.88	16 abc	3 ab	0 b	0 b
Saflufenacil + pendimethalin	0.43 + 3.8	0 c	0 b	1 b	3 b
Saflufenacil + rimsulfuron	0.43 + 0.0625	0 c	3 ab	0 b	0 b
Saflufenacil + pendimethalin + rimsulfuron	0.43 + 3.8 + 0.0625	0 c	0 b	0 b	0 b
Saflufenacil + paraquat	0.43 + 1.0	0 c	2 ab	4 b	7 b
Saflufenacil + paraquat + pendimethalin	0.43 + 1.0 + 3.8	0 c	1 b	0 b	0 b
Paraquat + simazine	1.0 + 0.5	0 c	0 b	2 b	0 b
Indaziflam + glufosinate	0.065 + 0.88	0 c	0 b	1 b	4 b
Indaziflam + glufosinate	0.0845 + 0.88	0 c	0 b	1 b	0 b
Indaziflam + glyphosate	0.065 + 1.5	0 c	0 b	0 b	0 b
Indaziflam + saflufenacil	0.065 + 0.043	0 c	0 b	0 b	0 b
Indaziflam + paraquat	0.065 + 1.0	3 c	0 b	0 b	0 b
Penoxsulam/oxyfluorfen	1.5	0 c	1 b	0 b	0 b
Flumioxazin + glyphosate	0.2 + 1.5	0 c	0 b	0 b	3 b
Isoxaben + glufosinate	1.33 + 0.88	11 bc	2 ab	1 b	0 b
Glufosinate + oxyfluorfen + pendimethalin	0.88 + 0.125 + 3.8	0 c	0 b	2 b	1 b

[1]Ammonium sulfate (10 lb/100 gal) was added to all glyphosate, glufosinate, and saflufenacil treatments. Saflufenacil and paraquat treatments included MSO (1% v/v).
[2]Second application: April 21, 2011.
[3]Glyphosate expressed as lb ae/A.
[4]Other broadleaf weeds: *Amaranthus* spp. and sow thistle. Means within a column followed by the same letter are not different statistically at P>0.05.

Table 2. Weed counts in a walnut orchard in Yolo County California treated with premium residual herbicides plus burndown materials January 11, 2011.

Treatment[1]	Rate[3]	18-Mar[4]		10-May[4]	
		Hairy fleabane	Other broadleaf	Hairy fleabane	Other broadleaf
	lb ai/A	no. 10 ft^{-2}			
Untreated	-	19 ab	5 b	16 ab	3 bc
Glyphosate fb glyphosate[2]	1.5 fb 1.5	5 b	10 ab	7 ab	0 c
Glufosinate fb glufosinate[2]	0.88 fb 0.88	0 b	0 b	3 b	0 c
Saflufenacil[2] + pendimethalin	0.43 + 3.8	0 b	1 b	1 b	2 bc
Saflufenacil + rimsulfuron	0.43 + 0.0625	0 b	0 b	0 b	0 c
Saflufenacil + pendimethalin + rimsulfuron	0.43 + 3.8 + 0.0625	0 b	0 b	0 b	0 c
Saflufenacil + paraquat	0.43 + 1.0	0 b	0 b	1 b	6 ab
Saflufenacil + paraquat + pendimethalin	0.43 + 1.0 + 3.8	0 b	0 b	5 b	8 a
Paraquat + simazine	1.0 + 0.5	31 a	29 a	21 a	3 bc
Indaziflam + glufosinate	0.065 + 0.88	18 ab	0 b	1 b	2 bc
Indaziflam + glufosinate	0.0845 + 0.88	0 b	0 b	9 ab	0 c
Indaziflam + glyphosate	0.065 + 1.5	0 b	2 b	1 b	0 c
Indaziflam + saflufenacil	0.065 + 0.043	0 b	0 b	0 b	0 c
Indaziflam + paraquat	0.065 + 1.0	0 b	0 b	1 b	1 c
Penoxsulam/oxyfluorfen	1.5	0 b	1 b	0 b	0 c
Flumioxazin + glyphosate	0.2 + 1.5	0 b	0 b	3 b	0 c
Isoxaben + glufosinate	1.33 + 0.88	0 b	2 b	0 b	4 abc
Glufosinate + oxyfluorfen + pendimethalin	0.88 + 0.125 + 3.8	0 b	0 b	2 b	0 c

[1]Ammonium sulfate (10 lb/100 gal) was added to all glyphosate, glufosinate, and saflufenacil treatments. Saflufenacil and paraquat treatments included MSO (1% v/v).
[2]Second application: April 21, 2011.
[3]Glyphosate expressed as lb ae/A.
[4]Other broadleaf weeds: common lambsquarters, *Amaranthus* spp., sow thistle, spotted spurge, chickweed, and willowherb. Means within a column followed by the same letter are not different statistically at P>0.05.

Annual bluegrass control and perennial ryegrass elimination in overseeded bermudagrass with amicarbazone and flucarbazone. Kai Umeda. (University of Arizona Cooperative Extension, Maricopa County, Phoenix, AZ 85040) A small plot experiment was conducted at Legend Trail Golf Course in Scottsdale, AZ in a rough area adjacent to a fairway. The Tifway 419 hybrid bermudagrass rough was overseeded with perennial ryegrass cultivar La Quinta during late September 2010. The ryegrass was mowed regularly during the winter at a height of 1.25 in and the bermudagrass was maintained at 1.0 in height. Treatment plots measuring 5 ft by 10 ft were established in a randomized complete block design with three replicates. Herbicide and transition-aid treatments were applied using a backpack sprayer pressurized by CO_2 at 30 psi and delivering sprays in 47 gpa water. The broadcast spray was applied with a hand-held boom equipped with three 8003 flat fan nozzles spaced 20-in apart. All sprays included a non-ionic surfactant, Latron CS-7 at 0.25% v/v. The first sprays of amicarbazone were initiated on 18 February 2011 when the air temperature was 64ºF, cloudy sky, 1 mph wind, dry turfgrass surface, and soil temperature at 4-inch depth was 50ºF. *P. annua* (POANN) was initiating flowering. The sequential applications of amicarbazone were applied three weeks later on 11 March when the air temperature was 71ºF, clear sunny sky, wind was 2.5 mph from the southwest, turfgrass had dew, and soil temperature at 4-inch depth was 52ºF. *P. annua* was flowering in 50% of the plots. ARY-0619 at 6.4 oz product/1000 sq ft was added to an amicarbazone 5.0 oz/A treatment at sequential timing of application at 3 weeks after the first application. On 26 May, the transition-aid treatments were applied to eliminate perennial ryegrass (LOLPE) from emerging bermudagrass (CYNDA) when it was 80ºF, clear and sunny sky, less than 3 mph wind from the west, and soil temperature was 64ºF at 2-3 inch depth. Following treatment applications, *P. annua* control, ryegrass elimination, and bermudagrass overall quality were evaluated at intervals until transition occurred.

Table. Efficacy of amicarbazone for *Poa annua* control and flucarbazone for ryegrass elimination at transition, Scottsdale, AZ, 2011.

Treatment[1]	Rate	Application timing[2]	POANN control 25 Mar	POANN control 05 May	POANN control 14 Jun	POANN control 24 Jun	LOLPE elimination 14 Jun	LOLPE elimination 24 Jun	LOLPE elimination 01 Jul	CYNDA quality[3] 24 Jun	CYNDA quality[3] 20 Jul
	lb ai/A		------------------------%			--------------------------	------------ %		--------------		
Untreated check			0	0	0	0	17	40	25	3	4
Amicarbazone + amicarbazone	0.13 + 0.13	February March	50	73	52	63	5	0	0	3	4
Amicarbazone + amicarbazone	0.18 + 0.18	February March	58	88	82	73	12	23	25	3	4
Amicarbazone + amicarbazone	0.22 + 0.22	February March	57	88	77	73	5	0	0	3	4
Amicarbazone + amicarbazone + ARY- 0619	0.22 + 0.22 + 6.4 oz	February March March	77	90	72	85	5	0	0	3	4
Flucarbazone	0.026	May			77	88	93	95	98	3.7	7
Amicarbazone + amicarbazone + flucarbazone	0.13 + 0.13 + 0.026	February March May	50	67	85	85	90	93	98	4	7
Amicarbazone + amicarbazone + amicarbazone + flucarbazone	0.13 + 0.13 + 0.13 + 0.026	February March May May	57	78	88	87	83	88	66	4	7
Trifloxysulfuron	0.016	May			95	99	95	98	99	3.7	5.7
Foramsulfuron	0.026	May			90	95	90	92	95	4	5.7
LSD (p=0.05)			14	13	27	23	10	28	36	0.8	0.4

[1]ARY-0619 applied at 6.4 oz product/1000 sq ft at sequential application only at +3 weeks. Latron CS-7 added to all herbicide treatments at 0.25% v/v.
[2]Applications timings: February 18, March 11, and May 26, 2011.
[3]Bermudagrass overall quality ratings: 1 = poorest and 9 = best

<u>Evaluating chemical and biological control options for management of field bindweed in small fruits (*Convolvulus arvensis*)</u>. Jessica M. Green and R. Edward Peachey (Dept. of Horticulture, Oregon State University, Corvallis, OR. 97331). Experiments evaluated the use of both chemical and biological control tactics to reduce field bindweed (*Convolvulus arvensis*) in blackberries, raspberries, and other perennial fruit crops. Quinclorac selectively controls bindweed in many crops, but tolerance of perennial fruit crops to this herbicide is unknown. The larval stage of *Tyta luctuosa*, a noctuid moth, defoliates field bindweed but little is known about the biology of the moth and synchronicity with the target weed in this region. Similarly, there is evidence that an eriophyid mite, *Aceria malherbae*, can reduce growth and flowering of field bindweed, but overwintering ability and the effects of common agricultural practices on establishment and efficacy of this mite is unknown.

In field experiments, quinclorac was applied before harvest, after harvest, and near the first frost in the fall to both every year (EY) and alternate year (AY) production blackberries, raspberries, and blueberries and provided 80-90% control of bindweed without affecting yield.

Field releases of *T. luctuosa* were made throughout the Willamette Valley of Oregon from June thru August, 2011. Although signs of herbivory were evident at each release site, mid-season light traps averaged less than 0.1% recapture.

A factorial experiment was conducted to test the effects of irrigation (drip vs. overhead), herbicide (quinclorac at two rates), and a gall-forming mite (*A.malherbae*) on bindweed growth and mite colonization. Field bindweed was planted in plastic pots, treatments were applied, and symptoms were evaluated for six weeks. Root and shoot biomass were collected the following spring. Leaf galling was greatest in inoculated pots receiving high-drip (8L/hr) irrigation. Root weight in 2010 was 40% greater in pots that had been inoculated with mites the previous summer (Table 1). Effects of 2011 treatments on root biomass and shoot growth will be determined in the spring of 2012.

Table 1. Main effects of treatment on potted field bindweed, as measured by above-ground (shoot) and below-ground (root) biomass. Mite = inoculation with *A.malherbae* (+/-); herbicide = one time application of quinclorac at 0, 1X (0.14 kg ai/ha), or 2X (0.28 kg ai/ha); and irrigation (OH = overhead 8L/hr, LD = low drip 4L/hr., HD = high drip 8L/hr.). For each effect, mean values within a column followed by the same letter do not differ (α=0.1).

		Shoot biomass		Root biomass
Main effect	Treatment	2010	2011	2010
		----------- *dry wt. (g)* --------------		
Mite	+	1.4 a	4.6 a	1.0 a
	-	1.4 a	5.0 a	0.6 b
Quinclorac	Untreated	1.8 a	5.0 a	1.0 a
	0.14 kg ai/ha	0.8 ab	4.8 a	0.6 ab
	0.28 kg ai/ha	0.3 b	4.4 a	0.3 b
Irrigation	OH	2.1 a	5.7 a	1.3 a
	LD	1.2 a	----	0.6 b
	HD	1.3 a	4.6 b	0.7 b

Weed control in potatoes with fomesafen or pyroxasulfone alone or in various tank mixtures, or rimsulfuron combinations applied preemergence. Pamela J.S. Hutchinson, Brent R. Beutler, and JaNan Farr (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this trial was to compare fomesafen or pyroxasulfone alone or tank mixtures with standard potato herbicides, or various rimsulfuron combinations applied preemergence.

The experimental area was fertilized with 200 lb N, 180 lb P, and 6 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 April 27, 2010 in a Declo loam soil with 1.42% organic matter and pH 8.1. 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 19, 2010. Herbicide treatments were applied after hilling and prior to potato emergence on May 21, 2010, with a CO_2-pressurized backpack sprayer that delivered 17.5 gpa at 30 psi. Herbicides were incorporated by 0.5 inch sprinkler irrigation on May 25, 2010. 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 on July 7 and 20, 2010 through the irrigation system. Potato vines were desiccated with 0.5 lb ai/A diquat August 19, 2010. Tubers were harvested from 20 feet of each of the two center rows in each plot using a single-row mechanical harvester on Sept. 8, 2010 and graded according to USDA standards.

Treatments included dimethenamid-p + pendimethalin at 0.84 + 1.0 lb ai/A; fomesafen alone at 0.25 or 0.5 lb ai/A; and fomesafen at 0.25 lb/A tank-mixed with s-metolachlor at 1.27 or dimethenamid-p at 0.84 or 1.0 lb ai/A. Fomesafen at that rate also was tank-mixed with a premix of metribuzin + s-metolachlor equivalent to 0.31 + 1.32 lb ai/A. Pyroxasulfone at 0.106 or 0.213 lb ai/A was applied alone or in tank-mixtures with flumioxazin at 0.047 lb ai/A. Pyroxasulfone at 0.213 lb also was combined with metribuzin or pendimethalin at 0.5 or 1.0 lb ai/A, respectively. In addition, various rates of rimsulfuron were applied in three-way combinations with pendimethalin + EPTC (4 lb ai/A), metribuzin, or flumioxazin at the aforementioned rates or in a 4-way tank-mix with pendimethalin, metribuzin and EPTC at 1.75 lb ai/A. Nontreated weedy and weed-free control treatments were included in the trial for tuber yield and quality comparisons. Weed control ratings were conducted 3 wks after treatment (WAT), just before row closure approximately 6 WAT, and just prior to harvest. The last rating represents season-long control and is shown in this report. Redroot pigweed, common lambsquarters, hairy nightshade, and green foxtail densities in the nontreated control at the late-season rating were 1, 10, 3, and 1 per sq ft, respectively. Weed control, crop injury, and tuber yield means were analyzed with PROC GLM and Fisher's Protected LSD Tests performed at the 0.05 probability level.

At 3 and 6 WAT, crop injury was not evident (data not shown). Redroot pigweed, hairy nightshade, and green foxtail control was 97 to 100% regardless of herbicide treatment (data not shown). There were differences in common lambsquarters control, however. Any treatment including pendimethalin and/or metribuzin provided 97 to 100% season-long control (Table). Fomesafen combined with s-metolachlor or dimethenamid-p controlled common lambsquarters 68 to 77% which was similar to the 78, 80, or 77% control by pyroxasulfone at 0.106 or 0.213 lb/A + flumioxazin, or fomesafen alone at the highest rate, respectively (Table). Control by pyroxasulfone alone was less than 60%. U.S. No. 1 and total tuber yields in all herbicide treated plots were greater than the weedy control yields and not different than yields in the nontreated weed-free control plots.

Table. Common lambsquarters control in potato with preemergence applications of fomesafen or pyroxasulfone alone or in various two-way tank mixtures or rimsulfuron in three- or a four-way combinations in 2010 at the Aberdeen Research and Extension Center, Aberdeen, ID.

Treatment[1]	Rate	Common lambsquarters control[2]
	lb ai/A	--- % ---
Fomesafen	0.25	60 cd
Fomesafen	0.5	77 b
Fomesafen	0.25	
+ s-metolachlor	+ 1.27	77 b
+ s-metolachlor /metribuzin (pre-mix)	+ 1.32 / 0.31	97 a
+ dimethenamid-p	+ 0.84	68 bc
+ dimethenamid-p	+ 1.0	73 b
Pyroxasulfone	0.25	37 e
+ flumioxazin	+ 0.047	78 b
Pyroxasulfone	0.5	53 d
+ flumioxazin	+ 0.047	80 b
+ pendimethalin	+ 1.0	100 a
+ metribuzin	+ 0.5	100 a
Dimethenamid-p	0.84	97 a
+ pendimethalin	+ 1.0	
Rimsulfuron	0.0156	100 a
+ pendimethalin	+ 1.0	
+ metribuzin	+ 0.5	98 a
+ EPTC	+ 4.0	98 a
Rimsulfuron	0.023	100 a
+ pendimethalin	+ 1.0	
+ metribuzin	+ 0.5	
Rimsulfuron	0.0313	97 a
+ pendimethalin	+ 1.0	
+ flumioxazin	+ 0.047	
Rimsulfuron	0.0117	100 a
+ pendimethalin	+ 1.0	
+ metribuzin	+ 0.5	
+ EPTC	+ 1.75	

[1] Treatments were applied preemergence to potato and common lambsquarters and sprinkler incorporated with 0.5 inches irrigation water.

[2] Means followed by the same letter are not significantly different according to a Fisher's Protected LSD test at the 0.05 probability level.

Linuron or pyroxasulfone tank mixtures for preemergence weed control in potato. Pamela J.S. Hutchinson, Brent Beutler, and JaNan Farr (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this study was to determine preemergence weed control and potato crop safety with linuron or pyroxasulfone alone or in tank mixtures with standard potato herbicides.

The trial area was fertilized on April 22, 2010 before planting with 200 lb N, 260 lb P, 6 lb Zn, and 100 lb S/A based on soil tests and received additional N injected through the sprinkler system on July 15 and 27 and August 12, 2010. 'Russet Burbank' potatoes were planted on May 3, 2010 5 inches deep at 12-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.47% organic matter and pH 8.4. Potatoes were hilled and 0.27 lb/A imidacloprid was applied on May 21, 2010, prior to potato emergence.

Treatments were replicated three times in a randomized block design and plot size was 12 by 30 ft. Herbicides were applied preemergence May 25, 2010 with a CO_2-pressurized backpack sprayer that delivered 17.5 GPA at 30 psi and incorporated with sprinkler irrigation totaling 0.5 inches of water within 24 h of application. No potato plants or weeds were exposed at the time of application.

Potatoes were sprinkler irrigated as needed throughout the growing season. Crop injury and weed control were evaluated visually. Potato vines were desiccated with 0.5 lb ai/A diquat September 8, 2010. Tubers were harvested from 20 feet of each of the two center rows in each plot using a single-row mechanical harvester on Sept. 22, 2010 and graded according to USDA standards.

Treatments included dimethenamid-p at 0.75 or 1.0 lb ai/A alone or with pendimethalin at 1.0 lb ai/A; linuron alone at 0.75 or 1.25 lb ai/A; linuron at 0.25 lb + dimethenamid-p at 1.0 or 0.047 lb ai/A flumioxazin. In addition, pyroxasulfone was applied alone at 0.213 lb ai/A or with EPTC, ethalfluralin, or rimsulfuron at 4.0, 0.75, or 0.023 lb ai/A, respectively. Nontreated, weed-free and weedy control were included for tuber yield and quality comparisons. Weed control ratings were conducted 4 wks after treatment (WAT), just before row closure approximately 7 WAT, and just prior to harvest. The last rating represents season-long control and is shown in this report. Crop injury was assessed at 4 and 7 WAT. Redroot pigweed, common lambsquarters, and hairy nightshade densities in the nontreated control at the late-season rating were 10, 1, and 7 per sq ft, respectively and green foxtail density was 1 per sq m. Crop injury, weed control, and yield means were separated using PROC GLM and Fisher's Protected LSD Tests performed at the 0.05 probability level.

Dimethenamid-p or linuron alone at 0.75 lb/A or linuron + flumioxazin provided 83 to 87% season long redroot pigweed control, otherwise, control was 93% or greater (Table). Rimsulfuron + pyroxasulfone, dimethenamid-p alone at the lowest rate, or pyroxasulfone alone controlled common lambsquarters 62, 40, or 17% (Table). Dimethenamid-p alone at the higher rate provided 85% control while all other treatments controlled the weed 97 to 100%. In general, linuron or pendimethalin with dimethenamid-p provided greater common lambsquarters control than dimethenamid-p alone. Hairy nightshade control with dimethenamid-p alone at 0.75 lb/A was only 63% and control improved somewhat to 77% when that rate was tank-mixed with pendimethalin (Table). Since the soil type in the trial area was a loam, however, and the recommended dimethenamid-p rate range for loam soils is 0.84 to 1.0 lb/A, the low rate may not have been high enough for more satisfactory hairy nightshade control. In contrast, control by dimethenamid-p alone at 1.0 lb/A or tank-mixed with pendimethalin was greater at 87 or 92%, respectively (Table). Hairy nightshade control by linuron alone was improved from 75% to greater than 90% when tank-mixed with flumioxazin or dimethenamid-p (Table). At 83%, pyroxasulfone alone provided similar hairy nightshade control ranging from 82 to 88% by pyroxasulfone combined with EPTC, flumioxazin, or rimsulfuron. Green foxtail control by linuron alone or with flumioxazin was 27 to 62% and generally less than control by any other treatment (Table).

Potato crop injury was less than 10% at either rating (data not shown). Herbicide treatment U.S. No. 1 and total tuber yields were greater than weedy control yields and not different than weed-free control yields (data not shown).

Table. Redroot pigweed, common lambsquarters, hairy nightshade, and green foxtail control in potato with preemergence-applied dimethenamid-p, linuron, or pyroxasulfone alone or in various combinations with other standard herbicides in 2010 at the Aberdeen Research and Extension Center, Aberdeen, ID.

Treatment[1]	Rate	Redroot pigweed	Common lambs-quarters	Hairy nightshade	Green foxtail
	lb ai/A	------------------------ % control[2] ------------------------			
Dimethenamid-p	0.75	85 cd	40 c	63 g	73 abc
Dimethenamid-p	1.0	98 a	85 a	87 b-e	85 ab
Dimethenamid-p + pendimethalin	0.75 + 1.0	95 abc	100 a	77 ef	92 a
Dimethenamid-p + pendimethalin	1.0 + 1.0	93 a-d	100 a	92 a-d	93 a
Linuron	0.75	87 bcd	97 a	75 f	27 d
Linuron	1.25	93 a-d	100 a	92 a-d	62 bc
Linuron + dimethenamid-p	0.75 + 0.75	95 abc	97 a	92 a-d	88 a
Linuron + flumioxazin	0.75 + 0.047	83 d	100 a	95 abc	57 c
Pyroxasulfone	0.213	95 abc	17 d	83 c-f	82 ab
Pyroxasulfone + EPTC	0.213 + 4.0	97 ab	92 a	88 a-e	100 a
Pyroxasulfone + ethalfluralin	0.213 + 0.75	100 a	95 a	82 def	100 a
Pyroxasulfone + rimsulfuron	0.213 + 0.023	100 a	62 b	88 a-e	93 a

[1] Treatments were applied preemergence to potato and weeds and sprinkler incorporated with 0.5 inches irrigation water.
[2] Means in a column followed by the same letter are not significantly different according to a Fisher's Protected LSD test at the 0.05 probability level.

<u>Tolerance of seed radish to clopyralid</u>. R. Edward Peachey, Alysia C. Greco, and Jessica M. Green (Dept. of Horticulture, Oregon State University, Corvallis, OR. 97331). Clopyralid provides exceptional control of many weeds of the Asteraceae family, including Canada thistle. Crop safety must be demonstrated before a label will be approved for use in radish grown for seed or for roots. Synthetic auxin herbicides such as clopyralid occasionally impact seed germination. The objective of this study was to determine the effect of clopyralid on radish plants, seed yield, and seed germination. Clopyralid was applied to both male and female plant rows early in the season (2-6 leaf, EPOST), or at bolting (LPOST), and at two rates (0.125 and 0.250 lb ai/A). This study was performed over two years in radish fields near Amity, OR. (2010), and Salem, OR. (2011).

Results from 2010 (Table 1) indicate that applying clopyralid at 0.250 lb ai/A at bolting stunted growth of male plants. Plant biomass of female plants at harvest was reduced when clopyralid was applied near bolting at 0.250 lb ai/A. Seed yield of the same treatment was reduced by nearly 25%. Time series ANOVA of data from seed germinated on a temperature gradient table indicated that clopyralid may have enhanced seed germination slightly, and that the effect was greatest shortly after harvest.

Table 1. Effect of clopyralid on crop growth, seed yield, and seed germination of hybrid radish grown for seed, Amity, OR, 2010. Values within a column followed by the same letter do not differ (LSD, α=0.05).

Clopyralid rate	Timing	Crop injury (2 WA 'bolting' treatment)		Dry-matter yield at harvest	Seed yield	Seed germination tests: Temp. gradient table	Cold stress test	Greenhouse emergence
		Females	Males	Females	Females			
lb ai/A		--------%------		*lb/plot*	*lb/plot*	------------------%		------------------
0.125	4-6 leaf	3a	0 a	14.7 a	1159 a	61ab	89 a	100 a
0.125	bolting	3 a	5 a	15.2 a	1001 a	70 a	90 a	90 a
0.250	4-6 leaf	3 a	8 a	14.9 a	1091 a	71 a	88 a	98 a
0.250	bolting	8 a	48 b	11.1 b	738 b	67 a	93 a	90 a
Untreated		-	-	13.8 ab	1066 a	60 b	89 a	95 a

In 2011, clopyralid damage to radish was not visible in field plots at either rate or timing (Table 2) although there was some indication at the latest evaluation that growth was slightly reduced. However, drymatter weights at harvest did not reflect this result. Similar to year 1 results, the 2X rate (0.250 lb ai/A clopyralid) applied at bolting negatively affected seed yield, as evidenced by seed weight and seed count. Germination tests (temperature gradient table and cold stress test) indicated a slight reduction in seed germination at the 0.250 lb ai/A when applied early in the season (treatment 3).

Table 2. Effect of clopyralid on crop growth, seed yield, and seed germination of hybrid radish grown for seed, Salem, OR. 2011. Values within a column followed by the same letter do not differ (LSD, α=0.05).

Clopyralid rate	Timing	Crop injury (2 WA 'bolting' treatment)		Dry-matter yield at harvest	Seed yield	Seed germination tests: Temp. gradient table	Cold stress test	Greenhouse emergence
		Females	Males	Females	Females			
lb ai/A		--------%------		*lb/plot*	*lb/plot*	------------------%		------------------
0.125	2-6 leaf	5 a	3 a	6.0 a	1058 a	98 a	97 a	100 a
0.125	bolting	0 a	0 a	7.1 a	1108 a	93 ab	96 a	98 a
0.250	2-6 leaf	6 a	3 a	6.0 a	938ab	83 b	93 a	100 a
0.250	bolting	7 a	0 a	6.0 a	751 b	99 a	97 a	98 a
Untreated		-	-	6.6 a	1129 a	98 a	98 a	100 a

Effects of drift control nozzles and carrier volumes on hairy fleabane control with glufosinate. Marcelo L. Moretti, Joi M. Abit, and Bradley D. Hanson. (Plant Sciences, University of California, Davis, CA 95616). Glufosinate is commonly utilized to control glyphosate-resistant hairy fleabane (ERIBO) in tree nut orchards in California. The objective of this study was to compare the effects of drift control nozzles and carrier volumes on control of hairy fleabane with glufosinate.

The experiment was conducted in a commercial walnut orchard with a natural infestation of ERIBO in Yolo County, CA. Plots were 20 by 7.5 ft arranged in a randomized complete block design with four replicates between walnut tree rows. Glufosinate was applied at 1.02 lbs ai/A to flowering hairy fleabane plants on July 7, 2011 using a CO_2 backpack sprayer at 2.5 mph with flat fan (FF), Turbo Teejet (TT), Turbo Twinjet (TTJ), and Air Induction (AI) nozzles to deliver 20 or 40 GPA. Environment conditions during application were air temperature 81.6ºF, relative humidity 43%, and wind speed 2.9 mph.

All treatments controlled hairy fleabane >93% regardless of nozzle type or carrier volume at 8 DAT (Table). However, by 18 DAT, control decreased up to 6% when glufosinate was applied using air induction nozzles. The bigger droplets may have compromised coverage and therefore allowed greater recovery of plants by the second evaluation. Increasing carrier volume from 20 to 40 did not significantly improve control of hairy fleabane in this study and actually decreased control in the case of the Turbo TeeJet nozzle. Within a carrier volume, flat fans, Turbo Teejet, and Turbo Twinjet were not different from each other; however, AI nozzles tended to slightly reduce hairy fleabane control compared to the best treatment at both carrier volumes tested.

Table. Effects of drift control nozzles on visual injury of hairy fleabane with glufosinate[1].

		Hairy fleabane	
Nozzle type	Carrier volume	8 DAT[2]	18 DAT
	GPA	-------------% control------------	
Untreated	--	0	0
11002 Flat Fan	20	95	94
11002 Turbo Twin Jet	20	96	94
11002 Turbo TeeJet	20	95	97
11002 Air Induction	20	93	89
11004 Flat Fan	40	96	95
11004 Turbo Twin Jet	40	95	94
11004 Turbo TeeJet	40	97	90
11004 Air Induction	40	93	88
LSD (0.05)		3	6

[1] All treatments included 1.02 lbs ai/A glufosinate (Rely 280) and ammonium sulfate at 10 lb/100 gal.
[2] Abbreviations: GPA gallons per acre; DAT days after treatment, LSD least significant difference

Post emergence control options of hairy fleabane and redroot pigweed in orchards. Marcelo L. Moretti, Joi M. Abit and Bradley D. Hanson. (Plant Sciences, University of California, Davis, CA 95616). Hairy fleabane (ERIBO) is a problematic weed in diverse cropping systems in California, and is present year round in many tree and vine crops. Summer and pre-harvest weed control in nut orchards relies on post emergence herbicides. However, glyphosate- and paraquat-resistant populations of hairy fleabane have been documented in the state thus limiting options for weed control. The objective of this study was to compare performance of various post emergence herbicides alone or in combinations for hairy fleabane control.

A field study in late summer was conducted in a walnut orchard in Yolo County, California, with natural populations of ERIBO and redroot pigweed (AMARE). Both weeds were at their reproductive stage. Plots were 7.5 by 20 ft arranged between walnut tree rows in a randomized complete block design with four replicates. Treatments were applied on July 7, 2011 using CO_2 pressurized back pack with flat fan XR8002 nozzle delivering 20 gallons per acre (GPA). Organic herbicides were applied at 60 GPA with flat fan XR8004 nozzles. Environmental conditions at application were: air temperature 81.6ºF, relative humidity 43%, and wind speed 2.9 mph. Treatments consisted of glyphosate, glufosinate, saflufenacil, paraquat, and carfentrazone alone or in various combinations (table). Additionally, two organic herbicides d-limonene and NH-fatty acid, were also tested. Visual control (% control) estimates were recorded on July 15 and 25, 2011 or 8 and 18 days after treatment (DAT), respectively. Dry biomass was determined in a 0.5 m^2 area in each plot 18 DAT.

Treatments containing glyphosate or glufosinate had good AMARE control (>82%) in both evaluations. Paraquat and saflufenacil treatments had excellent control 8 DAT; however, control decreased 18 DAT due to regrowth. A sequential treatment of glyphosate followed by paraquat 7 DAT, and the tank mix of paraquat + glyphosate also controlled AMARE (>94%).

Best control of hairy fleabane was achieved with glufosinate treatments regardless of rates or combinations (>91%). Saflufenacil and paraquat treatments had good initial control of ERIBO, but regrowth occurred by 18 DAT. The sequential treatment of glyphosate followed by paraquat had better ERIBO control 18 DAT but was not significantly different than paraquat alone. The paraquat + glyphosate tank mix demonstrated excellent control in both evaluations. Saflufenacil and saflufenacil + glyphosate had excellent ERIBO control (98%) but decreased to <48% control 18 DAT due to plant recovery. Glyphosate, carfentrazone, and the organic herbicides showed transient foliar injury but did not provide acceptable control of hairy fleabane. The sequential treatment of glyphosate fb paraquat, glyphosate + paraquat, lower rate of glufosinate, and glyphosate + glufosinate treatments reduced hairy fleabane biomass relative to the untreated control.

Table. Visual control and dry biomass of hairy fleabane and redroot pigweed.

Treatment[1]	Rate[2]	ERIBO[3]		AMARE		Dry biomass
		8 DAT	18 DAT	8 DAT	18 DAT	18 DAT
	lb ai/A	--------------	%	--------------		$g/0.5m^2$
Untreated	--	0	0	0	0	61.3
Glyphosate	1.125	2.5	2.5	99	100	59.2
Glufosinate	1.02	91	93	97	86	36.7
Glufosinate	1.5	96	100	97	100	53.8
Saflufenacil	0.04	98	43	99	76	48.8
Carfentrazone	0.03	3.3	0	65	50	73.1
Paraquat	1.0	96	73	98	73	39.2
Glyphosate fb paraquat[4]	1.125 fb 1.0	71	85	99	100	31.8
Glyphosate + saflufenacil	1.125 + 0.04	92	48	98	82	42.0
Glyphosate + glufosinate	1.125 + 1.5	96	99	100	95	29.6
Glyphosate + carfentrazone	1.125 + 0.03	7.5	16	90	97	50.3
Glyphosate + paraquat	1.125 + 1.0	98	95	99	94	26.2
D-limonene	7.7	16	0.3	56	2	78.6
NH-Fatty acid	2.64	7.5	7.5	81	47	56.4
LSD (0.05)		14	14	20	31	26.3

[1]Ammonium sulfate was added at 10 lb/100 gal to all treatments containing glyphosate, glufosinate, or saflufenacil. Non ionic surfactant (NIS) was added at 0.25% v/v to all treatments containing carfentrazone. Methylated seed oil (MSO) was added at 1% v/v to all treatments containing saflufenacil, paraquat, and or d-limonene.
[2]Rates are expressed in lbs ai/A except for glyphosate which is expressed in lb ae/A.
[3]Abbreviations: ERIBO, hairy fleabane; AMARE, redroot pigweed; DAT, days after treatment; n/a not applicable.
[4]Sequential treatment of glyphosate followed by (fb) paraquat 7 days after glyphosate application.

Liverwort control in container plantings. R. Edward Peachey and Jessica M. Green (Dept. of Horticulture, Oregon State University, Corvallis, OR. 97331). Thirteen herbicides (plus 1 control) were evaluated for efficacy in controlling liverwort in container plantings. Pots were grown without a crop to better evaluate liverwort control. One gallon pots were filled with Sunshine™ growers mix potting soil. Liverwort was collected and mixed into water to create a slurry of plant material and spores. Aliquots of 250 ml of slurry were spread evenly on each pot and placed in a lath house on Mar. 30, 2011. Containers were kept continuously moist until the gemmae and pieces of broken thallus regenerated. The indaziflam treatment was applied on Apr. 16th, 2011. All other treatments were applied on Oct. 13, 2011, when pots had at least 40% liverwort coverage. All liquid formulations were applied at 100 GPA with the exception of the potassium salt treatment applied at 200 GPA.

Immediate control (≥ a rating of 8.0 within one week) was observed in pots treated with sodium carbonate peroxyhydrate (TerraCyte Pro G), ammonium nanoanoate (Racer), d-limonene (GreenMatch), pelargonic acid (Scythe), and oregano oil (Bryophyter). In general, control increased over time in all treatments. However, re-growth of liverwort at 4 weeks after treatment was observed in pots treated with the following products: dimethenamid-p (Tower EC), cinnamon oil + rosemary oil (FlowerPharm), clove oil + rosemary oil + thyme oil (Sporotec), potassium salts (M-Pede), and petroleum hydrocarbon (Supreme oil).

Table. Efficacy of liverwort control treatments (0=no effect, 10=complete kill) at 1, 2, 4, and 6 weeks after treatment (WAT). Values within a column followed by the same letter do not differ (FPLSD, α=0.05).

Herbicide	**Rate**	**Rep**	**1 WAT**	**2 WAT**	**4 WAT**	**6 WAT**
			control (0=no control; 10=complete kill)			
Indaziflam	0.065 lbs ai/A	10	1.4 d	1.8 d	5.4 b	6.9 b
D-limonene	20%	10	9.8 a	9.9 a	10 a	9.9 a
Pelargonic acid	3%	10	9.5 a	10 a	9.6 a	9.5 a
Flumioxazin	0.38 lbs ai/A	10	1.2 d	1.7 d	5.4 b	7.2 b
Dimethenamid-p	1.50 lbs ai/A	10	1.4 d	2.3 cd	3.5 c	4.7 c
Sodium carbonate peroxyhydrate	1lb/10 ft^2	10	10 a	10 a	10 a	10 a
Oregano oil	2%	10	8.3 b	9.4 a	9.9 a	9.8 a
Cinnamon oil + rosemary oil	10%	10	2.3 c	3.0 cd	3.2 c	3.1 a
Clove + rosemary + thyme oil	1.2%	10	1.8 d	3.1 cd	2.8 c	2.0 a
Acetic acid	10%	10	9.1 ab	9.7 a	9.9 a	9.9 a
Ammonium nanoanoate	10%	5	10 a	10 a	9.6 a	9.6 a
Potassium salts	4% (@ 200gpa)	5	3.2 c	5.4 b	5.4 b	4.6 c
Petroleum hydrocarbon	1%	5	1.6 d	3.4 c	2.6 c	5.4 c
Untreated check	---	10	0.1 e	0.1 e	0.7 d	0.1 e

Winter annual broadleaf and grass weed control in alfalfa. Don W. Morishita, Donald L. Shouse, and Andy A. Nagy (Kimberly Research and Extension Center, University of Idaho, Kimberly, ID 83341). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to evaluate winter annual broadleaf and grass weed control in established alfalfa. Alfalfa was planted May 1, 2009 at 9 lb/A. Experimental design was a randomized complete block with four replications and individual plots that were 8 by 30 ft. Soil type was a Portneuf silt loam (7.7% sand, 74.6% silt, and 17.8% clay) with a pH of 8.4, 1.51% organic matter, and CEC of 16.6-meq/100 g soil. Weeds present were downy brome, (BROTE), dandelion, (TAROF), flixweed (DESSO), and common lambsquarters, (CHEAL). Herbicides were applied with a CO_2-pressurized bicycle-wheel sprayer with 110015 flat fan nozzles calibrated to deliver 15 gpa at 23 psi and 3 mph. Environmental conditions at application are shown on Table 1. Crop injury and weed control were evaluated visually 49 and 101 days after the last application (DALA) on April 22 and June 13. Alfalfa was harvested June 13 by hand clipping one square meter in each plot.

Table 1. Environmental conditions at each application data

Application date	9/29/2010	3/4/2011
Application timing	2" to 3" regrowth	Dormant
Air temperature (F)	55	48
Soil temperature (F	58	38
Relative humidity (%)	48	80
Wind velocity (mph)	1	2
Cloud cover (%)	0	90

Crop injury ranged from 0 to 5% over both evaluation dates with no differences among treatments (Table 2). Downy brome control 49 and 101 DALA ranged from 90 to 100% control. Flumioxazin + paraquat applied as a spring dormant application had the lowest downy brome control at both evaluation dates averaging 90 and 91% control at each respective evaluation date. Flixweed control with all herbicide treatments was excellent (98 to 100%) at both evaluation dates. Common lambsquarters and dandelion control were evaluated only at 101 DALA and control of both species with all herbicide treatments ranged from 95 to 100%. Yields of all weed species was relatively low, except for downy brome in the untreated control. Downy brome was clearly the predominant weed species and was the only species where there was a significant yield difference between the herbicide treatments and the untreated control. The untreated control had the lowest numerical yield and was significantly less than four herbicide treatments. Flumioxazin applied alone in the fall at 0.125 lb ai/A and flumioxazin + paraquat + nonionic surfactant applied in the spring were among the two treatments with the highest alfalfa yields.

Table 2. Crop injury, weed control, weed and alfalfa yield, near Kimberly, ID[1].

Treatment[3]	Application Rate	Application Timing	Crop injury 4/22	Crop injury 6/13	Weed control[2] BROTE 4/22	Weed control[2] BROTE 6/13	Weed control[2] DESSO 4/22	Weed control[2] DESSO 6/13	Weed control[2] CHEAL 6/13	Weed control[2] TAROF 6/13	Yield[2] BROTE	Yield[2] TAROF	Yield[2] DESSO	Yield[2] CHEAL	Yield[2] Alfalfa
	lb ai/A		-----%-----								-----lb/A-----				
Check			-	-	-	-	-	-	-	-	1,098 a	14 a	22 a	0 a	2,465 c
Flumioxazin	0.125	fall	0 a	0 a	100 a	91 cd	99 a	100 a	98 a	96 bc	42 b	8 a	0 a	0 a	3,397 a
V-10233	0.285	fall	5 a	0 a	100 a	95 bc	100 a	100 a	99 a	95 c	7 b	0 a	0 a	0 a	2,939 b
Hexazinone + paraquat + NIS	0.75 + 0.5 + 0.25% v/v	spring	1 a	0 a	100 a	100 a	100 a	100 a	100 a	100 a	0 b	0 a	0 a	0 a	2,680 bc
Metribuzin + paraquat + NIS	0.5 + 0.5 + 0.25% v/v	spring	1 a	3 a	100 a	99 ab	100 a	98 b	100 a	100 a	0 b	0 a	15 a	0 a	2,873 bc
Flumioxazin + paraquat + NIS	0.125 + 0.5 + 0.25% v/v	spring	0 a	0 a	91 b	90 d	100 a	100 a	100 a	99 ab	56 b	0 a	0 a	0 a	3,042 ab
V-10233 + paraquat + NIS	0.285 + 0.5 + 0.25% v/v	spring	1 a	0 a	100 a	98 ab	100 a	100 a	100 a	99 ab	1 b	0 a	0 a	0 a	2,909 b

[1]Means followed by same letter are not significantly different using Fisher's Protected LSD ($P \leq 0.05$).
[2]Weeds evaluated for control and yield were dandelion (TAROF), common lambsquarters (CHEAL), downy brome (BROTE), and flixweed (DESSO).
[3]Flumioxazin is sold as Chateau. V10233 is a non-registered herbicide. Hexazinone is sold as Velpar. Paraquat is sold as Gramoxone Inteon. Metribuzin is sold as Sencor. NIS is R-11 nonionic surfactant.

Comparing herbicide combinations for wild oat and broadleaf weed control in irrigated spring barley. Don W. Morishita, Donald L. Shouse, and Andy A. Nagy (Kimberly Research and Extension Center, University of Idaho, Kimberly, ID 83341). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare the efficacy of herbicide combinations for wild oat and broadleaf weed control in spring malt barley. 'Moravian 69' spring barley was planted April 22, 2011, at 100 lb/A. Experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Soil type was a Portneuf silt loam (7.7% sand, 74.6% silt, and 17.8% clay) with a pH of 8.4, 1.51% organic matter, and CEC of 16.6-meq/100 g soil. Weeds present were common lambsquarters, (CHEAL), and wild oats, (AVEFA). Environmental conditions at application were as follows: air temperature 50F, soil temperature 50F, relative humidity 56%, wind speed 4 mph, and 20% cloud cover. Common lambsquarters and wild oat densities averaged 2 and 2 plants/ft^2, respectively. Application began at 0930. Herbicides were applied May 27, with a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 22 psi and 3mph. Crop injury was evaluated visually 10, 31 and 52 days after the herbicide application (DAA) on June 6, 27 and July 18, 2011. Weed control was evaluated 31 and 52 DAA. Grain was harvested August 19 with a small-plot combine.

Crop injury 10 DAA ranged from 8 to 55% with all herbicide treatments (Table). Bromoxynil/MCPA + fenoxaprop had the highest injury at 55%, followed by bromoxynil/pyrasulfotole/fenoxaprop (34%). Freezing temperatures were recorded 7 DAA. At 31 DAA, crop injury ranged from 3 to 11% with no differences among treatments. By 52 DAA, no injury was observed in any treatment. More seasonal growing conditions followed the cooler temperatures observed in late May to early June. Wild oat control and common lambsquarters control was 100% with all treatments at both evaluation dates 31 and 52 DAA. This was due in part to the relatively light infestation of both weed species. Test weight of the untreated control was 49 lb/bu and was significantly lower than all of the herbicide treatments, which ranged from 51 to 52 lb/bu. Grain yield followed a similar pattern with the check having the lowest yield at 70 bu/A. All herbicide treatments was statistically equal and their yields ranged from 104 to 117 bu/A.

Table 1. Crop tolerance, weed control and spring barley yield, near Kimberly, ID[1]

Treatment[3]	Application rate	Crop injury 6/6	Crop injury 6/27	Crop injury 7/18	Weed control[2] AVEFA 6/27	AVEFA 7/18	CHEAL 6/27	CHEAL 7/18	Test weight	Grain yield
	lb ai/A	---	---	---	%	---	---	---	lb/bu	bu/A
Untreated control		-	-	-	-	-	-	-	49 b	70 b
Florasulam/MCPA + Pinoxaden/fluroxypyr	0.315 lb ae/A + 0.148 lb ae/A	10 c	6 a	0 a	100 a	100 a	100 a	100 a	51 a	115 a
Pinoxaden/fluroxypyr + thifensulfuron + tribenuron	0.148 lb ae/A + 0.015 + 0.0038	10 c	3 a	0 a	100 a	100 a	100 a	100 a	52 a	117 a
Pinoxaden/fluroxypyr + thifensulfuron + tribenuron	0.148 lb ae/A + 0.0126 + 0.0126	10 c	6 a	0 a	100 a	100 a	100 a	100 a	52 a	107 a
Pinoxaden/fluroxypyr + bromoxynil/MCPA	0.148 lb ae/A + 0.375 lb ae/A	8 c	9 a	0 a	100 a	100 a	100 a	100 a	52 a	116 a
Pinoxaden/fluroxypyr + bromoxynil/pyrasulfotole + AMS	0.148 lb ae/A + 0.0015 + 0.5	8 c	13 a	0 a	100 a	100 a	100 a	100 a	51 a	109 a
Bromoxynil/pyrasufatole/fenoxaprop	0.287	34 b	8 a	0 a	100 a	100 a	100 a	100 a	51 a	111 a
Bromoxynil/MCPA + fenoxaprop	0.375 + 0.0825	55 a	13 a	0 a	100 a	100 a	100 a	100 a	52 a	104 a
Pinoxaden/fluroxypyr + thifensulfuron/tribenuron +	0.148 lb ae/A + 0.05 +	12 c	11 a	0 a	100 a	100 a	100 a	100 b	52 a	116 a

[1]Means followed by same letter are not significantly different using Fisher's Protected LSD (P≤0.05).
[2]Weeds evaluated for control were wild oat (AVEFA) and common lambsquarters (CHEAL).
[3]Florasulam/MCPA is a formulated pre-mixture sold as Orion. Pinoxaden/fluroxypyr is a formulated pre-mixture sold as Axial Star. Bromoxynil/MCPA is a formulated pre-mixture sold as Bronate Advanced. Bromoxynil/pyrasulfotole is a formulated pre-mixture sold as Huskie. AMS is ammonium sulfate. Bromoxynil/fenoxaprop/pyrasulfotole is a formulated pre-mixture sold as Wolverine. Thifensulfuron and tribenuron is a 1:1 ratio sold as Affinity BroadSpec.

Comparing several herbicides in combination with glyphosate for weed control in sugar beet. Don W. Morishita, Donald L. Shouse, and Andy A. Nagy. (Kimberly Research and Extension Center, University of Idaho, Kimberly, ID 83341). A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare several soil-active and postemergence herbicides in combination with glyphosate for weed control in sugar beet. Experimental design was a randomized complete block with four replications. Individual plots were four rows by 30 ft. Soil type was a Rad silt loam (14.3 % sand, 66.6 % silt, and 19 % clay) with a pH of 8.1, 1.59 % organic matter, and CEC of 16.9-meq/100 g soil. 'Beta 27RR20' sugar beet was planted May 4, 2011 in 22-inch rows at a rate of 71,280 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), green foxtail (SETVI), Russian thistle, (SASKR) were the major weed species present. Herbicides were applied broadcast with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles at 22 psi and 3 mph. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 10 and 100 days after the last herbicide application (DALA) on June 24, and September 22. The two center rows of each plot were harvested mechanically October 10.

Table 1. Environmental conditions at each application date.

Application date	May 17	June 3	June 14
Application timing	cotyledon	2 leaf	6 leaf
Air temperature (F)	50	4	58
Soil temperature (F)	55	51	60
Relative humidity (%)	57	54	61
Wind velocity (mph)	2	4	8
Cloud cover (%)	90	10	0
Time of day	1515	0930	0830
Weed species/ft^2			
lambsquarters, common	9	16	14
foxtail, green	9	17	10
kochia	3	3	2
pigweed, redroot	10	21	12
thistle, Russian	1	1	2

Crop injury at 10 and 100 DALA was negligible (Table 2). Kochia, redroot pigweed and green foxtail control ranged from 95 to 100% for all herbicide treatments at 10 and 100 DALA. Common lambsquarters and Russian thistle control 10 DALA ranged from 90 to 100%. However, at 100 DALA, common lambsquarters and Russian thistle control 100 DALA with MON63410 applied at 1.125 lb ai/A pre-emergence followed by glyphosate at 0.77 lb ae/A applied to 2-leaf sugar beet was 89 and 82%, respectively and was significantly lower than all other herbicide treatments. Root yield of all treatments ranged from 8 to 47 ton/A. Root yield with MON63410 applied at 1.125 lb ai/A pre-emergence followed by glyphosate at 0.77 lb ae/A applied to 2-leaf sugar beet was 39 ton/A and lower than the highest yielding treatments. Sucrose yield followed a similar pattern as root yield, although there were fewer differences among treatments. The untreated control sucrose yield was 2,234 lb/A and significantly lower than all other treatments. MON63410 applied at 1.125 lb ai/A pre-emergence followed by glyphosate at 0.77 lb ae/A applied to 2-leaf sugar beet had the second lowest sucrose yield at 11,737 lb/A. Glyphosate at 0.77 lb ae/A + triflusulfuron at 0.0313 lb ai/A + ammonium sulfate applied at the 2 and 6-leaf growth stages was among the treatments with the highest sucrose yield.

Table 2. Crop tolerance, weed control, sugar beet yield, ERS, sugar content, conductivity and nitrates, near Kimberly, ID[1]

	Application		Crop injury		Weed control[2]												Quality parameters[4]		
					KCHSC		CHEAL		AMARE		SASKR		SETVI		Root	ERS	Sugar		
Treatment[3]	Rate	Date	6/24	9/22	6/24	9/22	6/24	9/22	6/24	9/22	6/24	9/22	6/24	9/22	yield	yield	content	Ntrts	Cndctvty
	lb ai/a		----------	----------	----------	----------	----------	----------	%	----------	----------	----------	----------	----------	ton/A	lb/A	-	PPM	Mmhos
Check			-	-	-	-	-	-	-	-	-	-	-	-	8 d	2334 f	15.84 a	97 a	0.735 ab
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/3, 6/14	0 a	0 a	100 a	100 a	95 cde	100 a	100 a	100 a	95 bc	100 a	100 a	100 a	42 bc	12372 b-e	16.64 a	63 a	0.710 abc
MON 63410	1.125	5/17	1 a	0 a	95 c	95 b	93 e	89 b	97 cd	100 a	90 d	82 c	96 a	100 ab	39 c	11737 e	16.74 a	92 a	0.665 b-e
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/3																	
Glyphosate + MON 63410 + AMS	0.77 lb ae/A + 1.125 + 2% w/w	6/3	0 a	0 a	99 ab	100 a	94 de	100 a	100 a	100 a	95 bc	99 b	100 a	100 a	42 bc	12404 b-e	16.47 a	96 a	0.692 abc
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/14																	
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/3	0 a	0 a	100 a	100 a	98 ab	100 a	99 abc	100 a	94 c	100 ab	99 a	100 a	45 ab	13501 abc	16.47 a	73 a	0.577 e
Glyphosate + MON 63410 + AMS	0.77 lb ae/A + 1.125 + 2% w/w	6/14																	
Glyphosate + dimethenamid-P + AMS	0.77 lb ae/A + 0.98 + 2% w/w	6/3	0 a	0 a	99 ab	100 a	99 ab	100 a	100 a	100 a	96 ab	100 ab	99 a	100 a	44 abc	12921 a-e	16.44 a	94 a	0.680a-d
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/14																	
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/3	0 a	0 a	100 a	100 a	100 a	100 a	100 ab	100 a	98 a	100 a	100 a	100 a	45 ab	13128 a-e	16.56 a	75 a	0.690abc
Glyphosate + dimethenamid-P + AMS	0.77 lb ae/A + 0.98 + 2% w/w	6/14																	
Glyphosate + metolachlor + AMS	0.77 lb ae/A + 1.27 + 2% w/w	6/3	0 a	0 a	100 a	100 a	99 a	100 a	100 a	100 a	95 bc	100 a	100 a	100 a	42 bc	12179 cde	16.40 a	87 a	0.677 a-d
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/14																	
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/3	0 a	0 a	100 a	100 a	98 ab	100 a	100 a	100 a	95 bc	100 a	99 a	100 a	44 abc	12721 a-e	16.38 a	105 a	0.772 a
Glyphosate + metolachlor + AMS	0.77 lb ae/A + 1.27 + 2% w/w	6/14																	

Table 2. continued

Treatment[3]	Application Rate	Application Date	Crop injury 6/24	Crop injury 9/22	Weed control[2] KCHSC 6/24	KCHSC 9/22	CHEAL 6/24	CHEAL 9/22	AMARE 6/24	AMARE 9/22	SASKR 6/24	SASKR 9/22	SETVI 6/24	SETVI 9/22	Root yield	ERS yield	Quality parameters[4] Sugar content	Ntrts	Cndctvty
	lb ai/a		-----	-----	-----	-----	-----	-----	%	-----	-----	-----	-----	-----	ton/A	lb/A	-	PPM	Mmhos
Glyphosate + EPTC + AMS	0.77 lb ae/A + 3 + 2% w/w	6/3	0 a	0 a	99 ab	100 a	96 bcd	100 a	100 a	100 a	95 bc	100 ab	100 a	100 a	44 abc	12865 a-e	16.50 a	81 a	0.700 abc
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/14																	
Glyphosate + AMS	0.77 lb ae/A + 2% w/w	6/3	0 a	0 a	100 a	100 a	96 bcd	100 a	99 abc	100 a	94 c	99 b	100 a	100 a	41 bc	11855 de	16.16 a	91 a	0.697 abc
Glyphosate + EPTC + AMS	0.77 lb ae/A + 3 + 2% w/w	6/14																	
Glyphosate + phen/des + AMS	0.77 lb ae/A + 0.25 + 2% w/w	6/3, 6/14	0 a	0 a	97 bc	100 a	99 ab	100 a	96 d	100 a	95 bc	100 ab	100 a	100 ab	47 a	13727 ab	16.39 a	62 a	0.682 a-d
Glyphosate + phen/des + AMS	0.77 lb ae/A + 0.33 + 2% w/w	6/3, 6/14	1 a	0 a	100 a	100 a	99 ab	100 a	99 abc	100 a	95 bc	100 ab	99 a	100 a	43 abc	12667 a-e	16.81 a	85 a	0.737 ab
Glyphosate + phen/des + AMS	0.77 lb ae/A + 0.4 + 2% w/w	6/3, 6/14	0 a	0 a	99 ab	100 a	99 ab	100 a	99 abc	100 a	95 bc	100 a	100 a	99 b	45 ab	12910 a-e	16.10 a	94 a	0.677 a-d
Glyphosate + phen/des + AMS	0.77 lb ae/A + 0.5 + 2% w/w	6/3, 6/14	1 a	0 a	99 ab	100 a	100 a	100 a	97 bcd	100 a	95 bc	100 a	98 a	99 b	44 abc	13226 a-d	16.61 a	68 a	0.587 de
Glyphosate + triflusulfuron + AMS	0.77 lb ae/A + 0.0313 + 2% w/w	6/3, 6/14	0 a	0 a	100 a	100 a	97 abc	100 a	99 abc	100 a	95 bc	100 a	99 a	100 a	47 a	14032 a	16.76 a	67 a	0.635 cde

[1]Means followed by the same letter are not significantly different using Fisher's Protected LSD (P = 0.05).
[2]Weeds evaluated for control were kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), Russian thistle (SASKR), and green foxtail (SETVI).
[3] AMS is ammonium sulfate. Glyphosate is Roundup PowerMax. MON 63410 is acetochlor. Dimethenamid is Outlook. Metolachlor is Dual Magnum. Phen/des is phenmediphan and desmedipham is a formulated pre-mixture sold as Betamix. Triflusulfuron is UpBeet. EPTC is Eptam
[4]Ntrts is nitrates. Cndctvty is conductivity.

Comparing weed control in Roundup Ready sugar beet to conventional sugar beet. Don W. Morishita, Donald L. Shouse, and Andy A. Nagy. (Kimberly Research and Extension Center, University of Idaho, Kimberly, ID 83341). A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare weed control in Roundup Ready sugar beet to weed control systems in conventional sugar beet. Experimental design was a randomized complete block with four replications. Individual plots were four rows by 30 ft. Soil type was a Rad silt loam (14.3 % sand, 66.6 % silt, and 19 % clay) with a pH of 8.1, 1.59 % organic matter, and CEC of 16.9-meq/100 g soil. '1339 RZ', 'RRSB H7-1', 'Beta 4773R' sugar beet varieties were planted May 4, 2011, in 22-inch rows at a rate of 71,280 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), Russian thistle, (SASKR) and green foxtail (SETVI) were the major weed species present. Herbicides were applied broadcast with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 8001 flat fan nozzles at 22 psi and 3mph. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 10 and 99 days after the last herbicide application (DALA) on June 24 and September 21. The two center rows of each plot were harvested mechanically on October 10.

Table 1. Environmental conditions at each application date.

Application date	May 16	May 23	June 1	June 10	June 14
Application timing	cotyledon	7 DAA	2 leaf	4 leaf	6 leaf
Air temperature (F)	51	60	66	60	60
Soil temperature (F)	50	57	70	55	60
Relative humidity (%)	38	50	38	50	60
Wind velocity (mph)	9	8	4	5	9
Cloud cover (%)	60	80	95	40	0
Time of day	1140	0945	1500	1000	0930
Weed species/ft^2					
foxtail, green	12	17	16	12	9
kochia	5	2	2	3	2
lambsquarters, common	8	8	11	12	9
pigweed, redroot	7	9	12	11	12
thistle, Russian	-	-	1	1	1

Crop injury 10 DALA ranged from 0 to 21%. The conventional herbicide treatment consisting of phenmedipham/ desmedipham/ethofumesate (pmp/dmp/etf) + triflusulfuron followed by pmp/dmp/etf + triflusulfuron + clopyralid applied to varieties 1339 RZ and Beta 4773R injured the crop 21 and 16%, respectively. None of the other treatments injured the crop more than 8%. At 99 DALA, which was approximately three weeks before harvest, the same two varieties had injury ratings of 9 and 10%, respectively. No injury was observed in any other treatment. Kochia control 10 DALA ranged from 95 to 100%. At 99 DALA, kochia control with the conventional herbicide treatment applied to variety 1339 RZ averaged 84%, while all other treatments averaged 91 to 100%. Common lambsquarters, redroot pigweed, and Russian thistle control ranged from 93 to 100% at both evaluation dates. Green foxtail control 10 DALA also ranged from 93 to 100%. At 99 DALA, green foxtail control with the conventional herbicide treatment applied to variety 1339 RZ averaged 89%, while all other treatments averaged 97 to 100%. All herbicide treatments had root and sugar yields greater than the untreated control. Among the herbicide treatments, the conventional herbicides applied to 1339 RZ and Beta 4773R had lower root and sucrose yields than all other treatments. The glyphosate treatments applied alone or in combination with other herbicides had root yields ranging from 41 to 44 ton/A. There were no differences in sugar content, conductivity or nitrate content among any of the treatments.

Table 2. Crop tolerance, weed control, sugar beet yield, ERS, sugar content, conductivity and nitrates, near Kimberly, ID[1]

	Application		Crop injury		Weed control[2]														Quality parameters		
					KCHSC		CHEAL		AMARE		SASKR		SETVI		Beet	ERS[3]	Sugar		
Treatment[4]	Rate	Date	6/24	9/21	6/24	9/21	6/24	9/21	6/24	9/21	6/24	9/21	6/24	9/21	yield	yield	content	Conductivity	Nitrates
	lb ai/A		----------	----------	----------	----------	----------	%	----------	----------	----------	----------	----------	----------	ton/A	lb/A	%	mmhos	ppm
RRSB H7-1			-	-	-	-	-	-	-	-	-	-	-	-	12 c	3461 f	15.9 a	0.748 a	116 a
Untreated control																			
RRSB H7-1			1 c	0 b	98 abc	96 ab	99 a	100 a	98 bc	94 b	98 a	100 a	94 bc	97 b	38 a	11,436 bcd	16.7 a	0.688 a	89 a
Pmp/dmp/etf + triflusulfuron	0.33 + 0.0156	5/16																	
Pmp/dmp/etf + triflusulfuron + clopyralid	0.33 + 0.0156 + 0.094 lb ae/A	5/23, 6/1, 6/10																	
1339 RZ			21 a	9 a	95 c	84 c	99 a	96 b	99 abc	93 b	96 a	95 b	93 c	89 c	24 b	6551 e	15.7 a	0.720 a	87 a
Pmp/dmp/ etf + triflusulfuron	0.33 + 0.0156	5/16																	
Pmp/dmp/ etf + triflusulfuron + clopyralid	0.33 + 0.0156 + 0.094 lb ae/A	5/23, 6/1, 6/10																	
Beta 4773R			16 a	10 a	97 bc	91 b	100 a	96 b	100 ab	93 b	95 a	98 a	95 b	97 b	28 b	10,017 d	15.9 a	0.782 a	108 a
Pmp/dmp/ etf + triflusulfuron	0.33 + 0.0156	5/16																	
Pmp/dmp/ etf + triflusulfuron + clopyralid	0.33 + 0.0156 + 0.094 lb ae/A	5/23, 6/1, 6/10																	
RRSB H7-1			0 c	0 b	95 c	96 ab	100 a	100 a	96 c	98 ab	95 a	100 a	94 bc	98 b	39 a	11,195 cd	16.5 a	0.798 a	114 a
Pmp/dmp/ etf + triflusulfuron	0.33 + 0.0156	5/16																	
Pmp/dmp/ etf + triflusulfuron + clopyralid	0.33 + 0.0156 + 0.094 lb ae/A	5/23, 6/1, 6/10																	
RRSB H7-1			0 c	0 b	99 ab	100 a	96 a	100 a	100 ab	100 a	97 a	100 a	100 a	100 a	41 a	12,142 abc	16.6 a	0.655 a	92 a
Glyphosate + AMS	0.75 lb ae/A + 1.25	6/1, 6/14																	
RRSB H7-1			0 c	0 b	99 ab	100 a	99 a	100 a	100 ab	100 a	99 a	100 a	100 a	100 a	42 a	12,306 abc	16.2 a	0.633 a	104 a
Glyphosate + AMS	1.125 lb ae/A + 1.25	6/1																	
Glyphosate + AMS	0.75 lb ae/A + 1.25	6/14																	

Table 2. continued.

Treatment[4]	Application Rate	Application Date	Crop injury 6/24	Crop injury 9/21	Weed control[2] KCHSC 6/24	KCHSC 9/21	CHEAL 6/24	CHEAL 9/21	AMARE 6/24	AMARE 9/21	SASKR 6/24	SASKR 9/21	SETVI 6/24	SETVI 9/21	Beet yield	ERS[3] yield	Quality parameters Sugar content	Conductivity	Nitrates
	lb ai/A		---%											---%	ton/A	lb/A	%	mmhos	ppm
RRSB H7-1			8 b	0 b	100 a	100 a	99 a	100 a	100 a	100 a	98 a	100 a	100 a	100 a	41 a	11,754 abc	16.2 a	0.763 a	125 a
Glyphosate +	0.75 lb ae/A +	6/1																	
AMS	1.25																		
Glyphosate +	0.75 lb ae/A +	6/14																	
ethofumesate +	3.75 +																		
AMS	1.25																		
RRSB H7-1			0 c	0 b	99 ab	100 a	98 a	100 a	100 a	100 a	99 a	100 a	100 a	100 a	43 a	12,468 abc	16.4 a	0.725 a	93 a
Glyphosate +	1.125 lb ae/A +	6/1																	
AMS	1.25																		
Glyphosate +	0.75 lb ae/A +	6/14																	
clopyralid +	0.093 lb ae/A +																		
AMS	1.25																		
RRSB H7-1			0 c	0 b	100 a	100 a	99 a	100 a	100 ab	100 a	98 a	100 a	100 a	100 a	42 a	12,225 abc	16.7 a	0.778 a	110 a
Glyphosate +	0.75 lb ae/A +	6/1																	
AMS	1.25																		
Glyphosate +	0.75 lb ae/A +	6/14																	
dimethenamid +	0.98 +																		
AMS	1.25																		
RRSB H7-1			0 c	0 b	95 c	100 a	95 a	100 a	100 ab	100 a	95 a	100 a	100 a	100 a	44 a	13,230 a	16.9 a	0.700 a	89 a
Glyphosate +	0.75 lb ae/A +	6/1																	
AMS	1.25																		
Glyphosate +	0.75 lb ae/A +	6/14																	
acetochlor +	1.125 +																		
AMS	1.25																		
RRSB H7-1			0 c	0 b	100 a	100 a	99 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	43 a	12,729 ab	16.6 a	0.680 a	102 a
Glyphosate +	0.75 lb ae/A +	6/1																	
AMS	1.25																		
Glyphosate +	1.5 lb ae/A +	6/14																	
s-metolachlor +	1.43 +																		
AMS	1.25																		

[1]Means followed by the same letter are not significantly different (P=0.05).
[2]Weeds evaluated for control were kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), Russian thistle (SASKR), and green foxtail (SETVI).
[3]ERS is estimated recoverable sugar.
[4] RRSB H7-1, 1339 RZ, Beta 4773R represent the varieties grown in this experiment. RRSB H7-1 is a glyphosate tolerant variety and the others are conventional varieties. Pmp/dmp/etf is phenmedipham, desmedipham and ethofumesate and is a formulated pre-mixture sold as Progress. Triflusulfuron is UpBeet. Clopyralid is Stinger. Glyphosate is Roundup PowerMax. Ethofumesate is Nortron. Dimethenamid is Outlook. Acetochlor is Warrant. *S*-metolachlor is Dual Magnum

Evaluation of registered and non-registered herbicides for weed control in chicory. Don W. Morishita, Donald L. Shouse, and Andy A. Nagy. (Kimberly Research and Extension Center, University of Idaho, Kimberly, ID 83341). A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to evaluate preplant, preemergence and postemergence herbicides for weed control in chicory. Experimental design was a randomized complete block with four replications. Individual plots were 7.33 by 30 ft. Soil type was a Portneuf silt loam (26.4 % sand, 65 % silt, and 5.6 % clay) with a pH of 8.1, 1.6 % organic matter, and CEC of 14.0-meq/100 g soil. Chicory was planted May 17, 2011, in 22-inch rows at a rate of 100,000 seed/A. Kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), annual sowthistle (SONOL), green foxtail (SETVI), was the major weed species present. Herbicides were applied broadcast with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa at 22 psi and 3 mph using 8001 flat fan nozzles. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 5 and 61 days after the last herbicide application (DALA) on July 26 and September 20. The two center rows of each plot were harvested mechanically on October 24.

Table 1. Environmental conditions at each application date.

Application date	May 12	June 1	June 10	June 23	July 1	July 21
Application timing	PPI	cotyledon	1-2 leaf	4-5 leaf	5-6 leaf	8 leaf
Air temperature (F)	67	54	61	76	63	90
Soil temperature (F)	70	50	42	70	62	73
Relative humidity (%)	45	61	42	49	46	30
Wind velocity (mph)	2	6	4	2	7	4.8
Cloud cover (%)	1	15	60	10	5	5
Time of day	1200	0830	1000	1000	0910	1430
Weed species/ft^2						
lambsquarters, common	-	16	11	10	16	25
foxtail, green	-	-	-	1	1	-
kochia	-	-	2	2	2	2
pigweed, redroot	-	3	5	5	12	10
sowthistle, annual	-	-	-	1	-	1

Crop injury ranged from 0 to 5% 5 and 61 DALA with no differences among herbicide treatments (Table 2). Common lambsquarters control 5 DALA ranged from 23 to 100% and 39 to 100% 61 DALA. Treatments with the best control (>90%) included a 2:1 ratio of rimsulfuron and thifensulfuron formulated as a premixed herbicide. This premix is currently being considered for registration as a postemergence herbicide in chicory. However, its maximum use rate would be 0.015 lb ai/A. Three of the rimsulfuron/thifensulfuron treatments were applied one time at 0.015 lb ai/A sequentially to or in tank mixture with trifluralin, dimethenamid-P and *s*-metolachlor. Common lambsquarters control 61 DALA ranged from 91 to 98%. Redroot pigweed control with the rimsulfuron/thifensulfuron premix ranged from 43 to 100% 6 DALA and 86 to 100% 61 DALA. Redroot pigweed control with rimsulfuron/thifensulfuron applied only one time at 0.015 lb ai/A in tank mixture or sequentially to trifluralin, dimethenamid-P and *s*-metolachlor averaged 98% control. Kochia control 6 DALA ranged from 73 to 100% with no differences among herbicide treatments due to variability in the kochia population. A similar pattern was observed for kochia control 61 DALA. Annual sowthistle control 6 DALA ranged from 61 to 100% control. No differences were observed due to variability in the annual sowthistle population. At 61 DALA, all treatments except trifluralin alone at 0.5 or 0.75 lb ai/A controlled annual sowthistle 94% or better.

Table 2. Crop injury, weed control and chicory yield, near Kimberly, ID[1]

					Weed control[2]										
	Application		Crop injury		CHEAL		AMARE		KCHSC		SONOL		SETVI		Root
Treatment[3]	Rate	Date	7/26	9/20	7/26	9/20	7/26	9/20	7/26	9/20	7/26	9/20	7/26	9/20	yield
	lb ai/A				---------------	---------------	---------------	---------------	---------------	%	---------------	---------------	---------------	---------------	ton/A
Untreated control			-	-	-	-	-	-	-	-	-	-	-	-	4 d
Trifluralin	0.75	5/12	0 a	0 a	25 cd	67 bc	43 c	88 b	100 a	100 a	71 a	95 ab	75 a	100 a	10 cd
Trifluralin	0.5	5/12	0 a	0 a	58 bc	78 ab	83 ab	86 a	74 a	100 a	61 a	77 c	94 a	100 a	19 ab
Trifluralin	0.5	5/12	0 a	0 a	23 d	51 bc	98 ab	95 a	73 a	97 a	79 a	85 bc	100 a	100 a	10 cd
Imazamox +	0.0313 lb ae/A +														
NIS +	0.25% v/v +														
UAN 32%	2.5% v/v														
Rmslfrn/thfnslfrn +	0.015 +	6/10	3 a	0 a	96 a	100 a	99 ab	100 a	88 a	89 a	98 a	100 a	93 a	99 a	24 a
NIS +	0.25% v/v +														
Rmslfrn/thfnslfrn +	0.015 +	7/1													
clethodim +	0.091 +														
NIS +	0.25% v/v +														
Rmslfrn/thfnslfrn +	0.015 +	6/10	5 a	0 a	99 a	100 a	100 a	100 a	95 a	100 a	98 a	100 a	100 a	100 a	24 a
NIS +	0.25% v/v +														
Rmslfrn/thfnslfrn +	0.015 +	6/23, 7/21													
clethodim +	0.091 +														
NIS +	0.25% v/v +														
Rmslfrn/thfnslfrn +	0.015 +	6/10	0 a	0 a	95 a	99 a	100 a	100 a	91 a	84 a	98 a	100 a	93 a	100 a	23 a
NIS +	0.25% v/v +														
Rmslfrn/thfnslfrn +	0.015 +	7/1													
NIS +	0.25% v/v +														
dimethenamid-P	0.75														
Trifluralin	0.75	5/12	0 a	0 a	91 ab	93 a	96 ab	99 a	74 a	99 a	73 a	96 ab	96 a	100 a	25 a
Rmslfrn/thfnslfrn +	0.015 +	6/23													
NIS +	0.25% v/v +														
dimethenamid-P	0.75														
Rmslfrn/thfnslfrn +	0.015 +	6/10	0 a	0 a	98 a	100 a	100 a	100 a	96 a	91 a	96 a	99 a	98 a	100 a	23 a
NIS +	0.25% v/v +														
Rmslfrn/thfnslfrn +	0.015 +	7/1													
NIS +	0.25% v/v +														
s-metolachlor	0.95														
Trifluralin	0.75	5/12	0 a	0 a	91 ab	91 a	95 ab	98 a	77 a	95 a	99 a	95 ab	96 a	100 a	23 a
Rmslfrn/thfnslfrn +	0.015 +	6/23													
NIS +	0.25% v/v +														
s-metolachlor	0.95														

Table 2. continued.

	Application		Crop injury		Weed control[2]										Root
					CHEAL		AMARE		KCHSC		SONOL		SETVI		
Treatment[3]	Rate	Date	7/26	9/20	7/26	9/20	7/26	9/20	7/26	9/20	7/26	9/20	7/26	9/20	yield
	lb ai/A				%										ton/A
Rmslfrn/thfnslfrn +	0.015 +	6/10	0 a	0 a	98 a	99 a	100 a	100 a	89 a	81 a	99 a	100 a	98 a	100 a	22 ab
NIS +	0.25% v/v +														
Rmslfrn/thfnslfrn +	0.015 +	7/1													
NIS +	0.25% v/v +														
s-metolachlor	1.9														
Trifluralin	0.75	5/12	3 a	0 a	94 a	98 a	98 a b	98 a	85 a	99 a	95 a	97 a	98 a	100 a	25 a
Rmslfrn/thfnslfrn +	0.015 +	6/23													
NIS +	0.25% v/v +														
s-metolachlor	1.9														
Trifluralin	0.75	5/12	3 a	0 a	31 cd	45 c	79 b	95 a	100 a	99 a	99 a	94 ab	100 a	100 a	11 c
s-metolachlor	0.95	6/10, 6/23													
Triflusulfuron +	0.0313 +	6/1, 6/10,	0 a	0 a	50 cd	59 bc	97 ab	100 a	99 a	100 a	100 a	100 a	100 a	100 a	16 bc
NIS	0.25% v/v	6/23													
Triflusulfuron +	0.0313 +	7/1													
NIS +	0.25% v/v +														
clethodim	0.091														
Triflusulfuron +	0.0313 +	6/1, 6/10,	0 a	0 a	23 d	39 c	86 ab	96 a	95 a	98 a	99 a	100 a	100 a	100 a	11 c
MSO	1% v/v	6/23													
Triflusulfuron +	0.0313 +	7/1													
MSO +	1% v/v +														
clethodim	0.091														
Handweeded check			0 a	0 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	23 a

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

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

[3] Trifluralin is Treflan. Imazamox is Raptor. NIS is R-11 nonionic surfactant. UAN is urea ammonium nitrate. Rmslfrn//thfnslfrn is 2:1 ratio of rimsulfuron and thifensulfuron formulated pre-mixture sold as Basis. AMS is ammonium sulfate and was applied only in rimsulfuron/ thifensulfuron treatments. Clethodim is Select Max. Dimethenamid-P is Outlook. *S*-Metolachlor is Dual Magnum. Triflusulfuron is UpBeet. MSO is methylated seed oil.

Comparison of various adjuvants in combination with glyphosate, diflufenzopyr and dicamba in field corn. Don W. Morishita, Donald L. Shouse, and Andy A. Nagy (Kimberly Research and Extension Center, University of Idaho, Kimberly, ID 83341). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare several adjuvants used in combination with glyphosate + diflufenzopyr/dicamba in field corn. 'DKC44-92' field corn was planted May 16, 2011, at 36,000 seed/A. Experimental design was a randomized complete block with four replications and individual plots were 10 by 30 ft. Soil type was a Portneuf silt loam (20.4% sand, 71% silt, and 8.6% clay) with a pH of 8.6, 1.5% organic matter, and CEC of 17-meq/100 g soil. Weeds present were common lambsquarters (CHEAL), barnyardgrass (ECHGC), kochia (KCHSC), wild oats (AVEFA), and pigweed redroot (AMARE). Herbicides were applied June 15 with a CO_2-pressurized bicycle-wheel sprayer equipped with 11001 flat fan nozzles calibrated to deliver 10 gpa at 12 psi and 3 mph. Environmental conditions at application were as follows: air temperature 61 F, soil temperature 61 F, relative humidity 46%, wind speed 8 mph, and 10% cloud cover. Common lambsquarters, redroot pigweed, green foxtail, barnyardgrass, and wild oat densities averaged 2, 9, 22, 2, and 5 plants/ft^2, respectively. Application began at 0815. Crop injury and weed control were evaluated visually 22 and 47 days after application (DAA) on July 7 and August 1. Grain was harvested November 21 with a small-plot combine.

Crop injury 22 DAA ranged from 1 to 8% with no differences among treatments (Table). At 47 DAA, crop injury ranged from 3 to 25%. The treatment with the highest numerical injury (25%) was diflufenzopyr/dicamba applied alone. Much of the 'injury' symptoms observed at the 47 DAA evaluation was likely due to weed competition. Kochia control 22 and 47 DAA ranged from 89 to 100%. Glyphosate alone and diflufenzopyr/dicamba alone had the lowest kochia control at 90 and 89%, respectively 22 DAA and 90 and 80%, respectively 47 DAA. Common lambsquarters control 22 and 47 DAA ranged from 88 to 95% control with all adjuvants applied with glyphosate + diflufenzopyr/dicamba. Treatments without an adjuvant controlled common lambsquarters ≤78%. Redroot pigweed control 22 DAA ranged from 85 to 90% with all glyphosate + diflufenzopyr/dicamba treatments with or without an adjuvant. Glyphosate alone and diflufenzopyr/dicamba alone controlled redroot pigweed 71 and 78%, respectively. By 47 DAA, redroot pigweed control ranged from 71 to 97% control with no statistical differences among treatments. Wild oat was the only species with large differences in control among the different adjuvants was observed. Wild oat control ranged from 0 to 94% 22 DAA. Glyphosate + diflufenzopyr/dicamba without an adjuvant, glyphosate alone without and adjuvant, glyphosate + diflufenzopyr/dicamba + EXT 856 + EXT 807 or EXT 853 or EXT 574 or EXT 535 + AMS controlled wild oats 90% or better 47 DAA. There was no statistical difference in barnyardgrass control at either evaluation date even though control ranged from 71 to 93%. The barnyardgrass population was somewhat variable in this study site. Grain corn yield ranged from 14 to 252 bu/A, with the untreated control having the lowest yield. The two highest yielding treatments were with EXT 767 and EXT 535 + AMS added to glyphosate + diflufenzopyr/dicamba. The herbicide treatments with the lowest yields were glyphosate alone, diflufenzopyr/dicamba alone and glyphosate + diflufenzopyr/dicamba + EXT 765, and EXT 813 at 142, 59, 190 and 202 bu/A.

Table. Crop tolerance, weed control and corn yield, near Kimberly, ID[1]

	Application		Crop injury		Weed control[2]										Corn
					KCHSC		CHEAL		AMARE		AVEFA		ECHCG		
Treatment[3]	Rate	Date	7/7	8/1	7/7	8/1	7/7	8/1	7/7	8/1	7/7	8/1	7/7	8/1	yield
	lb ai/A		----------	----------	----------	----------	----------	%	----------	----------	----------	----------	----------	----------	bu/A
Untreated check			-	-	-	-	-	-	-	-	-	-	-	-	14 f
Glyphosate + diflufenzopyr/dicamba	0.387 lb ae/A + 0.095	6/15	3 a	10 bcd	94 cd	94 ab	76 b	78 b	86 ab	83 a	84 ab	83 abc	83 a	87 a	214 abc
Glyphosate	0.387 lb ae/A	6/15	4 a	16 abc	90 de	90 b	36 c	26 d	71 c	87 a	88 ab	93 abc	90 a	94 a	142 d
Diflufenzopyr/dicamba	0.095	6/15	1 a	25 a	89 e	80 c	32 c	50 c	78 bc	97 a	0 e	51 d	71 a	77 a	59 e
Glyphosate + diflufenzopyr/dicamba + EXT 291 + EXT 807	0.387 lb ae/A + 0.095 + 1% v/v + 2.5% v/v	6/15	4 a	9 bcd	98 abc	99 ab	95 a	93 a	89 a	86 a	68 a-d	74 a-d	86 a	88 a	227 abc
Glyphosate + diflufenzopyr/dicamba + EXT856 + EXT 807	0.387 lb ae/A + 0.095 + 1% v/v + 2.5% v/v	6/15	4 a	3 d	99 ab	99 ab	94 a	94 a	91 a	81 a	89 a	90 abc	90 a	87 a	235 ab
Glyphosate + diflufenzopyr/dicamba + EXT 853	0.387 lb ae/A + 0.095 + 2.5% v/v	6/15	4 a	8 bcd	100 a	96 ab	95 a	95 a	90 a	81 a	90 a	94 ab	91 a	76 a	227 abc
Glyphosate + diflufenzopyr/dicamba + EXT 574 + AMS	0.387 lb ae/A + 0.095 + 0.25% v/v + 1.25	6/15	4 a	10 bcd	98 abc	98 ab	93 a	91 a	89 a	79 a	84 ab	91 abc	93 a	89 a	212 abc
Glyphosate + diflufenzopyr/dicamba + EXT 535 + AMS	0.387 lb ae/A + 0.095 + 0.5% v/v + 1.25	6/15	4 a	6 cd	99 abc	96 ab	95 a	93 a	91 a	71 a	94 a	98 a	91 a	75 a	250 a
Glyphosate + diflufenzopyr/dicamba + EXT 765	0.387 lb ae/A + 0.095 + 1% v/v	6/15	6 a	18 ab	99 ab	100 ab	90 a	95 a	89 a	93 a	45 cd	53 d	83 a	79 a	190 c
Glyphosate + diflufenzopyr/dicamba + EXT 812	0.387 lb ae/A + 0.095 + 0.5% v/v	6/15	1 a	11 bcd	100 a	100 a	88 a	95 a	85 ab	90 a	41 d	50 d	81 a	88 a	202 bc
Glyphosate + diflufenzopyr/dicamba + EXT 767	0.387 lb ae/A + 0.095 + 0.25% v/v	6/15	4 a	6 cd	95 bc	95 ab	94 a	90 a	90 a	85 a	81 ab	88 abc	87 a	88 a	252 a

Table. continued

Treatment[3]	Application Rate	Application Date	Crop injury 7/7	Crop injury 8/1	KCHSC 7/7	KCHSC 8/1	CHEAL 7/7	CHEAL 8/1	AMARE 7/7	AMARE 8/1	AVEFA 7/7	AVEFA 8/1	ECHCG 7/7	ECHCG 8/1	Corn yield
					Weed control[2]										
	lb ai/A		%												bu/A
Glyphosate + diflufenzopyr/dicamba + EXT 865	0.387 lb ae/A + 0.095 + 0.25% v/v	6/15	5 a	8 bcd	99 ab	100 a	93 a	93 a	85 ab	74 a	50 cd	83 abc	84 a	72 a	233 abc
Glyphosate + diflufenzopyr/dicamba + EXT 604	0.387 lb ae/A + 0.095 + 0.25% v/v	6/15	3 a	5 d	98 abc	98 ab	91 a	93 a	91 a	93 a	61 bcd	71 bcd	81 a	76 a	233 abc
Glyphosate + diflufenzopyr/dicamba + EXT 797	0.387 lb ae/A + 0.095 + 0.25% v/v	6/15	3 a	9 bcd	95 bc	95 ab	88 a	89 ab	90 a	85 a	70 abc	69 cd	85 a	75 a	220 abc
Glyphosate + diflufenzopyr/dicamba + EXT 852	0.387 lb ae/A + 0.095 + 1.25% v/v	6/15	8 a	10 bcd	99 ab	96 ab	94 a	90 a	89 a	80 a	81 ab	85 abc	89 a	77 a	231 abc

[1] Means followed by the same letter are not significantly different (P=0.05).
[2] Weeds evaluated for control were: kochia (KCHSC), common lambsquarters (CHEAL), redroot pigweed (AMARE), wild oat (AVEFA), and barnyardgrass (ECHCG).
[3] Glyphosate is Roundup PowerMax. Diflufenzopyr/dicamba is a formulated pre-mixture sold as Status. AMS is ammonium sulfate. EXT were adjuvants provided by Exacto, Inc.

<u>Comparison of preemergence herbicides in field corn</u>. Don W. Morishita, Donald L. Shouse, and Andy A. Nagy (Kimberly Research and Extension Center, University of Idaho, Kimberly, ID 83341). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to compare the efficacy of dimethenamid, pyroxasulfone, pendimethalin, and saflufenacil/dimethenamid for weed control in field corn. 'DKC44-92' corn was planted May 15, 2011, at 36000 seed/A. Experimental design was a randomized complete block with four replications and individual plots were 10 by 30 ft. Soil type was a Portneuf silt loam (20.4% sand, 71.0% silt, and 8.6% clay) with a pH of 8.0, 1.51% organic matter, and CEC of 17.0-meq/100 g soil. Major weeds present were common lambsquarters (CHEAL), wild oat (AVEFA), redroot pigweed (AMARE) and green foxtail (SETVI). Herbicides were applied with a CO_2-pressurized bicycle-wheel sprayer with 11001 flat fan nozzles calibrated to deliver 10 gpa at 15 psi and 3 mph. Environmental conditions and weed densities at time of application are given on Table 1. Crop injury and weed control were evaluated visually 20 days after first (preemergence) application (DAFA) on June 9 and 4 days after the last application (DALA) on July 5. Grain was harvested November 11 with a small-plot combine.

Table 1. Environmental conditions at each application date.

Application date	May 20	July 1
Application timing	Pre	Late post
Air temperature (F)	53	64
Soil temperature (F)	52	64
Relative humidity (%)	55	49
Wind velocity (mph)	6	5
Cloud cover (%)	30	20
Time of day	0820	1000
Weed species/ft^2		
lambsquarters, common	2	2
foxtail, green	1	2
kochia	1	1
pigweed, redroot	0	9
oat, wild	8	8

No crop injury was observed at 20 DAFA and 4 DALA (Table 2). Common lambsquarters control 20 DAFA ranged from 81 to 98%. Poorest control was with pyroxasulfone + glyphosate, dimethenamid-P + glyphosate and acetochlor + glyphosate at 85, 84 and 81%, respectively. All other herbicide treatments controlled common lambsquarters 91% or better. At 4 DALA, common lambsquarters control was 100% with all herbicide treatments. There was no statistical difference in redroot pigweed, wild oat or green foxtail control among any of the herbicide treatments at either evaluation date. Field corn grain yield in the untreated control was 42 bu/A and significantly less than all of the herbicide treatments. Grain yield of the herbicide treatments ranged from 234 to 275 bu/A with no differences among treatments.

Table 2. Crop tolerance, weed control, and corn yield near Kimberly, ID[1]

			Crop		Weed control[2]								
	Application		injury		CHEAL		AMARE		AVEFA		SETVI		Corn
Treatment[3]	Rate	Date	6/9	7/5	6/9	7/5	6/9	7/5	6/9	7/5	6/9	7/5	yield
	lb ai/A		--------------------------------------%	--------------------------------------									bu/A
Untreated control			-	-	-	-	-	-	-	-	-	-	42 b
Pyroxasulfone +	0.133 +	5/20	0 a	0 a	85 bc	100 a	94 a	100 a	85 a	94 a	88 a	99 a	267 a
glyphosate +	0.77 lb ae/A +												
Glyphosate +	0.77 lb ae/A +	7/1											
Pyroxasulfone +	0.266 +	5/20	0 a	0 a	91 ab	100 a	99 a	100 a	84 a	94 a	91 a	97 a	259 a
glyphosate +	0.77 lb ae/A +												
Glyphosate +	0.77 lb ae/A +	7/1											
Dimethenamid-P+	0.075 +	5/20	0 a	0 a	84 c	100 a	99 a	100 a	93 a	99 a	93 a	96 a	234 a
glyphosate +	0.77 lb ae/A +												
Glyphosate +	0.77 lb ae/A +	7/1											
Sflfncl/dmthnmd +	0.065 +	5/20	0 a	0 a	94 a	100 a	100 a	100 a	88 a	98 a	95 a	97 a	275 a
glyphosate +	0.77 lb ae/A +												
Glyphosate +	0.77 lb ae/A +	7/1											
Acetochlor +	0.0109 +	5/20	0 a	0 a	81 c	100 a	99 a	100 a	88 a	98 a	86 a	95 a	268 a
glyphosate +	0.77 lb ae/A +												
Glyphosate +	0.77 lb ae/A +	7/1											
Pyroxasulfone +	0.106 +	5/20	0 a	0 a	95 a	100 a	100 a	100 a	89 a	98 a	93 a	96 a	267 a
pendimethalin +	0.95 +												
glyphosate +	0.77 lb ae/A +												
Glyphosate +	0.77 lb ae/A +	7/1											
Dimethenamid-P+	0.075 +	5/20	0 a	0 a	95 a	100 a	100 a	99 a	85 a	98 a	94 a	98 a	251 a
pendimethalin +	0.095 +												
glyphosate +	0.77 lb ae/A +												
Glyphosate +	0.77 lb ae/A +	7/1											
Sflfncl/dmthnmd+	0.065 +	5/20	0 a	0 a	98 a	100 a	100 a	100 a	89 a	99 a	94 a	97 a	247 a
pendimethalin +	0.095 +												
glyphosate +	0.77 lb ae/A +												
Glyphosate +	0.77 lb ae/A +	7/1											

[1]Means followed by the same letter are not significantly different (P=0.05).
[2]Weeds evaluated for control include common lambsquarters (CHEAL), redroot pigweed (AMARE), wild oat (AVEFA), and green foxtail (SETVI).
[3] Pyroxasulfone is Zidua. Glyphosate is Roundup PowerMax. All glyphosate applications included ammonium sulfate at 0.17 lb/gal and methylated seed oil at 1% v/v. Dimethenamid-P is Outlook. Sflfncl/dmthnmd is a 1:8.8 ratio of safufenacil and dimethenamid-P and is a formulated pre-mixture sold as Verdict. Acetochlor is Warrant. Pendimethalin is Prowl H_20.

Broadleaf weed control in grain sorghum with postemergence herbicides. Richard N. Arnold, and Kevin A. Lombard and Samuel C. Allen. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 31, 2011 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of grain sorghum (var. DKS 53-67) and annual broadleaf weeds to postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 0.3%. The experimental design was a randomized complete block with four replications. Individual plots were 4, 34 in rows 30 ft long. Grain sorghum was planted with flexi-planters equipped with disk openers on May 31. Postemergence treatments were applied on June 28 when grain sorghum was in the V5 leaf stage and weeds were <6 inch in height. Russian thistle, prostrate and redroot pigweed infestations were heavy and common lambsquarters and black nightshade infestations were moderate throughout the experimental area. Postemergence treatments were evaluated on July 28. None of the treatments resulted in crop injury.

All treatments gave good to excellent control of common lambsquarters, black nightshade, prostrate pigweed and Russian thistle. Atrazine plus bromoxynil at 0.5+0.5 lb ai/A gave poor control of redroot pigweed.

Table. Broadleaf weed control in grain sorghum with postemergence herbicides.

		Crop	Weed control[3,4]				
Treatments[1,2]	Rate	Injury[3]	CHEAL	SOLNI	AMARE	AMABL	SASKR
	lb ai/A	—%–	————	————	—%—	————	————
Pyrasulfotole/bromoxynil +	0.16	0	100	100	100	100	100
atrazine + AMS	0.5						
Pyrasulfotole/bromoxynil +	0.21	0	100	100	98	100	100
atrazine + AMS	0.5						
Pyrasulfotole/bromoxynil +	0.25	0	100	100	98	100	100
atrazine + AMS	0.5						
Pyrasulfotole/bromoxynil +	0.41	0	100	100	100	100	100
atrazine + AMS	0.5						
Pyrasulfotole/bromoxynil + AMS	0.21	0	100	95	86	87	92
Atrazine + bromoxynil	0.5+0.5	0	100	100	68	95	100
Weedy check		0	0	0	0	0	0

[1]pm indicates packaged mix.
[2]Treatments applied with ammonium sulfate (AMS) at either 1 or 2 lb/A.
[3]Rated on a scale from 0 to 100 with 0 being no control or crop injury and 100 being dead plants.
[4]CHEAL (common lambsquarters), SOLNI (black nightshade), AMARE (redroot pigweed), AMABL (prostrate pigweed), and SASKR (Russian thistle).

Broadleaf weed control in field corn with preemergence herbicides. Richard N. Arnold, Kevin A. Lombard and Samuel C. Allen. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 10, 2011 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of field corn (var. Pioneer PO231HR) and annual broadleaf weeds to preemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 0.3%. The experimental design was a randomized complete block with four replications. Individual plots were 4, 34 in rows 30 ft long. Field corn was planted with flexi-planters equipped with disk openers on May 10. Preemergence treatments were applied on May 11 and immediately incorporated with 0.75 in of sprinkler applied water. Russian thistle, prostrate and redroot pigweed infestations were heavy and common lambsquarters and black nightshade infestations were moderate throughout the experimental area. Preemergence treatments and crop injury were evaluated on June 13. No crop injury was noted from any of the treatments.

All treatments gave excellent control of common lambsquarters and black nightshade except the weedy check. Saflufenacil alone or in combination with dimethenamid-p at 0.52 lb ai/A gave poor control of redroot pigweed. All treatments gave excellent control of prostrate pigweed except the weedy check and dimethenamid-p plus saflufenacil at 0.52 lb ai/A. Russian thistle control was poor with saflufenacil alone or in combination with dimethenamid-p, acetochlor plus atrazine and pyroxasulfone applied at 0.05, 0.52, 2.25 and 0.07 lb ai/A, respectively.

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

		Crop	Weed control[1,2]				
Treatments	Rate	Injury[1]	CHEAL	SOLNI	AMARE	AMABL	SASKR
	lb ai/A	%	%				
Dimethenamid-p/saflufenacil	0.52	0	100	100	25	75	45
Metolachlor/atrazine/mesotrione	2.0	0	100	100	100	100	95
Isoxaflutole	0.03	0	100	100	98	100	100
Thiencarbazone/isoxaflutole	0.06	0	100	100	100	100	98
Acetochlor/atrazine	2.25	0	100	100	100	100	45
Isoxaflutole+atrazine	0.04+0.5	0	100	100	100	100	98
Saflufenacil	0.05	0	100	100	40	100	35
Dimethenamid-p/saflufenacil + atrazine	0.52+ 0.5	0	100	100	100	100	99
Pyroxasulfone	0.07	0	100	100	100	100	45
Pyroxasulfone+ dimethenamid-p/saflufenacil	0.07+ 0.43	0	100	100	100	100	98
Weedy check			0	0	0	0	0

[1]Rated on a scale from 0 to 100 with 0 being no control or crop injury and 100 being dead plants.
[2]CHEAL (common lambsquarters), SOLNI (black nightshade), AMARE (redroot pigweed), AMABL (prostrate pigweed), and SASKR (Russian thistle).

Broadleaf weed control in field corn with preemergence followed by sequential postemergence treatments. Richard N. Arnold, Kevin A. Lombard and Samuel C. Allen. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 10, 2011 at the Agricultural Science Center, Farmington, New Mexico, to evaluate the response of field corn (var. Pioneer PO231HR) 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 0.3%. The experimental design was a randomized complete block with four replications. Individual plots were 4, 34 in rows 30 ft long. Field corn was planted with flexi-planters equipped with disk openers on May 10. Preemergence treatments were applied on May 11 and immediately incorporated with 0.75 in of sprinkler applied water. Sequential postemergence treatments were applied on June 13 when field corn was in the 3rd to 5th leaf stage and weeds were small. Russian thistle, prostrate and redroot pigweed infestations were heavy and common lambsquarters and black nightshade infestations were moderate throughout the experimental area. Preemergence followed by sequential postemergence treatments and crop injury were evaluated on July 12. No crop injury was noted from any of the treatments.

All treatments gave excellent control of common lambsquarters and black nightshade except the weedy check. Dimethenamid-p plus saflufenacil and isoxaflutole applied preemergence at 0.52 and 0.03 lb ai/A followed by a sequential postemergence treatment of glyphosate at 0.95 lb ai/A gave poor control of redroot pigweed. Dimethenamid-p plus saflufenacil applied preemergence at 0.52 lb ai/A followed by a sequential postemergence treatment of glyphosate at 0.95 lb ai/A gave poor control of prostrate pigweed and Russian thistle.

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

		Crop	Weed control[2,3]				
Treatments[1]	Rate	Injury[2]	CHEAL	SOLNI	AMARE	AMABL	SASKR
	lb ai/A	%	%				
Dimethenamid-p/saflufenacil +	0.52	0	100	100	15	70	45
glyphosate + NIS + AMS	0.95						
Isoxaflutole+	0.03	0	100	100	30	95	93
glyphosate + NIS + AMS	0.95						
Metolachlor/atrazine/mesotrione +	2.0	0	100	100	92	100	94
glyphosate + NIS + AMS	0.95						
Pyroxasulfone +	0.07	0	100	100	95	100	99
dimethenamid-p/saflufenacil +	0.43/						
glyphosate+	0.95						
dicamba/diflufenzopyr + NIS + AMS	0.19						
Dimethenamid-p/saflufenacil +	0.43	0	100	100	100	100	100
pyroxasulfone +	0.07						
glyphosate +	0.95						
dicamba/diflufenzopyr +AMS	0.19						
Weedy check			0	0	0	0	0

[1]Treatments applied either with or a combination of a non-ionic surfactant (NIS-Scanner) and ammonium sulfate (AMS) at 0.25% and 5 lb/A.
[2]Rated on a scale from 0 to 100 with 0 being no control or crop injury and 100 being dead plants.
[3]CHEAL (common lambsquarters), SOLNI (black nightshade), AMARE (redroot pigweed), AMABL (prostrate pigweed), and SASKR (Russian thistle).

Tolerance and grass weed control in timothy. Traci A. Rauch, Joan M. Campbell, and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Many annual grasses, including ventenata, downy brome, and rattail fescue, contaminate timothy hay which decrease stand life and lower quality for foreign export. No grass herbicides are currently registered in timothy. Studies were established in timothy in Latah and Boundary Co., Idaho with one site each to evaluate ventenata, downy brome, and rattail fescue control. Additionally, timothy response was evaluated at two weed-free sites, one for seed yield and one for forage hay. Studies were arranged in a randomized complete block design with four replications and included an untreated check. Treatments were applied before weed emergence (preemergence) in September and after weed emergence (postemergence) in mid-October at all sites, including the weed-free locations (Tables 1 and 2).All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph. Timothy injury and grass weed control were evaluated visually. Forage biomass was harvested at the weed-free forage site. Forage biomass was swathed from a 5 by 27 ft area and a wet in-field total weight was measured on July 26, 2011. A subsample was weighed and dried to determine percent moisture to calculate a forage hay weight. At the weed-free seed site, timothy was swathed on July 28 and seed yield was collected on August 9, 2011.

Table 1. Application data for grass weed sites.

Location	Harvard, ID		Princeton, ID		Princeton, ID	
Timothy variety and age	Titan - 3rd year		Climax – 3rd year		Climax – 8th year	
Application date	9/8/2010	10/18/2010	9/10/2010	10/19/2010	9/10/2010	10/19/2010
Growth stage						
Timothy	3-5 inch	4-6 inch	1-2 inch	3 inch	6 inch	6 inch
Ventenata	pre	1 leaf	--	--	--	--
Downy brome	--	--	pre	1 leaf	--	--
Rattail fescue	--	--	--	--	pre	1 leaf
Air temperature (F)	70	61	56	64	60	64
Relative humidity (%)	57	43	66	42	75	45
Wind (mph, direction)	2, NW	3, W	5, W	2, SE	0	1, W
Cloud cover (%)	100	10	100	0	100	20
Soil moisture	very dry	dry	very dry	dry	dry	dry
Soil temperature at 2 inch (F)	68	47	52	55	50	50
pH	5.1		6.2		4.8	
OM (%)	6.8		4.0		3.8	
CEC (meq/100g)	19.1		20.1		19.3	
Texture	silt loam		silt loam		silt loam	

Table 2. Application data for weed-free sites.

Study -location	Forage - Harvard, ID		Seed - Bonners Ferry, ID	
Timothy variety and age	Aurora – 3rd year		Talon – 4th year	
Application date	9/13/2010	10/18/2010	9/14/2010	10/21/2010
Timothy growth stage	4 to 8 inch	4 to 8 inch	12 to 14 inch	mowed – 3 inch
Air temperature (F)	75	59	70	44
Relative humidity (%)	37	40	58	95
Wind (mph, direction)	2, NE	2, W	4, NW	0
Dew present?	no	no	no	yes
Cloud cover (%)	10	10	50	0
Soil moisture	very dry	dry	dry	dry
Soil temperature at 2 inch (F)	60	48	62	45
pH	5.7		7.7	
OM (%)	3.8		4.4	
CEC (meq/100g)	15.5		16.1	
Texture	silt loam		silt loam	

Ventenata (VETDU) control was 80% or greater with pyroxsulam, oxyfluorfen plus diuron, diclofop, and flufenacet/metribuzin combinations, except with aminopyralid (Table 3). No treatment controlled downy brome (BROTE) due to a dense infestation and a low timothy stand, but tended to be better with primisulfuron combinations. Flufenacet/metribuzin alone at the high rate or in combination, except with diclofop, controlled rattail fescue (VLPMY) 80 to 96%. Oxyfluorfen plus diuron controlled ventenata and rattail fescue 94% and greater. Timothy tolerance was evaluated at the weed-free locations. At the forage site, diclofop treatments injured timothy 20 to 21%, which was also observed at the ventenata and rattail fescue locations but not rated. Dry forage hay weight did not differ among treatments and from the untreated check but tended to be lowest with diclofop treatments. At the seed site, pyroxsulam injured timothy 12%. Seed yield was less than the untreated check for primisulfuron combinations, pyroxsulam, and sulfosulfuron.

Table 3. Timothy response and ventenata, downy brome and rattail fescue control in 2011.

Treatment[1]	Rate	Timing[2]	Weed control[3] VETDU	Weed control[3] BROTE	Weed control[3] VLPMY	Forage site Injury	Forage site Forage dry weight	Seed site Injury	Seed site Yield
	lb ai/A		%	%	%	%	ton/A	%	lb/A
Flufenacet/metribuzin	0.319	pre	45	0	77	0	3.1	0	252
Flufenacet/metribuzin	0.425	pre	62	0	80	0	2.8	0	302
Metolachlor	1.27	pre	65	20	84	0	2.8	0	244
Ethofumesate	1	pre	62	20	76	0	3.1	0	289
Flufenacet/metribuzin +	0.319	pre							
terbacil	0.4	pre	84	13	88	5	2.6	0	270
Flucarbazone	0.027	pre	36	0	41	0	2.4	0	273
Flufenacet/metribuzin+	0.319	pre							
flucarbazone	0.018	pre	88	13	87	0	3.1	0	314
Diclofop	1	pre	91	0	38	21	2.0	1	244
Flufenacet/metribuzin+	0.319	pre							
diclofop	1	pre	90	27	44	20	1.9	0	257
Aminopyralid	0.078	pre	30	13	41	0	2.4	2	290
Flufenacet/metribuzin+	0.319	pre							
aminopyralid	0.078	pre	66	13	92	0	3.0	0	306
Flufenacet/metribuzin+	0.319	pre							
sulfosulfuron	0.023	post	91	30	88	1	2.5	4	236
Flufenacet/metribuzin+	0.319	pre							
primisulfuron	0.027	post	84	72	80	0	2.4	0	198
Flucarbazone+	0.018	pre							
primisulfuron	0.027	post	46	68	64	8	2.5	1	200
Primisulfuron	0.036	post	39	20	74	0	2.7	0	299
Oxyfluorfen +	0.375	post							
diuron	0.75	post	94	0	96	0	2.8	2	253
Pyroxsulam	0.0123	post	91	23	30	0	2.6	12	172
Sulfosulfuron	0.023	post	66	10	70	1	2.7	0	201
Untreated check	--	--	--	--	--	--	3.1	--	268
LSD (0.05)			21	30	32	5	NS	4	65
Density (plants/ft^2)			2	20	1				

[1]Sulfosulfuron and pyroxsulam were applied with a 90% non-ionic surfactant (R-11) at 0.25% v/v. Primisulfuron was applied with a crop oil concentrate (Moract) at 2.5% v/v. Pyroxsulam was applied with ammonium sulfate (Bronc) at 1.5 lb ai/A.
[2]Application timing based on weed growth stage, pre =preemergence, post= postemergence.
[3]VETDU= ventenata, BROTE= downy brome, and VLPMY= rattail fescue.

Downy brome control in winter wheat. Traci A. Rauch, Joan M. Campbell and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established to evaluate winter wheat response and downy brome control with flufenacet/metribuzin and pyroxasulfone combinations near Genesee and grass herbicide standards including a new formulation of pyroxsulam (GF-2468) near Lewiston, ID. Plots were arranged in a randomized complete block design with four replications and included an untreated check. Herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). At Genesee, the study was oversprayed with thifensulfuron/tribenuron at 0.025 lb ai/A and pyrasulfotole/bromoxynil at 0.24 lb ai/A on May 6, 2011 for broadleaf weed control. Both studies were oversprayed with azoxystrobin/propiconazole at 0.18 lb ai/A on June 5 to control stripe rust. On June 28, the Lewiston site was oversprayed with MCPA at 0.09 lb ae/A, thifensulfuron/tribenuron at 0.025 lb ai/A, and pyrasulfotole/bromoxynil at 0.24 lb ai/A for broadleaf weed control. In both experiments, wheat injury and downy brome control were evaluated visually.

Table 1. Application and soil data.

Location	Genesee, ID		Lewiston, ID
Application date	9/27/10	5/4/11	5/4/11
Growth stage			
Winter wheat	preemergence	11 tiller	5 tiller
Downy brome (BROTE)	preemergence	5 tiller	4 tiller
Air temperature (F)	81	60	69
Relative humidity (%)	47	50	48
Wind (mph, direction)	2, E	0	3, SE
Dew present?	no	no	no
Cloud cover (%)	0	80	0
Soil moisture	dry	adequate	adequate
Soil temperature at 2 in (F)	65	57	61
pH	5.4		5.3
OM (%)	6.4		4.8
CEC (meq/100g)	17		17
Texture	silt loam		silt loam

At Genesee, injury ranged from 0 to 14% and did not differ among treatments (Table 2). No preemergent herbicide alone adequately controlled downy brome (25 to 62%). Downy brome control was best with treatments containing propoxycarbazone and pyroxsulam (89 to 93%).

At Lewiston, no treatment injured winter wheat (data not shown). On June 5, downy brome control ranged from 87 to 96% with all treatments. By June 23, all treatments, except sulfosulfuron and GF-2468, control downy brome 80% or better but did not differ among all treatments (Table 3).

Table 2. Downy brome control and winter wheat response with flufenacet/metribuzin and pyroxasulfone combinations near Genesee, Idaho in 2011.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	BROTE control[3]
	lb ai/A		%	%
Flufenacet/metribuzin	0.425	preemergence	0	50
Pyroxasulfone	0.08	preemergence	0	62
Flucarbazone	0.027	preemergence	0	25
Flufenacet/metribuzin +	0.425	preemergence		
mesosulfuron	0.0134	5 tiller	9	74
Flufenacet/metribuzin +	0.425	preemergence		
propoxycarbazone/mesosulfuron	0.0246	5 tiller	14	89
Flufenacet/metribuzin +	0.425	preemergence		
pyroxsulam	0.0164	5 tiller	4	93
Pyroxasulfone +	0.08	preemergence		
mesosulfuron	0.0134	5 tiller	0	74
Pyroxasulfone +	0.08	preemergence		
pyroxsulam	0.0164	5 tiller	5	93
Mesosulfuron	0.0134	5 tiller	5	68
Propoxycarbazone/mesosulfuron	0.0246	5 tiller	4	89
Pyroxsulam	0.0164	5 tiller	2	93
LSD (0.05)			NS	21
Density (plants/ft^2)				5

[1]A 90% nonionic surfactant (R-11) at 0.5% v/v and urea ammonium nitrate (URAN) at 5% v/v was applied with all 5 tiller application timing treatments.
[2]Application timing based on downy brome growth stage.
[3]June 24, 2011 evaluation. BROTE =downy brome.

Table 3. Downy brome control in winter wheat with grass herbicide standards and a new pyroxsulam formulation near Lewiston, Idaho in 2011.

		Downy brome control	
Treatment[1]	Rate	June 5	June 23
	lb ai/A	%	%
Pyroxsulam	0.0164	94	88
GF-2468	0.0164	87	75
Propoxycarbazone	0.04	88	82
Sulfosulfuron	0.031	91	65
Propoxycarbazone/mesosulfuron +	0.0223		
ammonium sulfate	1.5	94	86
Propoxycarbazone/mesosulfuron +	0.0246		
urea ammonium nitrate	5% v/v	96	96
LSD (0.05)		NS	NS
Density (plants/ft^2)		8	

[1]GF-2468 is a new formulation of pyroxsulam (13.1% WDG). A 90% nonionic surfactant (Agral 90) was applied at 0.5% v/v with all treatments.
[2]Application timing based on downy brome growth stage.

Broadleaf weed control in winter wheat. Traci A. Rauch, Joan M. Campbell and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established to evaluate wheat response, catchweed bedstraw and mayweed chamomile control with 1) thifensulfuron/tribenuron and 2) pyrasulfotole/bromoxynil in 'OR CF 102' winter wheat near Lapwai, ID and pineapple-weed control with 3) thifensulfuron/tribenuron/fluroxypyr (thifen/triben/fluro) near Uniontown, WA. The studies were arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). At Uniontown, the study was oversprayed with propoxycarbazone at 0.04 lb ai/A on May 5 to control downy brome and with azoxystrobin/propiconazole at 0.18 lb ai/A on June 5, 2011 to control stripe rust. Wheat response and weed control were evaluated visually.

Table 1. Application and soil data.

Study	Thifen/triben study	Pyrasulf/bromo study	Thifen/triben/fluro study
Location	Lapwai, ID	Lapwai, ID	Uniontown, WA
Application date	May 6, 2011	May 6, 2011	May 5, 2011
Growth stage			
Winter wheat	5 tiller	5 tiller	7 tiller
Catchweed bedstraw	3 node	3 node	--
Mayweed chamomile	2 inch tall	2 inch tall	--
Pineapple-weed	--	--	0.5 inch tall
Air temperature (F)	67	67	65
Relative humidity (%)	52	52	40
Wind (mph), direction	0	3, SW	0
Cloud cover (%)	100	100	20
Soil moisture	adequate	adequate	adequate
Soil temperature at 2 inch (F)	58	58	64
pH	5.2		5.3
OM (%)	4.0		5.2
CEC (meq/100g)	20		18
Texture	silt loam		silt loam

In the thifensulfuron/tribenuron study, no treatment injured winter wheat (data not shown). Only thifensulfuron/tribenuron plus clopyralid/fluroxypyr controlled catchweed bedstraw (90%) (Table 2). Mayweed chamomile was controlled 94 and 98% by thifensulfuron/tribenuron combined with florasulam/MCPA or clopyralid/fluroxypyr.

In the pyrasulfotole/bromoxynil study, no winter wheat injury was visible (data not shown). All treatments containing fluroxypyr controlled catchweed bedstraw 98 to 99% (Table 3). Pyrasulfotole/bromoxynil plus florasulam/MCPA and treatments containing clopyralid controlled mayweed chamomile 83 to 97%. Pyrasulfotole/bromoxynil alone did not control catchweed bedstraw or mayweed chamomile.

In the thifensulfuron/tribenuron/fluroxypyr study, no visible winter wheat injury was present (data not shown). All thifensulfuron/tribenuron/fluroxypyr treatments and fluroxypyr/florasulam controlled pineapple-weed 84% or greater (Table 4). Pyrasulfotole/bromoxynil and clopyralid/fluroxypyr plus MCPA did not control pineapple-weed (20 and 38%).

Table 2. Catchweed bedstraw and mayweed chamomile control with thifensulfuron/tribenuron combinations near Lapwai, ID in 2011.

Treatment[1]	Rate[2]	Broadleaf weed control	
		GALAP[3]	ANTCO[4]
	lb ai/A	%	%
Thifensulfuron/tribenuron+	0.025		
bromoxynil	0.5	31	66
Thifensulfuron/tribenuron+	0.025		
pyrasulfotole/bromoxynil	0.217	20	70
Thifensulfuron/tribenuron+	0.025		
florasulam/MCPA	0.315	42	94
Thifensulfuron/tribenuron+	0.025		
clopyralid/fluroxypyr	0.25	90	98
LSD (0.05)		36	20
Density (plants/ft^2)		5	10

[1] Thifensulfuron/tribenuron is the premix Affinity Tankmix™. A nonionic surfactant (R-11) was applied with all treatments at 0.25% v/v.
[2]Rate is in lb ae/A for all treatments containing MCPA or fluroxypyr.
[3]28 DAT evaluation date for GALAP (catchweed bedstraw).
[4]48 DAT evaluation date for ANTCO (mayweed chamomile).

Table 3. Catchweed bedstraw and mayweed chamomile control with pyrasulfotole/bromoxynil combinations near Lapwai, ID in 2011.

Treatment	Rate[1]	Broadleaf weed control[2]	
		GALAP	ANTCO
	lb ai/A	%	%
Pyrasulfotole/bromoxynil	0.177	25	20
Pyrasulfotole/bromoxynil	0.217	50	49
Florasulam/fluroxypyr	0.092	99	76
Pyrasulfotole/bromoxynil +	0.177		
fluroxypyr/florasulam	0.092	98	74
Pyrasulfotole/bromoxynil +	0.217		
fluroxypyr/florasulam	0.092	98	72
Pyrasulfotole/bromoxynil +	0.217		
fluroxypyr/florasulam	0.0615	99	68
Pyrasulfotole/bromoxynil +	0.217		
clopyralid/fluroxypyr	0.188	99	97
Pyrasulfotole/bromoxynil +	0.217		
clopyralid/fluroxypyr	0.14	99	94
Pyrasulfotole/bromoxynil +	0.217		
florasulam/MCPA	0.315	32	83
LSD (0.05)		29	25
Density (plants/ft^2)		8	12

[1]Rate is in lb ae/A for all treatments containing fluroxypyr or MCPA.
[2]48 DAT evaluation date for GALAP (catchweed bedstraw) and ANTCO (mayweed chamomile).

Table 3. Pineapple-weed control with thifen/triben/fluro combinations near Uniontown, WA in 2011.

Treatment[1]	Rate[2]	Pineapple-weed control[3]
	lb ai/A	%
Thifensulfuron/tribenuron/fluroxypyr+	0.0775	
NIS	0.25% v/v	94
Thifensulfuron/tribenuron/fluroxypyr+	0.097	
NIS	0.25% v/v	90
Thifensulfuron/tribenuron/fluroxypyr+	0.097	
MCPA ester	0.347	95
Thifensulfuron/tribenuron/fluroxypyr+	0.097	
2,4-D ester	0.347	96
Thifensulfuron/tribenuron/fluroxypyr+	0.0775	
clopyralid	0.094	
NIS	0.25% v/v	97
Thifensulfuron/tribenuron/fluroxypyr+	0.0775	
clopyralid	0.07	
NIS	0.25% v/v	97
Thifensulfuron/tribenuron/fluroxypyr+	0.0775	
bromoxynil/MCPA	0.5	85
Thifensulfuron/tribenuron/fluroxypyr+	0.0775	
pyrasulfotole/bromoxynil	0.129	76
Thifensulfuron/tribenuron/fluroxypyr+	0.0775	
pyrasulfotole/bromoxynil	0.177	84
Clopyralid/fluroxypyr +	0.188	
MCPA ester	0.347	38
Fluroxypyr/florasulam +	0.092	
NIS	0.25% v/v	86
Pyrasulfotole/bromoxynil	0.21	20
LSD (0.05)		16
Density (plants/ft^2)		5

[1]Thifensulfuron/tribenuron/fluroxypyr is the premix Supremacy. NIS is a nonionic surfactant (R-11).
[2]Rate is lb ae/A for 2,4-D, clopyralid, fluroxypyr/florasulam and treatments containing MCPA .
[3]Evaluation date 56 DAT.

Italian ryegrass and catchweed bedstraw control in winter wheat with mesosulfuron combined with broadleaf herbicides. Traci A. Rauch, Joan M. Campbell and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in winter wheat near Lapwai, ID to evaluate Italian ryegrass and catchweed bedstraw control and winter wheat response with mesosulfuron combined with broadleaf herbicides. The study was arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The study was oversprayed with azoxystrobin/propiconazole at 0.18 lb ai/A to control stripe rust on June 3, 2011. Wheat response and weed control were evaluated visually.

Table 1. Application and soil data.

Application date	May 6, 2011
Growth stage	
Winter wheat 'ORCF 102'	5 tiller
Italian ryegrass (LOLMU)	1 tiller
Catchweed bedstraw (GALAP)	3rd node
Air temperature (F)	67
Relative humidity (%)	52
Wind (mph)	0
Cloud cover (%)	100
Soil moisture	adequate
Soil temperature at 2 inch (F)	58
pH	5.2
OM (%)	4.0
CEC (meq/100g)	20
Texture	silt loam

No treatment injured winter wheat (data not shown). Mesosulfuron combined with pyrasulfotole/bromoxynil and florasulam/fluroxypyr controlled catchweed bedstraw 90% but did not differ from mesosulfuron plus florasulam/fluroxypyr (72%) (Table 2). Treatments not containing fluroxypyr did not control catchweed bedstraw. Mesosulfuron treatments did not control Italian ryegrass due to an ALS resistant population (15 to 50%).

Table 2. Catchweed bedstraw and Italian ryegrass control with mesosulfuron combinations near Lapwai, ID in 2011.

Treatment[1]	Rate[2]	Weed control GALAP[3]	Weed control LOLMU[4]
	lb ai/A	%	%
Mesosulfuron	0.0134	22	18
Mesosulfuron +	0.0134		
pyrasulfotole/bromoxynil	0.217	62	28
Mesosulfuron +	0.0134		
florasulam/fluroxypyr	0.092	72	25
Mesosulfuron+	0.0134		
pyrasulfotole/bromoxynil +	0.177		
florasulam/fluroxypyr	0.092	90	25
Mesosulfuron+	0.0134		
pyrasulfotole/bromoxynil +	0.217		
florasulam/fluroxypyr	0.092	90	15
Mesosulfuron+	0.0134		
pyrasulfotole/bromoxynil +	0.217		
florasulam/MCPA	0.315	58	50
LSD (0.05)		27	NS
Density (plants/ft^2)		5	30

[1]A nonionic surfactant (R-11) was applied at 0.5% v/v and urea ammonium nitrate at 32% (URAN) at 5%v/v with all treatments.
[2]Rate is in lb ae/A for all treatments containing MCPA or fluroxypyr.
[3]GALAP (catchweed bedstraw) evaluation 28 DAT.
[4]LOLMU (Italian ryegrass) evaluation 48 DAT.

Rattail fescue control in winter wheat. Traci A. Rauch, Joan M. Campbell and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in winter wheat to evaluate rattail fescue control with flucarbazone, flufenacet/metribuzin and pyroxasulfone combinations at Genesee and Moscow, ID. The plots were arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Rattail fescue control were evaluated visually during the growing season. Crop injury was not evaluated due to a spare winter wheat crop.

Table 1. Application and soil data.

Location	Genesee, ID		Moscow, ID	
Winter wheat variety – seeding date	AP700 and WB1066 mix – 10/7/10		AP700 - 10/14/10	
Application date	10/14/10	5/11/11	10/20/10	5/13/11
Growth stage				
Winter wheat	pre	1 tiller	pre	1 tiller
Rattail fescue (VLPMY)	pre	2 tiller	pre	3 tiller
Air temperature (F)	74	74	66	75
Relative humidity (%)	34	41	45	47
Wind (mph, direction)	2, W	0	1, E	2, E
Cloud cover (%)	0	10	10	50
Soil moisture	adequate	wet	dry	wet
Soil temperature at 2 inch (F)	50	48	55	71
pH	5.0		5.6	
OM (%)	4.0		2.8	
CEC (meq/100g)	19		16	
Texture	silty clay loam		silt loam	

At Genesee, treatments containing flufenacet/metribuzin and pyroxasulfone controlled rattail fescue 91 to 96% at both evaluation times(Table 2). Flucarbazone preemergence alone and mesosulfuron or pyroxsulam alone did not control rattail fescue. Flucarbazone alone or in combination applied at the 2 tiller stage controlled rattail fescue 62 to 81% and tended to be better when combined with thifensulfuron and tribenuron (80 and 81%).

At Moscow, mesosulfuron plus flufenacet/metribuzin or pyroxasulfone and flufenacet/metribuzin plus pyroxsulam injured winter wheat 15 to 26% (Table 3). Flucarbazone preemergence alone or in combination, except when combined with flucarbazone postemergence (88%), controlled rattail fescue 62 to 75%. All other treatments controlled rattail fescue 84 to 97%.

Table 2. Rattail fescue control in winter wheat with flucarbazone, flufenacet/metribuzin, and pyroxasulfone combinations near Genesee, ID in 2011.

Treatment[1]	Rate	Application timing[2]	Rattail fescue control June 7	Rattail fescue control June 24
	lb ai/A		%	%
Flucarbazone	0.0134	pre	22	21
Flucarbazone	0.0268	pre	20	28
Flufenacet/metribuzin	0.425	pre	95	96
Pyroxasulfone	0.08	pre	96	95
Flucarbazone +	0.0134	pre		
flufenacet/metribuzin	0.34	pre	92	91
Flucarbazone +	0.0134	pre		
pyroxasulfone	0.08	pre	92	93
Flucarbazone +	0.0134	pre		
flucarbazone	0.0134	2 tiller	62	68
Flufenacet/metribuzin +	0.425	pre		
mesosulfuron	0.0134	2 tiller	92	92
Flufenacet/metribuzin +	0.425	pre		
pyroxsulam	0.0164	2 tiller	95	95
Pyroxasulfone +	0.08	pre		
mesosulfuron	0.0134	2 tiller	95	95
Pyroxasulfone +	0.08	pre		
pyroxsulam	0.0164	2 tiller	95	96
Mesosulfuron	0.0134	2 tiller	52	40
Pyroxsulam	0.0164	2 tiller	50	32
Flucarbazone	0.0268	2 tiller	78	70
Flucarbazone +	0.0268	2 tiller		
thifensulfuron +	0.0141	2 tiller		
tribenuron	0.0047	2 tiller	80	81
LSD (0.05)			20	19
Density (plants/ft^2)			10	

[1]A non-ionic surfactant (R-11) at 0.5% v/v and urea ammonium nitrate (URAN) at 5% v/v was applied with mesosulfuron and pyroxsulam. Basic blend (Quad 7) at 1% v/v was applied with the 2 tiller application timing flucarbazone treatments.

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

Table 3. Rattail fescue control in winter wheat with flucarbazone, flufenacet/metribuzin, and pyroxasulfone combinations near Moscow, ID in 2011.

Treatment[1]	Rate	Application timing[2]	Winter wheat injury[3]	Rattail fescue control[3]
	lb ai/A		%	%
Flucarbazone	0.0134	pre	0	62
Flucarbazone	0.0268	pre	0	62
Flufenacet/metribuzin	0.425	pre	0	92
Pyroxasulfone	0.08	pre	0	97
Flucarbazone +	0.0134	pre		
flufenacet/metribuzin	0.34	pre	5	75
Flucarbazone +	0.0134	pre		
pyroxasulfone	0.08	pre	0	97
Flucarbazone +	0.0134	pre		
triasulfuron	0.0134	pre	2	62
Flucarbazone +	0.0131	pre		
glyphosate	0.78	pre	5	62
Flucarbazone +	0.0131	pre		
triasulfuron +	0.0263	pre		
glyphosate	0.78	pre	0	64
Flucarbazone +	0.425	pre		
flucarbazone +	0.0134	3 tiller		
basic blend	1% v/v	3 tiller	5	88
Flufenacet/metribuzin +	0.425	pre		
mesosulfuron	0.0134	3 tiller	26	97
Flufenacet/metribuzin +	0.425	pre		
pyroxsulam	0.0164	3 tiller	19	94
Pyroxasulfone +	0.08	pre		
mesosulfuron	0.0134	3 tiller	15	94
Pyroxasulfone +	0.08	pre		
pyroxsulam	0.0164	3 tiller	6	97
Imazamox +	0.0313	pre		
glyphosate +	2.25	pre		
imazamox	0.0313	3 tiller	0	96
Imazamox	0.0625	3 tiller	5	97
Mesosulfuron	0.0134	3 tiller	0	95
Pyroxsulam	0.0164	3 tiller	0	84
Flucarbazone +	0.0258	3 tiller		
NIS +	0.5%v/v	3 tiller		
AMS	1.5	3 tiller	0	93
Flucarbazone +	0.0268	3 tiller		
basic blend	1% v/v	3 tiller	0	94
Flucarbazone +	0.0258	3 tiller		
triasulfuron	0.0263	3 tiller	1	94
Flucarbazone +	0.068	3 tiller		
thifensulfuron +	0.0141	3 tiller		
tribenuron +	0.0047	3 tiller		
basic blend	1% v/v	3 tiller	0	93
LSD (0.05)			10	18
Density (plants/ft^2)			0.5	

[1]Glyphosate rate is in lb ae/A. R-11, a non-ionic surfactant (NIS) was applied at 0.25% v/v with glyphosate and postemergence triasulfuron and at 0.5% v/v with imazamox, mesosulfuron and pyroxsulam. URAN, urea ammonium nitrate (UAN) was applied at 5% v/v with imazamox postemergence and pyroxsulam. Bronc, ammonium sulfate (AMS) was applied at 1.5 lb ai/A with glyphosate, pyroxsulam, and triasulfuron postemergence. Basic blend is Quad 7.

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

[3]June 8, 2011 evaluation.

Italian ryegrass control in winter wheat. Traci A. Rauch, Joan M. Campbell, and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in a mixture of 'OR CF102' and 'AP700' winter wheat to evaluate Italian ryegrass control with 1) flufenacet/metribuzin and pyroxasulfone combinations, 2) fall postemergence herbicides, and 3) spring postemergence flucarbazone plus thifensulfuron near Moscow, ID. The plots were arranged in a randomized complete block design with four replications and included an untreated check. All herbicides were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). All studies were oversprayed with azoxystrobin/propiconazole at 0.09 lb ai/A to control stripe rust on May 27, 2011. Winter wheat injury could not be evaluated due to rodent damage and standing water causing a non-uniform wheat stand. Italian ryegrass control was evaluated visually during the growing season. In general, all treatments had decreased Italian ryegrass control due to a dense Italian ryegrass population and a noncompetitive wheat stand.

Table 1. Application and soil data.

	Flufenacet/metribuzin and pyroxasulfone combos		Fall post herbicides	Spring flucarbazone
Application date	9/24/10	5/10/11	11/2/10	5/10/11
Growth stage				
Winter wheat	pre	5 tiller	2 leaf	5 tiller
Italian ryegrass	pre	4 tiller	1 leaf	4 tiller
Air temperature (F)	65	72	55	73
Relative humidity (%)	67	57	76	59
Wind (mph, direction)	2, W	3, NW	1, W	4, W
Cloud cover (%)	10	0	0	0
Soil moisture	adequate	wet	wet	wet
Soil temperature at 2 inch (F)	65	62	55	62
pH	5.4			
OM (%)	4.8			
CEC (meq/100g)	19			
Texture	silt loam			

In the flufenacet/metribuzin and pyroxasulfone combination study, Italian ryegrass control was best with flufenacet/metribuzin or pyroxasulfone combined with mesosulfuron or pyroxsulam (79 to 86%) (Table 2). In previous studies, preemergence plus postemergence treatment combinations consistently provide the greatest Italian ryegrass control under dense populations (data not shown). All other treatments suppressed Italian ryegrass 70% or less. Triasulfuron and pinoxaden resistant Italian ryegrass populations have been confirmed in an adjacent field.

In the fall postemergence study, pyroxsulam and flucarbazone alone or combined with triasulfuron did not control Italian ryegrass (5 to 49%) (Table 3).

In the spring flucarbazone study, pyroxsulam and flucarbazone plus thifensulfuron/tribenuron/fluroxypyr suppressed Italian ryegrass 61% but did not differ from the premix flucarbazone/thifensulfuron/tribenuron/fluroxypyr at 54%. (Table 4).

Table 2. Italian control in winter wheat with flufenacet/metribuzin and pyroxasulfone combinations near Moscow, ID in 2011.

Treatment[1]	Rate	Application timing[2]	Italian ryegrass control[3]
	lb ai/A		%
Flufenacet/metribuzin	0.425	preemergence	45
Triasulfuron	0.026	preemergence	28
Pyroxasulfone	0.08	preemergence	69
Flufenacet/metribuzin +	0.425	preemergence	
triasulfuron	0.026	preemergence	54
Pyroxasulfone +	0.08	preemergence	
triasulfuron	0.026	preemergence	70
Pyroxasulfone +	0.04	preemergence	
flufenacet/metribuzin	0.213	preemergence	64
Flufenacet/metribuzin +	0.425	preemergence	
mesosulfuron	0.0134	4 tiller	80
Flufenacet/metribuzin +	0.425	preemergence	
pyroxsulam	0.0164	4 tiller	79
Pyroxasulfone+	0.08	preemergence	
mesosulfuron	0.0134	4 tiller	86
Pyroxasulfone+	0.08	preemergence	
pyroxsulam	0.0164	4 tiller	84
Mesosulfuron	0.0134	4 tiller	56
Pyroxsulam	0.0164	4 tiller	50
Pinoxaden	0.054	4 tiller	28
LSD (0.05)			14
Density (plants/ft^2)			30

[1]A non-ionic surfactant (R-11) and urea ammonium nitrate (URAN) were applied at 0.5 and 5%v/v, respectively, with all postemergence treatments, except pinoxaden.
[2]Application timing based on Italian ryegrass growth stage.
[3]June 8, 2011 evaluation.

Table 3. Italian control in winter wheat with fall postemergence herbicides near Moscow, ID in 2011.

Treatment[1]	Rate	Italian ryegrass control[2]
	lb ai/A	%
Flucarbazone	0.026	5
Flucarbazone +	0.026	
triasulfuron	0.026	28
Pyroxsulam	0.0164	49
LSD (0.05)		22
Density (plants/ft^2)		30

[1]Flucarbazone is Sierra™ which is a 3.5 lb ai/gal soluble concentrate from Syngenta. A non-ionic surfactant (R-11) and ammonium sulfate (Bronc) were applied at 0.25% v/v and 1.5 lb/A, respectively, with all treatments.
[2]June 29, 2011 evaluation.

Table 4. Italian control in winter wheat with spring postemergence flucarbazone plus thifensulfuron near Moscow, ID in 2011.

Treatment[1]	Rate	Italian ryegrass control[2]
	lb ai/A	%
Flucarbazone +	0.027	
NIS +AMS	0.25% v/v + 1	42
Flucarbazone	0.027	41
Flucarbazone +	0.020	
thifensulfuron	0.0047	35
Flucarbazone +	0.020	
thifensulfuron	0.0094	41
Flucarbazone +	0.027	
thifensulfuron	0.0047	41
Flucarbazone +	0.027	
Thifen/triben/fluro	0.097	61
Flucarb/thifen/triben/fluro	0.148	54
Pyroxsulam	0.0164	61
LSD (0.05)		12
Density (plants/ft^2)		30

[1]Flucarbazone is Everest 2.0™ which is a 3.5 lb ai/gal soluble concentrate from Arysta LifeSciences. NIS is a non-ionic surfactant (R-11) and AMS is ammonium sulfate (Bronc). A basic blend (Quad 7) was applied at 1% v/v with all treatments except flucarbazone + NIS + AMS. Thifen/triben/fluro is thifensulfuron/tribenuron/fluroxypyr (Supremacy). Flucarb/thifen/triben/fluro is flucarbazone/thifensulfuron/tribenuron/fluroxypyr (ARY-0454-107).

[2]June 22, 2011 evaluation.

Winter barley tolerance to flufenacet. Campbell, Joan, Traci Rauch, Don Morishita, and Donn Thill. (Crop and Weed Science Division, University of Idaho) Winter annual grass weeds are a major concern in the production of winter cereals. Many of the herbicides registered for winter annual grass weed control in winter wheat are not labeled for use in winter barley. Flufenacet is not labeled for use on barley in the US, but it is in the United Kingdom. Thus, it could potentially be used in the US on winter barley. Three winter barley varieties were planted in Moscow (dryland) and Kimberly (irrigated), Idaho fall 2010. Endeavor and Charles are malt varieties and Eight-twelve is a feed variety. Flufenacet/metribuzin and flufenacet were applied to the soil before barley emergence (Table 1). Rates used were 0.5, 1, and 1.5 times the use rate of flufenacet/metribuzin which is 0.3 lb ai/a flufenacet. Pinoxaden applied post-emergence at 0.05 lb ai/a and untreated checks were included for comparison. The experimental design was a split-block with four replications. Plots were harvested at maturity. Yield, test weight, plumps and thins were measured.

Table 1. Application and edaphic data.

	Moscow		Kimberly	
Planting date	October 6, 2010		October 15, 2010	
Soil pH	4.9		8.3	
CEC	23		25.5	
Organic matter (%)	4.9		1.45	
Texture	Palouse silt loam		Portneuf silt loam	
	Pre-emergence	Postemergence	Pre-emergence	Postemergence
Application date	October 14, 2010	May 19, 2010	October 21, 2010	May 27, 2011
Barley leaf stage	-	3 leaf	-	4 leaf
Air temperature (F)	72	71	72	50
Soil temperature (F)	55	70	60	50
Relative humidity (%)	46	42	23	56
Soil moisture	Good	high	0.9 in rain after application	Good

Grain yield was lower with all treatments containing flufenacet compared to the untreated check at Moscow, but grain yield at Kimberly was lower than the check with the 1.5 use rates only (Tables 2 and 3). Grain yield from pinoxaden treated plots was not different from the untreated at either location. Test weight, plumps and thins were not different among flufenacet/metribuzin or flufenacet rates and the untreated check. All varieties responded similarly to herbicide treatments, although yield and quality was different among varieties. Yield was highest with Eight-twelve and lowest with Charles at Moscow (Table 4). At Kimberly, Endeavor was highest and Eight-twelve was lowest (Table 6). Eight twelve had lower plumps and more thins than Charles or Endeavour at both locations.

Table 2. Barley yield, test weight, plumps and thins averaged over variety at Moscow.

Herbicide	Rate	Yield	Test weight	Plumps	Thins
	lb ai/a	bu/a	lb/bu	%	%
Untreated	0	135 a[1]	53.4 abc	95	1
Flufenacet/metribuzin	0.231	120 bc	53.3 ab	94	1
Flufenacet/metribuzin	0.425	101 d	53.1 ab	94	1
Flufenacet/metribuzin	0.64	84 e	52.8 a	95	1
Flufenacet	0.17	109 cd	53.6 bc	94	2
Flufenacet	0.34	105 d	53.1 ab	96	1
Flufenacet	0.51	88 e	52.9 a	96	1
Pinaoxaden	0.054	129 ab	53.9 c	94	2

[1] Means followed by the same letter within a column are not statistically different at P>0.05. Data within a column with no letters are not statistically different from one another.

Table 3. Barley yield, test weight, plumps and thins averaged over variety at Kimberly.

Herbicide	Rate	Yield	Test weight	Plumps	Thins
	lb ai/a	bu/a	lb/bu	%	%
Untreated	0	153 c[1]	49.3	80	20
Flufenacet/metribuzin	0.231	141 c	49.3	81	19
Flufenacet/metribuzin	0.425	138 bc	49.7	80	20
Flufenacet/metribuzin	0.64	117 a	48.9	87	13
Flufenacet	0.17	142 bc	49.6	79	21
Flufenacet	0.34	142 bc	50.5	83	17
Flufenacet	0.51	120 ab	49.6	82	18
Pinoxaden	0.054	156 c	49.4	75	25

[1] Means followed by the same letter within a column are not statistically different at P>0.05. Data within a column with no letters are not statistically different from one another.

Table 4. Barley yield, test weight, plumps and thins averaged over herbicide at Moscow.

Variety	Yield	Test weight	Plumps	Thins
	bu/a	lb/bu	%	%
Endeavor	115 a[1]	53.3	97 a	1 a
Eight-twelve	126 b	52.7	90 b	2 b
Charles	86 c	53.7	98 a	1 a

[1] Means followed by the same letter within a column are not statistically different at P>0.05. Data within a column with no letters are not statistically different from one another.

Table 5. Barley yield, test weight, plumps and thins averaged over herbicide at Kimberly.

Variety	Yield	Test weight	Plumps	Thins
	bu/a	lb/bu	%	%
Endeavor	151 a[1]	52.4 a	84 a	16 a
Eight-twelve	130 b	47.6 b	66 b	34 b
Charles	142 ab	48.2 b	92 c	8 c

[1] Means followed by the same letter within a column are not statistically different at P>0.05. Data within a column with no letters are not statistically different from one another.

Comparison of fungicides tank mixed with bromoxynil, MCPA and fenoxaprop for crop safety and yield in malt barley. Don W. Morishita, Donald L. Shouse, and Andy A. Nagy (Kimberly Research and Extension Center, University of Idaho, Kimberly, ID 83341). A study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to evaluate the crop safety of various fungicides tank mixed with bromoxynil, MCPA and fenoxaprop. 'Morvavian 69' spring malt barley was planted April 22, 2011 at 100 lb/A and grown under sprinkler irrigation. Experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Soil type was a Portneuf silt loam (4.8% sand, 56.0% silt, and 39.2% clay) with a pH of 8.3, 1.45% organic matter, and CEC of 25.5-meq/100 g soil. Herbicide and fungicide tank mixtures were applied May 27, 2011, with a CO_2-pressurized bicycle-wheel sprayer equipped with 11001 flat fan nozzles calibrated to deliver 10 GPA at 20 psi and 3 mph. Environmental conditions at application as shown: air temperature 50°F, soil temperature 45°F, relative humidity 55%, wind speed 3 mph, and 15% cloud cover. Crop injury was evaluated visually 5, 10, and 21 days after herbicide application (DAA) on June 1, 6 and 17, respectively. Grain was harvested August 17with a small-plot combine.

Crop injury 5 DAA was evident on all treatments when compared to the untreated control, and ranged from 11 to 20% (Table). Air temperatures immediately prior to, during, and after application were below average. Freezing temperatures were recorded 7 DAA. Crop injury 10 DAA was more pronounced with all treatments. However, the bromoxynil/MCPA + fenoxaprop treatment without a fungicide had the highest injury rating at 49%. All fungicide tank mixtures with the same herbicide were statistically equal and ranged from 24 to 28%. More seasonal growing conditions followed the cooler temperatures observed in late May to early June. By 21 DAA, injury from all treatments ranged from 5 to 10% compared to the untreated control with no difference among the herbicide treatments. At harvest, no differences in crop injury could be seen among the treatments. Barley test weight ranged from 49 to 51 lb/bu with no differences among treatments. Barley yield ranged from 137 to 155 bu/A with no differences among treatments. The variability in barley yield that contributed to no yield differences may be attributed to poor barley growth on the one side of the study and affected eight of the 64 plots in this study.

Table. Crop tolerance in response to fungicide tank mixtures with herbicides, near Kimberly, ID[1]

Treatment[2]	Application rate	Crop injury 6/1	6/6	6/17	Test weight	Grain yield	
	lb ai/A	-------------%-------------			lb/bu	bu/A	lb/A
Untreated control		-	-	-	49 a	155 a	7684 a
Bromoxynil/MCPA +	0.5 +	20 a	49 a	6 a	50 a	147 a	7281 a
fenoxaprop +	0.083 +						
NIS	0.25% v/v						
Pyraclostrobin +	0.0975 +	15 a	25 b	6 a	50 a	149 a	7511 a
bromoxynil/MCPA+	0.5 +						
fenoxaprop +	0.083 +						
NIS	0.25% v/v						
Pyraclostrobin +	0.0975 +	14 a	26 b	6 a	50 a	137 a	6848 a
bromoxynil/MCPA +	0.5 +						
fenoxaprop +	0.083 +						
NIS	0.25% v/v						
Pyraclostrobin +	0.0488 +	11 a	26 b	10 a	51 a	155 a	7906 a
propiconazole +	0.113 +						
bromoxynil/MCPA +	0.5 +						
fenoxaprop +	0.083 +						
NIS	0.25% v/v						
Pyraclostrobin/metconazole-1+	0.123 +	18 a	24 b	5 a	50 a	151 a	7565 a
bromoxynil/MCPA +	0.5 +						
fenoxaprop +	0.083 +						
NIS	0.25%v/v +						
Pyraclostrobin/metconazole-2 +	0.131	19 a	28 b	10 a	51 a	142 a	7181 a
bromoxynil/MCPA +	0.5 +						
fenoxaprop +	0.083 +						
NIS	0.25% v/v						
Fluxapyroxad/Pyraclostrobin +	0.131 +	15 a	26 b	10 a	50 a	144 a	7227 a
bromoxynil/MCPA +	0.5 +						
fenoxaprop +	0.083 +						
NIS	0.25% v/v						

[1]Means followed by same letter are not significantly different using Fisher's Protected LSD ($P \leq 0.05$).
[2]Bromoxynil/MCPA is a formulated mixture sold as Bronate Advanced. Fenoxaprop is sold as Puma. Pyraclostrobin-1 and pyraclostrobin-2 are fungicides sold as Headline EC and Headline SC, respectively, Propiconazole is a fungicide sold as Tilt. Pyraclostrobin/metconazole-1 is a 1.62:1 formulated fungicide sold as Twinline. Pyraclostrobin/ metconazole-2 are a 2.6:1 formulated fungicide sold as Headline AMP. Fluxapyroxad/pyraclostrobin is a fungicide sold as Priaxor. NIS is R-11, a nonionic surfactant.

Pea, lentil, chickpea tolerance to pyroxsulam. Joan Campbell, Traci Rauch, and Donn Thill, (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Pea, lentil, and chickpea tolerance to pyroxsulam and florasulam was investigated at Walla Walla, Wa and Moscow, Id. Pyroxsulam and florasulam use rates are 0.016 and 0.00438 lb ai/a, respectively. The two herbicides were applied at 1/2, 1/4, 1/16, 1/64, and 1/256 of the use rates to simulate carryover of herbicide from a prior wheat crop (Table 1). Assuming a 30 day half-life, these rates would correspond to half-lives of 1, 2, 4, 6, and 8, respectively. Untreated plots were included for comparison. The herbicide was incorporated twice with a field cultivator after application. 'Aragorn' pea, 'Sierra' chickpea, and 'Pardina' lentil were seeded across the herbicide treatments 10 and 2 days after application at Walla Walla and Moscow, respectively. Crops were evaluated visually and harvested at maturity. In a second study, the effect of pyroxsulam and florasulam in combination was evaluated on pea, lentil, and chickpea at the same site in Moscow. Herbicide application and planting methods were the same as the first experiment. Each herbicide was applied at 1 and 2 half-lives plus untreated and every combination. Crops were harvested at maturity.

Table 1. Application and edaphic data.

Location	Walla Walla	Moscow (both experiments)
Application date	April 12, 2012	May 11, 2012
Planting date	April 22, 2012	May 13, 2012
Air temperature (F)	61	66
Soil temperature (F)	59	57
Relative humidity (%)	58	49
Soil pH	5.8	5.1
Soil CEC	15.1	19.4
Soil organic matter (%)	3.2	4.0
Soil texture	Silt loam	Silt loam

Seed yield from Walla Walla was not different statistically among treatments due to planting inconsistency, excessive weeds, and damaged plants from a heavy rain event. Data shown are from the Moscow site.

Data was averaged over herbicide since there was no statistical difference between pyroxsulam and florasulam (Table 2). Lentil yield was reduced with 1 and 2 half-life rates compared to the untreated, chickpea yields were reduced only at the 1 half-life rate, and pea yield was not different from the untreated. To compare yield among the three crops, data was converted to percent of untreated (Table 3). Lentil yield was lower than pea yield. Chickpea yield was between pea and lentil, but it was not statistically different.

In the combination study, it is apparent that pyroxsulam injury was greater than florasulam for both lentil and chickpea (Table 4.) At the zero rate of pyroxsulam, chickpea was not injured with florasulam at 1/8 or 1/4 rates and lentil was injured at the 1/4 rate only. However, at the zero rate of florasulam, chickpea and lentil were both injured at both the 1/8 and 1/4 rates of pyroxsulam compared to the untreated. Pea yield was not different statistically from the untreated with any treatments.

Table 2. Chickpea, lentil and pea yield averaged over herbicides.

	Seed yield		
Herbicide rate	Chickpea	Lentil	Pea
Portion of use rate	---------------------------------- lb/a	---	
1/2	1786 a	727 a[1]	1021 a
1/4	2007 ab	1120 b	1322 ab
1/16	2213 b	1537 c	1772 b
1/64	2353 b	1648 c	1648 b
1/256	2218 b	1660 c	1552 b
Untreated	2249 b	1749 c	1502 ab

[1]Means within a column followed by the same letter are not different statistically at P>0.05.

Table 3. Florasulam and pyroxsulam effect on comparative yield among crops averaged over half-life.

Crop	Herbicide	Seed yield	Crop mean
		------------ % of check ------------	
Chickpea	Florasulam	95 ab[1]	93 ab
Chickpea	Pyroxsulam	91 ab	
Lentil	Florasulam	78 a	80 a
Lentil	Pyroxsulam	81 a	
Pea	Florasulam	104 b	105 b
Pea	Pyroxsulam	107 b	

[1]Means within a column followed by the same letter are not different statistically at P>0.05.

Table 4. Florasulam and pyroxsulam combinations effect on yield.

Herbicide rate		Seed yield		
Pyroxsulam	Florasulam	Chickpea	Lentil	Pea
Portion of use rate		------------------------------------ lb/a -----------------------------		
0	0	2627 a[1]	1252 a	2221 a
0	1/8	2405 ab	991 ab	2023 a
0	1/4	2361 ab	849 bc	1956 a
1/8	0	2124 bc	978 b	1931 a
1/8	1/8	1803 c	541 c	1591 a
1/8	1/4	2489 a	667 bc	2060 a
1/4	0	2039 bc	818 bc	1698 a
1/4	1/8	1995 c	593 c	1872 a
1/4	1/4	1983 c	768 bc	2026 a

[1]Means within a column followed by the same letter are not different statistically at P>0.05.

Winter wheat, yellow mustard, and spring lentil response to iodosulfuron/mesosulfuron. Traci A. Rauch, Joan M. Campbell and Donald C. Thill (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies were established near Genesee, Idaho to evaluate winter wheat injury in 2009 and 1) yellow mustard and 2) spring lentil soil carryover response in 2010 to iodosulfuron/mesosulfuron. The experimental design was a randomized complete block with four replications. Each study was planted to 'Brundage 96' winter wheat on October 15, 2008 at 100 lb/A. All herbicide treatments were applied to winter wheat in 2009 using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The studies were oversprayed on May 20, 2009 for broadleaf weed control. The future yellow mustard site was treated with pyrasulfotole/bromoxynil at 0.193 lb ai/A, fluroxypyr at 0.117 lb ai/A, and clopyralid at 0.124 lb ai/A. The future spring lentil site was treated with pyrasulfotole/bromoxynil at 0.193 lb ai/A and fluroxypyr at 0.117 lb ai/A. The accidental inclusion of pyrasulfotole/bromoxynil in the overspray added 0.193 lb ai/A to all treatments including the untreated check. Wheat injury was evaluated visually. Wheat grain was harvested with a small plot combine on August 18, 2009. In 2010, yellow mustard or spring lentil was planted in each study. 'IdaGold' yellow mustard and 'Red Chief' spring lentil were direct-seeded on April 26, 2010. Rotational crop injury was evaluated visually and yellow mustard seed was harvested with a small plot combine on August 12, 2010. Spring lentil was not harvested due to a poor crop stand.

Table 1. Application and soil data.

	Yellow mustard study	Spring lentil study
Application date	5/17/2009	5/27/2009
Wheat growth stage	3 tiller	early joint
Air temperature (F)	64	66
Relative humidity (%)	69	56
Wind (mph, direction)	3, E	0
Cloud cover (%)	40	10
Soil moisture	excessive	adequate
Soil temperature at 2 inch (F)	50	60
pH	5.7	5.5
OM (%)	2.4	3.4
CEC (meq/100g)	25	23
Texture	silt loam	silt loam

At the yellow mustard site, mesosulfuron alone or combined with pyrasulfotole/bromoxynil and iodosulfuron/mesosulfuron plus pyrasulfotole/bromoxynil injured wheat 7 to 10% (Table 2). Iodosulfuron/mesosulfuron or mesosulfuron combined with pyrasulfotole/bromoxynil injured winter wheat 18 and 20% at 21 DAT. Wheat grain yield and test weight did not differ among treatments but tended to be the lowest for mesosulfuron combined with pyrasulfotole/bromoxynil (5112 lb/A and 59.5 lb/bu). At 35 DAT, yellow mustard injury ranged from 0 to 9%, but was not different among treatments. Likewise, by 56 DAT, yellow mustard injury did not differ among treatments but was above 10% for pyroxsulam and flucarbazone. Mustard seed yield did not differ among treatments.

At the spring lentil site, all treatments injured winter wheat 5% or less (Table 3). Winter wheat grain yield and test weight did not differ among treatments including the untreated check. Lentil injury ranged from 5 to 12% and 0 to 1% on 56 and 77 DAT, respectively. Lentil injury was difficult to evaluate due to a poor crop stand.

Table 2. Winter wheat and yellow mustard response to iodosulfuron/mesosulfuron near Genesee, Idaho in 2009 and 2010.

		Winter wheat 2009				Yellow mustard 2010		
		Injury				Injury		
Treatment[1]	Rate	7 DAT	21 DAT	Yield	Test weight	35 DAP	56 DAP	Yield[2]
	lb ai/A	%	%	lb/A	lb/bu	%	%	lb/A
Iodosulfuron/mesosulfuron	0.0158	1	0	5478	60.1	0	1	1000
Iodosulfuron/mesosulfuron	0.0315	5	8	5593	59.9	0	10	1036
Iodosulfuron/mesosulfuron +	0.0315							
pyrasulfotole/bromoxynil	0.435	8	18	5388	60.0	2	2	1040
Mesosulfuron	0.0268	7	9	5397	59.8	1	7	926
Mesosulfuron +	0.0268							
pyrasulfotole/bromoxynil	0.435	10	20	5112	59.5	8	8	980
Pyrasulfotole/bromoxynil	0.435	0	0	5269	60.4	9	7	1015
Pyroxsulam	0.0328	4	0	5282	59.8	5	17	942
Flucarbazone	0.0525	2	0	5214	60.0	4	12	955
Untreated check	--	--	--	5484	60.2	--	--	955
LSD (0.05)		3	5	NS	NS	NS	NS	NS

[1]90% nonionic surfactant (R-11) was applied at 0.5% v/v with all treatments, except pyrasulfotole/bromoxynil alone. Urea ammonium nitrate (URAN) was applied at 5% v/v with all treatments containing mesosulfuron. Ammonium sulfate (Bronc) was applied at 1.5 lb ai/A with pyroxsulam.
[2]Only 3 replication were analyzed due to non uniform yield.

Table 2. Winter wheat and spring lentil response to iodosulfuron/mesosulfuron near Genesee, Idaho in 2009 and 2010.

		Winter wheat 2009			Spring lentil 2010	
					Injury	
Treatment[1]	Rate	Injury (7 DAT)	Yield	Test weight	56 DAP	77 DAP
	lb ai/A	%	lb/A	lb/bu	%	%
Iodosulfuron/mesosulfuron	0.0158	4	6014	59.4	12	1
Iodosulfuron/mesosulfuron	0.0315	5	6475	60.0	8	1
Iodosulfuron/mesosulfuron +	0.0315					
pyrasulfotole/bromoxynil	0.435	5	6115	58.9	8	0
Mesosulfuron	0.0268	5	6623	59.5	9	1
Mesosulfuron +	0.0268					
pyrasulfotole/bromoxynil	0.435	5	6691	59.5	5	0
Pyrasulfotole/bromoxynil	0.435	1	6559	60.5	6	1
Pyroxsulam	0.0328	4	6697	58.9	6	0
Flucarbazone	0.0525	5	6737	59.5	6	1
Untreated check	--	--	6674	60.3	--	--
LSD (0.05)		2	NS	NS	NS	NS

[1]90% nonionic surfactant (R-11) was applied at 0.5% v/v with all treatments, except pyrasulfotole/bromoxynil alone. Urea ammonium nitrate (URAN) was applied at 5% v/v with all treatments containing mesosulfuron. Ammonium sulfate (Bronc) was applied at 1.5 lb ai/A with pyroxsulam.

Spring lentil response to fall applied pyroxsulam and florasulam in simulated winter-kill winter wheat. Traci A. Rauch, Joan M. Campbell, and Donald C. Thill. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in winter wheat at the University of Idaho Kambitsch Farm near Genesee, ID to evaluate spring lentil response to pyroxsulam and florasulam. Sulfosulfuron and mesosulfuron were included in the study for comparison purposes. Herbicide treatments were applied to winter wheat on November 4, 2010. Pyroxsulam was applied at 1X (labeled rate = 0.0164 lb ai/A), 2X and 4X rate of PowerFlex™. Florasulam was applied alone but it was equivalent to the 1X (0.00446 lb ai/A of florasulam), 2X, and 4X rate of florasulam in Orion™ (florasulam/MCPA ester). In the spring, glyphosate at 0.58 lb ae/A was applied to winter wheat to simulate winter-kill on April 4, 2011. 'Brewer' spring lentil was seeded on May 13 at 60 lb/A. The study was arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The study was oversprayed with sethoxydim at 0.0825 lb ai/A to control volunteer wheat. Lentil response was evaluated visually during the growing season and seed was harvested with a small plot combine at maturity on September 8.

Table 1. Application and soil data.

Winter wheat variety – seeding date and rate		Brundage 96 – October 22, 2010 at 100 lb/A
Application date		November 4, 2010
Winter wheat growth stage		spike
Air temperature (F)		62
Relative humidity (%)		70
Wind, direction (mph)		3, ENE
Cloud cover (%)		20
Soil moisture		adequate
Soil temperature at 2 inch (F)		58
Spring lentil variety – seeding date and rate		Brewer – May 13, 2011 at 60 lb/A
Soil data:	pH	5.0
	OM (%)	3.4
	CEC (meq/100g)	21
	Texture	silt loam

Lentil chlorosis, necrosis, stunting, and stand reduction (injury) was greatest at 5 WAP (weeks after planting) (Table 2). Lentil injury increased with herbicide rate (except with mesosulfuron) and decreased with time across all treatments. At all visual evaluations dates, spring lentil was injured by pyroxsulam (23 to 90%). Sulfosulfuron injured lentils 18 to 56% at the 1X rate and 41 to 78% at the 2X rate. At 5 WAP, all florasulam rates injured lentil 52 to 78% but by 8 WAP lentil injury was less than 15% for the 1X and 2X rates. Mesosulfuron did not injure lentil. Lentil seed yield was reduced 25 to 60% by sulfosulfuron, florasulam, and the two highest rates of pyroxsulam compared to the untreated check.

Table 2. Spring lentil visual injury and seed yield of fall applied pyroxsulam and florasulam in simulated winter-kill winter wheat near Genesee, ID in 2011.

Treatment[1]	Rate	Lentil injury[2] 5 WAP	7 WAP	8 WAP	Lentil seed yield
	lb ai/A	%	%	%	lb/A
Pyroxsulam	0.0164	44	24	23	573
Pyroxsulam	0.0328	79	70	56	482
Pyroxsulam	0.0656	90	85	72	283
Florasulam	0.00446	28	8	2	500
Florasulam	0.0091	41	19	14	447
Florasulam	0.0178	52	44	28	365
Sulfosulfuron	0.0312	56	35	18	529
Sulfosulfuron	0.0623	78	68	41	386
Mesosulfuron + AMS	0.0134 + 1.5	1	0	0	725
Mesosulfuron + AMS	0.0267 + 1.5	0	0	0	850
Untreated check	--	--	--	--	705
LSD (0.05)		15	13	13	163

[1]A nonionic surfactant (Agral 90) was applied at 0.5% v/v with all treatments. AMS is ammonium sulfate.
[2]WAP= weeks after planting.

Winter and spring wheat response to pyroxsulam, fluroxypyr/florasulam, and other herbicides. Traci A. Rauch, Joan M. Campbell and Donald C. Thill (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established near Genesee and Moscow, ID to evaluate 'Brundage 96'winter wheat and 'Alturas' spring wheat response, respectively, to pyroxsulam, fluroxypyr/florasulam, and other grass herbicides. The experimental design was a randomized complete block with four replications and plots were 16 by 30 ft. All herbicides were applied at 1X (labeled rate), 2X and 4X rate. 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 pyrasulfotole/bromoxynil at 0.193 lb ai/A and thifensulfuron/tribenuron at 0.025 lb ai/A to control broadleaf weeds on May 20 and azoxystrobin/propiconazole at 0.09 lb ai/A on May 28, 2011 to control stripe rust. Wheat injury was evaluated visually. Winter and spring wheat seed was harvested with a small plot combine on August 23 and September 8, 2011, respectively. In both studies, each plot will be planted to spring lentil, pea, and chickpea in spring 2012 to evaluate soil persistence of all herbicide treatments.

Table 1. Application and soil data.

Location	Genesee, ID	Moscow, ID
Application date	May 28, 2011	June 8, 2011
Winter wheat growth stage	early joint	--
Spring wheat growth stage	--	1 tiller
Air temperature (F)	57	60
Relative humidity (%)	61	60
Wind (mph, direction)	2, W	2, W
Cloud cover (%)	90	100
Soil moisture	adequate	adequate
Soil temperature at 2 in (F)	51	53
pH	5.6	4.5
OM (%)	3.7	3.9
CEC (meq/100g)	23	28
Texture	silt loam	clay loam

In the winter wheat study, pyroxsulam at the 4X rate injured winter wheat 28 and 24% at 7 and 21 DAT, respectively (Table 2). By 70 DAT, no winter wheat injury was visible (data not shown). Grain yield did not differ among treatments including the untreated check and ranged from 103 to 115 bu/A. The highest rate of pyroxsulam reduced grain test weight compared to the untreated check.

In the spring wheat study, the 4X rate of flucarbazone plus 2,4-D and the 2X and 4X rates of pyroxsulam/florasulam/fluroxypyr injured winter wheat 11 to 14% at 7 DAT (Table 3). At 14 and 70 DAT, spring wheat injury at the 4X rate of pyroxsulam/florasulam/fluroxypyr was 25 and 22%, respectively, while, injury ranged from 8 to 14% for pyroxsulam/fluroxypyr/florasulam at the 2X rate and flucarbazone plus 2,4-D at 4X rate. At all rating dates, wheat injury increased with increasing pyroxsulam/fluroxypyr/florasulam rate. For grain yield and test weight, only three replications were analyzed due to an uneven fertilizer application. Grain yield was reduced 20 to 32% by the 2X and 4X rates of flucarbazone plus 2,4-D, the 2X rate of fluroxypyr/florasulam, and the 2X rate of pyroxsulam/fluroxypyr/florasulam compared to the untreated check. The 4X rate of fluroxypyr/florasulam and pyroxsulam/fluroxypyr/florasulam did not affect grain yield. Test weight did not differ among treatments including the untreated check and ranged from 60.9 to 61.8 lb/bu.

Table 2. Winter wheat response to pyroxsulam and florasulam near Genesee, Idaho in 2011.

		Winter wheat			
		Injury			Test
Treatment[1]	Rate	7 DAT	21 DAT	Yield	weight
	lb ai/A	%	%	bu/A	lb/bu
Pyroxsulam +	0.0164				
NIS +	0.5% v/v				
AMS	1.5	11	0	113	60.4
Pyroxsulam +	0.0328				
NIS +	1% v/v				
AMS	3	12	5	115	60.4
Pyroxsulam +	0.0656				
NIS +	2% v/v				
AMS	6	28	24	110	59.9
Fluroxypyr/florasulam	0.092	3	2	109	60.9
Fluroxypyr/florasulam	0.185	8	2	105	60.7
Fluroxypyr/florasulam	0.37	5	2	114	60.8
Sulfosulfuron +	0.0313				
NIS	0.5% v/v	0	0	109	60.5
Sulfosulfuron +	0.0623				
NIS	1% v/v	4	0	106	60.8
Sulfosulfuron +	0.125				
NIS	2% v/v	3	2	104	61.2
Untreated check	--	--	--	103	60.9
LSD (0.05)		5	6	NS	0.5

[1]NIS is a 90% nonionic surfactant (Activator 90) and AMS is ammonium sulfate.

Table 3. Spring wheat response to pyroxsulam and florasulam near Moscow, Idaho in 2011.

		Spring wheat				
		Injury				Test
Treatment[1]	Rate	7 DAT	14 DAT	70 DAT	Yield[2]	weight[2]
	lb ai/A	%	%	%	bu/A	lb/bu
Pyroxsulam/fluroxypyr/florasulam +	0.105					
NIS +	0.5% v/v					
AMS	1.52	9	8	0	59	61.5
Pyroxsulam/fluroxypyr/florasulam +	0.21					
NIS +	1% v/v					
AMS	3.05	11	12	8	45	61.6
Pyroxsulam/fluroxypyr/florasulam +	0.42					
NIS +	2% v/v					
AMS	6.1	12	25	22	60	60.9
Fluroxypyr/florasulam	0.092	0	0	0	63	61.7
Fluroxypyr/florasulam	0.185	0	0	0	53	61.2
Fluroxypyr/florasulam	0.37	1	0	0	62	61.0
Flucarbazone +	0.0205					
2,4-D ester	0.374	0	0	0	63	61.5
Flucarbazone +	0.041					
2,4-D ester	0.75	2	4	0	45	61.6
Flucarbazone +	0.082					
2,4-D ester	1.5	14	14	14	45	61.8
Untreated check	--	--	--	--	66	61.7
LSD (0.05)		4	3	10	12	NS

[1]NIS is a 90% nonionic surfactant (Activator 90) and AMS is ammonium sulfate.
[2]Only three replications were analyzed due to uneven fertilizer application.

Newly reported exotic species in Idaho for 2011. Larry Lass and Timothy S. Prather. (Idaho Agricultural Experiment Station, University of Idaho, Moscow, Idaho, 83844-2339). The Lambert C. Erickson Weed Diagnostic Laboratory received 218 specimens for identification in 2011 (Figure 1). Sixty introduced species were identified. The lab received five weedy species not previously reported in the state and identified eleven exotic species that were new county records (see Table 1 and Figure 2). A total of 24 counties in Idaho submitted samples (Figure 3) and we had on-line photo submissions from two states. Species in Table 1 have not previously been reported from the county and state to the Erickson Weed Diagnostic Laboratory or the USDA Plants Database.

Table 1. Identified introduced species new to county and state based on USDA Plants Database.

County	Family	*Genus*	*Species*	Common Name
Bingham	Asteraceae	*Artemisia*	*absinthium*	absinthium
Bingham	Asteraceae	*Senecio*	*vulgaris*	old-man-in-the-spring
Bingham	Solanaceae	*Lycium*	*barbarum*	matrimony vine
Blaine	Brassicaceae	*Berteroa*	*incana*	hoary alyssum
Blaine	Tamericaceae	*Tamarix*	*sp.*	tamarisk
Boundary*	Liliaceae	*Allium*	*vineale*	wild garlic
Boundary	Ulmaceae	*Ulmus*	*pumila*	Siberian elm
Elmore*	Asteraceae	*Machaeranthera*	*canescens*	hoary tansyaster
Elmore	Scrophlariaceae	*Verbascum*	*blattaria*	moth mullein
Franklin	Polygonaceae	*Polygonum*	*cuspidatum*	Japanese knotweed
Idaho*	Scrophulariaceae	*Chaenorhinum*	*minus*	dwarf snapdragon
Kootenia	Valerianaceae	*Valeriana*	*officinalis*	garden valerian
Latah*	Apiaceae	*Foeniculum*	*vulgare*	sweet fennel
Latah*	Brassicaceae	*Sisymbrium*	*officinale*	hedgemustard
Valley	Cuscutaceae	*Cuscuta*	*sp.*	dodder
Washington	Chenopodiaceae	*Chenopodium*	*album*	lambsquarter

*= new to state of Idaho.

Figure 1. Erickson Weed Diagnostic Laboratory received 218 plant specimens for identification in 2011.

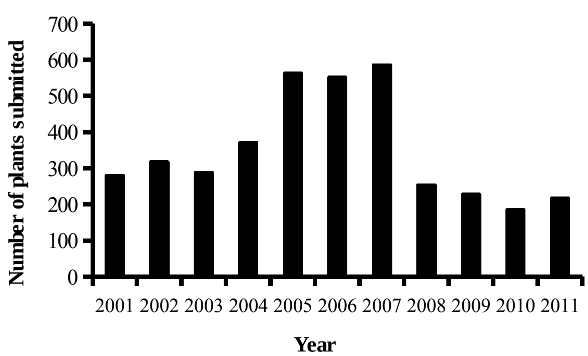


Figure 2. The lab identified 16 exotic species that were new Idaho records in 2011.

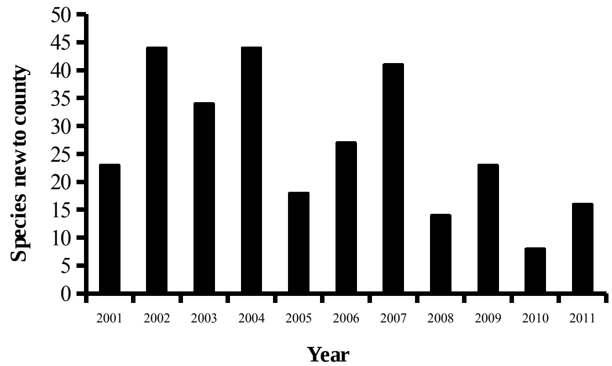
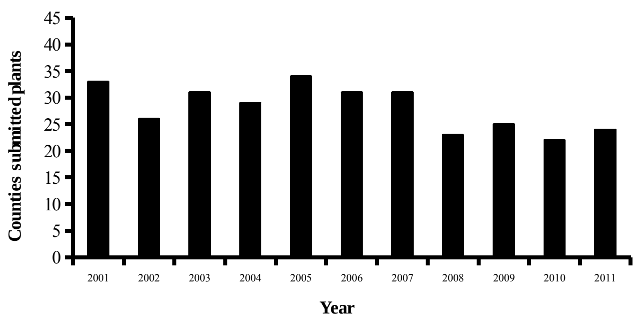


Figure 3. Twenty-four Idaho counties submitted plants in 2011.



Difference in weed seedling emergence is not involved with pea synergism to corn. Randy L. Anderson. (USDA-ARS, Brookings SD 57006). We have observed that corn is more tolerant to weeds when following dry pea compared to soybean. For example, when a uniform infestation of foxtail millet [*Setaria italica* (L.) Beauv] was present, corn yielded 2-fold more following dry pea than following soybean. We term this beneficial effect between dry pea and corn as synergism.

We wondered if foxtail millet seedling emergence and growth in corn varied when following dry pea or soybean, and thus possibly relate to why corn is more tolerance to foxtail millet when following dry pea. To answer this question, we recorded foxtail millet emergence and growth in corn when corn was grown after dry pea or soybean.

Methodology:

In 2008, 2009, and 2010, corn was established at 26,000 plants/acre with no-till into stubble of dry pea or soybean grown the preceding year. The hybrid was DeKalb 47-10 RR/YGCB; nitrogen and phosphorus was banded by the seed at planting at the rate of 7 lb N + 25 lbs P/acre. N fertilizer was also broadcast when corn had 6 leaves fully emerged, with rate based on a yield goal of 130 bu/ac.

Plot size was 20 feet by 70 feet; plots were split into equal-sized weed-free and weed-infested subplots. For the weed-infested subplot, 200 foxtail millet seeds/yd^2 were broadcast on the soil surface at corn planting. Three 0.5 yd^2 quadrats were randomly established in and seedling emergence recorded weekly from initial emergence until August 1. After counting, seedlings were removed by hand. Seven weeks after initial emergence, foxtail millet biomass was determined in six randomly-placed 0.33-yd^2 quadrats in the weed-infested sub-plot. Weeds in the weed-free subplot were controlled by a pre-emergence application of S-metolachlor, a post application of glyphosate, and hand weeding. Weeds present at time of planting were controlled with glyphosate. Grain yield was determined by harvesting 50% of the subplot area. Experiment design was split-plot design with main treatments arranged as a randomized complete block; there were 6 replications.

Results:

As found in previous research, corn yielded more in both weed-free and weed-infested conditions following dry pea. Compared to following soybean, corn yielded 11% and 102% more following dry pea in weed-free and weed-infested conditions, respectively (Figure 1).

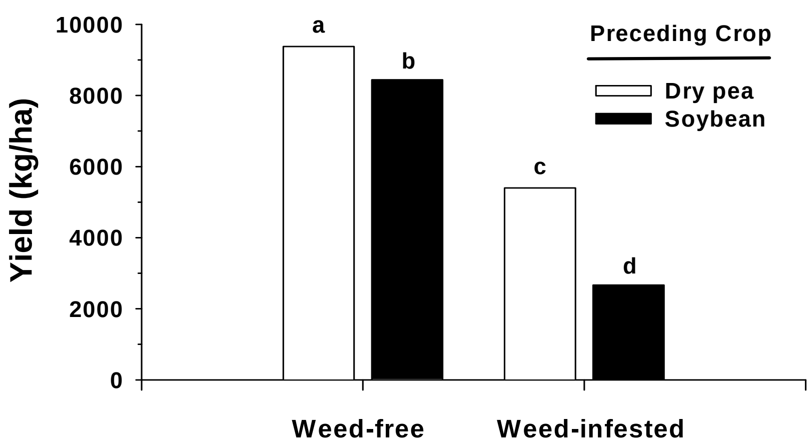


Figure 1. Corn yield in weed-free and weed-infested conditions as affected by the crop grown the preceding year. Data averaged across 3 years. Bars with the same letter are not significantly different based on Fisher's Protected LSD (0.05).

Foxtail millet seedling emergence did not differ whether following dry pea or soybean (Figure 2). Furthermore, foxtail millet biomass also did not differ between preceding crops; fresh weight of foxtail millet was approximately 1.3 lbs/yd^2 in both dry pea and soybean stubble. Based on our results, we feel that the yield difference in weed-infested conditions between preceding crops was not related to differences in foxtail millet emergence or growth.

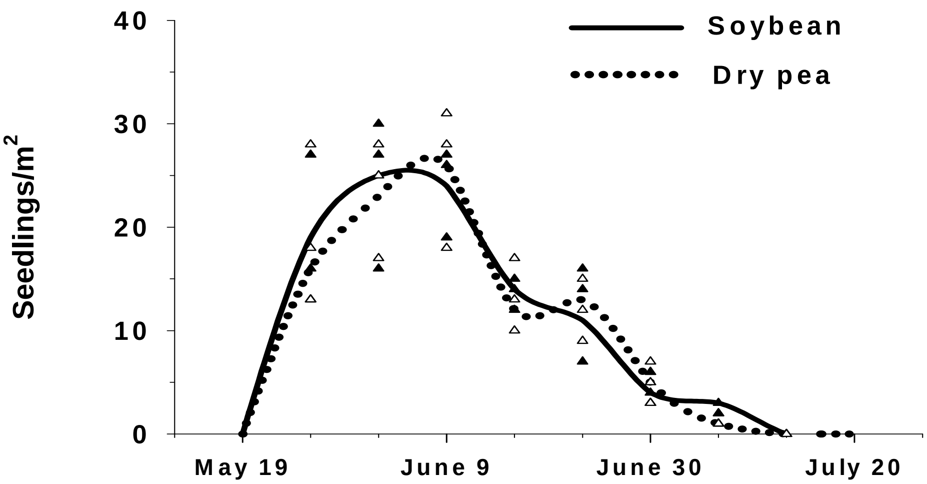


Figure 2. Seedling emergence of foxtail millet in corn as affected by the crop grown the preceding year. Data averaged across 3 years.

Dry pea may induce a change in corn physiology to cause synergism:

This study indicates that foxtail millet emergence and biomass production in corn was not affected by the preceding crop in rotation. Thus, improved tolerance of corn to foxtail millet interference when corn follows dry pea must be related to other biological factors. Earlier, we found that corn growth, development, and nutrient concentration did not differ when corn followed either dry pea or soybean [*WSWS research report, 2009; p. 102-103*]. We speculate that the beneficial impact of dry pea on corn may involve changes in corn physiology; in some way, dry pea synergistically improves corn growth efficiency to improve grain yield and tolerance to weeds.

Producers are considering more diverse rotations to achieve a multitude of benefit, such as improving pest management or nutrient cycling. Our studies show that some crop sequences can also improve crop tolerance to weed interference, which may help producers devise low-input systems where herbicide inputs are reduced.

An organic rotation to disrupt weed population dynamics. Randy L. Anderson. (USDA-ARS, Brookings SD 57006). Weeds are one of the primary obstacles to successful organic farming. Organic producers rely on tillage to control weeds, but soil health is being damaged by the extensive tillage. Thus, producers are interested in reducing the amount of tillage used in their production systems.

To help organic producers manage weeds with less tillage, we devised a 9-year rotation that disrupts population dynamics of weeds and reduces weed density across time (*Renewable Agriculture and Food Systems 25:189; 2010*). Our purpose with this research report is to explain our reasoning for this rotation design, and to encourage scientists working with organic farming to consider rotation design when planning their research program. Our proposed rotation involves cropping practices prevalent in the western edge of the Corn Belt, but we believe these principles will also apply to other regions where different crops are grown.

Proposed Rotation

Our rotation includes annual crops with different life cycles as well as a perennial legume (Figure 1). A corn-soybean sequence is followed by a 2-year interval of oat-winter wheat, and then a sequence of soybean-corn. Alfalfa is grown for 3 years; oat is planted with alfalfa as a companion crop to suppress weeds in the first year.

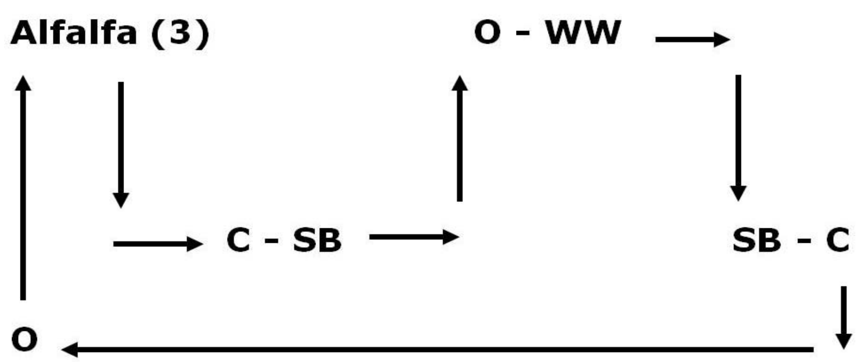


Figure 1. A rotation design to suppress weed dynamics in organic farming. Abbreviations: C, corn; SB, soybean; O, oat; WW, winter wheat. The (3) indicates 3 years of alfalfa; oat is grown as companion crop in the first year of alfalfa.

Seasonal intervals of cool- and warm-season crops:

We arrange warm-season crops like corn and soybeans and cool-season crops such as winter wheat in intervals of 2 years. In conventional farming, weed density was lowest in rotations comprised of 2 warm-season crops followed by 2 cool-season crops, compared with rotations of less crop diversity (Figure 2). This 2-year interval gains the benefit of natural decline of weed seed viability across time because the difference in life cycles provide more opportunities to prevent seed production by weeds.

***Alfalfa interval*:**

The 3-year interval of alfalfa disrupts population dynamics of weeds because mowing for forage harvest and the competitiveness of alfalfa makes it difficult for weeds to establish and produce weed seeds. Also, weed seeds remain on the soil surface during the alfalfa interval because the field is not tilled. Death of weed seeds occurs more rapidly when seeds remain on the soil surface. Weed populations decline in alfalfa across time, with the greatest

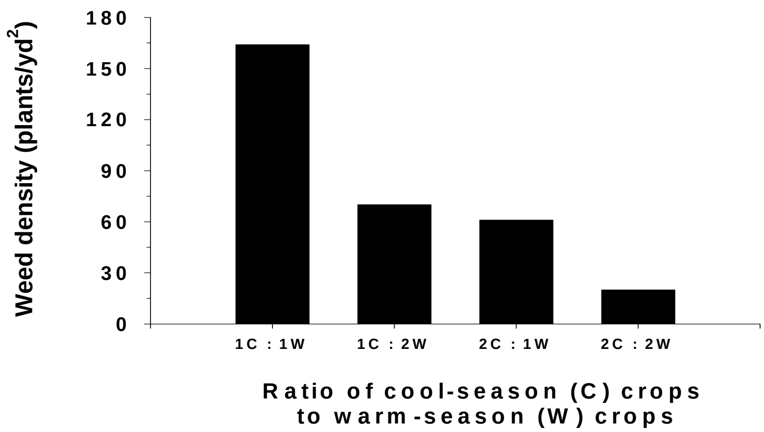


Figure 2. Weed community density in rotations where weeds are managed with herbicides, after rotations had been in place for 8 years. Data collected from 3 research sites in the Great Plains (*Agronomy Journal 97: 1279; 2005*). Crops included corn, soybean, proso millet, winter wheat, oat, and dry pea.

impact occurring in the third year; weed density can be reduced more than 90% compared with initial weed density in the first year of alfalfa (Figure 3). If alfalfa is grown for a longer interval, weeds adapted to alfalfa, such as downy brome or dandelion, start to proliferate.

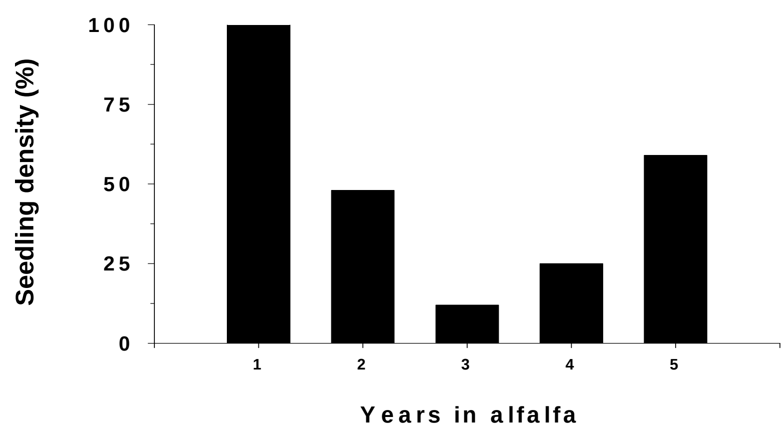


Figure 3. Seedling emergence of the weed community in alfalfa across time. Data are expressed as a percentage of emergence in the first year, and are averaged across several studies (*Renewable Agriculture and Food Systems 25:189; 2010*).

Can we develop a no-till system for organic farming?

Organic producers have asked if no-till systems can be developed for organic systems, both for soil health and economic benefits. We speculate that with diverse rotations such as our proposed rotation, no-till management may be possible. We are currently exploring cultural options to convert the 3-year no-till interval of alfalfa to cropland without tillage. Other scientists are developing alternative control equipment, such as the roller crimper, flamer, and between-row mower, to control weeds in crops without tillage. If these tactics are successful, integrating them with complex rotations and the use of cover crops may enable producers to farm organically without needing tillage.

AUTHOR INDEX

KEYWORD INDEX