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FOREWORD

The 2014 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.

Traci Rauch
Research Progress Report Editor
Western Society of Weed Science
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Effect of aminocyclopyrachlor applied as a dry or liquid formulation on common milkweed and prairie dogbane. Rodney G. Lym (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminocyclopyrachlor (AMCP) will control several invasive weeds in pasture, rangeland, and wildlands. While control of leafy spurge, Canada thistle, and the knapweeds are desirable, the gain must be measured against the loss of desirable native forbs. The purpose of this research was to evaluate the effect of AMCP on the native forbs common milkweed (*Asclepias syriaca* L.) and prairie dogbane (*Apocynum cannabinum* L.). While these native forbs are considered desirable in native prairie, they sometimes can be troublesome in cropland.

The common milkweed and prairie dogbane studies were separate experiments and were both established on July 1, 2013 in an ungrazed non-cropped area in north Fargo. The area was undisturbed prairie that had been heavily infested with leafy spurge. However, the *Aphthona* spp. biological control agents had reduced the weed to a minor component of the vegetation and many native species had returned. Treatments were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 3 by 3 feet and replicated six times in a randomized complete block design. The number of common milkweed or prairie dogbane plants in each plot were counted prior to treatment. First injury and then control was evaluated visually using percent injury or stand reduction compared to the untreated control.

Common milkweed was greatly reduced by all treatments in this study but there was a lot of variation from plant to plant and plot to plot as reflected in LSD values of up to 40% (Table 1). AMCP plus metsulfuron reduced common milkweed by an average of 92% compared to an average of 68% with AMCP plus 2,4-D. There was a natural reduction of 35% in the untreated plots from 2013 to 2014.

Prairie dogbane was also severely reduced by all treatments evaluated (Table 2). In contrast to the milkweed study, AMCP plus 2,4-D reduced prairie dogbane more than AMCP plus metsulfuron and control averaged 100 and 73%, respectively. Prairie dogbane declined 37% in the untreated control plots from 2013 to 2014.

AMCP applied with metsulfuron or 2,4-D reduced both common milkweed and prairie dogbane in this study. These species would be adversely affected in an invasive weed control program that included AMCP.

Table 1. Common milkweed control with aminocyclopyrachlor applied on July 1, 2013 at Fargo, North Dakota.

		Evaluation date		
Treatment[a]	Rate	31 July 13	30 Aug 13	14 July 14
	—— oz/A ——	% injury	—— % control ——	
AMCP + metsulfuron[b]	1.1 + 0.18	30	67	88
AMCP + metsulfuron	1.8 + 0.3	37	83	100
AMCP + 2,4-D[c]	1 + 7.6	27	75	72
AMCP + 2,4-D	1.7 + 12.7	58	100	64
Tribenuron + 2,4-D + dicamba	1.65 + 5.7 + 1	32	88	92
Untreated	•••	0	0	35
LSD (0.05)		20	40	35

[a]Commercial surfactant Induce at 0.25% applied with all treatments - Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.
[b]Commercial formulations - Rejuvra and [c]RRW97 by E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898.

Table 2. Prairie dogbane control with aminocyclopyrachlor applied on July 1, 2013 at Fargo, North Dakota.

Treatment[a]	Rate	Evaluation date		
		31 July 13	30 Aug 13	14 July 14
	—— oz/A ——	% injury	—— % control ——	
AMCP + metsulfuron[b]	1.1 + 0.18	13	0	71
AMCP + metsulfuron	1.8 + 0.3	32	70	76
AMCP + 2,4-D[c]	1 + 7.6	74	100	100
AMCP + 2,4-D	1.7 + 12.7	99	100	100
Tribenuron + 2,4-D + dicamba	1.65 + 5.7 + 1	29	90	80
Untreated	•••	0	0	37
LSD (0.05)		40	28	28

[a]Commercial surfactant Induce at 0.25% applied with all treatments - Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.
[b]Commercial formulations - Rejuvra and [c]RRW97 by E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898.

Effect of aminocyclopyrachlor on established grasses. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminocyclopyrachlor (AMCP) has been used to control a variety of invasive weed species in pasture and rangeland. AMCP is usually applied with chlorsulfuron for broad spectrum weed control, but will also be available as a commercial mixture with 2,4-D. The purpose of this research was to compare AMCP applied with chlorsulfuron formulated as a DG or with 2,4-D as a SL on cool- and warm-season grass species production.

The studies were conducted on North Dakota State University research land near Fargo, North Dakota. The grasses evaluated were the cool season species green needlegrass [*Nassella viridula* (Trin.) Barkworth] var. 'Lodorm' and intermediate wheatgrass [*Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey] var. 'Manifest' and the warm season grass big bluestem (*Andropogon gerardii* Vitman) var. 'Bison'. The AMCP treatments were compared to a standard leafy spurge control herbicide mixture of picloram plus imazapic plus 2,4-D.

Grasses were seeded at Natural Resource Conservation Service recommended rates of 8 to 10 lb/A pure live seed using a 6-row grain drill with 12-inch spacing on May 26, 2011. The plots were 10 by 14 feet and replicated four times in a randomized complete block. Weed competition consisted primarily of Canada thistle (*Cirsium arvense* L.), common ragweed (*Ambrosia artemisiifolia* L), and perennial sowthistle (*Sonchus arvensis* L.). Treatments were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi on June 7, 2013. Herbicide efficacy was estimated by visual assessment of grass response approximately 30 days after treatment and were made on a scale of 0 to 100, with 0 equal to no injury and 100 equal to complete above-ground grass control. Above-ground biomass was harvested in one 0.25-m^2 quadrats from the fourth and eighth rows, respectively, in each plot in mid-July 2013. Plants were separated into desired grass species, grass weeds, and broadleaf weeds. Harvested plant material was dried at 50 C for at least 72 hr and weighed to estimate yield.

Intermediate wheatgrass production tended to be greater than the untreated control when AMCP was applied at 0.6 to 0.7 oz/A with chlorsulfuron or 2,4-D, respectively (Table 1). Production tended to decrease as the AMCP rate increased. Intermediate wheatgrass production was 2075 lb/A when the standard treatment of picloram plus imazapic plus 2,4-D was applied compared to 3030 lb/A in the untreated control.

Green needlegrass production averaged 2510 lb/A when AMCP plus chlorsulfuron at 0.6 + 0.2 oz/A was used to control weeds compared to 2085 lb/A in the untreated control (Table 2). As in the intermediate wheatgrass study, production tended to decline when picloram plus imazapic plus 2,4-D was applied and only averaged 1690 lb/A. Big bluestem production was similar regardless of the treatment and averaged 3910 lb/A (Table 3)

In summary, treatments that included AMCP generally had greater grass production than the standard treatment of picloram plus imazapic plus 2,4-D. There was very little grass injury from any treatment except when 60% injury was observed when the standard was applied to green needlegrass. Based on this and other studies conducted at North Dakota State University, the use of AMCP for invasive weed control should not reduce desirable grass species production.

Table 1. Effect of aminocyclopyrachlor applied with chlorsulfuron or 2,4-D on established intermediate wheatgrass, at Fargo, North Dakota.

		Evaluation date/species				
		2 July 13	8 July 13			8 July 14
Treatment[a]	Rate	Intermediate wheatgrass		Weedy broad-leaves	Weedy grasses	Interm. wheat grass
	oz/A	% inj	lb/A dry weight			% inj
AMCP + chlorsulfuron[b,c]	0.6 + 0.2	1	3835	0	4	0
AMCP + chlorsulfuron[b]	1 + 0.4	3	3255	0	0	0
AMCP + 2,4-D[b,d]	0.7 + 5.1	3	3375	0	0	1
AMCP + 2,4-D[b]	1 + 7.6	3	3025	0	0	0
Picloram + imazapic + 2,4-D + MSO	4 + 1 +16 + 1 qt	8	2075	0	0	1
Untreated	• • •	2	3030	0	0	0
LSD (0.10)		3	538	NS	NS	NS

[a]Treatments were applied on June 7, 2013 to intermediate wheatgrass seeded on May 26, 2011.
[b]Surfactant - Induce included at 0.25% - Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.
[c]Formulations - Perspective and [d]RRW97 - E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898.

Table 2. Effect of aminocyclopyrachlor applied with chlorsulfuron or 2,4-D on established green needlegrass at Fargo, North Dakota.

		Evaluation date/species				
		2 July 13	10 July 13			8 July 14
Treatment[a]	Rate	Green needlegrass		Weedy broad-leaves	Weedy grasses	Green needle grass
	oz/A	% inj	lb/A dry weight			% inj
AMCP + chlorsulfuron[b,c]	0.6 + 0.2	0.5	2510	3	115	0
AMCP + chlorsulfuron[b]	1 + 0.4	0	2180	1	60	0
AMCP + 2,4-D[b,d]	0.7 + 5.1	1	1965	8	110	1
AMCP + 2,4-D[b]	1 + 7.6	0.5	2371	3	65	0
Picloram + imazapic + 2,4-D + MSO	4 + 1 +16 + 1 qt	60	1690	2	70	0
Untreated	• • •	0	2085	130	145	0
LSD (0.05)		20	671	32	NS	NS

[a]Treatments were applied on June 7, 2013 to green needlegrass seeded on May 26, 2011.
[b]Surfactant - Induce included at 0.25% - Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.
[c]Formulations - Perspective and [d]RRW97 - E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898. Surfactant Induce by Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.

Table 3. Effect of aminocyclopyrachlor applied with chlorsulfuron or 2,4-D on established big bluestem at Fargo, North Dakota.

		Evaluation date/specoes				
		2 July 13	22 July 13			8 July 14
Treatment[a]	Rate	Big bluestem		Weedy broad-leaves	Weedy grasses	Big bluestem
	— oz/A —	% inj	— lb/A dry weight —			% inj
AMCP + chlorsulfuron[b,c]	0.6 + 0.2	4	3980	0	65	1
AMCP + chlorsulfuron[b]	1 + 0.4	8	3930	0	0	1
AMCP + 2,4-D[b,d]	0.7 + 5.1	2	4620	0	0	0
AMCP + 2,4-D[b]	1 + 7.6	2	3440	0	15	1
Picloram + imazapic + 2,4-D + MSO	4 + 1 +16 + 1 qt	7	3575	0	0	1
Untreated	• • •	2	3465	6	0	0
LSD (0.05)		0.5	NS	NS	NS	NS

[a]Treatments were applied on June 7, 2013 to big bluestem seeded on May 26, 2011.
[b]Surfactant - Induce included at 0.25% - Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.
[c]Formulations - Perspective and [d]RRW97 - E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898. Surfactant Induce by Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.

Aminopyralid applied alone or in combination with clopyralid or chlorsulfuron in the spring for Canada thistle control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminopyralid is generally applied at 1.25 to 1.75 oz/A for Canada thistle control in North Dakota. Clopyralid was commonly used to control Canada thistle prior to the release of aminopyralid. Often combinations of herbicides have provided better long-term control of invasive species than a single herbicide used alone, even at maximum use rates. The purpose of this research was to evaluate aminopyralid applied alone or with clopyralid or chlorsulfuron for long-term Canada thistle control.

The experiment was established at two locations in North Dakota. The first site was located on a wildlife production area near Valley City. Treatments were applied June 12, 2012 when Canada thistle was 12 to 24 inches tall and beginning to bolt. The second site was established on an abandoned crop field that had become heavily infested with the weed on the North Dakota State University Agricultural Experiment Station in Fargo. The treatments were applied June 22, 2012 when Canada thistle was in the bolted to early bud growth stage and 8 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. Canada thistle control was evaluated visually using percent stand reduction compared to the untreated control. Results were similar so data were combined over locations.

All treatments provided excellent long-term Canada thistle control except chlorsulfuron applied alone (Table). Also, Canada thistle control was similar whether the location was nearly bareground (Fargo) or had a dense grass cover (Valley City). Aminopyralid applied alone at 1.25, 1.75 and 2.5 oz/A provided an average of 94% Canada thistle control 25 MAT (months after treatment). Control declined to an average of 78% by September 2014 but tended to increase as the application rate increased. Aminocyclopyrachlor plus chlorsulfuron at 1.9 + 0.75 oz/A provided 90% Canada thistle control 27 MAT (September 2014). Canada thistle control was similar whether aminopyralid was applied alone or with clopyralid or chlorsulfuron. Aminopyralid at 1.25 oz/A would be the most cost-effective treatment in this study and is currently widely used to control Canada thistle in pasture, rangeland, and wild lands in the region.

Table. Aminopyralid applied alone or with clopyralid or chlorsulfuron at two locations for Canada thistle control in June 2012 at two locations in North Dakota.

		Evaluation date				
		2012	2013		2014	
Treatment[a]	Rate	Sept	July	Sept	July	Sept
	oz/A	% control				
Aminopyralid	1.25	84	97	97	93	68
Aminopyralid	1.75	89	99	98	92	81
Aminopyralid	2.5	92	99	99	98	86
Aminopyralid + clopyralid	0.75 + 3.4	86	98	96	91	75
Aminopyralid + clopyralid	1 + 4.6	88	99	99	90	89
Aminopyralid + clopyralid	1.25 + 5.75	91	99	98	95	86
Aminopyralid + chlorsulfuron	1.25 + 0.5	89	98	98	94	84
Aminopyralid + chlorsulfuron	1.75 + 0.75	93	98	98	95	88
Clopyralid	5.75	87	97	95	84	69
Chlorsulfuron	0.75	78	33	24	31	22
Aminocyclpyrachlor + chlorsulfuron[b]	1.9 + 0.75	85	99	99	96	90
AMCP + chlorsulfuron + aminopyralid	0.8 + 0.3 + 1.75	93	99	99	97	84
LSD (0.05)		11	6	24	14	18

[a]Surfactant at 0.25% was applied with all treatments - Activator 90 by United Agri Products 7251 W. 4th St. Greeley, CO 80634.

[b]Commercial formulation aminocyclopyrachlor (AMCP) plus chlorsulfuron - Perspective by E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898.

Herbicide mixtures applied in the spring or fall for absinth wormwood control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminopyralid and clopyralid are commonly used to control absinth wormwood in a variety of environments. Aminocyclopyrachlor (AMCP) has also been used to control absinth wormwood in non-grazed or hayed areas. Often combinations of herbicides have provided better long-term control of invasive species than a single herbicide used alone. The purpose of this research was to evaluate aminopyralid or AMCP applied at reduced rates with other herbicides for long-term absinth wormwood control.

The aminopyralid study was established on an active gravel quarry near Valley City, ND that was heavily infested with absinth wormwood. The treatments were applied on May 26 or September 15, 2011. Absinth wormwood was in the vegetative growth stage and 11 to 18 inches tall when treatments were applied in May. Because absinth wormwood grows 4 to 6 feet tall, the plot area was mowed in late-July 2011. The plants had regrown and were 6 to 8 inches tall when the fall treatments were applied.

The AMCP study was established within a fenced area of a horse pasture near Spiritwood, ND. Herbicides were applied on June 3, 2013 when absinth wormwood was 4 to 16 inches tall in the rosette growth stage. Fall treatments were applied on September 13, 2013 to plants that had 12 to 18 inches of regrowth after being mowed in August.

Herbicides were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Experimental plots were 10 by 30 feet at Valley City and 10 by 25 feet at Spiritwood. Treatments were replicated four times in a randomized complete block design. Absinth wormwood control was evaluated visually using percent stand reduction compared to the untreated control.

All treatments that contained aminopyralid or clopyralid provided 90% or better absinth wormwood control 36 months after treatment (MAT) whether applied in June or September (Table 1). The most cost-effective treatment was clopyralid plus aminopyralid at 2.4 + 0.5 oz/A which provided 95% absinth wormwood control 36 MAT treatment. The least effective treatment was dicamba applied at 16 oz/A in the spring which provided 56% absinth wormwood control by the end of the study.

All treatments that contained AMCP or aminopyralid applied alone provided 90% or more absinth wormwood control the season after treatment in the pasture location (Table 2). Control was similar whether AMCP at 1.1 or 1.8 oz/A was applied with chlorsulfuron, metsulfuron, or 2,4-D.

In summary, absinth wormwood was easily controlled with aminopyralid or clopyralid applied alone or in combination and with any treatment that contained AMCP whether applied in the spring or fall. The choice of treatments should be based on both cost and other target weeds in the same area where absinth wormwood has established.

Table 1. Efficacy of aminopyralid and clopyralid for absinth wormwood control applied in the spring or fall near Valley City, ND.

		Evaluation date						
		2011		2012		2013		2014
Treatment[a]	Rate	13 July	5 Sept	17 May	22 Aug	3 June	14 Aug	20 May
	— oz/A —	— % control —						
Applied 26 May 2011								
Clopyralid + aminopyralid	2.4 +0.5	92	96	97	96	99	95	95
Clopyralid + aminopyralid	3.4 + 0.75	97	99	99	99	100	99	97
Clopyralid + aminopyralid	4.6 + 1	99	99	99	97	100	99	98
Clopyralid + aminopyralid	5.8 + 1.3	98	99	100	99	99	97	95
Clopyralid + aminopyralid	6.95 + 1.5	100	100	100	99	100	99	99
Aminopyralid	1.25	89	95	94	93	91	90	90
Aminopyralid	1.75	95	99	96	96	99	96	94
Clopyralid	6	95	99	97	99	99	97	96
Dicamba	16	93	80	65	75	73	71	56
Applied 15 Sept 2011								
Clopyralid + aminopyralid	3.4 + 0.75			99	100	100	99	98
Clopyralid + aminopyralid	4.6 + 1			99	99	100	98	97
Clopyralid + aminopyralid	5.8 + 1.3			99	100	100	96	97
Aminopyralid	1.25			99	99	100	96	96
Dicamba	16			91	96	79	84	86
LSD (0.05)		7	5	5	9	14	11	14

[a]Surfactant at 0.25% applied with all treatments -Activator 90 from United Agri Products 7251 W. 4th St. Greeley, CO 80634.

Table 2. Efficacy of aminocyclopyrachlor applied with various other herbicides on absinth wormwood applied in spring or fall at Spiritwood, ND.

		Evaluation date		
		2013	2014	
Treatment[a]	Rate	1 Aug	21 May	11 Sept
	— oz/A —		% control	
Applied 3 June 2013				
AMCP + metsulfuron[b]	1.1 + 0.2	94	94	95
AMCP + metsulfuron	1.8 + 0.3	98	98	95
AMCP + chlorsulfuron[c]	1 + 0.4	94	96	96
AMCP + chlorsulfuron	1.8 + 0.7	98	98	90
AMCP + 2,4-D[d]	1 + 7.6	95	97	96
AMCP + 2,4-D	1.7 + 12.7	98	99	98
Aminopyralid[e]	1.75	99	99	99
Applied 13 Sept 2013				
AMCP + metsulfuron[b]	1.1 + 0.2		93	94
AMCP + metsulfuron	1.8 + 0.3		97	95
AMCP + chlorsulfuron[c]	1 + 0.4		93	90
AMCP + chlorsulfuron	1.8 + 0.7		98	95
AMCP + 2,4-D[d]	1 + 7.6		95	95
AMCP + 2,4-D	1.7 + 12.7		98	95
Aminopyralid[e]	1.75		99	98
LSD (0.05)		NS	5	NS

[a]Surfactant at 0.25% applied with all treatments - Induce by Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.
[b]Formulations -Rejuvra, [c]Persective, [d]RRW97 by E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898.
[e]Commercial formulation - Milestone by Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268-1189.

Aminocyclopyrachlor application proximity affects common cottonwood injury. Rodney G. Lym (Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050). Aminocyclopyrachlor (AMCP) was sold in the turfgrass market starting in the fall of 2010 for broadleaf weed control. Previous research in the region found trees growing nearby but not within an AMCP treated area were not injured by the herbicide. However, DuPont voluntarily withdrew the product from the turf market in August 2011 because of widely reported tree damage following AMCP application. The purpose of this research was to estimate the distance from young cottonwood trees (*Populus deltoides* W. Bartram ex Marshal) AMCP could be applied to avoid injury.

The experiment was established May 2, 2012 in a row of volunteer cottonwood trees about 4 years old at the Maple River Dam in Cass County, ND. AMCP plus chlorsulfuron at 2.4 + 0.95 oz/A, respectively, or picloram at 16 oz/A were applied around a single tree or group of trees at the base, dripline, or 2X the dripline in a 15 foot wide band. Treatments were applied using a hand-held boom sprayer delivering 17 gpa at 35 psi. Care was take to avoid direct application of the herbicides to the tree bark when the base treatments were applied. Each tree (plot) was separated by at least 50 feet and there were two replications in a randomized complete block design. Tree injury was evaluated visually compared to the untreated control with 0 equal to no injury and 100% complete defoliation.

Leaf cupping on cottonwood trees was first noted 42 days after treatment (DAT) when AMCP plus chlorsulfuron was applied at either the base or dripline and averaged 48% (Table 1). Injury increased throughout the growing season and averaged 95 and 67% by 113 DAT for the base and dripline applied treatments, respectively. In comparison, injury only averaged 6% 113 DAT when AMCP + chlorsulfuron was applied at 2X the dripline. Injury symptoms (15%) appeared within 15 DAT when picloram was applied to the base of cottonwood trees and increased to 100% by 70 DAT. Picloram caused 18 and 50% tree injury 113 DAT when applied at the dripline and 2X the dripline, respectively. In general, normal rainfall occurred during the growing season with a total of 4.05 inches received by 113 DAT.

AMCP plus chlorsulfuron applied at the base and dripline resulted in severe cottonwood tree injury the season after treatment and averaged 100% 386 DAT (Table 2). Some leaf regrowth occurred during the second season, but the leaves were disfigured and brittle. AMCP plus chlorsulfuron applied at 2X the dripline resulted in only slight leaf cupping and averaged 18% injury 476 DAT. Cottonwood tree injury was higher with picloram than AMCP plus chlorsulfuron and averaged 100, 43, and 70% injury when applied at the base, dripline, and 2X the dripline, respectively, 476 DAT. A total of 22.84 inches of precipitation (including snow melt) was received during the study.

In summary, cottonwood tree injury from AMCP plus chlorsulfuron was generally less than injury from picloram. However, some injury from the AMCP treatments was observed even when applied at 2X the dripline. Treatments that contain AMCP should be applied greater than 2X the dripline from susceptible tree species.

Table 1. Cottonwood tree sensitivity to aminocyclopyrachlor and picloram the year of treatment at the Maple River Dam, near Embden, ND.

			2012 evaluation date/DAT[a]						
			15 May	30 May	13 June	28 June	11 July	26 July	23 Aug
Treatment[b]	Application	Rate	13	28	42	57	70	85	113
		— oz/A —	— % injury —						
AMCP[a] + chlorsulfuron[c]	Base	2.4 + 0.95	0	0	50	70	90	95	95
AMCP + chlorsulfuron	Dripline	2.4 + 0.95	0	0	45	52	62	68	67
AMCP + chlorsulfuron	2X dripline	2.4 + 0.95	0	0	0	0	0	8	6
Picloram + NIS	Base	16	15	60	68	70	100	100	100
Picloram + NIS	Dripline	16	0	3	15	15	12	13	18
Picloram + NIS	2X dripline	16	0	15	43	49	48	51	50
Untreated		•••							
Accumulated precipitation since establishment (inches)			0.11	1.48	1.8	1.8	2.1	3.67	4.05

[a]Abbreviations: DAT = days after treatment; AMCP = aminocyclopyrachlor.
[b]Surfactant at 0.25% added to all treatments - Induce by Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.
[c]Commercial formulation - Perspective by E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898.

Table 2. Cottonwood tree sensitivity to aminocyclopyrachlor and picloram 1 and 2 years after treatment at the Maple River Dam, near Embden, ND.

			2013 evaluation date/DAT[a]			
			23 May	11 June	13 July	7 Aug
Treatment[b]	Application	Rate	386	405	451	476
		— oz/A —	— % injury —			
AMCP[a] + chlorsulfuron[c]	Base	2.4 + 0.95	100	99	88	70
AMCP + chlorsulfuron	Dripline	2.4 + 0.95	100	98	60	64
AMCP + chlorsulfuron	2X dripline	2.4 + 0.95	25	55	20	18
Picloram	Base	16	100	100	100	100
Picloram	Dripline	16	50	65	35	43
Picloram	2X dripline	16	85	35	70	70
Untreated		•••				
Accumulated precipitation since establishment			14.95	16.61	21.72	22.84

[a]Abbreviations: DAT = days after treatment; AMCP = aminocyclopyrachlor.
[b]Surfactant at 0.25% added to all treatments - Induce by Helena Chemical Co., 225 Schilling Blvd, Collierville, TN 38017.
[c]Commercial formulation - Perspective by E.I. duPont de Nemours and Company, 1007 Market Street, Wilmington, DE 19898.

Topramezone for goosegrass control in bermudagrass turf. Kai Umeda. (University of Arizona Cooperative Extension, Maricopa County, Phoenix, AZ 85040) A small plot experiment was conducted at the Desert Canyon Golf Course in Fountain Hills, AZ in a rough area with common bermudagrass regularly mowed at about 1 inch height. *Eleusine indica* (goosegrass) ranged from 3 to 4 tiller stage to early boot stage of growth. Treatment plots measured 5 ft by 10 ft and were replicated three times in a randomized complete block design. Herbicide treatments were applied using a backpack CO_2 sprayer equipped with a hand-held boom with three flat fan 8003 nozzles spaced 20 inches apart. Sprays were applied in 50 gpa water at 30 psi and a methylated seed oil adjuvant, Hasten was added to all treatments at 0.5% v/v. The experiment was initiated on 11 July 2014 when the air temperature was 94°F, clear sky, humid, with a slight breeze at less than 3 mph and soil temperature at 80°F. A sequential application of topramezone alone at 0.0055, 0.011, and 0.022 lb a.i./A was applied on 07 August when the air temperature was 90°F, clear and calm with soil temperature at 80°F.

Near the end of the summer season at 47 days after the first application (DAA-1) and 20 DAA-2, treatments of topramezone alone 0.0055, 0.011, and 0.022 lb a.i./A gave near complete control of goosegrass at 98 and 99% control (Table 1). Bermudagrass injury was observed at 22% at 11 DAA-1 for the lowest rate of topramezone and recovery occurred within 3 weeks (Table 2). Sequential applications and single treatments of combinations with metribuzin or triclopyr caused unacceptable turfgrass injury. Foramsulfuron treatments gave less than acceptable control at 47 DAA-1. The pre-mix combination achieved acceptable control of 85% at about a month after a single application.

Table 1. Herbicides for goosegrass control in bermudagrass, Fountain Hills, AZ

Treatment[2]	Rate lb a.i/A	ELEIN control[1] 18 Jul	31 Jul	07 Aug	14 Aug	20 Aug	27 Aug
		%					
Untreated check		0 d	0 c	0 b	0 d	0 d	0 d
Topramezone	0.0055	73 b	78 b	82 a	93 a	93 ab	98 a
Topramezone	0.011	75 b	85 ab	85 a	98 a	99 a	99 a
Topramezone	0.016	82 ab	87 ab	88 a	98 a	99 a	98 a
Topramezone + Metribuzin	0.022 + 0.5	87 a	99 a	98 a	92 ab	92 ab	92 ab
Topramezone + Triclopyr	0.022 + 0.188	78 ab	92 ab	92 a	78 bc	77 bc	82 bc
Foramsulfuron	0.039	50 c	83 ab	80 a	72 c	75 bc	77 c
Foramsulfuron + Halosulfuron + Thiencarbazone	0.04 + 0.06 + 0.02	77 ab	83 ab	83 a	85 abc	82 bc	75 c

[1]Means followed by the same letter in a column are not significantly different using Tukey's HSD at 0.05.
[2]All treatments initially applied on 11 July 2014. Sequential topramezone only treatments applied on 07 August.

Table 2. Safety of herbicides for goosegrass control in bermudagrass, Fountain Hills, AZ

Treatment[2]	Rate lb a.i/A	Bermudagrass injury[1] 18 Jul	31 Jul	07 Aug	14 Aug	20 Aug	27 Aug
		%					
Untreated check		0 b	0 c	0 c	0 b	0 e	0 c
Topramezone	0.0055	22 b	7 c	8 bc	67 a	32 cde	23 bc
Topramezone	0.011	57 a	37 b	33 b	80 a	72 ab	57 ab
Topramezone	0.016	73 a	40 b	32 b	80 a	77 a	58 ab
Topramezone + Metribuzin	0.022 + 0.5	73 a	72 a	80 a	70 a	52 abc	67 a
Topramezone + Triclopyr	0.022 + 0.188	62 a	68 a	68 a	70 a	40 bcd	57 ab
Foramsulfuron	0.039	10 b	12 c	13 bc	8 b	0 e	5 c
Foramsulfuron + Halosulfuron + Thiencarbazone	0.04 + 0.06 + 0.02	10 b	12 c	17 bc	13 b	7 de	10 c

[1]Means followed by the same letter in a column are not significantly different using Tukey's HSD at 0.05.
[2]All treatments initially applied on 11 July 2014. Sequential topramezone only treatments applied on 07 August.

Farm-scale tests of the effect of Spring-applied clopyralid on peppermint oil yield.

Robert H. Callihan (P.O. Box 487, Potlatch, Idaho 83855) and Stuart A. Turner (Turner & Co, Inc, 5903 Kilawea Drive, West Richland, WA).

Summary:

May application of 0.19 lb/A clopyralid to a farmer's mature peppermint in central Washington resulted in a 42.92% reduction in yield of mint oil in 2011, and 34.91% reduction in several of this farmer's mint fields in 2012. In 2013, commercial-scale comparisons of the same treatment, replicated in three fields on this farm, showed that clopyralid caused a 30% reduction in harvested biomass and 31.3% reduction in peppermint oil. Clopyralid-induced suppression of oil production in peppermint in these commercial comparisons over three years was relatively large, and consistent with earlier-published small-plot research in the northwestern U.S. Whereas the probability of crop injury from Spring application of clopyralid may be low or location-dependent, our results show that the potential loss in both shoot biomass and mint oil can be substantial.

Introduction:

Published research on the effect of Spring application of clopyralid on peppermint oil production is sparse, particularly for Washington state, the major U. S. peppermint oil producer. In small-plot peppermint research in Oregon (Whitesides et. al. 1977[1], 1976[2], 1979[3] and Brewster, et. al. 1985[4]), Spring treatment with clopyralid at 0.19 lb/A reduced oil yield at some sites by nearly one-third. In University of Idaho research with mechanically-weeded small plots (Lee and Waters, 1986[5]), where neither degree of weed control nor mint crop injury caused any consistent effect on mint oil yield, mint oil yields from plots treated with clopyralid at 0.19 lb/A in the Spring was 43.5% lower than oil yields from the highest-yielding treatment.

In May of 2011, A pivot-irrigated field near Royal City,145 acres in size (field 75), was treated by the farmer with 0.19 lb/A of clopyralid, a current EPA-registered use[7], in 20 gallons water per acre with a 0.25% v/v nonionic surfactant[6] for control of meadow salsify (*Tragopogon pratensis L).* At August harvest, 1,140 acres of peppermint grown in 10 of the plaintiff's fields, all pivot-irrigated, that were not treated with clopyralid yielded an average 136.43 pounds of oil, whereas the field treated with clopyralid yielded 77.87 pounds of oil per acre (Figure 1), i.e. the oil yield from the clopyralid-treated field was 42.92% lower.

Between May 1 and June 3, 2012, this farmer applied the same treatment to 1,853 acres; a single 86.9-acre field on the farm was not so treated. All were pivot-irrigated. From August harvest, the average yield of oil from all treated fields was 83.14 pounds per acre, whereas the single untreated field yielded 127.73 pounds of oil per acre (Figure 2), i.e. the oil yield from the clopyralid-treated field was 34.91% lower than that from the untreated field. The average apparent reduction in oil production due to clopyralid for the two years was 38.91%, prompting an investigation of the likelihood of a consistent effect.

Procedure:

Three peppermint fields (field No. 66, 29 and 42) on silt loam soils, representing average production for this grower, were selected for paired testing in a commercial-scale field experiment. All were irrigated by center pivot and farmed alike. Within each of the three fields, a fifteen acre plot was selected for treatment, and an adjacent, larger area for the untreated plot. Treatment was with 0.1875 lb/A clopyralid (236 ml of formulated commercial product[7]) in the Spring with the same surfactant and spray volume, as was done in 2011 and 2012. Field 42 was treated April 28, field 29 on May 10, and field 66 on May 28. All plots were measured, and in August the mint was commercially swathed, chopped, weighed, and distilled, and the oil from each plot was weighed.

Effects of clopyralid on the peppermint crop were evaluated by three separate criteria: (1) injury symptoms, (2) shoot biomass, that is, weight of harvested plant material ("hay") from which oil is extracted and recovered by distillation) , and (3) yield of peppermint oil.

Results:

Symptoms: Treated peppermint plants showed injury symptoms consistent with clopyralid in all treated plots in all fields. The primary symptoms observed were stunting, loss of apical dominance, and distorted and undersized leaves.

Plant biomass: At harvest, the average harvested biomass (fresh mint weight) from treated plots was 7,100.7 lb/acre, compared to 9,948.97 lb/acre from untreated areas from the same fields; a difference of 2,848.27

lb/acre, or 28.63% , demonstrating a pronounced growth suppression by clopyralid. A paired-t analysis shows the probability of this growth suppression is greater than 99.99%.

<u>Oil yield</u>: The oil production from treated plots averaged 85.61 lb per acre; untreated portions of the same fields averaged 124.63 # per acre, a 31.31% yield suppression from clopyralid treatment (Table). A "one-tailed" paired-t statistical test shows the probability that the reduction in both biomass and oil yield was due to clopyralid is greater than 99.99%.

Table. Influence of Spring Application of Clopyralid on Peppermint Biomass and Oil Yield, 2013.

Field No.	Clopyra-lid, lb/A	Acres	Harvested shoot biomass				Peppermint oil			
			Yield		Reduction		Yield		Reduction	
			Total lb	lb/A	lb/A	%	Total	lb/A	lb/A	%
66	0	51.32	518,830	10,110	1,597	16	6,503	126.71	41.91	33
66	19	15.00	127,700	8,513			1,272	84.80		
29	0	47.62	398,630	8,371	1,606	19	5,810	122.01	32.77	27
29	19	15.52	105,000	6,765			1,385	89.24		
42	0	68.46	778,120	11,512	5491	48	8,570	125.18	42.38	34
42	19	15.47	93,180	6,023			1,281	82.80		
Total	0	167.40	1,695,580	10,129	3,044	30	20,833	124.45	31	32
	19	45.99	325,880	7,085			3,928	85.4		

Combined oil yield data from 2011, 2012, and 2013.

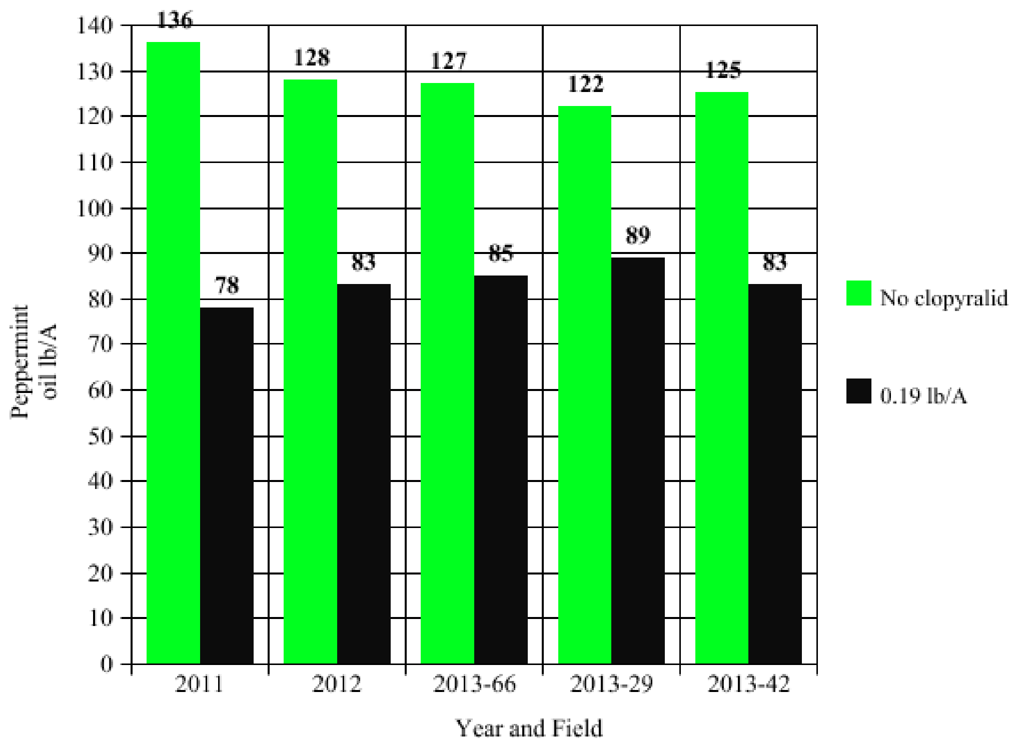
The reduction in oil yield associated with clopyralid in the 2013 experiment was15% lower than the average reduction for the years 2011 and 2013 (Figure, below). However, the 31.26% oil yield reduction caused by clopyralid in 2013 is, for practical considerations, comparable to the 38.41% reduction in 2011 and the 34.89% reduction in 2012.

The average reduction in 2011 and 2012 was 32.83%, which is within 1.57% of the results of the 2013 experiment. Across the five comparisons, the average oil yield from clopyralid-treated mint was 83.76 lbA, compared to the 127.81 lb/A average from non-treated mint, representing a 35% reduction in clopyralid-treated mint. Whereas published data from Oregon do not show consistent oil or biomass reduction due to Spring clopyralid treatment, the Washington data in the Figure show relatively large and consistent reductions in both. Paired-t statistical analysis of the data from three successive years indicate a probability greater than 99.99% that Spring treatment with 0.19 lb/A clopyralid was responsible for the suppression of peppermint oil production in this location.

Conclusions

Analysis of these practical, farm-scale experiences demonstrate that expression of hormonal effects, suppression of plant biomass and inhibition of peppermint oil production were related and due to Spring application of 0.19 lb/A of clopyralid. The question as to why this occurred under Central Washington center pivot irrigation conditions remains unanswered. In-depth examination of the specific factors responsible for complex physiological, morphological and functional changes resulting in reduced oil production appear to be a logical area of future study.

FIGURE: EFFECT OF CLOPYRALID ON OIL YIELD IN 3 YEARS .



Acknowledgement: The authors are indebted to Mr. Justin Brown and Royal Mint Co., Royal City, Washington, for contributing land, crop, equipment, and personnel for this project.

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Impact of preceding crop on alfalfa suppression of weeds. Randy L. Anderson. (USDA-ARS, Brookings SD 57006). Our research program is seeking to develop a continuous no-till system for organic farmers. To guide this program, we devised a rotation comprised of crops with different life cycles to disrupt population dynamics of weeds. Alfalfa is included in this proposed rotation, as it is difficult for weeds to complete their life cycle because of mowing operations and competitiveness of alfalfa. We plan to convert alfalfa to cropland by mowing in the fall of the third year.

One aspect of our program is to identify cultural practices that lead to the most competitive alfalfa stand to strengthen our proposed rotation. This report summarizes the impact of preceding crop on establishment of alfalfa and its suppression of weeds, focusing on weeds in the forage year preceding fall mowing.

Methodology:

The study involved a 4-year interval. In the first year, corn, soybean, and spring wheat were planted using conventional practices. Alfalfa was planted in August following spring wheat harvest, whereas alfalfa was planted in stubble of corn and soybean in April of the 2nd year. Oat was included as a companion crop for alfalfa only with spring planting. Seeding rate for alfalfa was 12 lbs/ac and for oat, 32 lbs/ac. Forage yield and weed measurements were collected in alfalfa during year 4 (the third forage year).

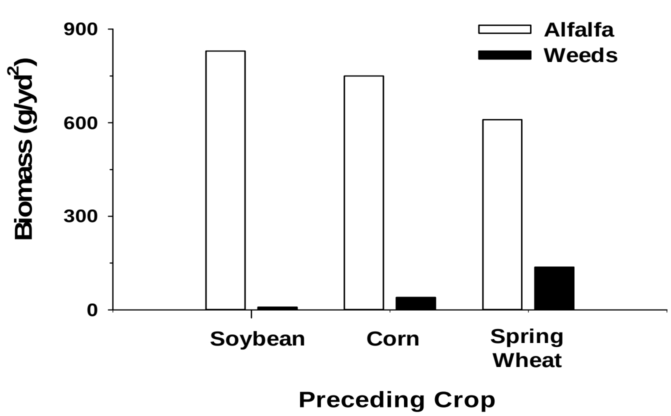
Fresh weight of alfalfa and the weed community was determined in a randomly-placed 2.2-yd^2 quadrat in each plot. The plots were sampled three times, with sampling occurring just before plots were harvested for forage (1/10 bloom stage). In early June after the first forage harvest, stand density of alfalfa was estimated by counting the number of inches in 1 m of row that was occupied by an alfalfa plant, with a maximum value of 40. Assessment were made at 8 randomly selected sites. This technique provided a non-destructive estimate of the uniformity and inherent competitiveness of the alfalfa stand.

Experimental design was a randomized complete block, with 6 replications. The study was conducted twice; data are averaged across three sampling dates and two studies. Average annual rainfall for the study location is 23 inches per year.

Results:

Weed biomass in alfalfa was highest when following spring wheat, and lowest following soybean (see Figure). Furthermore, alfalfa yield was highest following soybean, being 15% higher than following spring wheat. Weed biomass in alfalfa following spring wheat was 23% of the plant community, but less than 1% when alfalfa followed soybean. This increase in weed biomass likely was related to less dense stands of alfalfa following spring wheat. Based on our occupancy measurements, alfalfa occupied only 24 inches out of a maximum of 40 when following

Figure. Fresh weight of alfalfa and the weed community, averaged across three sampling dates and two studies.



spring wheat, but more than 38 when following soybean (see Table below). Alfalfa occupancy following corn was intermediate between soybean and spring wheat. The gaps in alfalfa stand enabled weeds such as downy brome, common lambsquarters, yellow foxtail, and green foxtail to establish and produce considerable biomass.

Alfalfa seedling establishment was reduced following spring wheat because of volunteer wheat plants and fall weed growth. Alfalfa germinated, but seedlings died due to competition. The dense canopy developed with alfalfa followed soybean was more competitive with weeds. Alfalfa establishment was disrupted somewhat following corn due to corn residues on the soil surface interfering with seed placement during alfalfa planting.

Table. Uniformity of alfalfa stand (occupancy) and downy brome infestation in the third forage year of the study, averaged across two studies.

		Downy brome	
Preceding crop	Occupancy	Area infested	Density of infestation
	no.	%	plants/yd^2
Soybean	38.6	0	0
Corn	32.2	3	28
Spring Wheat	23.6	21	155

Downy brome infested the study area, but was observed only in alfalfa following spring wheat or corn. In the third forage year, downy brome infested 21% of the plot area in the spring wheat-alfalfa sequence (See Table); density of downy brome in the infested area was 155 plants/yd^2. Downy brome was not present in alfalfa following soybean, whereas infesting 3% of the land area when alfalfa followed corn.

Management Implications:

In our proposed organic rotation for continuous no-till, we included alfalfa because of its beneficial impact of reducing weed density in cropland. To achieve the most competitive canopy of alfalfa to suppress weeds, we suggest planting alfalfa after soybean.

We are encouraging organic producers to consider a 9-year rotation that includes 3 years of alfalfa, a corn-soybean sequence followed by winter wheat and oat, and then corn and soybean again. Alfalfa is grown with an oat companion crop to suppress weed growth in the first year of alfalfa. We believe this rotation design will help producers manage weeds without tillage.

Glyphosate application timing and tank mixtures with phenmedipham and desmedipham. Kelli M. Belmont, Don W. Morishita, Kyle G. Frandsen. (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 various rates of phenmedipham and desmedipham (pmp&dmp) tank mixed with glyphosate and the timing of glyphosate applications for weed control in sugar beet. The pmp&dmp tank mix combinations with glyphosate was of interest because of grower concerns over crop injury 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 Portneuf silt loam (19% sand, 60% silt, and 21% clay) with a pH of 8.3, 1.3% organic matter, and CEC of 28.4-meq/100 g soil. 'Holly Hybrid SX1502RR' sugar beet was planted April 17, 2014, in 22-inch rows at a rate of 60,589 seed/A. Common lambsquarters (CHEAL), redroot pigweed (AMARE), kochia (KCHSC), 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 11001 flat fan nozzles. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 13, 55, and 104 days after the last herbicide application (DALA) on July 2, August 13, and October 1, respectively. The two center rows of each plot were harvested mechanically on October 7.

Table 1. Environmental conditions and weed species densities at application

Application date	5/1/2014	5/22/2014	6/7/2014	6/19/2014
Application timing	pre-emergence	2 leaf	4 leaf	6 leaf
Air temperature (F)	67	74	56	57
Soil temperature (F)	53	43	55	52
Relative humidity (%)	30	74	43	69
Wind velocity (mph)	2	1	3	5
Cloud cover (%)	5	15	5	15
Time of day	1140	0755	0800	1000
Weed species/ft^2				
foxtail, green	-	-	5	1<
kochia	-	-	5	11
lambsquarters, common	-	-	7	10
lettuce, prickly	-	-	1<	-
mallow, common		-	1<	-
nightshade, hairy	-	-	1<	-
pigweed, redroot	-	-	14	6

Crop injury 13 DALA ranged from 1 to 5% in all treatments that included pmp&dmp. By 55 DALA, no injury was observed in these same treatments. At 104 DALA crop injury ranged from 0 to 4%, but there was no statistical difference among any of the treatments. Common lambsquarters control with the pmp&dmp + glyphosate combinations provided better season-long control with the 0.25 and 0.33 lb ai/A rates of pmp&dmp compared to the 0.41 and 0.49 lb ai/A pmp&dmp rates. Other treatments that controlled common lambsquarters throughout the season included: 1) glyphosate at 0.77 lb ae/A + AMS at 0.85 lb ai/A applied preemergence (PRE) fb glyphosate at 1.125 lb ae/A + dimethenamid-P at 0.984 lb ai/A + AMS at 0.85 lb ai/A applied at the 4-leaf stage fb glyphosate + AMS applied at the 6-leaf stage; and 2) glyphosate at 1.125 lb ae/A + dimethenamid-P at 0.984 lb ai/A + AMS at 0.85 lb ai/A applied at the 2-leaf stage fb glyphosate + AMS alone with the same rate at the 4-leaf stage. Kochia was controlled kochia 89% or better at the end of the season with no significant difference among herbicide treatments. Redroot pigweed control ranged from 80 to 99% over all of the evaluations dates with no significant difference at any of the evaluation dates. Green foxtail control 104 DALA ranged from 50 to 98%. Glyphosate at 1.125 lb ae/A + AMS at 0.85 lb ai/A applied at the 4-leaf stage fb glyphosate at 0.77 lb ae/A + AMS at 0.85 lb ai/A applied at the 6-leaf stage provided only 50% control. The most effective overall weed control treatments included: 1) glyphosate at 0.77 lb ae/A + AMS at 0.85 lb ai/A applied preemergence (PRE) fb glyphosate at 1.125 lb ae/A + dimethenamid-P at 0.984 lb ai/A + AMS at 0.85 lb ai/A applied at the 4-leaf stage fb glyphosate + AMS applied at the 6-leaf stage; 2) glyphosate at 0.77 lb ae/A + AMS at 0.85 lb ai/A applied PRE fb glyphosate + AMS applied at the 2, 4, and 6-leaf stages; and 3) glyphosate at 1.125 lb ae/A + dimethenamid-P at 0.984 lb ai/A + AMS at 0.85 lb ai/A applied at the 2-leaf stage fb glyphosate + AMS alone with the same rate at the 4-leaf stage. Root yield ranged from 6 to 56 ton/A with the untreated control having the lowest yield. All of the herbicide treatments had statistically equal yields. The higher yielding treatments ranged from 49 to 56 ton/A. Estimated recoverable sugar (ERS) yield ranged from 1,166 to 11,190 lb/A and basically followed the same pattern as root yield.

Table 2. Crop tolerance, weed control, root yield, and ERS in sugar beets near Kimberly, ID[1]

						Weed control[2]														
	Application		Crop injury			CHEAL			KCHSC			AMARE			SETVI			Root	
Treatment[3]	rate	date	7/2	8/13	10/1	7/2	8/13	10/1	7/2	8/13	10/1	7/2	8/13	10/1	7/2	8/13	10/1	yield	ERS[4]
	lb ai/a		---	---	---	---	---	---	---	---	%	---	---	---	---	---	---	ton/A	lb/A
Untreated control			-	-	-	-	-	-	-		-	-	-	-	-	-	-	5 b	1,049 b
Glyphosate +	0.77 lb ae/a	5/22	1 b	0 a	0 a	94 a	97 a	98 a	89 bcd	99 a	99 a	95 a	98 a	98 a	91 b	96 ab	94 a	46 a	9,064 a
pmp&dmp+	0.2437																		
AMS fb	0.425																		
Glyphosate +	0.77 lb ae/a	6/7																	
pmp&dmp+	0.2437																		
AMS fb	0.425																		
Glyphosate +	0.77 lb ae/a	6/19																	
pmp&dmp+	0.2437																		
AMS	0.425																		
Glyphosate +	0.77 lb ae/a	5/22	5 a	0 a	1 a	96 a	98 a	96 abc	82 d	97 a	95 a	98 a	93 a	96 a	95 ab	92 abc	94 a	47 a	9,348 a
pmp&dmp+	0.325																		
AMS fb	0.425																		
Glyphosate +	0.77 lb ae/a	6/7																	
pmp&dmp+	0.325																		
AMS fb	0.425																		
Glyphosate +	0.77 lb ae/a	6/19																	
pmp&dmp+	0.325																		
AMS	0.425																		
Glyphosate +	0.77 lb ae/a	5/22	3 a	0 a	0 a	95 a	87 a	87 d	87 cd	95 a	95 a	97 a	97 a	96 a	94 ab	82 b-e	84 ab	47 a	8,6090 a
pmp&dmp+	0.41																		
AMS fb	0.425																		
Glyphosate +	0.77 lb ae/a	6/7																	
pmp&dmp+	0.41																		
AMS fb	0.425																		
Glyphosate +	0.77 lb ae/a	6/19																	
pmp&dmp+	0.41																		
AMS	0.425																		
Glyphosate +	0.77 lb ae/a	5/22	5 a	0 a	0 a	95 a	86 a	89 cd	87 cd	95 a	89 a	96 a	91 a	93 a	89 b	80 cde	74 b	46 a	8,752 a
pmp&dmp+	0.487																		
AMS fb	0.425																		
Glyphosate +	0.77 lb ae/a	6/7																	
pmp&dmp+	0.487																		
AMS fb	0.425																		
Glyphosate +	0.77 lb ae/a	6/19																	
pmp&dmp+	0.487																		
AMS	0.425																		
Glyphosate +	0.77 lb ae/a	5/1	0 b	0 a	4 a	97 a	95 a	96 abc	99 a	98 a	98 a	99 a	95 a	95 a	96 ab	90 a-d	88 ab	50 a	10,071 a
AMS fb	0.85																		
Glyphosate +	1.125 lb ae/a	6/7																	
dimethenamid-P +	0.984																		
AMS fb	0.85																		
Glyphosate +	0.77 lb ae/a	6/19																	
AMS	0.85																		

Table 2. Continued

Treatment[3]	Application rate	Application date	Crop injury 7/2	Crop injury 8/13	Crop injury 10/1	Weed control[2] CHEAL 7/2	CHEAL 8/13	CHEAL 10/1	KCHSC 7/2	KCHSC 8/13	KCHSC 10/1	AMARE 7/2	AMARE 8/13	AMARE 10/1	SETVI 7/2	SETVI 8/13	SETVI 10/1	Root yield	ERS[4]
	lb ai/a		----------							%							----------	ton/A	lb/A
	lb ai/a																	ton/A	lb/A
Glyphosate +	0.77 lb ae/a	5/1	0 b	0 a	0 a	75 b	84 a	87 d	93 a-d	91 a	91 a	85 a	80 a	92 a	75 c	73 de	88 ab	46 a	9,480 a
AMS fb	0.85																		
Glyphosate +	0.77 lb ae/a	5/22																	
AMS fb	0.85																		
Glyphosate +	1.125 lb ae/a	6/7																	
AMS	0.85																		
Glyphosate +	0.77 lb ae/a	5/1	0 b	0 a	0 a	97 a	98 a	97 ab	98 ab	98 a	98 a	98 a	98 a	96 a	98 a	96 a	96 a	48 a	10,009 a
AMS fb	0.85																		
Glyphosate +	0.77 lb ae/a	5/22																	
AMS fb	0.85																		
Glyphosate +	1.125 lb ae/a	6/7																	
AMS fb	0.85																		
Glyphosate +	0.77 lb ae/a	6/19																	
AMS	0.85																		
Glyphosate +	1.125 lb ae/a	6/7	0 b	3 a	4 a	96 a	92 a	87 d	98 ab	97 a	97 a	98 a	84 a	89 a	96 ab	71 e	50 c	45 a	9,372 a
AMS fb	0.85																		
Glyphosate +	0.77 lb ae/a	6/19																	
AMS	0.85																		
Glyphosate +	0.77 lb ae/a	6/7	0 b	0 a	0 a	97 a	96 a	95 a-d	99 a	99 a	99 a	99 a	88 a	97 a	95 ab	83 a-e	85 ab	49 a	10,014 a
AMS fb	0.85																		
Glyphosate +	1.125 lb ae/a	6/19																	
AMS	0.85																		
Glyphosate +	1.125 lb ae/a	5/22	0 b	0 a	0 a	92 a	96 a	97 abc	96 abc	89 a	89 a	98 a	96 a	97 a	92 ab	95 ab	97 a	44 a	9,183 a
dimethenamid-P +	0.984																		
AMS fb	0.85																		
Glyphosate +	0.77 lb ae/a	6/7																	
AMS	0.85																		
Glyphosate +	0.77 lb ae/a	5/22	0 b	0 a	0 a	95 a	95 a	87 d	98 ab	98 a	98 a	91 a	98 a	97 a	96 ab	96 a	98 a	44 a	9,216 a
AMS fb	0.85																		
Glyphosate +	1.125 lb ae/a	6/7																	
dimethenamid-P +	0.984																		
AMS	0.85																		

[1]Means followed by same letter are not significantly different using Fisher's Protected LSD (P=0.05).
[2]Weeds evaluated for control were: common lambsquarters (CHEAL), kochia (KCHSC), redroot pigweed (AMARE), and green foxtail (SETVI),
[3]Glyphosate is Roundup PowerMax. Pmp&dmp is phenmedipham and desmedipham and is sold as Betamix. AMS is ammonium sulfate and sold as BroncMax. Dimethenamid-P is Outlook. Fb = followed by.
[4]ERS is estimated recoverable sugar.

Tank mix partners used with glyphosate for weed control in Roundup Ready sugar beet. Kyle G. Frandsen, Don W. Morishita, Kelli M Belmont (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 determine effective tank mix partners used in combination with glyphosate as a resistance management strategy in Roundup Ready sugar beet. Experimental design was a randomized complete block with four replications. Individual plots were four rows by 30 ft. Soil type was a Portneuf silt loam (19% sand, 60% silt, and 21% clay) with a pH of 8.3, 1.3% organic matter, and CEC of 28.4-meq/100 g soil. 'Holly Hybrid SX1502RR' sugar beet was planted April 14, 2014, in 22-inch rows at a rate of 60,589 seed/A. Green foxtail (SETVI), kochia (KCHSC), common lambsquarters (CHEAL), common mallow (MALNE), and redroot pigweed (AMARE) were the major weed species present. Herbicides were applied broadcast with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 15 gpa using 11001 flat fan nozzles. Additional environmental and application information is given in Table 1. Crop injury and weed control were evaluated visually 9, 13, and 85 days after the last herbicide application (DALA) on June 16, July 2, and September 12. The two center rows of each plot were harvested mechanically on October 7.

Table 1. Environmental conditions and weed species densities at application

Application date	4/29/2014	5/27/2014	6/7/2014	6/19/2014
Application timing	pre-emergence	2 leaf	4 leaf	6 leaf
Air temperature (F)	62	89	56	67
Soil temperature (F)	48	80	55	52
Relative humidity (%)	26	19	43	69
Wind velocity (mph)	2	1	3	5
Cloud cover (%)	5	5	5	15
Time of day	1135	1435	0820	1000
Weed species/ft^2				
foxtail, green	-	-	3	5
kochia	-	-	6	20
lambsquarters, common	-	-	7	20
mallow, common		-	1<	1<
nightshade, hairy	-	-	1<	1<
pigweed, redroot	-	-	2	3

Crop injury 9 DALA ranged from 0 to 7% (Table 2). By 85 DALA, injury ranged from 0 to 3% and there were no statistical differences in injury between the treatments. Common lambsquarters control 13 DALA ranged from 82 to 99%. Only glyphosate at 1.125 lb ae/A applied at the 2-leaf stage followed by (fb) glyphosate at 0.75 lb ae/A + dimethenamid-P at 0.84 lb ai/A applied at the 4-leaf growth stage did not control common lambsquarters better than 82%. A similar pattern for common lambsquarters control 85 DALA was observed for this same treatment. At the late season evaluation, common lambsquarters control was only 77%. Kochia and redroot pigweed control ranged from 90 to 99% at 13 and 85 DALA for all herbicide treatments. Although there were statistical differences between 90% control and 98% control, the differences were not biologically significant. There were no statistical differences among the treatments for common mallow control on either evaluation date even though control ranged numerically from 74 to 99%. This is likely due to sporadic mallow populations between replications. Green foxtail control 13 DALA ranged from 78 to 99%. Two of the best treatments included acetochlor at 1.125 lb ai/A + glyphosate at 1.125 lb ae/A applied at the 2-leaf growth stage. Green foxtail control with both of these treatments averaged 97%. One of the poorest treatments was acetochlor at 1.125 lb ai/A + glyphosate at 0.75 lb ae/A applied at the 4-leaf growth stage. It was not clear why there was a big difference in green foxtail control between these treatments. At 85 DALA, all of the treatments containing acetochlor controlled green foxtail 90 to 99%. Poorest green foxtail control 85 DALA was with glyphosate alone applied three times and glyphosate + dimethenamid-P at 0.984 lb ai/A applied at the 2-leaf growth stage. Root yield ranged from 44 to 54 ton/A for the herbicide treatments with the untreated control yielding 11 ton/A. Sucrose yield ranged from 9263 lb/A 11788 lb/A with the untreated control averaging 2178 lb/A. Although there were numerical differences in both root and sucrose yield there were only slight statistical differences in treatments. Because weed control was generally good for all treatments it is likely that there was little yield loss from weed competition the variability in yield may likely be attributed to factors other than herbicide treatment such as nutrient or water availability in the field.

Table 2. Crop tolerance, weed control, root yield, and ERS in sugar beets near Kimberly, ID[1]

Treatment[3]	Application rate	Application dates	Crop injury 6/16	Crop injury 9/12	Weed control[2] CHEAL 7/2	CHEAL 9/12	KCHSC 7/2	KCHSC 9/12	AMARE 7/2	AMARE 9/12	MALNE 7/2	MALNE 9/12	SETVI 7/2	SETVI 9/12	Yield Root	Yield ERS[4]
	lb ai/a		%												ton/a	lb/a
Untreated control			-	-	-	-	-	-	-	-	-	-	-	-	10 c	1,960 c
Glyphosate fb	1.125 lb ae/a	5/27	7 a	1 a	95 b	95 ab	99 a	99 a	98 a	97 abc	95 a	92 a	83 cd	69 bc	46 ab	9,801 ab
glyphosate fb	0.75 lb ae/a	6/7														
glyphosate	0.75 lb ae/a	6/19														
Glyphosate +	1.125 lb ae/a	5/27	1 bc	0 a	98 ab	97 ab	99 a	98 a	99 a	99 a	93 a	86 a	97 a	96 a	40 b	8,337 b
acetochlor fb	1.125															
glyphosate fb	0.75 lb ae/a	6/7														
glyphosate	0.75 lb ae/a	6/19														
Glyphosate fb	1.125 lb ae/a	5/27	4 ab	0 a	97 ab	97 ab	99 a	99 a	99 a	99 a	98 a	96 a	78 d	95 a	46 ab	9,482 ab
glyphosate +	0.75 lb ae/a	6/7														
acetochlor fb	1.125															
glyphosate	0.75 lb ae/a	6/19														
Glyphosate +	1.125 lb ae/a	5/27	1 bc	0 a	96 ab	95 ab	99 a	98 a	99 a	99 a	95 a	86 a	96 ab	90 a	46 ab	9,536 ab
acetochlor fb	1.125															
glyphosate +	0.75 lb ae/a	6/7														
triflusulfuron +	0.015															
clopyralid fb	0.094 lb ae/a															
glyphosate	0.75 lb ae/a	6/19														
Glyphosate +	1.125 lb ae/a	5/27	7 a	3 a	97 ab	93 ab	99 a	99 a	99 a	98 ab	96 a	97 a	84 cd	94 a	45 ab	8,565 b
triflusulfuron +	0.015															
clopyralid fb	0.094 lb ae/a															
glyphosate +	0.75 lb ae/a	6/7														
acetochlor fb	1.125															
glyphosate	0.75 lb ae/a	6/19														
Glyphosate +	1.125 lb ae/a	5/27	1 bc	0 a	98 ab	98 a	98 a	99 a	99 a	99 a	96 a	99 a	97 a	97 a	45 ab	9,272 ab
acetochlor fb	1.125															
glyphosate +	0.75 lb ae/a	6/7														
acetochlor fb	1.125															
glyphosate	0.75 lb ae/a	6/19														
Ethofumesate fb	1.125	4/29	0 c	0 a	99 a	99 a	99 a	98 a	99 a	99 a	96 a	90 a	99 a	99 a	43 ab	8,859 b
glyphosate +	1.125 lb ae/a	5/27														
acetochlor fb	1.125															
glyphosate fb	0.75 lb ae/a	6/7														
glyphosate	0.75 lb ae/a	6/19														

Table 2. Continued[1]

Treatment[3]	Application rate	Application dates	Crop injury 6/16	Crop injury 9/12	Weed control[2] CHEAL 7/2	CHEAL 9/12	KCHSC 7/2	KCHSC 9/12	AMARE 7/2	AMARE 9/12	MALNE 7/2	MALNE 9/12	SETVI 7/2	SETVI 9/12	Yield Root	Yield ERS[4]
	lb ai/a		-----	-----	-----	-----	-----	-----	%	-----	-----	-----	-----	-----	ton/a	lb/a
Ethofumesate fb glyphosate fb glyphosate + acetochlor fb glyphosate	1.125 1.125 lb ae/a 0.75 lb ae/a 1.125 0.75 lb ae/a	4/29 5/27 6/7 6/19	3 abc	0 a	99 a	95 ab	99 a	98 a	99 a	98 ab	99 a	74 a	98 a	98 a	43 ab	8,968 b
Glyphosate + dimethenamid-P fb glyphosate fb glyphosate	1.125 lb ae/a 0.984 0.75 lb ae/a 0.75 lb ae/a	5/27 6/7 6/19	2 abc	3 a	94 b	89 bc	99 a	99 a	99 a	96 bc	97 a	85 a	99 a	65 c	45 ab	9,505 ab
Glyphosate fb glyphosate + dimethenamid-P fb glyphosate	1.125 lb ae/a 0.75 lb ae/a 0.984 0.75 lb ae/a	5/27 6/7 6/19	0 c	0 a	96 ab	94 ab	98 a	98 a	99 a	99 a	94 a	96 a	90 bc	98 a	49 a	10,609 a
Glyphosate fb glyphosate + dimethenamid-P	1.125 lb ae/a 0.75 lb ae/a 0.84	5/27 6/7	0 c	3 a	82 c	77 c	93 b	90 b	94 b	93 c	91 a	78 a	91 bc	88 ab	43 ab	9,339 ab

[1]Means followed by same letter are not significantly different using Fisher's Protected LSD (P=0.05).
[2]Weeds evaluated for control were: common lambsquarters (CHEAL), kochia (KCHSC), redroot pigweed (AMARE), common mallow (MALNE), and green foxtail (SETVI).
[3] All herbicide applications included ammonium sulfate at 17 lb/100 gallons spray solution. Glyphosate is sold as Roundup PowerMax. Acetochlor is sold as Warrant. Triflusulfuron is sold as UpBeet. Clopyralid is sold as Stinger. Ethofumesate is sold as Nortron SC. Dimethenamid-P is sold as Outlook. Fb=followed by.
[4]ERS is estimated recoverable sugar.

Timing of soil-active herbicide incorporation with sprinkler irrigation. Don W. Morishita, Kyle G. Frandsen, and Kelli M. Belmont (Kimberly Research and Extension Center, University of Idaho, Kimberly, ID 83341). A question often asked by growers is how long can a soil-applied herbicide remain on the soil surface before it is incorporated into the soil, either mechanically or with overhead water, and still be effective? Some labels have, such as the Eptam herbicide label, have instructions on how soon a herbicide must be incorporated, but other soil-active herbicides do not. A field experiment was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho to determine how soon soil-active herbicides applied with glyphosate for weed control in sugar beet need to be incorporated with sprinkler irrigation before they lose their effectiveness. The experimental design was a 4 by 5 factorial randomized complete block with four replications. Five herbicides treatments, consisting of acetochlor, dimethenamid-P, EPTC, ethofumesate, s-metolachlor and glyphosate alone were applied 9, 6, 3, and 0 days before incorporation (DBI) with overhead sprinker irrigation. All of these herbicide treatments, except glyphosate alone, were applied in combination with glyphosate at the 4-leaf sugar beet growth stage. These applications were applied sequentially to glyphosate alone at 0.77 lb ae/A applied at the 2-leaf growth stage. Individual plots were four rows by 30 ft. Soil type was a Portneuf silt loam (19% sand, 60% silt, and 21% clay) with a pH of 8.3, 1.3% organic matter, and CEC of 28.4-meq/100 g soil. 'Holly Hybrid SX1502RR' sugar beet was planted April 14, 2014, in 22-inch rows at a rate of 60,590 seed/A. Common lambsquarters (CHEAL), kochia (KCHSC), redroot pigweed (AMARE), hairy nightshade (SOLSA), common mallow (MALNE) 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 11001 flat fan nozzles. Additional environmental and application information is given in Table 1. Weed counts by species were taken on July 1 and 14; 14 and 28 days after the herbicide incorporation (DAHI). The two center rows of each plot were harvested mechanically on October 7.

Table 1. Environmental conditions at application.

Application date	5/22	5/27	6/9	6/12	6/16
Application timing	2 leaf	9 DBI[1]	6 DBI	3 DBI	0 DBI
Air temperature (F)	75	59	78	54	53
Soil temperature (F)	70	55	60	62	63
Relative humidity (%)	37	43	32	48	64
Wind velocity (mph)	2	3	1	9	3
Cloud cover (%)	5	0	5	40	100
Time of day	1310	0830	1000	0800	0715

[1]DBI = days before sprinkler incorporation

Analysis of the data showed significant differences in weed response to incorporation timing and herbicide treatment alone (Tables 2 and 3). There was no interaction between herbicide and incorporation timing. Weed densities 14 DAHI were highest or among the highest in the 9 DBI treatment for all weed species, except KCHSC and the total weed density. There was no statistical difference in weed density for any of the species between the 6 and 3 DBI treatments. For reasons unknown, CHEAL and KCHSC densities in the 0 DBI treatment were equal to or higher than the 3, 6 and 9 DBI treatments. There was no difference in weed densities between the 0, 3, and 6 DBI treatments for AMARE, SETVI, MALNE and SOLSA. When all weed species densities were combined, herbicide applications 3 DBI had the lowest total weed density. At 28 DAHI, there were no differences in weed density between the 0, 3, and 6 DBI treatments for AMARE, SETVI, MALNE and SOLSA. Common lambsquarters and KCHSC densities at 0 DBI were equal to the 9 DBI treatments. Why this occurred is not known. When all weeds species were combined, the total weed density was highest with the 9 DBI treatment and there were no differences between the 0, 3 and 6 DBI treatments. When comparing herbicide treatments, glyphosate applied alone had the highest or was statistically equal to the highest weed densities at 14 and 28 DAHI. Glyphosate applied alone also had the highest total weed densities among the herbicide treatments at 14 and 28 DAHI. *S*-metolachlor and dimethenamid-P had the lowest total weed densities 28 DAHI, but were not statistically lower than ethofumesate or acetochlor. No differences in sugar beet root or sucrose yield were observed among the different herbicide incorporation treatments. And, as we have seen in previous years, there were no differences in sugar beet root or sucrose yield among any of the herbicide treatments.

Table 2. Weed densities, sugar beet root yield and ERS in response to water incorporation timing with sprinkler irrigation pooled across herbicide treatments, near Kimberly, ID[1]

Treatment[3]	Weed density[2]														Yield	
	CHEAL		KCHSC		SETVI		AMARE		MALNE		SOLSA		All weeds			
	7/1	7/14	7/1	7/14	7/1	7/14	7/1	7/14	7/1	7/14	7/1	7/14	7/1	7/14	root	ERS[4]
DBI	plants/30ft[2]														ton/A	lb/A
9	50 a	51 a	8 b	6 a	24 a	30 a	9 a	12 a	38 a	22 a	14 a	6 a	144 a	127 a	48 a	9,940 a
6	29 b	36 b	8 b	2 b	11 b	18 b	7 ab	6 b	21 b	13 b	6 b	4 ab	81bc	78 b	52 a	10,770 a
3	21 b	22 c	4 b	1 b	6 b	14 b	1 b	3 b	17 b	8 b	3 b	2 b	55 c	49 c	52 a	10,180 a
0	40 a	35 b	13 a	6 a	6 b	12 b	4 b	5 b	17 b	11 b	7 b	3 b	86 b	72 bc	52 a	10,573 a

[1]Means followed by same letter are not significantly different using Fisher's Protected LSD (P=0.05).
[2] Weeds counted were: common lambsquarters (CHEAL), kochia (KCHSC), green foxtail (SETVI), redroot pigweed (AMARE), hairy nightshade (SOLSA), All weeds included: common lambsquarters (CHEAL), kochia (KCHSC), green foxtail (SETVI), redroot pigweed (AMARE), hairy nightshade (SOLSA), and annual sowthistle,
[3]DBI = days before incorporation with sprinkler irrigation. All herbicides were applied at different intervals before sprinkler irrigation incorporation.
[4]ERS is estimated recoverable sugar.

Table 3. Weed counts per plot, sugar beet root yield, and ERS in response to herbicide treatment pooled across water incorporation timing treatments near Kimberly, ID[1]

Treatment[3]	Weed density[2]														Yield	
	CHEAL		KCHSC		SETVI		AMARE		MALNE		SOLSA		All weeds			
	7/1	7/14	7/1	7/14	7/1	7/14	7/1	7/14	7/1	7/14	7/1	7/14	7/1	7/14	root	ERS[4]
	plants/30ft[2]														ton/A	lb/A
S-metolachlor	25 c	26 b	6 a	2 a	5 b	3 d	4 b	3 a	31 a	15 a	9 ab	5 a	80 b	52 c	51 a	10,406 a
EPTC	43 ab	38 b	12 a	6 a	11 b	22 b	4 b	6 a	16 a	14 a	7 abc	4 ab	93 b	90 b	52 a	9,827 a
Ethofumesate	30 c	32 b	8 a	3 a	11 b	17 bc	6 b	6 a	20 a	14 a	8 abc	4 a	83 b	77 bc	54 a	10,841 a
Dimethenamid-P	28 c	27 b	5 a	2 a	11 b	11 cd	4 b	4 a	28 a	12 a	5 bc	3 ab	80 b	58 c	50 a	10,149 a
Acetochlor	34 bc	30 b	9 a	4 a	10 b	11 cd	4 b	8 a	21 a	12 a	3 c	1 b	81 b	65 bc	50 a	10,409 a
Glyphosate	51 a	64 a	9 a	4 a	22 a	46 a	12 a	12 a	25 a	14 a	12 a	6 a	133 a	146 a	50 a	10,563 a

[1]Means followed by same letter are not significantly different using Fisher's Protected LSD (P=0.05).
[2] Weeds counted were: common lambsquarters (CHEAL), kochia (KCHSC), green foxtail (SETVI), redroot pigweed (AMARE), common mallow (MALNE), hairy nightshade (SOLSA), All weeds consisted of a total for all weeds counted.
[3]Herbicide treatments were applied 0, 3, 6, or 9 days before sprinkler irrigation incorporation. Glyphosate (Roundup PowerMax) plus ammonium sulfate was applied at 0.77 lb ae/A and 2.55 lb ai/A at each of the following times: 2-leaf stage, 9, 6, 3, and 0 days before sprinkler incorporation (5/22, 6/7, 6/9, 6/12, and 6/16) alone and in combination with the soil-active herbicides: *s*-metolachlor (Dual Magnum) at 1.27 lb ai/A, EPTC (Eptam) at 3 lb ai/A, ethofumesate (Nortron SC) at 1.0 lb ai/A, dimethenamid-P (Outlook) at 0.84 lb ai/A, and acetochlor (Warrant) at 1.125 lb ai/A.
[4]ERS is estimated recoverable sugar.

Herbicide application timing in chickpeas. Drew Lyon, Brianna Cowan, Rod Rood and Henry Wetzel (Crop and Soil Sciences Department, Washington State University, Pullman, WA, 99164) A field study was conducted on the WSU Cook Agronomy Farm near Pullman, WA to evaluate different herbicide application timings for the control of broadleaf weeds in chickpeas. The soil at the site is a Palouse silt loam with pH of 5.2 and organic matter content of 3.7%. The experimental design was a randomized complete block with four replications. Plots were eight feet wide by 35 feet in length, trimmed to 33 feet prior to harvest. Fall pre-plant (fallPREPLA) herbicide applications took place on October 31, 2013 using a CO_2 backpack sprayer calibrated to deliver 15 gpa using a spray boom equipped with four, TeeJet XR11002 nozzles on a 20-inch spacing. The air temperature at the time of application was 43°F, relative humidity was 63% and winds were out of the southwest at 1 mph. The pre-plant (PREPLA) application took place on March 25 using the same sprayer specifications. The air temperature was 51°F, relative humidity was 39% and winds were out of the southwest at 2 mph. Mayweed chamomile (ANTCO) was present as rosettes, approximately 1-inch in diameter. On May 2, 200 lb/acre 'Sierra' chickpeas were planted at a depth of 2 inches using a Monsosem vacuum planter with a 10-inch row spacing. The following day, an application of glyphosate at 1.125 lb ae/acre plus ammonium sulfate at 17 lb/100 gal finished spray solution was applied to control emerged weeds. The post-plant, pre-emerge (POSPRE) spray application took place on May 4 using the same sprayer specifications. The air temperature was 53°F, relative humidity was 49% and the wind was still.

The only treatment providing acceptable control of mayweed chamomile in chickpeas was the sulfentrazone treatment applied pre-plant on March 25, approximately five weeks prior to planting. This treatment received 0.56 inch of rain within four days of application and a total of 1.72 inch of rain by planting time. The post-plant, pre-emerge treatment of sulfentrazone received 0.51 inch of rain within five days of application, but only a total of 0.81 inch over the first five weeks after application. Although there were statistically significant treatment differences for crop injury, no commercially meaningful differences were observed.

Table. Herbicide application timing in chickpeas.

			June 25	
Treatment	Rate	Timing[1]	Crop injury	Mayweed chamomile control
	lb ai/a		-----------------------%-------------------------	
Linuron	0.625	fallPREPLA	0	4
Linuron	0.625	PREPLA	3	46
Linuron	0.625	POSPRE	0	38
Metribuzin	0.375	fallPREPLA	5	8
Metribuzin	0.375	PREPLA	0	33
Metribuzin	0.375	POSPRE	0	44
Sulfentrazone	0.25	fallPREPLA	1	33
Sulfentrazone	0.25	PREPLA	1	84
Sulfentrazone	0.25	POSPRE	0	46
Flumioxazin	0.064	fallPREPLA	0	28
Flumioxazin	0.064	PREPLA	0	25
Flumioxazin	0.064	POSPRE	1	10
Nontreated check	--	--	--	--
LSD (5%)			2	37

[1] FallPREPLA, PREPLA and POSPRE treatments were applied October 31, 2013; March 25 and May 4; respectively.

Efficacy of pyroxasulfone, fluthiacet, thiencarbazone, flumetsulam, and clopyralid in glyphosate-resistant irrigated corn. Randall S. Currie and Patrick W. Geier. (K-State Research and Extension Center, 4500 E. Mary Street, Garden City, KS 67846) An experiment at the Kansas State University Southwest Research-Extension Center in Garden City, KS determined the efficacy of pyroxasulfone, fluthiacet, thiencarbazone, flumetsulam, and clopyralid in irrigated corn. Herbicides were applied as preemergence, early postemergence or preemergence followed by postemergence sequential treatments. Application dates and information is shown in Table. 1. Glyphosate-resistant corn was planted May 21, 2014. Preemergence herbicides were applied using a tractor-mounted, CO_2-pressurized sprayer delivering 20 gpa at 4.1 mph and 30 psi. All early postemergence and postemergence treatments were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 20 gpa at 3.0 mph and 27 psi. Soil was a Ulysses silt loam with 1.4% organic matter, pH of 8.0, and cation exchange capacity of 18.4. Plots were 10 by 35 feet arraigned in a randomized complete block with four replications. Visual weed control was determined on August 20, 2014, which was 91, 68, and 48 days after preemergence, early postemergence and postemergence applications, respectively. Corn yields were determined October 30, 2014 by mechanically harvesting the center two rows of each plot and adjusting grain to 15.5% moisture content. All treatments provided excellent kochia and Russian thistle control (Table 2). Kochia pressure was very light. Treatments that provided 85, 95, 93 or 95 pecent control of Palmer amaranth, green foxtail, crabgrass, or shattercane, respectively, were not statistically superior to the best treatments. All treatments dramatically increased corn yield compare to the control. Treatments that elevated yield above 123.2 bu/A were not statistically superior to the best treatments.

Table 1. Application information.

Application timing	Preemergence	Early postemergence	Postemergence
Application date	May 21, 2014	June 13, 2014	July 3, 2014
Air temperature (F)	78	60	66
Relative humidity (%)	44	60	64
Soil temperature (F)	52	45	52
Wind speed (mph)	8 to 11	4 to 6	3 to 5
Wind direction	Northeast	South	South
Soil moisture	Good	Good	Good

Table 2. Weed control with pyroxasulfone, fluthiacet, thiencarbazone, flumetsulam, and clopyralid in glyphosate-resistant irrigated corn.

Herbicide[1]	Rate	Timing[2]	91 Days after planting						Yield
			SASKR[3]	KCHSC[4]	AMAPA[5]	SETVI[6]	DIGSS[7]	SORVU[8]	
			%						Bu/A
Atrazine/	32 oz	A	100	100	96	98	94	98	102.5
Pyroxasulfone/fluthiacet									
Isoxaflutole	2 oz	A							
Atrazine/	32 oz	A	100	100	100	100	99	100	141.9
Pyroxasulfone/fluthiacet									
Glyphosate+AMS	32 oz	C							
Thiencarbazone/	4 oz	A	100	100	97	100	96	100	135.4
Isoxaflutole									
Glyphosate+AMS	32 oz	C							
Acetochlor/	2 qt	A	100	100	99	100	97	100	131.0
Atrazine									
Glyphosate+AMS	32 oz	C							
Pyroxasulfone/fluthiacet	8 oz	A	100	100	100	100	98	98	130.7
Mesotrione/	2.5 oz	C							
Fluthiacet									
Atrazine	16 oz	C							
Glyphosate+AMS	32 oz	C							
Pyroxasulfone/fluthiacet	6 oz	A	99	100	91	100	98	100	128.7
Mesotrione/fluthiacet	2.5 oz	C							
Atrazine	16 oz	C							
Glyphosate+AMS	32 oz	C							
Atrazine/	24 oz	A	100	100	100	100	98	100	134.7
Pyroxasulfone/fluthiacet									
Mesotrione/fluthiacet	2.5 oz	C							
Atrazine	16 oz	C							
Glyphosate+AMS	32 oz	C							
Atrazine/	16 oz	A	100	100	98	100	95	100	127.7
Pyroxasulfone/fluthiacet									
Mesotrione/fluthiacet	2.5 oz	C							
Atrazine	16 oz	C							
Glyphosate+AMS	32 oz	C							
Atrazine/	16 oz	B	100	100	92	100	91	100	121.2
Pyroxasulfone/									
Fluthiacet									
Glyphosate+AMS	32 oz	B							
COC	1%	B							

Mesotrione/fluthiacet	2.5 oz	B	100	100	97	100	91	100	128.5
Pyroxasulfone/fluthiacet	4 oz	B							
Glyphosate+AMS	32 oz	B							
COC	1%	B							
Mesotrione/fluthiacet	2.5 oz	B	100	100	93	100	80	100	122.1
Atrazine	16 oz	B							
Glyphosate+AMS	32 oz	B							
COC	1%	B							
Mesotrione/fluthiacet	2.5 oz	B	100	100	85	81	76	100	137.4
Glyphosate+AMS	32 oz	B							
COC	1%	B							
Dicamba/ Diflufenzopyr	5 oz	B	100	100	75	84	78	100	121.8
Glyphosate+AMS	32 oz	B							
Acetochlor/ Atrazine	2 qt	A	100	100	83	80	73	75	92.8
Flumetsulam/ Clopyralid	4 oz	A							
Acetochlor/ Clopyralid/ Flumetsulam	2 pt	A	100	100	97	73	96	100	137.4
Glyphosate+AMS	24 oz	C							
Acetochlor/ Clopyralid/ Flumetsulam	2 pt	B	100	99	92	100	94	100	124.4
Glyphosate+AMS	24 oz	B							
Untreated control			0	0	0	0	0	0	43.3
LSD @ 5%=			2.9	3.2	14.7	5.3	5.7	5.3	14.2

[1] AMS is ammonium sulfate at 2 or 2.5% w/v, COC is crop oil concentrate.
[2] A is preemergence, B is early postemergence, C is postemergence.
[3] Russian thistle.
[4] Kochia.
[5] Palmer amaranth.
[6] Green foxtail.
[7] Crabgrass.
[8] Shattercane.

Weed control in irrigated corn with combinations of thiencarbazone, isoxaflutole, pyroxasulfone, fluthiacet, dicamba, and tembotrione. Randall S. Currie and Patrick W. Geier. (K-State Research and Extension Center, 4500 E. Mary Street, Garden City, KS 67846) An experiment at the Kansas State University Southwest Research-Extension Center in Garden City, KS evaluated weed control in irrigated corn with preemergence, early-postemergence, or preemergence followed by postemergence herbicide treats. Glyphosate-resistant corn was planted on April 24, 2014, with preemergence herbicides applied the following day. Early-postemergence and postemergence herbicides were applied on May 30 and June 16, 2014, respectively (Table 1). Preemergence herbicides were applied using a tractor-mounted, CO_2-pressurized sprayer calibrated to deliver 20 gal/A at 30 psi and 4.1 mph. Early-postemergence and postemergence herbicides were applied with a CO_2-pressurized backpack sprayer delivering 20 gpa, at 27 psi and 3.0 mph. Soil was a Ulysses silt loam with 1.4% organic matter, pH of 8.0, and cation exchange capacity of 18.4. Plots were 10 by 35 feet arraigned in a randomized complete block with four replications. Weed control was visually determined 105 days after planting, which was 104, 69, and 52 days after application of the preemergence, early-postemergence, and postemergence herbicides, respectively. Yields were determined October 27, 2014 by harvesting the center two rows of each plot and adjusting the grain to 15.5% moisture. Most preemergence treatments followed by postemergence treatments provided better Palmer amaranth control than preemergence treatments alone or early postemergence treatments alone (Table 2). Treatments providing 86, 93, 89, 87, 84 or 91% control of Palmer amaranth, kochia, Russian thistle, crabgrass, green foxtail or shattercane, respectively, were not statistically superior to the best treatment for control of that weed species. All treatments elevated yield over the untreated control. Treatments elevating yield above 82.4 bu/A were not statistical different from the best yielding treatment.

Table 1. Application information.

Application timing	Preemergence	Early-postemergence	Postemergence
Application date	April 25, 2014	May 30, 2014	June 16, 2014
Air temperature (F)	53	86	71
Relative humidity (%)	39	33	79
Soil temperature (F)	38	59	51
Wind speed (mph)	8	5	7
Wind direction	Southwest	South-Southeast	South-Southeast
Soil moisture	Fair	Fair	Good

Table 2. Weed control with thiencarbazone, isoxaflutole, tembotrione, and dicamba in glyphosate-resistant irrigated corn.

Herbicide[1]	Rate	Timing[2]	105 DAP[3] AMAPA[4]	KCHSC[5]	SASKR[6]	DIGSS[7]	SETVI[8]	SORVU[9]	Yield
	oz/A		%						Bu/A
Untreated control			0	0	0	0	0	0	44.8
Thiencarbazone/ Isoxaflutole	5.6	A	83	100	68	68	63	80	97.7
Atrazine	32	A							
Glyphosate+AMS	32	A							
Isoxaflutole	4.0	A	86	73	75	93	91	83	91.2
Acetochlor	46	A							
Atrazine	32	A							
Glyphosate+AMS	32	A							
Isoxaflutole	4.0	A	83	100	78	83	60	73	95.4
Atrazine/ Pyroxasulfone/ Fluthiacet	32	A							
Glyphosate+AMS	32	A							
Isoxaflutole	4.0	A	83	100	80	70	63	78	75.4
S-metolachlor	21	A							
Atrazine	32	A							
Glyphosate+AMS	32	A							
Thiencarbazone/ Tembotrione	3.0	B	84	100	98	88	83	100	102.0
Dicamba	8	B							
Atrazine	32	B							
Glyphosate+AMS	32	B							
Superb HC	0.5%	B							
Thiencarbazone/ Isoxaflutole	3.3	A	93	100	83	90	86	98	109.7
Atrazine	32	A							
Glyphosate+AMS	32	A							
Tembotrione	3.0	C							
Atrazine	16	C							
Glyphosate+AMS	32	C							
Destiny HC	1.0%	C							
Isoxaflutole	3.0	A	94	100	85	91	93	100	103.2
Atrazine/ Pyroxasulfone/ Fluthiacet	32	A							

Glyphosate+AMS	32	A							
Thiencarbazone/ Tembotrione	3.0	C							
Atrazine	16	C							
Glyphosate+AMS	32	C							
Superb HC	0.5%	C							
Thiencarbazone/ Isoxaflutole	3.3	A	78	100	78	75	63	93	96.7
Glyphosate+AMS	32	A							
Atrazine	32	A							
Dicamba/ Cyprosulfamide	10	C							
Glyphosate+AMS	32	C							
Destiny HC	1.0%	C							
LSD @ 5%=			8.0	7.3	9.5	5.6	6.9	9.2	20.8

[1] AMS is ammonium sulfate at 1.5 lb/A.
[2] A is preemergence, B is early postemergence, C is postemergence.
[3] Days after planting.
[4] Palmer amaranth.
[5] Kochia.
[6] Russian thistle.
[7] Crabgrass.
[8] Green foxtail.
[9] Shattercane.

Efficacy of bicyclopyrone, mesotrione, saflufenacil, topramezone, and rimsulfuron in irrigated glyphosate-resistant corn. Randall S. Currie and Patrick W. Geier. (K-State Research and Extension Center, 4500 E. Mary Street, Garden City, KS 67846) An experiment at the Kansas State University Southwest Research-Extension Center in Garden City, KS evaluated weed control in irrigated corn with bicyclopyrone, mesotrione, topramezone, saflufenacil and rimsulfuron thank mixtures. Glyphosate-resistant corn was planted May 7, 2014, and preemergence herbicides were applied on May 9, 2014 using a tractor-mounted, compressed CO_2 sprayer delivering 20 gpa at 4.1 mph and 30 psi. Postemergence herbicides were applied July 2, 2014 with a CO_2-pressurized backpack sprayer delivering 20 gpa at 3.0 mph and 27 psi. Soil was a Ulysses silt loam with 1.4% organic matter, pH of 8.0, and cation exchange capacity of 18.4. Plots were 10 by 35 feet arraigned in a randomized complete block with four replications. Weed control was visually rated on August 21, 2014. This was 104 and 50 days after preemergence and postemergence treatments were applied, respectively. Corn yields were determined October 31, 2014 by mechanically harvesting the center two rows of each plot and adjusting grain moistures to 15.5%. All treatments provided statistically superior control of Palmer amaranth compared to the control or a single application of glyphosate. All treatments provided excellent control of all other weed species. Although all herbicide tank mixes elevated corn yield compared to the control there were no statistically significant difference between herbicides in their ability to do so.

Table. Weed control with mesotrione, bicyclopyrone, saflufenacil, topramezone, and rimsulfuron in irrigated glyphosate-resistant corn.

Herbicide[1]	Rate	Timing[2]	106 Days after planting						Yield
			SASKR[3]	AMAPA[4]	KCHSC[5]	SETVI[6]	DIGSS[7]	SORVU[8]	
			%						Bu/A
Mesotrione/ *S*-metolachlor/ Atrazine	2.7 qt	A	99	99	100	100	97	100	138.6
Atrazine	0.75 qt	A							
Glyphosate+AMS	28 oz	B							
Mesotrione/ *S*-metolachlor/ Atrazine	1.5 qt	A	99	99	100	99	99	100	131.7
Atrazine	0.5 qt	A							
S-metolachlor/ Glyphosate	3.5 pt	B							
Atrazine	0.5 qt	B							
NIS	0.5%	B							
AMS	2%	B							
Bicyclopyrone/ Mesotrione/ *S*-metolachlor/ Atrazine	2.5 qt	A	100	100	100	99	96	100	113.2
Atrazine	0.65 qt	A							
Glyphosate+AMS	28 oz	B							
Bicyclopyrone/ Mesotrione/ *S*-metolachlor/ Atrazine	1.25 qt	A	100	99	100	99	96	100	132.6
Atrazine	0.35 qt	A							
Glyphosate+AMS	28 oz	B							
Bicyclopyrone/ Mesotrione/ *S*-metolachlor/ Atrazine	1.25 qt	B							
Atrazine	0.35 qt	B							
COC	1%	B							
AMS	2%	B							
Dimethenamid	17.5 oz	A	100	99	100	100	95	100	115.8

Atrazine	1 qt	A							
Glyphosate+AMS	22 oz	B							
Topramezone	0.75 oz	A	100	93	96	100	93	100	139.8
Glyphosate+AMS	22 oz	B							
Dimethenamid	17.5 oz	A	100	100	100	100	97	100	110.4
Topramezone	0.75 oz	A							
Atrazine	1 qt	A							
Glyphosate+AMS	22 oz	B							
Pendimethalin	1 qt	A	100	99	100	100	96	100	137.1
Saflufenacil	2 oz	A							
Atrazine	1 qt	A							
Topramezone	0.5 oz	B							
Dimethenamid	12 oz	B							
Atrazine	0.5 qt	B							
Glyphosate+AMS	22 oz	B							
MSO	1%	B							
Saflufenacil/ Dimethenamid	10 oz	A	100	95	100	99	93	100	145.7
Atrazine	1 qt	A							
Topramezone	0.5 oz	B							
Dimethenamid	12 oz	B							
Atrazine	0.5 qt	B							
Glyphosate+AMS	22 oz	B							
MSO	1%	B							
Thiencarbazone/ Isoxaflutole	3.3 oz	A	99	96	100	98	96	100	136.7
Atrazine	1 qt	A							
Tembotrione	2 oz	B							
Atrazine	0.5 qt	B							
Glyphosate+AMS	22 oz	B							
MSO	1%	B							
Pyroxasulfone	2 oz	A	100	99	99	100	97	100	134.9
Saflufenacil	2 oz	A							
Atrazine	1 qt	A							
Topramezone	0.5 oz	B							
Dimethenamid	12 oz	B							
Atrazine	0.5 qt	B							
Glyphosate+AMS	22 oz	B							
MSO	1%	B							
Isoxaflutole	3 oz	A	100	98	100	99	94	100	136.8

Atrazine	1 qt	A							
Tembotrione	2 oz	B							
Atrazine	0.5 qt	B							
Glyphosate+AMS	22 oz	B							
MSO	1%	B							
Saflufenacil/ Dimethenamid	10 oz	A	100	95	100	100	91	100	139.8
Atrazine	1 qt	A							
Topramezone	0.75 oz	B							
Pendimethalin	1 qt	B							
Atrazine	0.5 qt	B							
Glyphosate+AMS	22 oz	B							
MSO	1%	B							
Rimsulfuron	1 oz	A	100	95	100	96	95	100	132.6
Mesotrione	5 oz	A							
Atrazine	1 qt	A							
Glyphosate+AMS	22 oz	B							
Glyphosate+AMS	22 oz	B	98	75	100	100	85	100	140.1
Untreated control			0	0	0	0	0	0	64.7
LSD@ 5%=			2.4	4.2	1.9	2.9	3.0	4.1	26.3

[1] AMS is ammonium sulfate at 2% w/v, NIS is nonionic surfactant, COC is crop oil concentrate, and MSO is methylated seed oil.
[2] A is preemergence, B is postemergence.
[3] Russian thistle.
[4] Palmer amaranth.
[5] Kochia.
[6] Green foxtail.
[7] Crabgrass.
[8] Shattercane.

Sequential treatments of rimsulfuron, mesotrione, thifensulfuron, isoxaflutole, and glyphosate mixtures for weed control in irrigated corn. Randall S. Currie and Patrick W. Geier. (K-State Southwest Research-Extension Center, 4500 E. Mary Street, Garden City, KS 67846) Broadleaf and grass weed control was evaluated in irrigated corn at the Kansas State University Southwest Research-Extension Center in Garden City, KS. Glyphosate-resistant corn was planted on April 24, 2014, with preemergence herbicides applied the following day. Air temperature, soil temperature, wind speed, relative humidity and soil moisture conditions were 79 F, 48 F, 5 mph, 17%, and good, respectively, at the time of preemergence applications. Soil was a Ulysses silt loam with 1.4% organic matter, pH of 8.0, and cation exchange capacity of 18.4. Preemergence herbicides were applied with a tractor-mounted, CO_2-pressurized sprayer calibrated to deliver 20 gal/A at 30 psi and 4.1 mph. Plots were 10 by 35 feet arraigned in a randomized complete block with four replications. Postemergence herbicides were applied June 6, 2014 using a CO_2-pressurized backpack sprayer delivering 20 gpa, at 27 psi and 3.0 mph. Air temperature, soil temperature, wind speed, relative humidity and soil moisture conditions were 77 F, 60 F, 10 mph, 46%, and good, respectively, at the time of postemergence applications. Weed control was visually estimated 101 days after planting (100 days after preemergence applications and 57 days after postemergence treatments). Yields were determined October 27, 2014 by harvesting the center two rows of each plot and adjusting the grain to 15.5% moisture. No treatment with less than 1.5 lb/A atrazine provided commercially acceptable Palmer amaranth control. The best level of Palmer amaranth control was produced by treatments that had good preemergence control augmented by a postemergence application with two or more modes of action that contained 0.5 lb/A atrazine. All treatments provided excellent kochia control. The best Russian thistle treatments provided from 77 to 88% control. The best foxtail or crabgrass treatments provided from 91 to 94% control. Excellent shattercane control was achieved by combinations of preemergence treatments followed by a postemergence treatment.

Table. Weed control in irrigated glyphosate-resistant corn with tank mixtures of rimsulfuron, mesotrione, thifensulfuron, atrazine, isoxaflutole, *S*-metolachlor, and pendimethalin.

Herbicide[1]	Rate	Timing	101 Days after planting AMAPA[2]	KCHSC[3]	SASKR[4]	SETVI[5]	DIGSS[6]	SORVU[7]	Yield
			%						Bu/A
Untreated			0	0	0	0	0	0	55.4
Rimsulfuron	1 oz	A	98	98	70	91	89	96	113.6
Mesotrione	5 oz	A							
S-metolachlor	1 pt	A							
Glyphosate+AMS	32 oz	A							
Atrazine	1.5 qt	B							
Glyphosate+AMS	32 oz	B							
Rimsulfuron	1 oz	A	100	99	75	90	91	93	106.1
Mesotrione	5 oz	A							
S-metolachlor	1 pt	A							
Glyphosate+AMS	32 oz	A							
Rimsulfuron	1.2 oz	B							
Mesotrione	2.5 oz	B							
Isoxadifen	0.3 oz	B							
Atrazine	1.5 qt	B							
Glyphosate+AMS	32 oz	B							
Rimsulfuron	1 oz	A	98	100	78	95	93	100	101.4
Mesotrione	5 oz	A							
S-metolachlor	1 pt	A							
Glyphosate+AMS	32 oz	A							
Rimsulfuron	0.92 oz	B							
Thifensulfuron	0.1 oz	B							
Isoxadifen	0.23 oz	B							
Atrazine	1.5 qt	B							
Glyphosate+AMS	32 oz	B							
Rimsulfuron	1 oz	A	92	100	78	89	91	100	113.4
Mesotrione	5 oz	A							
S-metolachlor/atrazine	1.5 pt	A							
Glyphosate+AMS	32 oz	A							
Atrazine	1.5 qt	B							
Glyphosate+AMS	32 oz	B							
Rimsulfuron	1 oz	A	94	100	80	95	94	100	108.0
Mesotrione	5 oz	A							
S-metolachlor/atrazine	1.5 pt	A							
Glyphosate+AMS	32 oz	A							

Rimsulfuron	1.2 oz	B							
Mesotrione	2.5 oz	B							
Isoxadifen	0.3 oz	B							
Atrazine	1.5 qt	B							
Glyphosate+AMS	32 oz	B							
Rimsulfuron	1 oz	A	91	100	84	86	91	100	109.6
Mesotrione	5 oz	A							
S-metolachlor/atrazine	1.5 pt	A							
Glyphosate+AMS	32 oz	A							
Rimsulfuron	0.92 oz	B							
Thifensulfuron	0.1 oz	B							
Isoxadifen	0.23 oz	B							
Atrazine	1.5 qt	B							
Glyphosate+AMS	32 oz	B							
Mesotrione/ *S*-metolachlor/atrazine	3 qt	A	98	100	86	91	94	100	120.1
Glyphosate+AMS	32 oz	A							
Atrazine	1.5 qt	B							
Glyphosate+AMS	32 oz	B							
Isoxaflutole	1 oz	A	85	100	68	58	70	58	72.9
Atrazine	1 qt	A							
Glyphosate+AMS	32 oz	A							
Isoxaflutole	1 oz	A	86	100	88	88	75	94	111.1
Atrazine	1 qt	A							
Glyphosate+AMS	32 oz	A							
S-metolachlor	2 pt	B							
Glyphosate+AMS	32 oz	B							
Isoxaflutole	1 oz	A	85	100	78	80	73	88	104.4
Atrazine	1 qt	A							
Glyphosate+AMS	32 oz	A							
Pendimethalin	2 pt	B							
Glyphosate+AMS	32 oz	B							
LSD @ 5%=			7	3	11	6	4	5	11.7

[1] AMS is ammonium sulfate at 1.5 to 2.0 lb/A.
[2] Palmer amaranth.
[3] Kochia.
[4] Russian thistle.
[5] Green foxtail.
[6] Crabgrass.
[7] Shattercane.

Fallow weed control with preemergence tank mixes of saflufenacil, pyroxasulfone, metribuzin, dicamba, atrazine, isoxaflutole, and thiencarbazone. Randall S. Currie and Patrick W. Geier. (K-State Southwest Research-Extension Center, 4500 E. Mary Street, Garden City, KS 67846) Broadleaf weed control was evaluated with preemergence herbicides applied at the Kansas State University Southwest Research-Extension Center in Garden City, KS. Applications were made March 14, 2014. Air temperature, soil temperature, wind speed, relative humidity and soil moisture conditions were 72 F, 32 F, 5 mph, 12%, and dry, respectively. Soil was a Ulysses silt loam with 1.4% organic matter, pH of 8.0, and cation exchange capacity of 18.4. Herbicides were applied with a tractor-mounted, CO_2-pressurized sprayer calibrated to deliver 20 gal/A at 30 psi and 4.1 mph. Plots were 10 by 35 feet arraigned in a randomized complete block with four replications. Weed control was visually determined 53 and 143 days after treatment (DAT). With the exception of the tankmix of saflufenacil and metribuzin all other tankmixes that provided 100% kochia control 53 DAT were three way tankmixes of a trazine herbicide plus dicamba and isoxaflutole or pyroxasulfone. Only two tankmixes provided 98% kochia control 143 DAT. These were also three way tank mixes of these chemistries. These combinations of isoxaflutole and metribuzin were needed to provide greater than 93% control of Russian thistle 143 DAT. No tankmix provided good control of Palmer amaranth 143 DAT. However, tankmixes of Saflufenacil, metribuzin and pyroxasulfone provided 84% control 143 DAT. This might provide a foundation for a subsequent postemergence application in a two pass weed control program.

Table. Weed control in fallow with pyroxasulfone, metribuzin, saflufenacil, isoxaflutole, dicamba, thiencarbazone, and atrazine.

		53 Days after treatment		143 Days after treatment		
Herbicide	Rate	Kochia	Russian thistle	Kochia	Russian thistle	Palmer amaranth
	(oz/A)	%		%		
Saflufenacil/ Imazethapyr Pyroxasulfone Metribuzin	2 2 5	98	96	83	70	50
Dicamba Pyroxasulfone Metribuzin	8 2.5 5	100	100	86	65	79
Saflufenacil Atrazine	2 24	98	100	80	60	47
Saflufenacil Metribuzin	2 5	100	98	68	65	55
Saflufenacil Dicamba Atrazine	2 8 24	97	100	80	68	29
Saflufenacil Metribuzin Pyroxasulfone	2 5 2.5	93	96	84	73	84
Isoxaflutole Metribuzin	3 8	96	100	85	90	29
Isoxaflutole Metribuzin	2 5.4	98	100	88	93	32
Isoxaflutole Metribuzin	1.5 4	93	100	76	79	61
Isoxaflutole Metribuzin Dicamba	3 8 12	100	100	98	93	25
Isoxaflutole Metribuzin Dicamba	1.5 4 12	100	100	78	83	16
Isoxaflutole Metribuzin Idosulfuron/ Thiencarbazone	3 8 0.5	98	100	89	89	42
Isoxaflutole Metribuzin Idosulfuron/	1.5 4 0.5	95	99	84	84	30

Thiencarbazone						
Thiencarbazone/ Isoxaflutole Metribuzin	3.5 8	96	100	91	83	34
Thiencarbazone/ Isoxaflutole Metribuzin Dicamba	3.5 8 12	98	100	93	91	34
Thiencarbazone/ Isoxaflutole Atrazine	3.5 16	99	98	86	80	34
Thiencarbazone/ Isoxaflutole Atrazine Dicamba	3.5 16 16	100	100	98	95	24
Atrazine Dicamba	16 16	98	99	93	83	31
Untreated control		0	0	0	0	0
LSD @ 5%=		6.7	3.4	11.6	12.5	18.1

Crop tolerance to fall herbicide applications in established perennial ryegrass grown for seed. Daniel W. Curtis, Kyle C. Roerig, Andrew G. Hulting and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331) A study was conducted in established perennial ryegrass grown for seed that had one previous harvest with the objective of determining yield responses to fall applications of preemergence herbicides. Plots were 8 x 36 ft arranged in a randomized complete block design with four replications. Perennial ryegrass had been carbon seeded in 12 inch rows on October 8, 2012. One lb ai of diuron was then applied on October 9, 2012. The plot area was swathed on July 10, 2013 and seed was thrashed and collected on August 2, 2013. Fifteen treatments consisting of fourteen herbicides or combinations of herbicides were applied on October 2, 2013. A second series of herbicide applications was made on November 15, 2013. Application information and soil data are summarized in Table 1. Herbicide treatments were applied with a compressed air pressurized boom mounted on a unicycle frame calibrated to deliver 20 gpa at 20 psi. Injury to the perennial ryegrass and percent control of volunteer perennial ryegrass seedlings (weed) were evaluated visually on May 9, 2014. The perennial ryegrass was swathed on July 3, 2014 and seed thrashed with a small plot combine on July 16, 2014. Seed was then cleaned with a Clipper cleaner and yields quantified (Table 2).

Table 1. Application information and soil data, Hyslop Research Farm, Corvallis, OR

Application date	October 2, 2013		November 15, 2013
Crop growth stage	Dormant, 4 inches tall		4 inches tall
Sprout growth stage	1 – 2 leaf		1-3 leaf
Air temperature (F)	46		45
Relative Humidity (%)	90		100
Wind (mph, direction)	1, N		1, SSE
Cloud cover (%)	100		100
First rainfall (inches)	October 2, 0.14 inches		November 15, 0.05 inches
Soil temperature at 2 inches (F)	48		44
Soil pH		5.7	
Soil OM (%)		2.83	
Soil CEC (meq/100g)		14.9	
Soil Texture		silty clay loam	

Yields in the untreated check treatment and the oxyfluorfen treatment were reduced by uncontrolled volunteer crop seedlings. Yields for the flufenacet/metribuzin treatment which is registered in grasses grown for seed are comparable to the yields from the pyroxasulfone/flumioxazin treatments. Flufenacet/metribuzin + oxyfluorfen is an industry standard practice for the control of annual bluegrass and volunteer crop seedlings. The addition of diuron to flufenacet/metribuzin and pyroxasulfone/flumioxazin resulted in yield increases compared with those herbicides applied alone. The sequential treatments applied in November provided an additional increase in yields. Pyroxasulfone/flumioxazin is in the IR-4 project for registration in grasses grown for seed. Indaziflam also provided equivalent control and yields to flufenacet/metribuzin and would add a new mode of action to the grass seed cropping system if registered.

Table 2. Control of volunteer crop seedlings and grass seed yields with fall herbicide treatments in established perennial ryegrass grown for seed, 2013-2014.

Treatment	Rate	Volunteer seedlings	Crop injury	Clean seed Yield
	lb ai/A	--- % control[1] ---	-%-	lb/A
Untreated check	0	0	0	631
Flufenacet/metribuzin	0.425	93	0	789
Diuron	2	95	0	760
Oxyfluorfen	0.06	10	0	650
Indaziflam	0.02	93	9	788
Flufenacet/metribuzin + diuron	0.425 + 2	98	3	854
Flufenacet/metribuzin + oxyfluorfen	0.425 + 0.07	93	0	783
Pyroxasulfone/flumioxazin	0.095	93	0	790
Pyroxasulfone/flumioxazin	0.143	93	0	787
Pyroxasulfone/flumioxazin + diuron	0.143 + 2	100	3	856
Pyroxasulfone/flumioxazin + oxyfluorfen	0.143 + 0.07	99	3	786
Flufenacet/metribuzin + diuron fb[2] dimethenamid-P	0.425 + 2 0.98	100	3	931
Flufenacet/metribuzin + diuron fb metolachlor	0.425 + 2 0.95	100	5	973
Flufenacet/metribuzin + diuron fb pyroxasulfone/flumioxazin	0.425 + 2 0.143	100	5	916
Pyroxasulfone/flumioxazin +diuron fb flufenacet/metribuzin	0.143 + 2 0.425	100	8	932
LSD (P = 0.05)		11	5	117
CV		9	143	10

[1] % control and crop injury evaluated May 9, 2014.

[2] Abbreviations: fb, (followed by). Application made on November 15, 2013.

Palmer amaranth control and sorghum response to pyrasulfotole/bromoxynil tank mixtures. Randall S. Currie and Patrick W. Geier. (K-State Research and Extension Center, 4500 E. Mary Street, Garden City, KS 67846) An experiment conducted at the Kansas State University Southwest Research-Extension Center in Garden City, KS examined crop tolerance and Palmer amaranth control with pyrasulfotole/bromoxynil plus atrazine and other tank mix partners in irrigated grain sorghum. Grain sorghum was planted June 16, 2014. All herbicides were applied postemergence on July 11, 2014 when sorghum was 6 to 8 inches tall and Palmer amaranth was 1 to 5 inches tall. Treatments were applied using a CO_2-pressurized, backpack sprayer delivering 20 gpa at 3.0 mph and 27 psi. Soil was a Ulysses silt loam with 1.4% organic matter, pH of 8.0, and cation exchange capacity of 18.4. Plots were 10 by 35 feet, and arraigned as a randomized complete block replicated four times. Sorghum injury was visually determined on July 14 and July 31, 2014 (3 and 20 days after treatment). Visual weed control ratings were taken on July 31 and August 17, 2014, which was 20 and 37 days after treatment, respectively. Grain yields on were determined on November 18, 2014 by harvesting the center two rows of each plot and adjusting the weights to 14% moisture. Although pyrasulfotole and bromoxynil treatments caused significant chlorosis 28 DAP, by 45 DAP the sorghum recovered fully. All tankmixes of pyrasulfotole and bromoxynil provided good Palmer amaranth control at all rating dates. Fluroxypyr and bromoxynil provided poor Palmer amaranth control at all rating dates. All tankmixes of pyrasulfotole and bromoxynil significantly elevated yield compared to the untreated controls or fluroxypyr treatments.

Table. Palmer amaranth control with and crop response to pyrasulfotole/bromoxynil tank mixtures in grain sorghum.

		Sorghum		Palmer amaranth		
		Chlorosis	Injury	Control		
Herbicide[1]	Rate	28 DAP[2]	45 DAP	45 DAP	59 DAP	Yield
	oz/A	——— % ———		——— % ———		Bu/A
Pyrasulfotole/ Bromoxynil Atrazine	13 16	21	0	100	99	52.4
Pyrasulfotole/ Bromoxynil Atrazine	16 16	24	0	96	94	48.5
Pyrasulfotole/ Bromoxynil Atrazine 2,4-D ester	13 16 4	23	0	100	96	44.3
Pyrasulfotole/ Bromoxynil Atrazine Dicamba	13 16 4	23	0	99	99	37.1
Pyrasulfotole/ Bromoxynil Atrazine Fluroxypyr	13 16 3	21	0	99	95	58.2
Fluroxypyr/ Bromoxynil	14	9	0	50	43	7.6
Untreated control		0	0	0	0	4.2
LSD @ 5%=		3.8	ns	6.7	5.3	27.8

[1] All pyrasulfotole/bromoxynil treatments included ammonium sulfate at 1 lb/A plus nonionic surfactant at 0.25% v/v.
[2] Days after planting.

Weed control and crop tolerance in acetolactase-synthase tolerant grain sorghum with liquid nicosulfuron tank mixtures. Randall S. Currie and Patrick W. Geier. (K-State Research and Extension Center, 4500 E. Mary Street, Garden City, KS 67846) An experiment conducted at the Kansas State University Southwest Research-Extension Center in Garden City, KS examined crop tolerance and weed control with liquid nicosulfuron tank mixtures as either stand-alone or sequential treatments in irrigated acetolactase synthase (ALS) tolerant irrigated grain sorghum. Sorghum was planted June 19, 2014, and preemergence herbicides were applied the following day (Table 1). Early postemergence (stand-alone) and postemergence (sequential) treatments were applied on July 11 and July 28, 2014 respectively. All herbicides were applied with a CO_2-pressurized, backpack sprayer delivering 20 gpa at 3.0 mph and 27 psi. Soil was a Ulysses silt loam with 1.4% organic matter, pH of 8.0, and cation exchange capacity of 18.4. Plots were 10 by 35 feet arraigned in a randomized complete block with four replications. Sorghum injury was evaluated July 14 (3 days after early postemergence treatments) and August 1, 2014 (4 days after postemergence treatments). Weed control was determined visually on August 20 2014, which was 1, 40, and 23 days after preemergence, early postemergence and postemergence applications, respectively. Grain yields were not determined. Although preemergence applications of *S*-metolachlor and atrazine provided excellent green foxtail control, it did not provide commercially acceptable levels of Palmer amaranth or crabgrass control (Table 2). All postemergence tankmixes of nicosulfuron raised the level of control achieved by the preemergence applications of *S*-metolachlor and atrazine to greater than 93% for these species. With the exception of the pyrasulfotole tank mix which provided excellent Palmer amaranth control, no total postemergence program provided greater than 86, 73 or 88% control of Palmer amaranth, crabgrass or green foxtail, respectively. Weed pressure of these species was extreme. Under conditions of extreme weed pressure it is clear that a foundation treatment of *S*-metolachlor and atrazine followed by a postemergence application would be needed for commercially acceptable levels of weed control. All treatments provided 100% control of shattercane seeded across the entire plot area.

Table 1. Application information.

Application timing	Preemergence	Early postemergence	Postemergence
Application date	June 20, 2014	July 11, 2014	July 28, 2014
Air temperature (F)	70	87	82
Relative humidity (%)	70	33	51
Soil temperature (F)	58	59	60
Wind speed (mph)	5	5	6
Wind direction	South	South Southwest	Southeast
Soil moisture	Fair	Good	Good

Table 2. Crop tolerance and weed control with liquid nicosulfuron, atrazine, pyrasulfotole, dicamba, and 2,4-D tank mixtures in ALS-tolerant grain sorghum.

			Sorghum injury			Weed Control		
			25 DAP[3]	25 DAP	43 DAP	62 DAP		
Herbicide[1]	Rate	Timing[2]	Epinasty	Chlorosis	Epinasty	Palmer amaranth	Crabgrass	Green foxtail
				%			%	
Untreated control			0	0	0	0	0	0
S-metolachlor/atrazine	1.6 qt	A	0	0	0	68	83	100
S-metolachlor/atrazine Nicosulfuron Atrazine 2,4-D ester	1.6 qt 12 oz 13 oz 8 oz	A C C C	0	0	14	100	93	100
S-metolachlor/atrazine Nicosulfuron Atrazine Pyrasulfotole/bromoxynil	1.6 qt 12 oz 13 oz 13 oz	A C C C	0	0	0	100	94	100
S-metolachlor/atrazine Nicosulfuron Atrazine Dicamba	1.6 qt 12 oz 13 oz 8 oz	A C C C	0	0	15	100	93	100
Nicosulfuron Atrazine	12 oz 13 oz	B B	10	24	0	70	80	88
Nicosulfuron Atrazine Pyrasulfotole/bromoxynil	12 oz 13 oz 13 0z	B B B	7	28	0	100	65	85
Nicosulfuron Atrazine Dicamba	12 oz 13 oz 8 oz	B B B	30	25	0	86	63	83
Nicosulfuron Atrazine 2,4-D ester	12 oz 13 oz 8 oz	B B B	24	23	0	73	73	88
Nicosulfuron Atrazine Metsulfuron 2,4-D ester	12 oz 13 oz 0.05 oz 8 oz	B B B B	24	24	2	74	68	83
LSD @ 5%=			2.7	2.9	4.6	7.8	4.9	4.8

[1] All early postemergence and postemergence herbicides included crop oil concentrate 1% v/v and ammonium sulfate at 2 lb/A.
[2] A is preemergence, B is early postemergence, C is postemergence.
[3] Days after planting.

Comparison of wild oat and broadleaf herbicides in irrigated spring wheat. Kyle G. Frandsen, Don W. Morishita, Kelli M. Belmont. (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 determine the effectiveness of various herbicides in controlling wild oat and broadleaf weeds in spring wheat. 'Pettit' spring wheat was planted March 21, 2014, at 100 lb/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% sand, 71% silt, and 9% clay) with a pH of 8.1, 1.5% organic matter, and CEC of 17-meq/100 g soil. Herbicides were applied on May 8 with a CO_2-pressurized bicycle-wheel sprayer using 11001 flat fan nozzles calibrated to deliver 10 GPA at 20 PSI and 3 MPH. Environmental conditions at application were as follows: air temperature 51 F, soil temperature 52 F, relative humidity 53%, wind speed 2 MPH, and 10% cloud cover. Green foxtail, wild oat kochia, common lambsquarters and Russian thistle densities averaged 21, 5, 4, 75 and 1 plants/ft^2, respectively. Application began at 8:40 a.m. Crop injury and weed control was evaluated visually 50 days after application (DAA) on June 27. Grain was harvested August 19 with a small-plot combine.

Little or no crop injury (0 to 1%) was recorded for all treatments. Common lambsquarters control ranged from 56 to 94%. However, there was a great deal of variation between replications leaving only few statistical differences between treatments. Pinoxaden/fluroxypyr + thifensulfuron/tribenuron + MCPA LVE and Pinoxaden + thifensulfuron/tribenuron were among the treatments with the best control, a5 94 and 93%, respectively. Kochia control was good for all treatments ranging from 89 to 95%, except two treatments- pinoxaden/fluroxypyr + bromoxynil/MCPA and pinoxaden + thifensulfuron/tribenuron, which only had 65 and 34%, respectively. Russian thistle control was excellent for all treatments, ranging from 94 to 99%, with no differences among treatments. Wild oat control was excellent averaging 98 to 99% control for all treatments except those containing florasulam/pyroxsulam/fluroxypyr. For those two treatments wild oat control ranged from 46 to 54%. None of the treatments controlled green foxtail which ranged from 0 to 18%. However, poor green foxtail control may have been due to late emerging plants that emerged after unusual summer rains and likely were not competitive in the maturing grain. Therefore, it is possible that lack of green foxtail control did not significantly affect grain yield for the treatments. Due to a fertilizer misapplication error, the wheat in this study did not receive the recommended nitrogen rate. Consequently, all yields were below the area average. Grain yield for all herbicide treatments ranged from 74 to 98 bu/A and the untreated control yielded 59 bu/A. The two treatments containing florasulam/pyroxsulam/fluroxypyr both had yields averaging 75 bu/A that were statistically lower than other higher yielding herbicide treatments. This is likely due to the poor wild oat control associated with these treatments creating competition for available resources, thus reducing yield. Those treatments not containing florasulam/pyroxsulam/fluroxypyr had yields ranging from 85 to 99 bu/A.

Table 2. Comparison of wild oat and broadleaf herbicides in irrigated spring wheat near Kimberly, ID[1]

Treatment[3]	Application rate	Application date	Crop injury 6/27	Weed Control[2] CHEAL 6/27	KCHSC 6/27	SASKR 6/27	AVEFA 6/27	SETVI 6/27	Grain Yield
	lb ae/a		%	%	%	%	%	%	bu/A
Untreated Control			-	-	-	-	-	-	59 d
A19278 +	0.19	5/8	0 b	61 cd	89 a	99 a	99 a	5 a	85 abc
pinoxaden +	0.054								
A20916A	0.197 % v/v								
A19278 +	0.19	5/8	0 b	56 d	95a	97 a	98 a	3 a	99 a
pinoxaden/fluroxypyr +	0.147								
A20916A	0.197 % v/v								
Flrsulm/pyrxsulm/flurxypyr +	0.191	5/8	0 b	84 abc	90 a	94 a	46 b	0 a	76 bcd
MCPA LVE	0.231								
Flrsulm/pyrxsulm/flurxypyr +	0.191	5/8	1 a	89 ab	94 a	96 a	54 b	0 a	74 cd
MCPA LVE +	0.231								
AMS	2.5 lb ai/100 gal								
Pinoxaden/fluroxypyr+	0.135	5/8	1 a	94 a	95 a	99 a	98 a	18 a	95 ab
thifensulfuron/tribenuron	0.0125 lb ai/a								
MCPA LVE	0.231								
pinoxaden /fluroxypyr+	0.135	5/8	0 b	71 bcd	65 b	97 a	98 a	6 a	95 ab
Bromoxynil/MCPA	0.375								
Pinoxaden	0.054 lb ai/a	5/8	0 b	93 a	34 c	95 a	99 a	18 a	91 abc
thifensulfuron/tribenuron	0.0125 lb ai/a								
MCPA LVE	0.231								
Axial XL +	0.054 lb ai/a	5/8	0 b	83 abc	94 a	97 a	99 a	3 a	98 a
bromoxynil/ pyrasulfotole	0.217 lb ai/a								
Pinoxaden +	0.054 lb ai/a	5/8	0 b	77 a-d	90 a	96 a	99 a	10 a	98 a
bromoxynil/ pyrasulfotole	0.241 lb ai/a								

[1]Means followed by same letter do not significantly differ (P=0.05, LSD).
[2]Weed species evaluated for control were: common lambsquarters (CHEAL), kochia (KCHSC), Russian thistle (SASKR), wild oat (AVEFA), and green foxtail (SETVI).
[3]A19278 is an unregistered chemical. Pinoxaden is sold as Axial XL. A20916A is an unregistered chemical. Pinoxaden/fluroxypyr is Axial Star. Flrsulm/pyrxsulm/flurxypyr is florasulam/pyroxsulam/fluroxypyr and is sold as GoldSky. MCPA LVE is sold as Rhonox. AMS contains ammonium sulfate and crop oil and is sold as Class Act NG. Thifensulfuron/tribenuron-1 is a 1:1 formulation and sold as Affinity Broadspec. Bromoxynil/MCPA is a 1:1 formulation and sold as Bronate Advanced. Bromoxynil/pyrasulfotole is sold as Huskie.

Broadleaf weed control in spring wheat with A19278A**.** Drew Lyon, Brianna Cowan, Rod Rood and Henry Wetzel (Crop and Soil Sciences Department, Washington State University, Pullman, WA, 99164) A field study was conducted on the WSU Cook Agronomy Farm near Pullman, WA to evaluate the efficacy of an experimental herbicide from Syngenta on broadleaf weeds. The soil at the site is a Palouse silt loam with 4.2% organic matter and a pH of 5.0. On April 7, the study area received an application of glyphosate (0.84 lb ae/acre) plus AMS (12 lb per 100 gallons finished spray solution). On April 15, 90 lb/acre 'Diva' spring wheat was planted at a depth of 1.5 using a Horsch air drill with 12-inch row spacing. Fertilizer was applied concurrently at 100, 10 and 15 lb/acre of N:P:K. The experimental design was a randomized complete block with four replications. Plots were eight feet wide by 35 feet in length, trimmed to 33 feet prior to harvest. On May 20, herbicide applications were made using a CO_2 backpack sprayer set to deliver 15 gpa using a spray boom equipped with four, TeeJet XR11002 nozzles on a 20-inch spacing. Conditions were an air temperature of 68°F, relative humidity of 30% and the wind out of the west at 2 mph. The wheat was 6 to 8 inches tall and in the 2-leaf stage. Weeds present at the time of application were common lambsquarters (CHEAL) at 1- to 2-inch diameter and mayweed chamomile (ANTCO) at 1-inch diameter. Plots were harvested on August 22 using a Kincaid 8XP small plot combine.

No crop injury was observed in this experiment (data not shown). All treatments provided excellent control of CHEAL and ANTCO. No significant differences in grain yield were observed. Syngenta's A19278A applied with or without A20916A plus COC, caused no crop injury and provided excellent control of CHEAL and ANTCO.

Broadleaf weed control in spring wheat with A19278A

Treatment[1]	Rate	July 2: Common lambsquarters control	July 2: Mayweed chamomile control	August 22: Yield
	lb ae/a	---%---		bu/a
A19278A	0.19	99	94	32
A20916A	0.2% v/v			
COC	1.0% v/v			
A19278A	0.22	100	98	30
A20916A	0.2% v/v			
COC	1.0% v/v			
A19278A	0.25	100	100	39
A20916A	0.2% v/v			
COC	1.0% v/v			
Pyrasulfotole/bromoxynil	0.18 lb ai	100	95	35
NIS (1)	0.5% v/v			
AMS	1 lb			
Pyrasulfotole/bromoxynil	0.18 lb ai	99	91	31
MCPA Ester	0.37			
A19278A	0.19	100	99	32
Pinoxaden/fluroxypyr	0.15 lb ai			
A19278A	0.19	100	99	34
MCPA Ester	0.37			
Pyrasulfotole/bromoxynil	0.22 lb ai	100	96	36
NIS (2)	0.25% v/v			
UAN	32 fl oz			
Pyrasulfotole/bromoxynil	0.24 lb ai	100	95	39
NIS (2)	0.25% v/v			
UAN	32 fl oz			
Nontreated Check	.	.	.	31
LSD (5%)		ns	ns	ns

[1] All treatments were applied POSPOS on May 20.

Italian ryegrass control in spring wheat. Traci A. Rauch and Joan M. Campbell. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in 'Diva' spring wheat near Moscow, ID to evaluate Italian ryegrass control with pyroxasulfone alone and in combinations with flucarbazone, pinoxaden, and pyroxsulam/florasulam/fluroxypyr. 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). Crop injury and Italian ryegrass control were evaluated visually during the growing season.

Table 1. Application and soil data.

S. wheat-variety/seeding date	Diva – 4/21/14		
Application date	5/1/14	5/14/14	5/22/14
Growth stage			
Spring wheat	preemergence- germinated	1 leaf	3 leaf
Italian ryegrass (LOLMU)	preemergence -germinated	spike	3 leaf
Air temperature (F)	80	72	79
Relative humidity (%)	32	38	46
Wind (mph, direction)	2, SE	2, S	1, NW
Cloud cover (%)	20	10	0
Soil moisture	good	good	good
Soil temperature at 2 inch (F)	52	56	75
pH		4.9	
OM (%)		5.2	
CEC (meq/100g)		16.6	
Texture		silt loam	

On May 30, flucarbazone + ARY-0547-102 (thifensulfuron/tribenuron at 1:1 ratio) alone or combined with pyroxasulfone preemergence injured spring wheat 5% (Table 2). Pyroxsulam/florasulam/fluroxypyr treatments injured spring wheat 10%. By July 8, no spring wheat injury was visible (data not shown). No treatment at any application time adequately controlled Italian ryegrass. Pinoxaden alone or combined with pyroxasulfone suppressed Italian ryegrass 72% and did not differ from pyroxasulfone applied preemergence followed by flucarbazone + ARY-0547-102 at the 3 leaf stage (65%).

Table 2. Italian ryegrass control in spring wheat with pyroxasulfone alone or in combination near Moscow, ID in 2014.

Treatment[1]	Rate	Application timing[2]	Spring wheat injury[3]	Italian ryegrass control[4]
	lb ai/A		%	%
Pyroxasulfone	0.053	preemergence	0	39
Pyroxasulfone	0.066	preemergence	0	45
Pyroxasulfone +	0.053	preemergence		
flucarbazone +	0.027	3 leaf		
ARY-0547-102	0.0125	3 leaf	5	65
Pyroxasulfone +	0.053	preemergence		
pinoxaden	0.054	3 leaf	0	72
Pyroxasulfone +	0.053	preemergence		
Pyroxsulam/fluroxypyr/florasulam	0.105	3 leaf	10	45
Pyroxasulfone +	0.053	1 leaf		
flucarbazone +	0.027	1 leaf		
ARY-0547-102	0.0125	1 leaf	0	32
Flucarbazone +	0.027	3 leaf		
ARY-0547-102	0.0125	3 leaf	5	42
Pinoxaden	0.054	3 leaf	0	72
Pyroxsulam/fluroxypyr/florasulam	0.105	3 leaf	10	50
LSD (0.10)			1	18
Density (plants/ft^2)				10

[1]Flucarbazone and pyroxsulam/florasulam/fluroxypyr treatments were applied with ammonium sulfate at 1 lb ai/A and nonionic surfactant at 0.25% v/v. ARY-0547-102 is thifensulfuron/tribenuron at 1:1 ratio.
[2]Application timing based on wheat growth stage. Delayed pre = seed germinated but not emerged.
[3]Evaluation date May 30, 2014.
[4]Evaluation date July 8, 2014.

Pyroxasulfone on spring wheat – crop safety and efficacy on Italian ryegrass. Kyle C. Roerig, Andrew G. Hulting, Daniel W. Curtis, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis OR 97331) In 2014 pyroxasulfone received registration in spring and winter wheat. Crop safety and weed control efficacy of pyroxasulfone on winter wheat in western Oregon is well documented. However, at the time of registration no trial had been conducted in western Oregon with pyroxasulfone in spring wheat. Therefore, This trial was conducted to evaluate pyroxasulfone in spring wheat under local conditions. The product label requires waiting until at least 80% of germinated seed have at least a 0.5 inch shoot in both spring and winter wheat. Past results indicate that an application of pyroxasulfone prior to germination is safe on winter wheat in western Oregon. 'Louise' spring wheat was planted and over seeded with Italian ryegrass on March 24, 2014, near Corvallis, Oregon. The first application of pyroxasulfone was made prior to germination at a rate that has been shown to be safe on winter wheat at that timing. Other treatments followed label recommendations. All applications of pyroxasulfone controlled Italian ryegrass. Early preemergent application reduced wheat emergence and reduced yield by 36 bushels per acre, compared to the untreated check. No injury or yield reduction was observed in the other treatments.

Table. Timings and tank mix applications of pyroxasulfone to spring wheat.

	Rate	Applied	Italian ryegrass[a] control	Spring wheat[b] yield
	lb ai/a		%	bu/a
Check			0	107
Pyroxasulfone	0.093	pre-germ[c]	100	71
Pyroxasulfone	0.0664	germinated [d]	100	119
Pyroxasulfone	0.0664	germinated	100	117
+ pyroxasulfone	0.0664	spike[e]		
Pyroxasulfone	0.106	spike	100	113
Pyroxasulfone	0.106	three leaf[f]	100	119
+ pinoxaden	0.054	three leaf		
Pyroxasulfone	0.106	three leaf	100	115
+ flucarbazone	0.0273	three leaf		
Pyroxasulfone	0.106	three leaf	100	118
+ florasulam-fluroxypyr-pyroxsulam	0.105	three leaf		
LSD (P=.05)			0	10.0

[a]Evaluated 6/5/2014
[b]Harvested 8/20/2014
[c]Applied 3/26/2014, prior to wheat germination
[d]Applied 4/2/2014, when 80% of germinated seed had at least a 0.5 inch shoot
[e]Applied 4/8/2014, at wheat spiking
[f]Applied 4/21/2014, to three leaf wheat

Wild oat control in spring wheat with flucarbazone-sodium. Drew Lyon, Brianna Cowan, Derek Appel, Rod Rood and Henry Wetzel (Crop and Soil Sciences Department, Washington State University, Pullman, WA, 99164) A study was conducted near Egypt, WA to determine the efficacy of flucarbazone-sodium on wild oat (AVEFA) in spring wheat. The soil at the site is a Broadax silt loam with 8.2% organic matter and a pH of 6.7. On May 17, 75 lb/acre 'Diva' soft white spring wheat was planted to a one inch depth using a Yielder 1818 drill on a 10-inch row spacing. Fertilizer was applied concurrently at a depth of three inches at 60, 10 and 10 lb/acre N:P:S. The experimental design was a randomized complete block with four replications. Plots were eight feet wide by 35 feet in length, trimmed to 33 feet prior to harvest. An early post-emergence (EPOST) herbicide application was made on June 6 with air temperature 78°F, relative humidity 18% and wind from the northeast at 5 to 7 mph. Wheat was at the three-leaf stage and wild oat had two leaves. A late post-emergence (LPOST) herbicide application was made on June 20 with air temperature was 66°F, relative humidity 60%, and the wind was from the south at 4 to 9 mph. The wheat had four to eight tillers and was 11 to 12 inches tall. The wild oat had two to five tillers and was four to seven inches tall. All herbicide applications were completed using a CO_2 backpack sprayer set to deliver 15 gpa using a spray boom equipped with four, TeeJet XR11002 nozzles on a 20-inch spacing. Plots were harvested on August 27 using a Kincaid 8XP plot combine.

On June 28, significant crop injury was observed with all LPOST treatments except pinoxaden. By July 16, no significant crop injury was observed in any treatment. On June 28, wild oat control with all EPOST treatments was excellent, but insufficient time had elapsed following the LPOST treatments to accurately evaluate control. On July 16, all EPOST treatments were still providing excellent control of wild oat, as were all LPOST treatments except for flucarbazone-sodium plus thifensulfuron/tribenuron or florasulam/fluroxypyr/pyroxsulam, which were providing fair to good control. For these last two treatments, the two week delay in application between EPOST and LPOST treatments resulted in a significant reduction in wild oat control. No significant differences in grain yield were observed.

Table. Wild oat control in spring wheat with flucarbazone-sodium.

Treatment	Rate	Timing[1]	June 28 Crop injury	June 28 Wild oat control	July 16 Crop injury	July 16 Wild oat control	Aug 27 Yield
	lb ai/a						bu/a
Flucarbazone-sodium	0.027	EPOST	6	100	0	94	55
NIS	0.25% v/v						
AMS	1 lb						
Flucarbazone-sodium	0.027	EPOST	4	100	0	100	51
Thifensulfuron/ tribenuron	0.012						
NIS	0.25% v/v						
AMS	1 lb						
Florasulam/fluroxypyr/ pyroxsulam	0.1	EPOST	5	100	0	99	65
NIS	0.25% v/v						
AMS	1 lb						
Pinoxaden	0.054	EPOST	1	100	0	100	59
Flucarbazone-sodium	0.98	LPOST	13	38	0	95	47
NIS	0.25% v/v						
AMS	1 lb						
Flucarbazone-sodium	0.027	LPOST	9	30	0	83	53
Thifensulfuron/ tribenuron	0.012						
NIS	0.25% v/v						
AMS	1 lb						
Florasulam/fluroxypyr/ pyroxsulam	0.1	LPOST	18	43	1	78	54
NIS	0.25% v/v						
AMS	1 lb						
Pinoxaden	0.054	LPOST	4	50	0	99	55
Nontreated check	.		.	.	.	.	56
LSD (5%)			7	9	ns	14	ns

[1] Treatments were applied on June 6 and 20, EPOST and LPOST, respectively.

Italian ryegrass control with pyroxasulfone/carfentrazone in wheat. Traci A. Rauch and Joan M. Campbell. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established to evaluate Italian ryegrass (LOLMU) control with pyroxasulfone/carfentrazone in winter wheat near Moscow and spring wheat near Potlatch, 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). At Moscow, the entire study was oversprayed 5 days after planting with glyphosate at 0.77 lb ae/A. Both sites were oversprayed with pyrasulfotole/bromoxynil at 0.21 lb ai/A, clopyralid/fluroxypyr at 0.188 lb ae/A and thifensulfuron/tribenuron at 0.031 lb ai/A for broadleaf weed control on May 15 at Moscow and June 16, 2014 at Potlatch. Wheat injury, Italian ryegrass and mayweed chamomile control were evaluated visually during the growing season. Grain was harvested with a small plot combine on August 18 at Moscow and September 8, 2014 at Potlatch.

Table 1. Application and soil data.

Location	Moscow, ID			Potlatch, ID			
Wheat variety – seeding date	Winter-'Trifecta' – 10/10/13			Spring – 'Whit' – 5/1/14			
Application date	10/9/13	10/16/13	5/2/14	5/1/14	5/8/14	5/22/14	6/5/14
Application timing	preplant	postplant pre	postemergence	preplant	postplant pre	early post	late post
Wheat	--	pre	1 tiller	--	pre	1 tiller	2 tiller
Mayweed chamomile	--	--	--	pre	pre	0.5 inch	2 inch
Italian ryegrass	pre	pre	3 leaf	pre	pre	2 leaf	3 leaf
Air temperature (F)	50	61	69	75	58	81	63
Relative humidity (%)	81	54	54	42	69	28	63
Wind (mph, direction)	0	1, SW	0	2, S	4, ESE	0	2, SW
Cloud cover (%)	30	60	10	10	100	0	0
Soil moisture	adequate	adequate	adequate	adequate	adequate	adequate	adequate
Soil temperature at 2 inch (F)	40	45	52	50	44	59	59
Dew present?	no	no	yes	no	no	no	no
Next rain occurred	10/9/13	11/2/13	5/4/14	5/4/14	5/28/14	5/28/14	6/17/14
pH	4.7			4.6			
OM (%)	4.4			4.0			
CEC (meq/100g)	14.1			14.8			
Texture	silt loam			silt loam			

At Moscow, pyroxasulfone/carfentrazone preplant and postplant pre treatments, except alone preplant at 0.094 lb ai/A and alone postplant pre at 0.078 lb ai/A, injured winter wheat 10 to 16% (Table 2). By mid-June, strips of winter wheat were drying down at a faster rate in portions of some of the plots making injury ratings confounded. The winter wheat dry down was caused by gravel strips in the soil. Italian ryegrass control was 90% or greater with all preplant and postplant pre treatments. Winter wheat yield and test weight were confounded by the gravel strips.

At Potlatch, pyroxasulfone/carfentrazone preplant and pyroxasulfone/carfentrazone + pyroxsulam/fluroxypyr/florasulam treatments injured wheat 5 to 12% on June 4 (Table 3). By July 14, only flucarbazone + pyroxsulam/fluroxypyr/florasulam caused 14% wheat injury. Pyrasulfotole/bromoxynil and pyroxsulam/fluroxypyr/florasulam treatments, except at the 2 tiller timing, controlled mayweed chamomile 90% or greater. Pyroxasulfone/carfentrazone + sulfentrazone suppressed mayweed chamomile 77%. On June 5, pyroxasulfone/carfentrazone preplant alone or in combination controlled Italian ryegrass 84 to 94%, while pyroxasulfone/carfentrazone applied postplant pre or postemergence with pyroxsulam/fluroxypyr/florasulam and flucarbazone + pyroxsulam/fluroxypyr/florasulam controlled Italian ryegrass 71 to 89%. By July 14, pyroxsulam/fluroxypyr/florasulam combined with flucarbazone or pyroxasulfone/carfentrazone preplant suppressed Italian ryegrass 70 and 71%, respectively. No treatment controlled Italian ryegrass by that date. Spring wheat yield was 33 to 40% greater in all pyroxasulfone/carfentrazone preplant treatments compared to the untreated check. Wheat test weight did not differ between treatments including the untreated check.

Table 2. Winter wheat response and Italian ryegrass control with pyroxasulfone/carfentrazone near Moscow, ID in 2014.

Treatment[1]	Rate	Application timing[2]	Wheat injury[3]	LOLMU control[4]	Wheat[5] Yield	Wheat[5] Test weight
	lb ai/A		%	%	bu/A	lb/bu
Pyroxasulfone/carfentrazone	0.094	preplant	6	92	35	58.3
Pyroxasulfone/carfentrazone	0.117	preplant	12	94	36	58.6
Pyroxasulfone/carfentrazone	0.078	postplant pre	5	94	38	58.5
Pyroxasulfone/carfentrazone	0.117	postplant pre	11	92	34	58.7
Pyroxasulfone/carfentrazone +	0.094	postplant pre				
sulfentrazone	0.125	postplant pre	16	94	32	57.9
Pyroxasulfone/carfentrazone +	0.094	postplant pre				
pyrasulfotole/bromoxynil +	0.241	1 tiller				
MCPA ester	0.463	1 tiller	12	94	34	58.0
Pyroxasulfone/carfentrazone +	0.094	preplant				
pyroxsulam	0.105	1 tiller	10	92	32	57.6
Pyroxasulfone/carfentrazone +	0.078	postplant pre				
pyroxsulam	0.105	1 tiller	14	90	34	58.3
Pyroxasulfone/carfentrazone +	0.094	1 tiller				
pyroxsulam	0.105	1 tiller	4	66	32	57.7
Flucarbazone +	0.027	1 tiller				
pyroxsulam	0.105	1 tiller	0	44	32	58.3
Pyrasulfotole/bromoxynil +	0.241	1 tiller				
MCPA ester	0.463	1 tiller	0	--	27	57.2
Untreated check			--	--	32	58.7
LSD (0.05)			9	13	NS	NS
Density (plants/ft^2)				20		

[1]A 90% nonionic surfactant at 0.25% v/v and ammonium sulfate at 1.5 lb ai/A was applied with pyroxsulam.

[2]Application timing based on winter wheat growth stage. Preplant = 1 day before planting. Postplant pre = post-plant preemergence wheat that was germinated.

[3]Wheat injury evaluated on May 16, 2014

[4]LOLMU = Italian ryegrass. Evaluation date May 16, 2014. Pyrasulfotole/bromoxynil + MCPA ester does not control grass weeds and therefore was excluded from the Italian ryegrass control analysis.

[5]Wheat yield and test weight confounded by differential dry down in random strips thought out study.

Table 3. Spring wheat response, mayweed chamomile and Italian ryegrass control with pyroxasulfone/carfentrazone near Potlatch, ID in 2014.

Treatment[1]	Rate	Application timing[2]	Wheat injury		Weed control			Wheat	
						LOLMU[4]			
			June 4	July 14	ANTCO[3]	6/5	7/14	Yield	Test weight
	lb ai/A		%	%	%	%	%	bu/A	lb/bu
Pyroxasulfone/carfentrazone	0.094	preplant	5	2	20	84	35	40	61.3
Pyroxasulfone/carfentrazone	0.117	preplant	5	1	42	89	68	43	61.2
Pyroxasulfone/carfentrazone	0.078	postplant pre	0	5	45	20	28	32	60.9
Pyroxasulfone/carfentrazone	0.117	postplant pre	0	4	42	18	43	33	60.8
Pyroxasulfone/carfentrazone +	0.094	postplant pre							
sulfentrazone	0.125	postplant pre	1	2	77	22	32	34	61.1
Pyroxasulfone/carfentrazone +	0.094	postplant pre							
pyrasulfotole/bromoxynil +	0.241	1 tiller							
MCPA ester	0.463	1 tiller	0	2	95	30	31	33	60.7
Pyroxasulfone/carfentrazone +	0.094	preplant							
pyroxsulam/fluroxypyr/florasulam	0.105	1 tiller	12	2	95	94	71	39	60.7
Pyroxasulfone/carfentrazone +	0.078	postplant pre							
pyroxsulam/fluroxypyr/florasulam	0.105	1 tiller	6	5	94	89	51	38	60.8
Pyroxasulfone/carfentrazone +	0.094	1 tiller							
pyroxsulam/fluroxypyr/florasulam	0.105	1 tiller	6	1	90	71	38	32	61.1
Flucarbazone +	0.027	1 tiller							
pyroxsulam/fluroxypyr/florasulam	0.105	2 tiller	2	14	40	75	70	37	61.2
Pyrasulfotole/bromoxynil +	0.241	1 tiller							
MCPA ester	0.463	1 tiller	0	0	95	--	--	24	60.6
Untreated check			--	--	--	--	--	26	60.6
LSD (0.05)			4	7	19	23	22	7	NS
Density (plants/ft^2)					10	30			

[1]A 90% nonionic surfactant at 0.25% v/v and ammonium sulfate at 1 lb ai/A was applied with pyroxsulam/fluroxypyr/florasulam and flucarbazone treatments.
[2]Application timing based on wheat growth stage. Preplant = 4 hours before planting. Postplant pre = post-plant preemergence wheat that was germinated.
[3]ANTCO = mayweed chamomile. Evaluation date June 4, 2014
[4]LOLMU = Italian ryegrass. Pyrasulfotole/bromoxynil + MCPA ester does not control grass weeds and therefore was excluded from the Italian ryegrass control analysis.

Rattail fescue and downy brome control in winter wheat. Traci A. Rauch and Joan M. Campbell. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in 'Ovation' winter wheat to evaluate rattail fescue and downy brome control with flucarbazone, flufenacet/metribuzin and pyroxasulfone combinations near Moscow, ID. The plots were arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The entire study was oversprayed on May 7, 2014 with pyrasulfotole/bromoxynil at 0.19 lb ai/A and thifensulfuron/tribenuron at 0.025 lb ai/A for broadleaf weed control and with azoxystrobin/propiconazole at 0.09 lb ai/A for stripe rust control. Crop injury, rattail fescue and downy brome control were evaluated visually during the growing season.

Table 1. Application and soil data.

Winter wheat seeding date		10/15/13	
Application date	10/24/13	5/1/14	5/13/14
Growth stage			
Winter wheat	pre (seed germinated)	3 tiller	3 tiller
Rattail fescue (VLPMY)	pre	1 tiller	2 tiller
Downy brome (BROTE)	pre	1 tiller	2 tiller
Air temperature (F)	65	39	61
Relative humidity (%)	56	98	50
Wind (mph, direction)	1, E	0	3, N
Cloud cover (%)	0	0	20
Dew present?	no	yes	no
Soil moisture	adequate	adequate	adequate
Soil temperature at 2 inch (F)	45	40	45
Next rain occurred	11/2/13	5/4/14	5/28/14
pH		4.5	
OM (%)		3.6	
CEC (meq/100g)		16	
Texture		silt loam	

Flufenacet/metribuzin and pyroxasulfone treatments, except pyroxasulfone + pinoxaden, injured wheat 15 to 34% (Table 2). Shallow seeding, lack of row closure, and a thick rattail fescue residue layer (poor seed to soil contact) increased the level of injury caused by the herbicides. Flufenacet/metribuzin alone at 0.0425 lb ai/A, flufenacet/metribuzin and pyroxasulfone combinations (except with pinoxaden), flucarbazone treatments, and pyroxsulam at the 2 tiller timing controlled rattail fescue 86 to 99%. Pyroxsulam at the 1 tiller timing and pyroxasulfone or flufenacet/metribuzin combined with pyroxsulam or flucarbazone plus ARY-0547-102 (thifensulfuron/tribenuron at a 1 to 1 ratio) controlled downy brome 91 to 94%. Pinoxaden or flucarbazone alone and ARY-0454-122 (new flucarbazone formulation) + ARY-0547-102 did not control downy brome.

Table 2. Rattail fescue control in winter wheat with flucarbazone, flufenacet/metribuzin, and pyroxasulfone combinations near Moscow, ID in 2014.

Treatment[1]	Rate	Application timing[2]	Wheat injury	Rattail fescue control[3]	Downy brome control[4]
	lb ai/A		%	%	%
Flufenacet/metribuzin	0.34	pre	15	48	83
Flufenacet/metribuzin	0.425	pre	19	98	90
Pyroxasulfone	0.067	pre	21	78	80
Flufenacet/metribuzin +	0.34	pre			
flucarbazone +	0.27	2 tiller			
ARY-0547-102	0.0125	2 tiller	34	98	94
Pyroxasulfone +	0.067	pre			
flucarbazone +	0.027	2 tiller			
ARY-0547-102	0.0125	2 tiller	21	99	93
Flufenacet/metribuzin +	0.34	pre			
pyroxsulam	0.0164	2 tiller	28	93	94
Pyroxasulfone +	0.067	pre			
pyroxsulam	0.0164	2 tiller	21	98	91
Flufenacet/metribuzin +	0.34	pre			
pinoxaden	0.054	2 tiller	20	75	80
Pyroxasulfone +	0.067	pre			
pinoxaden	0.054	2 tiller	2	80	84
ARY-0454-122+	0.027	1 tiller			
ARY-0547-102	0.0125	1 tiller	0	91	46
Flucarbazone +	0.027	1 tiller			
ARY-0547-102	0.0125	1 tiller	6	86	66
Pyroxsulam	0.0164	1 tiller	8	53	91
Flucarbazone	0.027	2 tiller	12	90	46
Flucarbazone +	0.027	2 tiller			
ARY-0547-102	0.0125	2 tiller	13	95	80
Pyroxsulam	0.0164	2 tiller	10	90	72
Pinoxaden	0.054	2 tiller	5	6	35
LSD (0.05)			14	32	26
Density (plants/ft^2)				15	10

[1]Glyphosate at 0.75 lb ae/A and ammonium sulfate at 1 lb ai/A were applied to the entire study at the preemergence timing, except the untreated check plots. ARY-0547-102 is a 1:1 ratio of thifensulfuron and tribenuron. ARY-0454-122 is a new formulation of flucarbazone. A non-ionic surfactant at 0.25% v/v and ammonium sulfate at 1 lb ai/A were applied with flucarbazone and pyroxsulam treatments.

[2]Application timing based on grass weed growth stage.

[3]Evaluation date June 28, 2014. Only 3 replications were analyzed.

[4]Evaluation date May 27, 2014.

Italian ryegrass control with flumioxazin and pyroxasulfone in winter wheat. Traci A. Rauch and Joan M. Campbell. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established in winter wheat to evaluate Italian ryegrass control with flumioxazin, pyroxasulfone, and flufenacet/metribuzin. 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). Fertilizer was applied with the seed drill in the direct seed system and before planting in the conventional tillage systems. Crop injury and weed control were evaluated visually during the growing season.

Table 1. Application and soil data.

Location	Moscow, ID	Genesee, ID	Lapwai, ID
Tillage system	conventional	conventional	direct seed
Winter wheat-variety/seeding date	'Trifecta' – 10/10/13	'Ovation' - 10/14/13	'Ovation' - 10/17/13
Application date	11/1/13	11/11/13	10/22/13
Growth stage			
Winter wheat	spike	spike	preemergence - not germinated
Italian ryegrass (LOLMU)	spike	spike	preemergence - not germinated
Mayweed chamomile (ANTCO)	--	--	preemergence - not germinated
Air temperature (F)	53	54	64
Relative humidity (%)	72	82	65
Wind (mph, direction)	1, S	0	1, NE
Cloud cover (%)	0	60	0
Soil moisture	adequate	wet	dry
Soil temperature at 2 inch (F)	34	42	45
Next moisture occurred on:	11/2/13	11/16/13	11/2/13
pH	4.7	5.0	5.0
OM (%)	4.4	4.0	3.7
CEC (meq/100g)	14.1	18.6	21.1
Texture	silt loam	silt loam	silt loam

At Moscow on May 16, pyroxasulfone plus flumioxazin at 0.048 lb ai/A and flufenacet/metribuzin injured wheat 22 and 28%, respectively, but did not differ from pyroxasulfone plus flumioxazin at 0.032 ib ai/A (18%) (Table 2). By mid-June, strips of winter wheat were drying down at a faster rate in portions of some of the plots making injury ratings confounded. The accerlated winter wheat dry down was caused by gravel strips in the soil. All treatments, except flumioxazin alone, controlled Italian ryegrass 86 to 93%.

At Genesee on May 20, pyroxasulfone plus flumioxazin at 0.048 lb ai/A injured wheat 17% (Table 2). By June 23, no wheat injury was visible (data not shown). At Genesee, Italian ryegrass control ranged from 74 to 90% with all treatments except flumioxazin alone (41%).

At Lapwai on May 16, flufenacet/metribuzin and pyroxasulfone flumioxazin combinations injured winter wheat 12 to 30% (Table 3). By July 7, wheat injury (19 to 29%) was still visible with pyroxasulfone flumioxazin combinations only. All treatments containing pyroxasulfone controlled Italian ryegrass 88 to 95%. Flufenacet/metribuzin suppressed Italian ryegrass 72%. Flumioxazin alone did not control Italian ryegrass (45%).

Table 2. Winter wheat injury and Italian ryegrass control with flumioxazin, pyroxasulfone, and flufenacet/ metribuzin in conventional tillage systems in 2014.

		Winter wheat injury		Italian ryegrass control	
Treatment	Rate	Moscow[1]	Genesee[2]	Moscow[3]	Genesee[4]
	lb ai/A	%	%	%	%
Flumioxazin	0.032	10	8	57	41
Pyroxasulfone	0.053	10	0	91	78
Pyroxasulfone +	0.053				
flumioxazin	0.032	18	8	86	87
Pyroxasulfone +	0.053				
flumioxazin	0.048	22	17	93	90
Flufenacet/metribuzin	0.425	28	2	91	73
LSD (0.06)		11	8	12	20
Density (plants/ft^2)				15	10

[1]Evaluation date May 16, 2014.
[2]Evaluation date May 20, 2014. Only three replications were analyzed.
[3]Evaluation date May 16, 2014. Only three replications were analyzed.
[4]Evaluation date July 15, 2014.

Table 3. Winter wheat injury, mayweed chamomile and Italian ryegrass control with flumioxazin, pyroxasulfone, and flufenacet/metribuzin in a direct seed system near Lapwai, ID in 2014.

		Winter wheat injury		ANTCO	LOLMU
Treatment	Rate	May 16	July 7	control[1]	control[1]
	lb ai/A	%	%	%	%
Flumioxazin	0.032	0	0	60	45
Pyroxasulfone	0.08	4	5	38	88
Pyroxasulfone/flumioxazin	0.143	30	29	92	95
Pyroxasulfone +	0.08				
flumioxazin	0.032	15	19	88	90
Flufenacet/metribuzin	0.34	12	8	28	72
LSD (0.05)		9	8	15	20
Density (plants/ft^2)				8	10

[1]Evaluation date May 16, 2014. ANTCO = mayweed chamomile. LOLMU = Italian ryegrass.

Cereal rye control winter wheat. Traci A. Rauch and Joan M. Campbell. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in two gene imidazolinone-tolerant 'WB 1081' winter wheat near Kendrick, ID to evaluate cereal rye control with imazamox. Cereal rye has been difficult to control in single-gene imidazolinone-tolerant winter wheat due to winter wheat injury from fall applications of imazamox. 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). Crop injury and cereal rye control were evaluated visually during the growing season.

Table 1. Application and soil data.

W. wheat variety/seeding date	'WB 1081' – 10/11/13		
Application date	10/30/13	11/11/13	5/2/14
Growth stage			
Winter wheat	spike	1 leaf	5 tiller
Cereal rye	preemergence	1 leaf	7 tiller
Air temperature (F)	47	52	76
Relative humidity (%)	52	83	64
Wind (mph, direction)	0	3, SW	1, SW
Cloud cover (%)	10	20	30
Soil moisture	good	good	good
Soil temperature at 2 inch (F)	34	40	55
Next moisture occurred on:	11/2/13	11/23/13	5/4/14
pH		5.1	
OM (%)		4.2	
CEC (meq/100g)		23.9	
Texture		silt loam	

No treatment at any timing injured winter wheat (data not shown). Imazamox split and spring applications controlled cereal rye 99% (Table 2). Pyroxasulfone did not control cereal rye.

Table 2. Cereal rye control in winter wheat with imazamox near Kendrick, ID in 2014.

Treatment[1]	Rate	Application timing[2]	Cereal rye control[3]
	lb ai/A		%
Pyroxasulfone	0.08	preemergence	5
Imazamox	0.094	1 leaf	65
Imazamox +	0.078	1 leaf	
imazamox	0.047	7 tiller	99
Imazamox +	0.0625	1 leaf	
imazamox	0.0625	7 tiller	99
Imazamox +	0.047	1 leaf	
imazamox	0.078	7 tiller	99
Imazamox	0.094	7 tiller	99
Imazamox	0.125	7 tiller	99
LSD (0.10)			12
Density (plants/ft^2)			1

[1]Imazamox 1 leaf timing treatments were applied with ammonium sulfate at 1 lb ai/A and nonionic surfactant at 0.25% v/v. Imazamox 7 tiller timing treatments were applied with ammonium sulfate at 1 lb ai/A and modified seed oil at 1% v/v.

[2]Application timing based on cereal rye growth stage.

[3]Evaluation date July 18, 2014.

Management of multiple resistant annual ryegrass with pyroxasulfone. Kyle C. Roerig, Andrew G. Hulting, Daniel W. Curtis, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis OR 97331) Herbicide resistant Italian ryegrass remains a severe problem wheat fields in western Oregon. As demonstrated by this and other trials flufenacet-metribuzin and pyroxsulam provide unacceptable control in many wheat fields. Pyroxasulfone (Zidua) is a new group 15 herbicide registered for pre and early post-emergent control of grass weeds in wheat. This trial was a continuation of several years of studying pyroxasulfone in winter wheat. Results in this trial were similar to results from previous trials in different locations with different populations of Italian ryegrass. This trial was conducted in a winter wheat field near Amity, Oregon, planted October 18, 2012. Pre-emergent treatments applied October 25, 2012. Post-emergent applications were applied December 24, 2012 to one tiller wheat. All pyroxasulfone + pyroxsulam treatments controlled 98% or more Italian ryegrass and these plots yielded 105 bushels per acre or more. Flufenacet-metribuzin + pyroxsulam provided poor control of Italian ryegrass and plots yielded 72 bushels per acre. Pyroxsulam alone provided no visually discernible control and these plots yield only 45 bushels per acre. Flufenacet-metribuzin and pyroxsulam provide excellent control of susceptible populations of Italian ryegrass either alone or in combination. In fields where resistant Italian ryegrass is present, pyroxasulfone stands to have a significant positive effect on yield; however, the potential for resistance to pyroxasulfone seems high.

Table. Pyroxasulfone applied to multiple resistant Italian ryegrass.

	Rate	Applied	Italian ryegrass[a] control	Winter wheat[b] yield
	lb ai/a		%	bu/a
Check			0	28
Pyroxasulfone	0.08	10/25/2012	99	105
+ pyroxsulam	0.0164	12/24/2012		
Pyroxasulfone	0.093	10/25/2012	98	111
+ pyroxsulam	0.0164	12/24/2012		
Pyroxasulfone	0.106	10/25/2012	99	110
+ pyroxsulam	0.0164	12/24/2012		
Pyroxasulfone	0.093	10/25/2012	98	111
+ saflufenacil	0.0445	10/25/2012		
+ pyroxsulam	0.0164	12/24/2012		
Flufenacet-metribuzin	0.426	10/25/2012	36	72
+ pyroxsulam	0.0164	12/24/2012		
Flufenacet-metribuzin	0.426	10/25/2012	18	52
+ pendimethalin	0.71	10/25/2012		
+ pyroxsulam	0.0164	12/24/2012		
Pendimethalin	0.71	10/25/2012	8	29
+ pyroxsulam	0.0164	12/24/2012		
Pendimethalin	1.43	10/25/2012	0	45
+ pyroxsulam	0.0164	12/24/2012		
Pyroxasulfone	0.08	10/25/2012	99	112
+ pendimethalin	0.71	10/25/2012		
+ pyroxsulam	0.0164	12/24/2012		
Pyroxsulam	0.0164	12/24/2012	0	45
LSD (P=.05)			16.6	19.2

[a]Evaluated 6/5/2013
[b]Harvested 7/31/2014

Weed seed management during winter wheat harvest. Kyle C. Roerig, Andrew G. Hulting, Daniel W. Curtis, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis OR 97331) Italian ryegrass resistant to multiple herbicide sites of action continues to limit winter wheat production in western Oregon. Italian ryegrass resistant to diclofop was first documented in western Oregon in 1987 (Stanger and Appleby 1989), after less than 10 years of use. Since that time the list of herbicides Italian ryegrass populations have been documented to be resistant to has grown to include diclofop (WSSA group 1), diuron (WSSA group 7), flucarbazone (WSSA group 2), flufenacet (WSSA group 15), mesosulfuron (WSSA group 2), pinoxaden (WSSA group 1), propoxycarbazone (WSSA group 2) and pyroxsulam (WSSA group 2). For example in a 2013 wheat field trial, plots treated with pyroxsulam alone and flufenacet-metribuzin followed by pyroxsulam yielded 45 and 72 bu/a respectively. Untreated plots and plots where Italian ryegrass was controlled yielded 28 and 110 bu/a respectively (Roerig et al. unpublished data). In 2014, pyroxasulfone a new group 15 herbicide that provides pre-emergent and early post-emergent control of grass weeds, including those resistant to flufenacet, was registered for use in wheat. Previous patterns of resistance development in Italian ryegrass indicate that Italian ryegrass will likely develop resistance to pyroxasulfone as well. An Italian ryegrass plant does not have the means to distribute its seed more than a few feet, however harvest equipment does. This factor makes harvest equipment important in the distribution of resistant Italian ryegrass. Some progress has been made in controlling weeds seeds in the chaff, such as use of chaff collection carts, narrow windrow burning and placing the chaff on top of the straw for baling. Additionally, the Harrington Seed Destructor has been in limited use in Australia for several years. This device routes chaff exiting the combine through a cage mill where 90-99% of weeds seeds are destroyed (Walsh et al. 2012). There has also been discussion of major equipment manufacturers integrating milling or microwave systems to destroy weed seeds into the combines they manufacture. This type of equipment may become available for growers in the Pacific Northwest in the future.

Two trials were initiated to test the feasibility and efficacy of weed seed management at harvest. The first was started in 2012. ‘Goetze’ winter wheat was planted with Italian ryegrass on a 7.2 acre field at the Hyslop Research Farm, near Corvallis, Oregon. The trial area has been maintained according to grower standards including fertilizer, fungicide applications and broadleaf herbicides. Plots are 60 feet wide and 200 feet long. A 10 foot border in one direction and a 30 foot border in the other ensure that plots are not cross contaminated by tillage or harvest operations. The larger border separates plots where tillage and harvest equipment would travel from one plot to the other or turn around. Plots are organized in a randomized complete block with four replications. Treatments include an untreated check (no herbicide, standard harvest practices), propoxycarbazone, propoxycarbazone plus harvest using a chaff collection system and chaff collection alone. Propoxycarbazone was chosen for the herbicide treatment because it is expected to provide marginal control of Italian ryegrass. Thus Italian ryegrass with no herbicide resistance could be planted and we could achieve approximately 50-70% control thereby simulating the level of control which might occur in a wheat field with resistant Italian ryegrass using the best herbicides available. Chaff is collected by an Echo Bearcat debris loader capable of moving 2500 cubic feet per minute which is mounted on a tractor and attached by a hose to a funnel on the back of a John Deere 7700 combine. The mounting system and funnel were fabricated by GK Machine, Donald, Oregon. The chaff is vacuumed as is exits the combine off the sieve and is blown into a wagon towed by the tractor. Following harvest in 2013, the trial area was replanted to ‘Goetze’ winter wheat and plots were treated with the same herbicide and harvest method as the previous year. No additional Italian ryegrass seed has or will be planted since the initial planting. The field has been planted for a third year of winter wheat and will be treated the same in 2015. In the fall of 2015, the field will be planted to a broadleaf crop typically found in a wheat rotation followed by one more year of wheat. The herbicide treatment will be a graminicide instead of propoxycarbazone during the non-wheat year. The trial is expected to conclude following harvest in 2017. Effects of the treatments have been and will be monitored by measuring the number of plants per square foot in the plots and wheat yield. Plant counts indicate the amount of seed distributed by the combine or shattered from the plant in previous years which is available for germination. Wheat yield will also indicate the relative status of the seed bank and the efficacy of chaff collection in maintaining wheat yield. At the conclusion of the trial soil samples will be collected and Italian ryegrass seedlings will be counted to estimate total seed bank in each plot.

The second trial was established in 2014. A 7.2 acre field adjacent to the first trial was planted with ‘Bobtail’ winter wheat. This trial will be maintained according to grower standards including fertilizer, fungicide applications and broadleaf herbicides. The previous trial focused on the reduction of the population, while this trial focuses on the prevention of the movement of seed. To accomplish this a strip on one end of each plot was planted with Italian ryegrass. Harvest will be conducted in one direction starting on the end where the Italian ryegrass was planted. The treatments will be the same for this trial and it will conclude following the third year of wheat harvest. In addition to counts of plants per square foot and yield, this trial will also include seed counts from a series of catch basins placed in the center of the path of the combine during harvest to measure the number of and distance seed is carried inside the combine before being deposited. Tillage between cropping seasons will be conducted opposite of the harvest direction to prevent the possibility of additive effects.

Results for the first year of the first trial were mixed. Following harvest in 2013, emerged seedlings were counted in several sub-samples of each plot. Propoxycarbazone, propoxycarbazone plus chaff collection and chaff collection alone had average populations of 10, 7, and 8 Italian ryegrass plants per square foot, respectively, while the check had an average of 20 plants per square foot. The number of Italian ryegrass plants was not different in the treated plots at p-value 0.05. Yields following one year of harvest were only affected by herbicide treatments and were not affected by chaff collection in the previous year (Table). It would be expected that the plots with a lower population would yield better than the check. However, this was not the case and the reason for these seemingly contradictory results is not clear. Continued evaluation over the coming years of this trial may provide a clearer picture. It was observed that the majority of seed produced by Italian ryegrass shattered before harvest and was not collected by the chaff collection system. It is not clear whether the removal of the remaining seed has an impact on the overall population. No data for the second trial have been collected yet. It is anticipated that the effect of the chaff collection treatment in this setting will be that the seeds from the end of the plot will not be distributed across the plot or may decrease the total population in the plot.

Table. Italian ryegrass population and wheat yield following one year of chaff collection.

	Rate	Italian ryegrass count[a]	Winter wheat grain yield[b]
	lb ai/a	plants/ft^2	bu/a
Check		20	56
Propoxycarbazone	0.028	10	90
Propoxycarbazone + chaff collection	0.028	7	96
Chaff collection		8	62
LSD (P=.05)		5.4	8.4

[a]Evaluated 12/30/2013
[b]Harvested 07/30/2014

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ORCF-102 Clearfield® winter wheat tolerance to tank-mixes of imazamox and sulfonylurea herbicides. Drew Lyon, Brianna Cowan, Rod Rood and Henry Wetzel (Crop and Soil Sciences Department, Washington State University, Pullman, WA, 99164) A field study was conducted near Prescott, WA to determine the crop safety of tank-mixes of imazamox herbicide with the sulfonylurea (SU) herbicides, thifensulfuron, tribenuron and metsulfuron, on one-gene Clearfield wheat. The purpose of this study was to determine if ORCF-102 has sufficient tolerance to ALS-inhibitors to allow tank-mixing of SU herbicides with imazamox. The soil at this site is a Walla Walla silt loam with 3.8% organic matter and a pH of 5.0. ORCF-102 was planted on October 8, 2013 using a Great Plains drill with 10-inch row spacing and set to a depth between 1.5 to 2 inches. The seeding rate was 95 lb/acre along with 100, 15 and 15 lb/acre of N:P:S. The experimental design was a randomized complete block with four replications. Plots were eight feet wide by 35 feet in length, trimmed to 33 feet prior to harvest. Post-emergence applications took place on April 1 using a CO_2 backpack sprayer set to deliver 15 gpa using a spray boom equipped with four, TeeJet XR11002 nozzles on a 20-inch spacing. The air temperature was 52°F, relative humidity was 66% with the wind out of the southeast at 3 mph. Wheat was at the 3-tiller stage and was between 6 and 10 inches tall. Light weed pressure in the plots prior to herbicide treatment applications was largely controlled by the herbicide treatments or by subsequent hand weeding. Harvest took place on July 17 using an 8XP Kincaid plot combine.

One week after the herbicide treatments were applied, some visual crop injury was noted in all treatments. By one month after application, this visual injury was no longer apparent in treatments without an SU herbicide and in treatments containing thifen/triben/met + pyrasulfotole/bromoxynil + dicamba. Adding clopyralid/fluroxypyr to imazamox + thifen/triben reduced crop injury compared to treatments containing imazamox + thifen/triben alone, but slight crop injury was still visible. No herbicide treatments had significantly reduced head counts when compared to the nontreated check. Plant heights were reduced by all herbicide treatments compared to the nontreated check. Although, not all treatments significantly reduced plant height when compared to the nontreated plants. Plots treated with SU herbicides exhibited the greatest reduction in plant height. While several treatments containing an SU herbicide had grain yields significantly lower than the nontreated check, only in the case of imazamox + thifen/triben/met was the higher thifen/triben/met use rate (0.016 lb ai/a) also significantly lower yielding than the lower use rate (0.0097 lb ai/a). The single-gene Clearfield wheat variety, ORCF-102, appears to have marginal tolerance to imazamox plus an SU herbicide tank-mix partner. It does appear, however, that including a synthetic auxin (Group 4) herbicide, such as dicamba or clopyralid/fluroxypyr, may provide some safening from crop injury when an SU herbicide is added to imazamox.

Table. ORCF-102 Clearfield® winter wheat tolerance to tank-mixes of imazamox and sulfonylurea herbicides.

Treatment[1]	Rate	Crop injury April 8	Crop injury April 28	Head counts June 4	Plant height June 4	Yield July 17
	lb ai/a	%	%	#/foot row	inches	bu/a
Imazamox	0.047	9	0	41	36	99
Imazamox	0.047	9	6	46	33	95
Thifen/triben/met[2]	0.0097					
Imazamox	0.047	15	10	53	34	88
Thifen/triben/met	0.016					
Imazamox	0.047	11	0	41	35	93
Thifen/triben/met	0.0097					
Pyrasulfotole/bromoxynil	0.22					
Dicamba	0.062					
Imazamox	0.047	10	0	38	36	96
Thifen/triben/met	0.016					
Pyrasulfotole/bromoxynil	0.22					
Dicamba	0.062					
Imazamox	0.047	15	10	48	34	90
Thifen/triben	0.019					
Imazamox	0.047	9	11	47	33	96
Thifen/triben	0.025					
Imazamox	0.047	13	5	47	34	94
Thifen/triben	0.019					
Clopyralid/fluroxypyr	0.25					
Imazamox	0.047	11	4	42	34	95
Thifen/triben	0.025					
Clopyralid/fluroxypyr	0.25					
Pyrasulfotole/bromoxynil	0.22	11	0	45	35	97
Dicamba	0.062					
Imazamox	0.047	9	0	44	35	99
Clopyralid/fluroxypyr	0.25					
Nontreated Check	.	.	.	46	37	100
LSD (5%)		ns	4	7	2	7

[1] All treatments were applied post-emergence on April 1 and tank-mixed with 32% UAN and NIS at 2.5% v/v and 0.25% v/v, respectively.
[2] Thifen is thifensulfuron, triben is tribenuron and met is metsulfuron.

Winter wheat response to pyroxasulfone applied at two timings and followed by irrigation. Traci A. Rauch and Joan M. Campbell. (Crop and Weed Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established near Moscow, ID to evaluate winter wheat response to pyroxasulfone applied at two timings with the early timing supplemented by sprinkler irrigation. 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). 'Ovation' winter wheat was planted in the morning on October 14, 2013. Immediately after seeding, pyroxasulfone, 0 days after planting (DAP) timing, was applied. Sprinkler irrigation added ½ inch of water to the entire study by evening At 10 DAP, pyroxasulfone and flufenacet/metribuzin were applied to germinated wheat seed on October 24. No additional irrigation was used. The entire study was oversprayed on April 29, 2014 with pyrasulfotole/bromoxynil at 0.19 lb ai/A and thifensulfuron/tribenuron at 0.025 lb ai/A for broadleaf weed control and with azoxystrobin/propiconazole at 0.09 lb ai/A for stripe rust control. Crop injury was evaluated during the growing season and grain was harvested with a small plot combine on July 30, 2014.

Table 1. Application and soil data.

Application date	10/14/13	10/24/13
Application timing	seeding day (0 DAP)	seed germinated (10 DAP)
Air temperature (F)	60	66
Relative humidity (%)	52	50
Wind (mph, direction)	0	1, SE
Cloud cover (%)	30	0
Soil moisture	adequate	adequate
Soil temperature at 2 inch (F)	42	50
Next moisture occurred	10/14/13 - irrigated	11/2/13 - rain
pH	5.2	
OM (%)	3.2	
CEC (meq/100g)	18	
Texture	silt loam	

No visual winter wheat injury was present at any evaluation time (Table 2). Grain yield and test weight did not differ among treatments, including the untreated check.

Table 2. Winter wheat response to pyroxasulfone with two application times and irrigation following 0 DAP timing near Moscow, Idaho in 2014.

Treatment	Rate	Application timing	Injury 11/11	4/8	5/14	6/17	7/16	Yield	Test weight
	lb ai/A	DAP	%	%	%	%	%	bu/A	lb/bu
Pyroxasulfone	0.07	0	0	0	0	0	0	135	61.9
Pyroxasulfone	0.13	0	0	0	0	0	0	139	62.1
Pyroxasulfone	0.07	10	0	0	0	0	0	138	61.6
Pyroxasulfone	0.08	10	0	0	0	0	0	138	62.1
Pyroxasulfone	0.13	10	0	0	0	0	0	142	62.3
Pyroxasulfone	0.16	10	0	0	0	0	0	140	62.2
Flufenacet/metribuzin	0.425	10	0	0	0	0	0	139	61.6
Untreated check	--	--	--	--	--	--	--	138	61.4
LSD (0.05)			NS	NS	NS	NS	NS	NS	NS

Newly reported exotic species in Idaho for 2014. 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 172 specimens and digital images for identification in 2014 (Figure 1). Ninety introduced species were identified. The lab received 23 exotic species that were new weed records for the county with five of these species being state records (see Table 1 and Figure 2). A total of 27 counties in Idaho submitted samples (Figure 3) and we had on-line photo submissions from western states, Missouri, New Mexico, New York, North Dakota, Wyoming and British Columbia and Ontario, Canada. Latah and Twin Falls counties sent in *Setaria italica*, a new species to Idaho. *Setaria italica*, also known as foxtail millet or Chinese millet, is a cultivated millet dating back to 6,000 BC (Copper Age). Seeds were valued and traded across Asia and the Fertile Crescent into Europe. Seed first appeared in central Europe in 2,000 BC (Bronze Age). Chinese millet is currently the second most widely planted millet in the world. Although listed as a weedy species in the Southeastern United States, it has recently found new life as a cover crop or a fall crop in many western states. *Setaria italica* has the potential to be weedy along roadsides and field borders in Idaho based on information from adjacent states.

Table 1. Identified introduced species new to county and state based on Erickson Weed Diagnostic Laboratory records and the USDA Plants Database.

COUNTY	FAMILY	*GENUS*	*SPECIES*	COMMON NAME
Ada*	Asteraceae	*Centaurea*	*calcitrapa*	purple starthistle
Ada	Chenopodiaceae	*Chenopodium*	*murale*	nettleleaf goosefoot
Benewah	Fabaceae	*Lotus*	*corniculatus*	birdsfoot trefoil
Blaine	Asteraceae	*Centaurea*	*cyanus*	cornflower
Bonneville	Brassicaceae	*Lepidium*	*campestre*	field pepperweed
Camas	Liliaceae	*Ornithogalum*	*umbellatum*	star of Bethlehem
Canyon*	Solanaceae	*Datura*	*quercifolia*	oakleaf datura
Cassia	Ranunculaceae	*Ranunculus*	*acris*	tall buttercup
Gem	Brassicaceae	*Sisymbrium*	*altissimum*	tumble mustard
Gooding	Euphorbiaceae	*Euphorbia*	*dentata*	toothed spurge
Latah	Boraginaceae	*Anchusa*	*arvensis*	small bugloss
Latah	Chenopodiaceae	*Salsola*	*iberica*	Russian thistle
Latah*	Poaceae	*Setaria*	*italica*	foxtail millet
Latah	Papaveraceae	*Papaver*	*dubium*	field poppy
Latah	Ranunculaceae	*Ranunculus*	*repens*	creeping buttercup
Madison	Scrophulariaceae	*Veronica*	*arvensis*	corn speedwell
Nez Perce	Amaranthaceae	*Amaranthus*	*blitoides*	prostrate pigweed
Nez Perce*	Caryophyllaceae	*Silene*	*vulgaris*	bladder campion
Nez Perce*	Solanaceae	*Solanum*	*nigrum*	black nightshade
Nez Perce	Tamaricaceae	*Tamarix*	*ramosissima*	saltcedar
Owyhee	Cucurbitaceae	*Bryonia*	*alba*	white bryony
Twin Falls*	Asteraceae	*Centaurea*	*calcitrapa*	purple starthistle
Twin Falls*	Poaceae	*Setaria*	*italica*	foxtail millet
Twin Falls	Scrophulariaceae	*Verbascum*	*blattaria*	moth mullein
Washington	Poaceae	*Echinochloa*	*crus-galli*	barnyardgrass

*= New to state

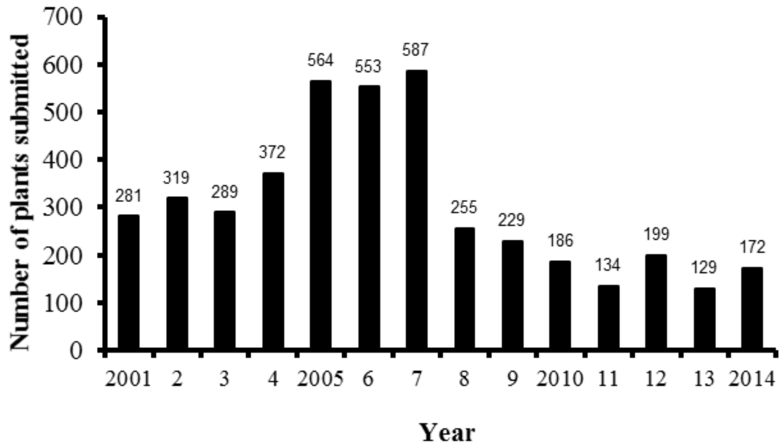

Figure 1. Erickson Weed Diagnostic Laboratory received 172 plants for identification in 2014.

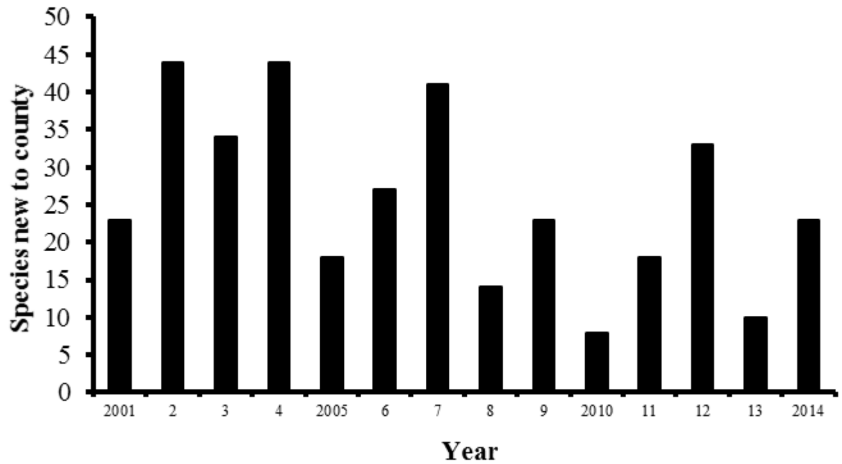

Figure 2. The lab identified 23 exotic species that were new Idaho records in 2014.

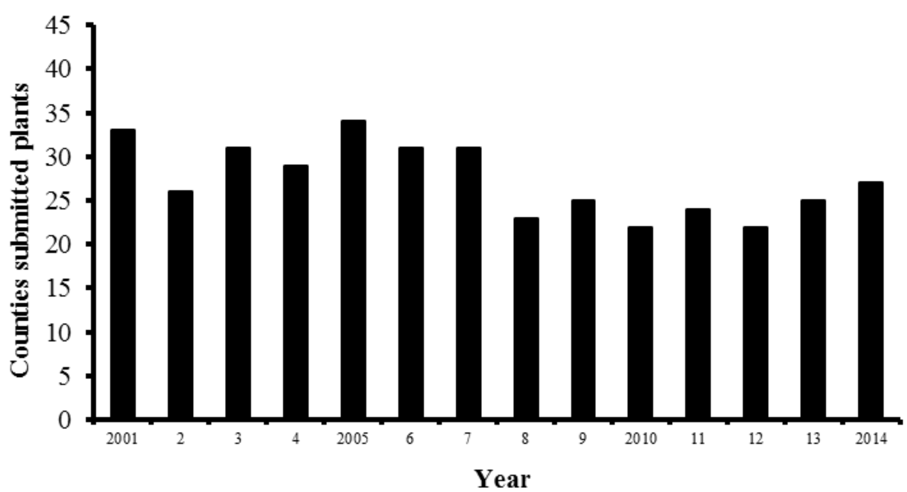

Figure 3. Twenty-seven Idaho counties submitted plants in 2014.

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