Green Section: Weed control in small grains Page

Green Section: Weed control in small grains continues Page

Wheat response to Glyphosate 4.5 at 2 leaf stage. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded near Fargo on April 27. Treatments were applied to 2 leaf wheat, cotyledon to 2 leaf wild buckwheat, cotyledon Venice mallow, and spike yellow foxtail on May 27, with 73°F, 50% relative humidity, approximately 15% cloud cover, 4 mph wind at 225°, and damp soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was on August 20.

Treatment	Rate	Stage	6/19 Wht	7/1 Wht	8/20 Grain
	oz ae/A		%	%	bu/A
Glyt 4.5+NIS+AMS	1+0.25%+12	2L	97	96	0
Glyt 4.5+NIS+AMS	0.75+0.25%+12	2L	86	92	0
Glyt 4.5+NIS+AMS	0.5+0.25%+12	2L	80	71	14
Glyt 4.5+NIS+AMS	0.35+0.25%+12	2L	58	29	22
Glyt 4.5+NIS+AMS	0.25+0.25%+12	2L	33	13	44
Glyt 4.5+NIS+AMS	0.1+0.25%+12	2L	4	3	47
Glyt 4.5+NIS+AMS	0.05+0.25%+12	2L	0	0	51
Glyt 4.5+NIS+AMS	0.01+0.25%+12	2L	0	0	50
Untreated Check	0		0	0	54
CV			12	13	6
LSD 0.05			7	7	4

Glyphosate at less than 1% of field rate (0.1 oz ae/A) was enough to cause visible injury to wheat although not significantly different from the untreated. This rate resulted in 13% less grain yield than the untreated. As glyphosate rate increased from 0.1 oz/A, injury and grain yield loss increased quickly. Only 6% of glyphosate field rate caused greater than 90% injury and eliminated grain yield. Drift or sprayer contamination is of serious concern in wheat production.

Wheat response to Glyphosate at 4 leaf stage. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 27. Treatments were applied to 4.5 to 5 leaf wheat, flowering mustard, 2 to 5 inch wild buckwheat, 3 to 5 inch common cocklebur, 1 to 2 leaf foxtail, pigweed, and Venice mallow on June 11 with 85°F, 34% relative humidity, clear sky, 1 to 5 mph wind at 30°, and moist soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 20.

Treatment	Rate	Growth Stage	6/26 Wht	7/10 Wht	8/20 Grain
	oz ae/A		%	%	bu/A
Glyt+NIS+AMS	1+0.25%+12	4L	99	99	0
Glyt+NIS+AMS	0.75+0.25%+12	4L	97	99	0
Glyt+NIS+AMS	0.5+0.25%+12	4L	88	97	0
Glyt+NIS+AMS	0.35+0.25%+12	4L	83	95	0
Glyt+NIS+AMS	0.25+0.25%+12	4L	79	88	0
Glyt+NIS+AMS	0.1+0.25%+12	4L	18	8	44
Glyt+NIS+AMS	0.05+0.25%+12	4L	0	0	56
Glyt+NIS+AMS	0.01+0.25%+12	4L	0	0	58
Untreated Check	0		0	0	55
CV			4	3	7
LSD 0.05			3	2	8

Glyphosate at less than 1% of field rate (0.1 oz ae/A) was enough to cause visible injury to wheat and resulted in 20% less grain yield than the untreated. As glyphosate rate increased from 0.1 oz/A, wheat injury and grain yield loss increased rapidly. Only 2% of glyphosate field rate caused nearly 90% injury and eliminated grain yield. Drift or sprayer contamination is of serious concern in wheat production.

Wheat response to Glyphosate 4.5 at Flag leaf stage. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 27. Treatments were applied to 6 leaf wheat, 6 to 8 inch common cocklebur, 1 to 3 inch Venice mallow, 1 to 4 inch redroot pigweed, 4 to 8 inch foxtail, 4 to 6 inch wild buckwheat, and 3 to 6 inch commons lambsquarters. Treatments were applied on June 19 with 74°F, 100% relative humidity, cloud-cover approximately 10%, 9 to 15 mph wind at 135°, and dry soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 20.

Treatment	Rate	7/1 Wht	7/16 Wht	8/20 Grain
	oz ae/A	%	%	bu/A
Glyt 4.5+NIS+AMS	1+0.25%+12	88	99	0
Glyt 4.5+NIS+AMS	0.75+0.25%+12	85	98	0
Glyt 4.5+NIS+AMS	0.5+0.25%+12	80	96	0
Glyt 4.5+NIS+AMS	0.35+0.25%+12	73	84	7
Glyt 4.5+NIS+AMS	0.25+0.25%+12	68	72	10
Glyt 4.5+NIS+AMS	0.1+0.25%+12	5	4	44
Glyt 4.5+NIS+AMS	0.05+0.25%+12	3	0	51
Glyt 4.5+NIS+AMS	0.01+0.25%+12	1	0	54
Untreated Check	0	0	0	55
CV		5	3	9
LSD 0.05		4	3	6

Glyphosate at less than 1% of field rate (0.1 oz ae/A) was enough to cause visible injury to wheat. This rate resulted in 20% less grain yield than the untreated. As glyphosate rate increased from 0.1 oz/A, injury and grain yield loss increased quickly. Only 4% of glyphosate field rate caused greater than 90% injury and eliminated grain yield. Drift or sprayer contamination is of serious concern in wheat production.

Wheat response to Glyphosate 4.5 at Anthesis. Howatt, Roach, Harrington. 'Prosper' hard red spring was seeded near Fargo on April 27. Treatments were applied to anthesis wheat, flowering mustard, vining 12 to 24 inch wild buckwheat, 12 to 24 inch common cocklebur, 6 to 8 inch Venice mallow, and 6 to 10 inch foxtail on July 2 with 69°F, 85% relative humidity, sky 50% smoke haze, 3 to 7 mph wind at 135°, dry soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide are the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 20.

Treatment Name	Rate	Growth Stage	7/16 Wht	7/29 Wht	8/20 Grain
	oz ae/A		%	%	bu/A
Glyt 4.5+NIS+AMS	1+0.25%+12	Anthesis	80	95	6
Glyt 4.5+NIS+AMS	0.75+0.25%+12	Anthesis	64	84	7
Glyt 4.5+NIS+AMS	0.5+0.25%+12	Anthesis	31	59	29
Glyt 4.5+NIS+AMS	0.35+0.25%+12	Anthesis	16	20	42
Glyt 4.5+NIS+AMS	0.25+0.25%+12	Anthesis	6	11	45
Glyt 4.5+NIS+AMS	0.1+0.25%+12	Anthesis	0	0	56
Glyt 4.5+NIS+AMS	0.05+0.25%+12	Anthesis	0	0	53
Glyt 4.5+NIS+AMS	0.01+0.25%+12	Anthesis	0	0	60
Untreated Check	0		0	0	54
C.V.			11	11	14
LSD P=.05			3	5	8

Glyphosate at less than 1% of field rate (0.1 oz ae/A) did not cause visible injury to wheat or reduce grain yield. However, 0.25 oz/A glyphosate caused 11% visible injury to wheat and resulted in 25% less yield than the maximum measured value. As glyphosate rate increased from 0.25 oz/A, injury and grain yield loss increased gradually. Glyphosate at 0.75 oz/A caused 84% injury but even 1 oz/A did not eliminate grain yield. Drift or sprayer contamination is of serious concern in wheat production, but this late stage of wheat is not affected as greatly as younger stages investigated in other studies.

Barley tolerance to preemergence herbicides. (Minot). Some green foxtail populations across North Dakota are known to be resistant to Group 1 herbicides like Puma, Discover, and Axial XL. The objective of the study was to evaluate barley tolerance to soil-applied preemergence herbicides for foxtail control. This study was conducted in 2012, 2014, and 2015. All treatments were applied preemergence (after barley was planted).

In 2012, Dual, Pre-Pare, and Valor caused early moderate crop injury; however, the crop generally recovered by mid-July. Zidua, Warrant, and Prowl caused minimal crop injury in 2012 (Table 3).

In contrast, Zidua and Warrant caused slight to moderate crop injury in 2014 (Table 2). Pre-Pare and Prowl caused only slight crop injury in 2014. Valor caused moderate crop injury both years. Dual and Outlook caused severe injury in 2014. Despite crop injury in 2012, there was minimal effect on crop yield. In 2014, only Dual and Outlook reduced barley yield.

In 2015, all treatments except Prowl caused moderate to severe early-season crop injury (Table 1). However, as in previous years, the crop generally recovered as the season progressed. Only Warrant, Dual, and Outlook tended to have a slightly lower yield, though not statistically significant. These data show that barley generally will recover from herbicide injury and still produce nearly normal yields.

Table 1. Barley tolerance to preemergence herbicides in 2015. (1508)

Treatment[a]	Rate	Injury				Yield	Test wt.
		Jun-12	Jun-20	Jul-3	Jul-23	Aug-11	Aug-11
		----------%----------				bu/A	lb/bu
Untreated		0	0	0	0	89.7	45.4
Zidua	3 oz	28	30	23	14	87.3	46.1
Warrant	1.5 qt	18	16	13	5	80.4	46.1
Dual II Magnum	1.67 pt	30	47	33	18	81.7	45.0
Pre-Pare	0.3 oz	40	35	26	15	86.3	45.2
Prowl H2O	3 pt	7	7	1	2	88.5	46.6
Valor	2 oz	22	22	17	9	82.1	45.8
Outlook	18 oz	27	40	33	17	74.2	45.0
LSD (0.05)		11.7	13.5	7.0	5.7	NS	NS
CV		31.1	31.4	27.4	32.1	8.8	2.1

[a] *All treatments applied PRE*

Table 2. Barley tolerance to preemergence herbicides in 2014. (1408)

Treatment[a]	Rate	Injury				Yield	Test wt.
		Jun-09	Jun-18	Jul-03	Jul-15	Aug-20	Aug-20
		----------%----------				bu/A	lb/bu
Untreated		0	0	0	0	66.4	42.9
Zidua	3 oz	13	14	15	12	70.3	43.7
Warrant	1.5 qt	10	12	12	9	70.2	44.3
Dual II Magnum	1.67 pt	26	49	54	55	64.6	44.2
Pre-Pare	0.3 oz	5	6	7	3	76.3	43.1
Prowl H2O	3 pt	9	7	5	1	71.3	44.5
Valor	2 oz	18	17	17	14	76.4	45.2
Outlook	18 oz	23	42	45	45	60.1	42.4
LSD (0.05)		3.7	14.4	16.4	18.6	9.8	1.3
CV		16.3	44.7	48.1	60.8	8.1	1.7

[a] *All treatments applied PRE*

Table 3. Barley tolerance to preemergence herbicides in 2012. (1208)

Treatment[a]	Rate	Injury				Yield	Test wt.
		Jun-05	Jun-25	Jul-11	Jul-21	Aug-06	Aug-06
		----------%----------				bu/A	lb/bu
Untreated		0	0	0	0	76.3	42.4
Zidua	3 oz	0	0	0	0	70.7	43.3
Warrant	1.5 qt	2	1	1	0	77.6	43.3
Dual II Magnum	1.67 pt	15	13	6	5	74.2	43.1
Pre-Pare	0.3 oz	25	17	5	3	72.9	42.6
Prowl H2O	3 pt	2	1	0	0	72.4	43.5
Valor	3 oz	30	20	5	2	73.8	42.9
LSD (0.05)		6	5	NS	NS	NS	NS
CV		29	40	139	257	10	3

[a] *All treatments applied PRE*

Spring wheat tolerance to triallate, Fargo. Howatt, Hansen, Roach, and Harrington. Soil-applied treatments were applied and incorporated on April 23 followed by seeding of 'Prosper' hard red spring wheat near Fargo. Conditions on April 23 were 32°F, 49% relative humidity, clear sky, calm wind, and dry soil at 36°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 feet. The experiment was a randomized complete block design with four replicates and established in an area with light weed pressure expected. Herbicides were applied to eliminate weed competitors.

Treatment	Rate	Grain
	oz ai/A	bu/A
Triallate	12	48
Triallate	16	57
Triallate	24	55
Triallate	32	54
Triallate	48	41
Triallate	64	49
Untreated	0	56
CV		14
LSD 5%		11

Triallate applied at up to four times the labeled rate, 64 oz/A, did not result in less yield than typical use rates, 12 to 16 oz/A. Injury was noted early in the season at nearly all rates (data not shown).

Spring wheat tolerance to triallate, Campus. Howatt, Hansen, Roach, and Harrington. Treatments were pre-plant incorporated and 'Prosper' hard red spring wheat was seeded April 23, 2015 near North Dakota State University, campus in Fargo. Conditions at application and planting were 38°F, 35% relative humidity, clear sky, calm wind and dry soil at 36°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates and established in an area with light weed pressure expected. Herbicides were applied to eliminate weed competitors.

Treatment	Rate	Grain
	oz ai/A	bu/A
Triallate	12	61
Triallate	16	58
Triallate	24	59
Triallate	32	62
Triallate	48	58
Triallate	64	54
Untreated	0	59
CV		11
LSD 5%		9

Triallate applied at up to four times the labeled rate, 64 oz/A, did not result in less yield than typical use rates, 12 to 16 oz/A. Injury was noted early in the season at nearly all rates (data not shown).

Spring wheat tolerance to triallate, Prosper. Howatt, Hansen, Roach, and Harrington. Soil-applied treatments were applied and incorporated April 30 followed by seeding 'Prosper' hard red spring wheat near Prosper, North Dakota. Environmental conditions on April 30 were 70°F, 30% relative humidity, clear sky, 7 to 11 mph wind at 180°, and dry soil at 60°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates and established in an area with light weed pressure expected. Herbicides were applied to eliminate weed competitors. Harvest for yield was August 14.

Treatment	Rate	Grain
	oz ai/A	bu/A
Triallate	12	44
Triallate	16	45
Triallate	24	46
Triallate	32	41
Triallate	48	39
Triallate	64	33
Untreated	0	45
CV		9
LSD 5%		6

Triallate applied at 48 oz/A, did not result in less yield than typical use rates, 12 to 16 oz/A. Injury was noted early in the season at nearly all rates (data not shown). Injury of wheat in plots treated with 64 oz/A included 26% less grain recovered.

Triallate incorporation. Howatt, Roach, and Harrington. Pre-plant treatments were applied and incorporated according to prescribed sequence and 'Prosper' hard red spring wheat was seeded April 17 near Fargo. The preemergence treatments were applied following seeding on April 17 with 62°F, 19% relative humidity, clear sky, 4 to 6 mph wind at 270°, and dry soil at 46°F. All treatments were applied with a backpack sprayer delivering 17 gpa at 40 psi through 11002 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Application	6/15 Wioa
	oz ai/A		%
Triallate	16	PPI	95
Triallate	20	PPI	98
Triallate	24	PPI	99
Triallate	16	PRE	78
Triallate	20	PRE	84
Triallate	24	PRE	90
CV			3
LSD 0.05			4

Incorporation of 16 oz/A triallate provided better control, 95%, than 24 oz/A applied pre-emergence, although this treatment gave more control than expected, 90%. Triallate at 16 oz/A applied pre-emergence gave 78% control of wild oat, and each higher rate within this application gave better control. Wild oat control among preplant incorporated treatments essentially was similar at 95% control or better.

Wheat Tolerance to Pyroxasulfone at Different Rates and Application Timings

Caleb Dalley, HREC, Hettinger, ND, 2015

A field trial was conducted to evaluate the tolerance of spring wheat to the herbicide pyroxasulfone and experimental herbicide BAS 820ABH when applied preemergence (PRE), delayed PRE (DPRE), and early postemergence (EPOST). Spring wheat was planted on Friday April 24, 2015 at a rate of approximately 80 lbs/A at a depth of 1.5 inches using a John Deere 1590 no-till planter. Starter fertilizer (18-46-0) was applied at planting at a rate of 40 lbs/acre and granular urea fertilizer was broadcast at 100 lbs/acre on May 16 using a drop spreader. After planting, the entire trial was treated with glyphosate (26 oz/A Roundup PowerMAX) plus AMS to control emerged weeds (primarily wild buckwheat and wild mustards). PRE treatments were applied on April 30. At time of application wheat seed was imbibed and the root radicle had emerged from some of the seed. DPRE treatments were applied on May 5th. At time of application, the coleoptile had emerged from the seed, but had not yet emerged from the soil. The EPOST treatments were applied on May 13th when wheat was at the 1-leaf stage. Unfortunately, no rainfall occurred until May 6th, the day after the DPRE application was made, therefore the treatments applied at the PRE timing were not incorporated into the soil until this rainfall had occurred. Rainfall also occurred on the day of, and on the day after the EPOST timing. Weed infestation levels were low in this trial and no ratings were possible. Injury to wheat (minor stunting) was not observed until the June 8th rating when wheat had begun to elongate. Wheat was harvested on August 7th. Wheat yield, regardless of treatment rate or timing was similar to that in the weed free check. There was also no differences in test weight or seed moisture due to herbicide treatment. Currently, only DPRE and EPOST treatments of pyroxasulfone are labelled for use in wheat production. Further research needs to be conducted to verify wheat tolerance to pyroxasulfone and to determine appropriate tank-mix partners for weed control.

Treatment		Rate	Timing	Wheat		Test wt	Yield
				May 15	Jun 8	Aug 7	
				injury(%)		lbs/bu	bu/A
1	Pyroxasulfone	1oz/a	PRE	0a	1bc	58.2a	72.5a
2	BAS 820ABH	1.68fl oz/a	PRE	0a	2abc	58.6a	72.6a
3	Pyroxasulfone	2oz/a	PRE	0a	3ab	58.8a	66.4a
4	BAS 820ABH	3.13fl oz/a	PRE	0a	4a	58.1a	76.6a
5	Pyroxasulfone	1oz/a	DPRE	0a	0c	58.4a	72.2a
6	BAS 820ABH	1.68fl oz/a	DPRE	0a	1bc	58.9a	73.8a
7	Pyroxasulfone	2oz/a	DPRE	0a	1bc	59.0a	74.3a
8	BAS 820ABH	3.13fl oz/a	DPRE	0a	4a	58.0a	71.1a
9	Pyroxasulfone	1oz/a	EPOST	0a	0c	58.8a	73.9a
10	BAS 820ABH	1.68fl oz/a	EPOST	0a	0c	58.7a	74.1a
11	Pyroxasulfone	2oz/a	EPOST	0a	1bc	58.4a	72.6a
12	BAS 820ABH	3.13fl oz/a	EPOST	0a	1bc	59.2a	72.7a
13	Check- Weed Free			0a	0c	59.4a	73.0a
LSD P=.05				NS	2.3	NS	NS
Standard Deviation				0.0	1.6	1.047	4.20
CV				0.0	124.09	1.79	5.77
Treatment F				0.000	3.568	0.662	1.220
Treatment Prob(F)				1.0000	0.0015	0.7747	0.3073

Control of multiple resistant wild oat population. Howatt, Roach, Ciernia, Harrington. 'Soren' hard red spring wheat was seeded, followed by application of preemergence treatments on April with 80°F, 27% relative humidity, clear sky, 3 mph wind at 180°, dry soil at 62°F. Post treatments were applied to 6 leaf wheat, and 3 to 6.5 inch wild oat on June 10 with 70°F, 55% relative humidity, 65% cloud-cover, 2 to 6 mph wind at 315°, and dry soil at 66°F. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Stage	6/17 wht	6/17 wioa	6/29 wht	6/29 wioa
	oz ai/A		%	%	%	%
Pxsf&Carf	1.5	PRE	0	66	0	66
Pyroxasulfone	1.1	PRE	0	69	0	59
Pxsf&Carf/Flcz2+Thif-sg+Trib-sg+ NIS+AMS-L	1.5/0.43+0.1+0.1+ 0.25%+37	PRE/ 3L	5	78	0	89
Pxsf/Flcz2+Thif-sg+Trib-sg+ NIS+AMS-L	0.86/0.43+0.1+0.1+ 0.25%+37	PRE/ 3L	6	71	0	88
Pxsf&Carf/Pxdn+Brox&MCPA5	1.5/0.86+8	PRE/ 3L	4	74	0	84
Pxsf&Carf/Pxlm&Flas&Flox+ NIS+AMS-L	1.5/1.67+ 0.25%+37	PRE/ 3L	7	71	0	83
Flcz2+Thif-sg+Trib-sg+ NIS+AMS-L	0.43+0.1+0.1+ 0.25%+37	3L	6	71	0	94
Pxdn+Brox&MCPA5	0.86+8	3L	2	69	0	80
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+37	3L	8	73	0	75
Brox&Pyst&Thcz+NIS+AMS-L	4.1+0.25%+37	3L	8	71	0	73
Flcz2+Pxdn+Thif-sg+Trib-sg+ NIS+AMS-L	0.43+0.86+0.1+0.1+ 0.25%+37	3L	2	71	0	92
Untreated Check	0		0	0	0	0
CV			40	64	0	5
LSD P=0.05			2	6	.	5

Minor wheat injury of 2 to 8% was recorded when herbicides were applied post emergence. Wheat injury was greater with ALS (group 2) herbicides than with ACCase (group 1) herbicides, except when flucarbazone was tankmixed with pinoxaden. Flucarbazone and pinoxaden include the cloquintocet as a safener. Wheat damage from herbicide was not observed June 29. Pyroxasulfone PRE gave about 63% control of wild oat. Pyroxasulfone did not improve control of wild oat with flucarbazone or pinoxaden.

POST grass control with pre-emergence herbicides. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 23, near North Dakota State University campus. Treatments were applied to 3 leaf wheat, 1 to 3 inch wild mustard and wild buckwheat, 1 to 2 inch common ragweed, 0.5 to 1 inch Venice mallow, and 1 to 2 leaf yellow foxtail on June 5 with 68°F, 70% relative humidity, 100% cloud-cover, 1 to 5 mph wind at 125°, and moist soil at 60°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield on August 12.

Treatment	Rate	6/12 Wht	6/12 Fxtl	6/125 Wimu	6/12 Corw	6/12 Vema	6/12 Wibw	6/19 Wht	6/19 Fxtl	6/19 Wimu	6/19 Corw
	oz ai/A	%	%	%	%	%	%	%	%	%	%
Flum	0.77	8.5	90.8	85.5	85.0	86.3	88.8	0.0	85.0	57.5	12.5
Flum&Pysf	1.14	9.5	91.8	92.3	87.5	90.8	93.0	0.0	85.0	82.5	25.0
Flum&Pysf	2.28	12.0	96.0	97.0	92.0	93.3	94.0	0.0	90.3	92.5	52.5
Flct&Metr	5.4	3.5	66.3	88.8	30.0	47.5	27.5	0.0	82.5	88.8	17.5
Pysf	0.85	0.8	62.5	47.5	5.0	15.0	0.0	0.0	87.5	0.0	0.0
Untreated	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CV		30	10	6	13	9	10	0	6	8	50
LSD 0.05		3	11	6	9	7	7	.	6	7	13

Treatment	Rate	6/19 Vema	6/19 Wibw	7/2 Yeft	7/2 Wimu	7/2 Corw	7/2 Vema	7/2 Wibw	8/12 Grain
	oz ai/A	%	%	%	%	%	%	%	bu/A
Flumioxazin	0.77	81.3	73.8	86.3	85.0	45.0	87.0	80.0	60
Flum&Pysf	1.14	80.0	85.5	95.3	94.5	80.0	86.3	90.0	59
Flum&Pysf	2.28	91.3	94.5	95.3	94.8	77.5	89.3	88.8	60
Flct&Metr	5.4	82.5	15.0	93.5	95.0	47.5	80.0	58.8	61
Pyroxasulfone	0.85	0.0	0.0	96.3	0.0	0.0	0.0	0.0	53
Untreated	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54
CV		7	17	5	3	9	6	7	8
LSD 0.05		6	12	6	3	6	5	5	8

Pyroxasulfone provided 96% control of yellow foxtail but only caused temporary injury to broadleaf weeds. Flumioxazin gave 86% control of foxtail but also gave 45 to 87% control of broadleaf weeds. Combination of flumioxazin and pyroxasulfone increased common ragweed control from 45% with flumioxazin alone to 80% with the combination. Temporary injury to wheat was caused by flumioxazin, but the injury was not present on June 19 after first leaves naturally senesced.

POST grass control with pre-emergent herbicides, location 2. Howatt, Roach, and Harrington. Treatments were applied to 1 to 4 leaf foxtail and 1 to 2 trifoliolate soybean on July 9 with 61°F, 100% relative humidity, 50% smoke haze in sky, 1 to 3 mph wind at 225°, and dry soil at 60°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Stage	Yeft	Soybean
	oz ai/A		%	%
Flum	0.77	1L	8	7
Flum&Pysf	1.14	1L	73	6
Flum&Pysf	2.28	1L	74	10
Flct&Metr	5.4	1L	23	16
Pysf	0.85	1L	73	0
Untreated	0		0	0
CV			27	38
LSD 0.05			16	4

Pyroxasulfone provided substantial control of yellow foxtail, 73%, at relatively advanced growth stage for a typically soil applied herbicide. Flumioxazin injury to foxtail was minor and manifested as slight necrotic speckling on exposed tissue. Newly emerging tissue did not express symptoms. The same injury was present on soybean from flumioxazin or flufenacet and metribuzin.

New HPPD for wheat. Howatt, Roach, and Harrington. 'Faller' hard red spring wheat was seeded April 6 at Rogers, North Dakota. Treatments were applied to 5 leaf wheat, 2 to 5 inch kochia and 1 to 4 inch common lambsquarters on June 8 with 83°F, 43% relative humidity, 3 to 6 mph wind at 330°, a slight cloud-cover, and soil was damp at 72°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/16 wht	6/22 wht	6/22 koch	6/22 colq	7/6 koch	7/6 colq	7/23 koch	7/23 colq
	oz ai/A	%	%	%	%	%	%	%	%
Pxdn+A20916+A19278+COC	0.86+0.2%+3+1%	4	0	91	92	94	98	94	97
Pxdn+A20916+A19278+COC	0.86+0.2%+3.5+1%	5	0	97	99	99	99	99	99
Pxdn+A20916+A19278+COC	0.86+0.2%+4.1+1%	7	0	96	98	97	99	93	99
Pxdn+Brox&Pyst+NIS+AMS	0.86+3+0.25%+16	2	0	97	98	99	99	99	99
Pxdn+Brox&Flox	0.86+7.5	2	0	94	92	96	86	96	94
Pxdn+Flox+MCPA+Thif-sg	0.86+2+6+0.3	2	0	89	90	91	98	96	99
Pxdn+Dica&Flox	0.86+2.6	7	0	83	76	88	81	93	90
Pxdn	0.86	0	0	0	0	0	0	0	0
CV		43	0	3	4	4	4	4	3
LSD 0.05		2	.	3	5	4	5	5	4

All herbicide treatments caused injury to wheat of 7% or less 1 wee after application, but injury was not present on June 22. A20916 plus A19278 resulted in slightly more injury than most other labeled herbicides. Weed control across species and evaluations was better with A19278 at 3.5 oz/A than at 3 oz/A. A19278 at 3.5 oz/A provided weed control that was similar to or better than labeled herbicides.

Group 1-resistant wild oat control with Varro tank mixes. (Minot). The objective of this study was to evaluate wild oat control with Varro tank mixes. 'Barlow' spring wheat was planted May 5. POST herbicide treatments were applied June 4 at the 4-leaf wheat stage. All treatments caused slight to moderate chlorosis, which disappeared within two weeks after application. All treatments provided excellent wild oat control regardless of tank mix partner.

Table. Grass control with Varro tank mixes. (1526)

			Wheat			Weed Control		
			Injury			Wild oat		
Treatment[a]	Rate	Timing	Jun-11	Jun-19	Jun-26	Jun-19	Jun-26	Aug-10
			----------%----------			----------%----------		
Untreated			0	0	0	0	0	0
Varro + Bronate (Bison)	6.85 oz + 1 pt	4-leaf	15	0	0	80	94	99
Varro + Weld	6.85 oz + 1.3 pt	4-leaf	18	0	0	82	94	99
Varro + Carnivore	6.85 oz + 1 pt	4-leaf	14	0	0	81	94	99
Varro + WideMatch + 2,4-D Ester	6.85 oz + 1 pt + 0.5 pt	4-leaf	18	0	0	81	94	99
Varro + WideMatch + MCPA Ester	6.85 oz + 1 pt + 0.5 pt	4-leaf	14	0	0	82	95	99
Affinity TM + Varro + WideMatch	0.6 oz + 6.85 oz + 1 pt	4-leaf	17	0	0	81	95	99
Olympus + Varro + Carnivore	0.2 oz + 6.85 oz + 1 pt	4-leaf	16	0	0	82	94	99
Huskie Complete	13.7 oz	4-leaf	14	0	0	81	94	98
Varro + Starane Flex	6.85 oz + 13.5 oz	4-leaf	15	0	0	81	94	99
LSD (0.05)			1.0	NS	NS	3.4	2.2	1.3

[a] *AMS applied with all treatements at 1.47 gal/100 gal*

Thiencarbazone tank-mixes for wild oat control. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 27 near Fargo. Treatments were applied to 3 leaf wheat, 2 to 3 leaf wild oat, flowering wild mustard, and 1 to 2 leaf yellow foxtail on June 9 with 78°F, 44% relative humidity, clear sky, 4 to 7 mph wind at 180°, and wet soil at 68°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 10.

		6/15				6/30				7/3	7/27	8/10
Treatment	Rate	Wht	Wioa	Yeft	Wimu	Wht	Wioa	Yeft	Wimu	Wioa	Wioa	Grain
	oz ai/A	%	%	%	%	%	%	%	%	%	%	bu/A
Thcz+Brox&MCPA+AMS	0.07+8+8	0	77	63	90	0	82	85	99	73	67	41
Thcz+Clpy&Flox&MCPA+AMS	0.07+7.5+8	0	68	57	68	0	89	88	99	87	87	47
Thcz+Brox&MCPA&Flox+AMS	0.07+8+8	0	80	67	94	0	92	88	98	90	88	43
Thcz+Clpy&Flox+2,4-De+AMS	0.07+3+3.8+8	0	75	60	73	0	90	87	88	88	83	44
Thcz+Clpy&Flox+MCPAe+AMS	0.07+3+4+8	0	70	60	70	0	90	89	92	87	83	42
Thcz+Clpy&Flox+Thif-sg+Trib-sg+AMS	0.07+3+0.24+0.06+8	0	60	50	55	0	85	90	90	93	88	45
Thcz+Prcz+Brox&MCPA&Flox+AMS	0.07+0.14+8+8	0	72	63	57	0	96	93	94	90	93	43
Brox&Pyst&Thcz+AMS	3+8	0	73	60	87	0	92	87	99	88	87	46
Fenx&Brox&Pyst	5.4	0	68	57	87	0	78	85	99	88	88	44
Flcz+Thif-sg+Trib-sg+2,4-D+AMS-L	0.35+0.15+0.15+6+8	0	68	57	55	12	94	90	96	92	91	41
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25+24	0	67	57	63	0	89	82	90	87	86	39
Untreated Check	0	0	0	0	0	0	0	0	0	0	0	28
CV		0.0	8	8	8	86	4	5	3	5	5	10
LSD 0.05		.	9	8	10	1	6	6	4	7	6	7

Injury to wheat with herbicides was not observed June 15, but on June 30, 12% injury primarily as stunting and chlorosis was recorded. Wheat injury was not noted on July 3. Wild oat control was similar across many treatments on June 15 with highest control when thiencarbazone was combined with the premix of bromoxynil and MCPA and fluroxypyr. This treatment was in the group of best control on June 30 as well, with thiencarbazone tankmixes of clopyralid and fluroxypyr plus 2,4-D, clopyralid and fluroxypyr plus MCPA, propoxycarbazone plus bromoxynil and MCPA and fluroxypyr, and the premix with bromoxynil and pyrasulfotole as well as the flucarbazone treatment. By July 27, only thiencarbazone plus bromoxynil and MCPA gave less than 70% control while flucarbazone or thiencarbazone plus propoxycarbazone provided better than 90% control. All herbicide treatments resulted in greater grain yield than the untreated check.

Adjuvants with Thiencarbazone. Howatt, Roach, Harrington. 'Prosper' hard red spring wheat was seeded April 17 near Fargo, North Dakota. Treatments were applied to 3 to 4 leaf wheat and 2 to 3 leaf wild oat on June 9 with 66°F, 65% relative humidity, 100% cloud-cover, 1 to 4 mph wind at 340°, and damp soil at 62°F (light rain). Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/23 Wht	6/23 Wioa	7/9 Wioa
	oz ai/A	%	%	%
Thcz	0.053	0	68	75
Thcz+Preference	0.053+0.25%	0	68	77
Thcz+Preference+Interlock	0.053+0.25%+4	0	72	85
Thcz+AG14039	0.053+4	0	78	85
Thcz+Masterlock	0.053+6.4	0	75	82
Thcz+AG14039	0.053+6.4	0	73	92
Thcz+AG14019	0.053+0.5%	0	80	91
Thcz+AG14019	0.053+1%	0	70	82
Thcz+AG14020	0.053+0.5%	0	82	88
Thcz+AG14020	0.053+1%	0	73	83
Thcz+Destiny HC	0.053+6.4	0	75	86
Thcz+Destiny HC	0.053+16	0	78	85
Thcz+AG14039	0.053+16	0	82	80
Thcz+Basic Blend	0.053+%	0	80	93
CV		0	7	5
LSD P=0.05		.	9	7

Treatments did not cause visible injury to wheat. Thiencarbazone alone gave 68% control of wild oat on June 23. A standard treatment with basic blend adjuvant improved control to 80%. Average control as amended with other adjuvants was numerically higher than thiencarbazone alone but not statistically greater. Wild oat control with thiencarbazone on July 9 was 75%. All adjuvants except Preference enhanced thiencarbazone activity, most resulting in about 85% control averaged within adjuvant. The standard provided 93% control.

Weld formulation as adjuvant for wild oat ALS. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 27 near Fargo, North Dakota. Treatments were applied to 3 leaf wheat and wild oat on June 9, with 78°F, 44% relative humidity, clear sky, 5 to 8 mph wind at 180°, and wet soil at 68°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/23 Wht	6/23 Wioa	7/7 Wioa
	oz ai/A	%	%	%
Flcz	0.35	0	70	78
Flcz+BB	0.35+1%	3	75	86
Flcz+Clpy&Flox+MCPA	0.35+3+4	8	73	81
Flcz+Clpy&Flox&MCPA	0.35+7.5	8	71	88
Thcz	0.07	0	76	86
Thcz+BB	0.07+1%	0	66	91
Thcz+Clpy&Flox+MCPA	0.07+3+4	1	80	84
Thcz+Clpy&Flox&MCPA	0.07+7.5	0	70	91
Pxlm	0.19	0	73	78
Pxlm+BB	0.19+1%	0	78	83
Pxlm+Clpy&Flox+MCPA	0.19+3+4	1	73	93
Pxlm+Clpy&Flox&MCPA	0.19+7.5	2	73	85
CV		97	5	5
LSD 0.05		3	5	6

Flucarbazone caused visible injury to wheat when applied with adjuvant or tankmixed with herbicide but did not cause injury when applied alone. Weed control also was reduced when applied without adjuvant. Herbicide gave adequate adjuvant for flucarbazone if the premix (Weld) was used rather than the tankmix (Widematch plus MCPA). Similar relationship was determined for thiencarbazone, but the best control with pyroxsulam was obtained with the tankmix of broadleaf herbicides, 93%.

Adjuvants with Flucarbazone. Howatt, Roach, and Harrington. Prosper hard red spring wheat was seeded April 27 near Fargo, North Dakota. Treatments were applied to 3 to 4 leaf wheat, flowering wild mustard, 2 to 3 leaf wild oat, and 2 to 4 inch wild buckwheat on June 9 with 66°F, 65% relative humidity, 100% cloud-cover, 1 to 3 mph wind at 340°, and damp soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide are the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/23 Wht	6/23 Wioa	7/7 Wioa
	oz ai/A	%	%	%
Flucarbazone	0.25	1	65	70
Flcz+Preference	0.25+0.25%	4	73	80
Flcz+Preference+Interlock	0.25+0.25%+4	6	70	82
Flcz+AG14039	0.25+4	5	68	78
Flcz+Masterlock	0.25+6.4	2	65	73
Flcz+AG14039	0.25+6.4	5	72	82
Flcz+AG14019	0.25+0.5%	8	77	90
Flcz+AG14019	0.25+1%	8	75	80
Flcz+AG14020	0.25+0.5%	11	75	87
Flcz+AG14020	0.25+1%	9	70	83
Flcz+Destiny HC	0.25+6.4	10	65	85
Flcz+Destiny HC	0.25+16	11	68	83
Flcz+AG14039	0.25+16	10	73	87
Flcz+Basic Blend	0.25+1%	8	67	87
CV		348	6	7
LSD P=0.05		4	7	10

Injury to wheat with flucarbazone was greater with adjuvant except with Preference. The basic blend entry was included as the standard commercial treatment. None of the treatments produced more wheat injury than the standard. Only Preference or Masterlock resulted in less flucarbazone injury to wheat than the standard. The highest value for wild oat control on June 23 was obtained with the treatment of flucarbazone plus AG14019, 76% average. Masterlock gave poor enhancement for flucarbazone activity. Other adjuvants improved control with flucarbazone but were similar in benefit to the standard.

New Flucarbazone Formulation. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 17 near Fargo, North Dakota. Treatments were applied to 3 leaf wheat and wild oat on June 8 with 78°F, 44% relative humidity, 30% cloud-cover, 4 to 7 mph wind at 180°, and wet soil at 68°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide are the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 10.

Treatment	Rate	6/23 wht	6/23 wioa	7/9 wioa	8/10 Grain
	oz ai/A	%	%	%	bu/A
X1341+NIS+AMS-L	0.36+0.25%+37	0	67	90	39
X1341+Thif-sg+Trib-sg +NIS+AMS-L	0.36+0.1+0.1 +0.25%+37	0	75	84	32
X1341+Thif-sg+Trib-sg +NIS+AMS-L	0.43+0.1+0.1 +0.25%+37	0	75	91	32
X1341+ARY547 +NIS+AMS-L	0.36+0.1 +0.25%+37	0	75	87	33
Thcz+NIS+AMS-L	0.07+0.25%+37	0	72	88	30
X1341+Clpy&Flox +NIS+AMS-L	0.36+3 +0.25%+37	0	68	87	33
X1341+Clpy&Flox +NIS+AMS-L	0.43+3 +0.25%+37	0	72	88	31
Pxlm-13+Clpy&Flox +NIS+AMS-L	0.22+3 +0.25%+37	0	62	53	30
X1341+Thif-sg+Trib-sg +Clpy&Flox+NIS+AMS-L	0.36+0.1+0.1 +3+0.25%+37	0	73	89	32
X1341+Clpy&Flox +2,4-D+NIS+AMS-	0.36+3 +8.4+0.25%+37	0	77	83	29
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+37	0	73	86	34
Brox&Pyst&Thcz+NIS+AMS-L	4.1+0.25%++37	0	72	82	29
X1341+Thif-sg+Trib-sg +Brox&Pyst+NIS+AMS-L	0.36+0.1+0.1 +3+25%+37	0	68	87	30
X1341+Thif-sg+Trib-sg +2,4-D+NIS+AMS-L	0.36+0.1+0.1 +8.4+0.25%+37	0	68	82	27
X1341+Thif-sg+Trib-sg +Brox&MCPA+NIS+AMS-L	0.36+0.1+0.1 +8+0.25%+37	0	62	82	29
Flcz+Clpy&Flox+NIS+AMS-L	0.36+3+0.25%+37	0	72	88	31
Untreated Check	0	0	0	0	23
CV		0	5	5	24
LSD P=0.05		.	6	6	12

The numbered flucarbazone gave 67% control of wild oat on June 23. Inclusion of tribenuron increased control to 75%. On July 9, advantage of tribenuron was not present but flucarbazone alone gave 90% wild oat control.

Timing of ALS grass application. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded on April 17 near Fargo. Treatment application details are as follows:

Date	wht stage	fxtl stage	wioa stage	Air °F	RH %	% cloud-cover	wind mph	Wind ° direction
5/28	1.5 - 2L	-	-	80	37	15	4-6	350
6/9	3	1 - 2L	1 - 3L	78	44	30	2-4	180
6/12	5	1 - 2 "	3 - 4L	70	65	0	2-6	225

All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 11.

Treatment	Rate	Stage	6/15 wioa	6/15 yeft	6/23 wioa	7/7 wioa	8/11 Grain
	oz ai/A		%	%	%	%	bu/A
Flcz+Clpy&Flox+MCPA+ NIS+AMS-L	0.33+3+4+ 0.25%+37	1L	97	88	95	92	43
Flcz+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.33+0.1+0.1+3+ 0.25%+37	1L	94	85	95	91	44
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+37	1L	94	87	97	92	45
Thcz+Clpy&Flox+MCPA+ NIS+AMS-L	0.07+3+4+ 0.25%+37	1L	91	85	90	88	42
Flcz+Clpy&Flox+MCPA+ NIS+AMS-L	0.43+3+4+ 0.25%+37	3L	74	48	75	82	34
Flcz+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.33+0.1+0.1+3+ 0.25%+37	3L	70	40	70	83	32
Flcz+Thif-sg+Trib-sg+Clpy&Flox+NIS+AMS-L	0.43+0.1+0.1+3+ 0.25%+37	3L	70	40	75	83	34
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+37	3L	70	40	75	84	33
Thcz+Clpy&Flox+MCPA+ NIS+AMS-L	0.07+3+4+ 0.25%+37	3L	70	40	73	81	36
X1341+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.33+0.1+0.1+3+ 0.25%+37	3L	70	40	71	86	35
Flcz+Clpy&Flox+MCPA+ NIS+AMS-L	0.43+3+4+ 0.25%+37	5L	40	20	64	85	34
Flcz+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.43+0.1+0.1+3+ 0.25%+37	5L	40	20	64	83	29
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+37	5L	40	20	60	85	32
Thcz+Clpy&Flox+MCPA+ NIS+AMS-L	0.07+3+4+ 0.25%+37	5L	40	20	58	81	33
X1341+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.43+0.1+0.1+3+ 0.25%+37	5L	40	20	59	80	30
Untreated Check	0		0	0	0		25
CV			3	8	5	3	14
LSD P=0.05			3	5	5	4	7

In addition to removing weeds sooner with earlier application timing, eventual control level is greater. Wild oat control July 7 averaged 91% across herbicides applied at 1 leaf stage compared with 83% when applied at the 3 or 5 leaf stage. Grain yield was improved 76% over the control and 30% over the 3 leaf stage by treating at the 1 leaf stage.

Formulation compatibility with AMS. Howatt, Roach, Harrington. 'Prosper' hard red spring wheat was seeded April 17. Treatments were applied to 3 leaf wheat and wild oat on June 8 with 78°F, 44% relative humidity, 30% cloud-cover, 4 to 7 mph wind at 180°, and wet soil at 68°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 10.

Treatment	Rate	Stage /mx order	6/23 wht	6/23 wioa	7/9 wioa	8/10 Grain
	oz ai/A		%	%	%	bu/A
Flcz+2,4-D++NIS++AMS	0.32+4+0.25%+16	3L/Flcz	17	70	91	33
Flcz+2,4-D+NIS+AMS	0.32+40.25%+16	3L/AMS	20	70	85	32
Flcz+2,4-D+NIS+AMS-L	0.32+4+0.25%+37	3L/Flcz	23	70	88	25
Flcz+2,4-D+NIS+AMS-L	0.32+4+0.25%+37	3L/AMS	17	70	83	28
Flcz2.0+2,4-D+NIS+AMS	0.32+4+0.25%+16	3L/Flcz	0	70	84	35
Flcz2.0+2,4-D+NIS+AMS	0.32+4+0.25%+16	3L/AMS	0	70	82	34
Flcz2.0+2,4-D+NIS+AMS-L	0.32+4+0.25%+37	3L/Flcz	0	70	84	31
Flcz2.0+2,4-D+NIS+AMS-L	0.32+4+0.25%+37	3L/AMS	0	70	86	35
X1341+2,4-D+NIS++AMS	0.32++4+0.25%+16	3L/Flcz	0	70	83	29
X1341+2,4-D+NIS++AMS	0.32+4+0.25%+16	3L/AMS	0	70	75	31
X1341+2,4-D+NIS++AMS-L	0.32+4+0.25%+37	3L/Flcz	0	70	83	26
X1341+2,4-D+NIS++AMS-L	0.32+4+0.25%+37	3L/AMS	0	70	90	32
CV			23	0	4	17
LSD P=.05			2	.	5	9

Incompatible mixtures have been observed with flucarbazone and AMS. Mixing order and formulation has affected this interaction with other herbicides. Mix order refers to which product is dispersed in water first. Flucarbazone was the DF formulation without safener and caused substantial injury as stunting and slight chlorosis. Formulations that included safener did not shorten or discolor wheat.

Control of wild oat across all treatments was similar on June 23. Later evaluation did not demonstrate wide variation but differences within flucarbazone formulation were present. Flucarbazone gave better control than flucarbazone 2.0 or the numbered formulation except when liquid AMS was added to water first. This treatment could represent antagonism caused by treatment preparation order. Precipitate was not observed in mixture at application. Flucarbazone 2.0 gave similar control regardless of AMS formlation or mixing order. The numbered flucarbazone formulation provided the best control when liquid AMS was included first and worst control when dry AMS was added first.

Wild oat herbicides. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 27 near Fargo, North Dakota. Treatments were applied to 3 leaf wheat and wild oat on June 9 with 78°F, 44% relative humidity, 40% cloud-cover, 4 to 6 mph wind at 180°, and wet soil at 68°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Growth Stage	6/23 Wht	6/23 Wioa	7/9 Wioa
	oz ai/A		%	%	%
Flcz+Brox&MCPA5+BB	0.32+8+1%	3L	0	87	96
Prcz+Brox&MCPA5+BB	0.42+8+1%	3L	0	67	72
Prcz&Mess+Brox&MCPA5+BB	0.2+8+1%	3L	0	77	93
Pxlm+Brox&MCPA5+BB	0.26+8+1%	3L	0	72	92
Pxlm&Flas&Flox+BB	1.68+1%	3L	0	73	87
Thcz+Brox&MCPA5+BB	0.07+8+1%	3L	0	83	94
Brox&Pyst&Thcz+UAN	3+16	3L	0	73	87
Fenoxaprop+Brox&MCPA5	1.32+8	3L	0	75	73
Clodinafop+Brox&MCPA5	0.8+8	3L	0	86	96
Pinoxaden+Brox&MCPA5	0.86+8	3L	0	86	98
Brox&MCPA5	8	3L	0	0	0
CV			0	6	5
LSD 0.05			.	7	7

Herbicides did not cause symptoms in wheat. Wild oat control 2 weeks after application was best among flucarbazone, clodinafop, and pinoxaden. These three herbicides tended to give better control on July 9 as well. Propoxycarbazone or fenoxaprop gave less than 75% control of wild oat. Thiencarbazone plus bromoxynil and MCPA gave better control than the premix formulation of bromoxynil and pyrasulfotole and thiencarbazone.

Antagonism of ACC-ase herbicides. Howatt, Roach, Harrington. 'Prosper' hard red spring wheat was seeded April 17 near Fargo. Treatments were applied to 3 to 4 leaf wheat and 3 leaf wild oat on June 9 with 68°F, 68% relative humidity, 100% cloud-cover, 3 .5 mph wind at 340°, and wet soil at 62°F (light rain occurring during the final half of treatment application). Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was on August 10.

Treatment	Rate	6/23 wioa	7/9 wioa	8/10 Grain
	oz ai/A	%	%	bu/A
Fenx	1.2	73	85	39
Fenx+Clpy&Flox&MCPA	1.2+7.5	78	86	41
Fenx+Clpy&Flox+Carf	1.2+3+0.128	77	93	35
Fenx+AGH15004	1.2+24 fl oz	72	75	40
Fenx+AGH15005	1.2+24 fl oz	72	75	40
Fenx+Thif-sg+Trib-sg+2,4-D	1.2+0.2+0.2+6	73	80	47
Clfp NG	0.7	84	88	31
Clfp NG+Clpy&Flox&MCPA	0.7+7.5	80	94	45
Clfp NG+Clpy&Flox+Carf	0.7+3+0.128	80	96	38
Clfp NG+AGH15004	0.7+24 fl oz	68	77	35
Clfp NG+AGH15005	0.7+24 fl oz	78	80	41
ClfpN G+Thif-sg+Trib-sg+2,4-D	0.7+0.2+0.2+6	70	72	31
Pxdn	0.75	83	98	39
Pxdn+Clpy&Flox&MCPA	0.75+7.5	85	99	46
Pxdn+Clpy&Flox+Carf	0.75+3+0.128	83	98	43
Pxdn+AGH15004	0.75+24 fl oz	82	99	39
Pxdn+AGH15005	0.75+24 fl oz	82	99	38
Pxdn+Thif-sg+Trib-sg+2,4-D	0.75+0.2+0.2+6	83	98	48
CV		4	3	14
LSD P=.05		5	5	9

Herbicides did not cause visible injury to wheat (data not shown). Fenoxaprop activity was antagonized by AGH15004 and AGH15005 according to the July 9 evaluation resulting in control decrease of 10 percentage points. But control was greater than fenoxaprop alone when tankmixed with clopyralid and fluroxypyr plus carfentrazone. This combination also provided the best control with clodinafop and was similar in control with clopyralid and fluroxypyr and MCPA. The other three tankmixes reduced control with clodinafop by 8 to 16 percentage points. Pinoxaden has exceptional activity on wild oat even at the reduced rate used and was not antagonized by broadleaf herbicides.

Wheat tolerance to ALS graminicides. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 27. Treatments (3L) were applied to 4 to 5 leaf wheat, cotyledon to 1 leaf common mallow, 2 leaf common cocklebur, 1 to 3 leaf wild buckwheat, and 2 to 4 leaf redroot pigweed on June 12 with 82°F, 31% relative humidity, sky with 5% haze, 7 to 9 mph wind at 180°, and damp soil at 82°F. Treatments (6L) were applied to 6 leaf wheat, 1 to 3 inch redroot pigweed, Venice mallow and common lambsquarters; 4 to 12 inch wild buckwheat; and 3 to 6 inch foxtail on June 19 with 74°F, 100% humidity, 5% cloud-cover, 10 to 15 mph wind at 135°, and dry soil at 62°F. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Weed-free plots were weeded by hand to limit competition between wheat and weeds. Harvest for yield was August 20.

Treatment	Rate	Stage	6/17 Wht	6/25 Wht	6/25 Yeft	7/2 Wht	7/2 Yeft	7/10 Wht	7/10 Yeft	8/20 Grain
	oz ai/A		%	%	%	%	%	%	%	bu/A
Flcz+NIS+AMS-L	0.43+0.25%+37	3L	5	3	90	4	87	1	91	46
Flcz+NIS+AMS-L	0.86+0.25%+37	3L	5	2	88	3	84	2	90	51
X1341+NIS+AMS-L	0.86+0.25%+37	3L	5	4	87	4	89	2	91	54
Pxlm&Flas&Flox+NIS+MS-L	1.67+0.25%+37	3L	5	2	91	3	88	3	92	53
Pxlm&Flas&Flox+NIS+AMS-L	3.34+0.25%+37	3L	5	4	92	6	86	5	90	50
Thcz+NIS+AMS-L	0.07+0.25%+37	3L	5	2	91	4	88	1	92	53
Thcz+NIS+AMS-L	0.14+0.25%+37	3L	5	3	93	5	92	3	93	50
Weed-Free	0	3L	0	0	0	0	0	1	95	52
Flcz+NIS+AMS-L	0.43+0.25%+37	6L	0	2	69	1	60	1	91	49
Flcz+NIS+AMS-L	0.86+0.25%+37	6L	0	4	70	6	63	4	86	51
X1341+NIS+AMS-L	0.86+0.25%+37	6L	0	4	69	5	64	2	90	52
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+37	6L	0	6	73	4	68	4	95	49
Pxlm&Flas&Flox+NIS+AMS-L	3.34+0.25%+37	6L	0	5	73	5	65	4	96	48
Thcz+NIS+AMS-L	0.07+0.25%+37	6L	0	3	70	5	68	3	91	52
Thcz+NIS+AMS-L	0.14+0.25%+37	6L	0	4	79	5	65	4	96	50
Weed-Free	0	6L	0	0	0	0	0	0	95	54
CV			0	43	6	55	5	63	3	11
LSD 0.05			.	2	6	3	5	2	4	8

All of the treatments resulted in wheat injury that persisted through the season although injury was mild at 6% or less. Yellow foxtail control was relatively consistent across treatments as was final yield.

Timing of ALS grass application. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 27 near Fargo, North Dakota. Treatment application details are as follows:

Date	Wheat stage	Yellow foxtail stage	Air °F	RH %	% clouds	Wind mph	Wind° direction
5/28	1 L	spike	84	31	0	1-2	300
6/10	3 L	1 - 2 L	74	0	0	1-2	330
6/19	5.5 - 6 L	2 - 4 L	70	100	10	7-15	135

All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was on August 12.

Treatment	Rate	Stage	6/19 Wht	6/19 Yeft	6/26 Wht	6/26 Yeft	7/2 Wht	7/2 Yeft	8/12 Grain
	oz ai/A		%	%	%	%	%	%	bu/A
Flcz+Clpy&Flox+ MCPA+NIS+AMS-L	0.33+3+ 4+0.25%+37	1L	3	91	1	88	1	86	56
Flcz+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.33+0.1+0.1+ 3+0.25%+37	1L	3	93	2	91	2	93	60
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+37	1L	3	93	2	90	3	87	59
Thcz+Clpy&Flox+ MCPA+NIS+AMS-L	0.07+3+ 4+0.25%+37	1L	3	88	0	90	1	91	59
Flcz+Clpy&Flox+ MCPA+NIS+AMS-L	0.43+3+ 4+0.25%+37	3L	3	73	1	84	3	88	56
Flcz+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.33+0.1+0.1+ 3+0.25%+37	3L	3	78	1	85	4	83	54
Flcz+Thif-sg+Trib-sg +Clpy&Flox+NIS+AMS-L	0.43+0.1+0.1+ 3+0.25%+37	3L	3	79	2	90	4	89	55
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+37	3L	3	76	4	88	4	87	53
Thcz+Clpy&Flox+MCPA+ NIS+AMS-L	0.07+3+ 4+0.25%+37	3L	3	78	1	88	3	93	62
X1341+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.33+0.1+0.1+ 3+0.25%+37	3L	3	70	2	87	5	80	51
Flcz+Clpy&Flox+MCPA+ NIS+AMS-L	0.43+3+4+ 0.25%+37	5L	-	-	2	71	3	73	57
Flcz+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.43+0.1+0.1+ 3+0.25%+37	5L	-	-	3	75	2	74	53
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+37	5L	-	-	2	70	3	71	54
Thcz+Clpy&Flox+MCPA+ NIS+AMS-L	0.07+3+4+ 0.25%+37	5L	-	-	2	75	1	75	51
X1341+Thif-sg+Trib-sg+ Clpy&Flox+NIS+AMS-L	0.43+0.1+0.1+ 3+0.25%+37	5L	-	-	1	73	3	71	52
Untreated Check	0		0	0	0	1	0	0	62
CV			0	5	112	5	83	5	9
LSD 0.05			.	3	2	5	3	6	7

Mild injury to wheat was observed with all herbicide treatments. Injury was primarily stunting and persisted throughout the season. Yellow foxtail control on July 2 was lowest when treated at 5L wheat stage and highest when treated at 1L stage. Thiencarbazone or flucarbazone plus tribenuron tended to give better control of foxtail within application timing than other herbicide treatments.

Thiencarbazone tank-mixes for green foxtail control. Howatt, Roach, Harrington. 'Prosper' hard red spring wheat was seeded April 23 near the North Dakota State University campus. Treatments were applied to 3.5 to 4 leaf wheat, 1 to 2 leaf green and yellow foxtail, pre-flowering wild mustard, 0.5 to 1.5 inch Venice mallow, and 2 to 6 inch wild buckwheat on June 10 with 76°F, 46% relative humidity, 95% cloud-cover, 1 to 8 mph wind at 330°, and dry soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 12.

Treatment	Rate	6/12 Chlor	6/12 Stunt	6/19 Wht	6/19 Fxtl	6/19 Wimu	6/19 Vema	6/19 Wibw	7/1 Wht	7/1 Fxtl	7/1 Wimu	7/1 Vema	7/1 Wibw	8/12 Grain
	oz ai/A	%	%	%	%	%	%	%	%	%	%	%	%	bu/A
Thcz+Brox&MCPA+AMS	0.07+8+8	8	10	5	79	95	80	78	4	90	99	86	90	45
Thcz+Clpy&Flox&MCPA+AMS	0.07+7.5+8	6	5	5	81	79	79	69	4	93	99	84	76	50
Thcz+Brox&MCPA+AMS	0.07+8+8	5	6	5	83	88	80	79	3	88	99	84	86	45
Thcz+Clpy&Flox+2,4-De+AMS	0.07+3+3.8+8	4	8	5	79	81	81	80	4	91	98	90	93	48
Thcz+Clpy&Flox+MCPAe+AMS	0.07+3+4+8	4	3	5	79	85	88	85	2	90	99	90	91	47
Thcz+Clpy&Flox+Thif-sg+Trib-sg+AMS	0.07+3+0.24+0.06+8	5	6	5	75	80	80	85	3	92	99	90	93	46
Thcz+Prcz+Brox&MCPA&Flox+AMS	0.07+0.14+8+8	7	9	5	76	91	85	84	3	88	99	90	91	51
Brox&Pyst&Thcz+AMS	3+8	3	6	5	80	90	81	89	2	89	99	91	95	50
Fenx&Brox&Pyst	5.4	1	1	0	79	92	80	91	0	86	99	80	73	50
Flcz+Thif-sg+Trib-sg+2,4-D+AMS-L	0.35+0.15+0.15+6+8	1	12	5	76	85	85	83	13	90	99	87	86	43
Pxlm&Flas&Flox+NIS+AMS-L	1.67+0.25%+24	4	9	5	74	76	81	76	5	75	99	84	81	42
Untreated Check		0	0	0	0	0	0	0	0	0	0	0	0	48
CV		67	44	0	6	4	5	5	50	6	1	5	6	10
LSD 0.05		4	4	.	6	5	5	5	2	7	1	6	6	8

Injury to wheat, either chlorosis or stunting or both, was present with all herbicides except fenoxaprop and bromoxynil and pyrasulfotole on June 12. This treatment remained the only that didn't cause wheat injury during subsequent evaluations. However, injury later in the season was only prominent with the flucarbazone combination, which caused 13% injury as stunting on July 1.

Control of foxtail at early evaluation was essentially similar across thiencarbazone treatments. Foxtail control with thiencarbazone was less when tankmixed with clopyralid and fluroxypyr plus thifensulfuron and tribenuron (75%) than with bromoxynil and MCPA (83%). By July 1, all grass herbicides except pyroxsulam provided at least 86% foxtail control, and as confirmed by inspection on August 1, all foxtail remaining in herbicide plots was yellow foxtail. Green foxtail was controlled by each herbicide treatment.

Broadleaf weed control varied by species and herbicide treatment, but generally, good control was achieved. None of the herbicide treatments really separated from the group.

Postemergence Weed Control Options in Durum

Caleb Dalley, HREC, Hettinger, ND, 2015

A field trial was conducted to evaluate weed control and crop tolerance to POST herbicides. 'Carpio' durum wheat was seeded at 80 lb/A using a 1590 no-till drill on April 24, 2015. Starter fertilizer (18-46-0) was applied at planting at 40 lb/A. Durum emerged on May 7. Granular urea fertilizer was spread at 100 lb/A on May 16. Wheat and weeds were allowed to grow together until treatment application. Herbicide treatments were applied using a hand-held backpack spray system on May 28 when durum was in the 3-4 leaf stage. Wild buckwheat and field bindweed were just beginning to vine and Japanese brome was tillering at time of application.

	Treatment	Rate	Durum			Field bindweed		Wild buckwheat		Japanese Brome	Durum yield	
			Jun 1	Jun 12	Jun 26	Jun 12	Jun 26	Jun 12	Jun 26	Jun 26	Aug 12	
		-lb ai/A-	Injury (%)			Control (%)					Test wt	bu/A
1	Untreated		0 d	0 c	0 a	0 e	0 d	0 f	0 d	0 c	60 a	58.6 a
2	Thiencarbazone-methyl	0.031	4 bc	3 ab	1 a	63 abc	78 ab	96 a	96 a	95 ab	60 a	65.5 a
	Bromoxynil	0.5										
	AMS	0.5										
3	Thiencarbazone-methyl	0.031	6 ab	4 a	2 a	57 c	78 ab	88 bcd	96 a	90 ab	61 a	69.5 a
	Weld Herbicide*	0.47										
	AMS	0.5										
4	Thiencarbazone-methyl	0.031	6 ab	2 ab	1 a	73 a	90 a	91 abc	97 a	95 ab	60 a	63.1 a
	Carnivore Herbicide*	0.502										
	AMS	0.5										
5	Thiencarbazone-methyl	0.031	4 bc	2 ab	1 a	65 abc	80 ab	85 d	99 a	83 b	60 a	65.8 a
	Widematch*	0.187										
	2,4-D Ester	0.238										
	AMS	0.5										
6	Thiencarbazone-methyl	0.031	5 abc	4 a	1 a	75 a	87 ab	86 bcd	100 a	90 ab	60 a	66.2 a
	Widematch	0.187										
	MCPA Ester	0.25										
	AMS	0.5										
7	Thiencarbazone-methyl	0.031	6 ab	1 bc	1 a	70 ab	80 ab	86 cd	99 a	100 a	61 a	74.6 a
	Widematch	0.187										
	Affinity Tankmix*	0.019										
	AMS	0.5										
8	Thiencarbazone-methyl	0.031	6 abc	3 a	0 a	68 abc	75 b	92 ab	89 b	94 ab	60 a	66.1 a
	Propoxycarbazone-Na	0.009										
	Carnivore Herbicide	0.502										
	AMS	0.5										
9	Huskie Complete*	0.215	7 a	4 a	2 a	60 bc	77 b	84 d	82 b	88 ab	60 a	70.2 a
	AMS	0.5										
10	Wolverine Advanced	0.307	4 c	2 bc	0 a	33 d	57 c	65 e	68 c	2 c	61 a	70.9 a
LSD P=.05			2.2	1.7	2.1	11.9	13.2	6.2	6.8	15.1	NS	NS
Standard Deviation			1.5	1.1	1.4	6.9	7.7	4.3	4.7	10.4	1.0	8.41
CV			32.8	48.93	173.12	12.26	11.0	5.54	5.66	14.11	1.69	12.54
Treatment F			6.478	4.210	0.927	33.415	34.480	175.721	173.193	55.355	0.803	1.132
Treatment Prob(F)			0.0001	0.0017	0.5175	0.0001	0.0001	0.0001	0.0001	0.0001	0.6175	0.3751

*Weld herbicide: MCPA, 1.75lb/gal, fluroxypyr, 0.64lb/gal, clopyralid, 0.5lb/gal; Carnivore herbicide: MCPA, 1.67lb/gal, bromoxynil, 1.67lb/gal, fluroxypyr, 0.67lb/gal; WideMatch: clopyralid, 0.75lb/gal, fluroxypyr, 0.75lb/gal; Affinity TankMix: thifensulfuron-methyl, 40%, tribenuron-methyl, 10%; Huskie Complete: thiencarbazone-methyl, 0.042lb/gal, pyrasulfotole, 0.26lb/gal, bromoxynil, 1.46lb/gal; Woverine Advanced: fenoxaprop-p-ethyl, 0.40lb/gal, pyrasulfotole, 0.53lb/gal, bromoxynil, 0.52lb/gal.

Durum was evaluated for injury at 4, 8, 15, and 28 days after treatment (DAT). Mild injury (yellowing), was observed in all herbicide treatments and diminished by 28 DAT. Field bindweed was suppressed by all treatments. Wild buckwheat was controlled by all treatments containing Varro, and was suppressed with Huskie Complete and Wolverine treatments. Japanese brome was controlled by all thiencarbazone-methyl tank-mixes. Durum was harvested on August 12. No differences in yield, seed moisture, or test weight were observed at harvest. Weed populations were light in this test and did not lead to significant yield losses, although yield in the untreated control was numerically less (4.5 to 16 bushels per acre less) than all other treatments. Further research should be conducted on different weed populations in order to

determine efficacy. It appears that thiencarbazone-methyl, when applied at the 3 to 4 leaf stage in durum is safe and does not lead to yield losses. Further evaluations at different growth stages of durum is needed to ensure safety and to evaluate for weed control.

Foxtail barley control with Olympus, Varro, or Huskie Complete tank mixes. (Minot). The objective of this study was to evaluate foxtail barley control with Olympus applied PRE or POST, and Varro or Huskie Complete applied POST. 'Joppa" durum was planted May 11 followed by preemergence herbicides applied May 15. POST herbicides were applied at the 3-leaf durum stage on June 5. Foxtail barley plants 2-8 inches tall at the PRE application and 8-16 inches tall at the POST application. Glyphosate was applied with all PRE treatments.

All POST treatments caused slight, temporary crop injury, mostly in the form of chlorosis with very slight stunting. Glyphosate applied PRE provided only 30% foxtail barley control at the August 10 evaluation. Olympus applied PRE or POST tended to provide 10-20% more foxtail barley control over that provided by "Varro + Carnivore" or "Huskie Complete". Even though Olympus isn't providing complete control, the additional control provided by Olympus could significantly reduce seed production.

Table. Foxtail barley control with Varro tank mixes. (1525)

			Durum Injury		Weed Control Foxtail barley		
Treatment[ab]	Rate	Timing	Jun-17	Jun-26	Jun-17	Jun-26	Aug-10
			---%---		---%---		
Untreated			0	0	0	0	0
Gly / Varro + Carnivore	22 oz / 6.85 oz + 1 pt	PRE / 3-leaf	9	7	72	65	64
Gly / Olympus + Varro + Carnivore	22 oz / 0.2 oz + 6.85 oz + 1 pt	PRE / 3-leaf	17	9	80	73	72
Gly + Olympus / Varro + Carnivore	22 oz + 0.2 oz / 6.85 oz + 1 pt	PRE / 3-leaf	15	10	90	82	82
Gly + Olympus / Olympus + Varro + Carnivore	22 oz + 0.2 oz / 0.2 oz + 6.85 oz + 1 pt	PRE / 3-leaf	22	8	86	91	81
Gly / Huskie Complete	22 oz / 13.7 oz	PRE / 3-leaf	15	3	71	66	60
Gly / Olympus + Huskie Complete	22 oz / 0.2 oz + 13.7 oz	PRE / 3-leaf	13	8	81	81	84
Gly + Olympus / Huskie Complete	22 oz + 0.2 oz / 13.7 oz	PRE / 3-leaf	16	11	79	74	69
Gly + Olympus / Olympus + Huskie Complete	22 oz + 0.2 oz / 0.2 oz + 13.7 oz	PRE / 3-leaf	19	12	87	89	84
Gly	22 oz	PRE	0	0	45	35	30
LSD (0.05)			6.2	7.4	4.4	6.7	11.4

[a] *AMS applied with all treatments at 1.47 gal/100 gal*

[b] *Gly=Glyphosate*

Comparison of POST and PRE/POST Combinations for Weed Control in Spring Wheat

Caleb Dalley, HREC, Hettinger, ND, 2015

A trial was conducted to evaluate preemergence (PRE) and postemergence (POST) options for weed control in spring wheat. 'Elgin' spring wheat was drilled using a John Deere 1590 no-till drill on April 24, 2015. Starter fertilizer (18-46-0) was applied at planting at 40 lbs/acre. Olympus PRE treatments were applied on April 27. Wheat emerged on approximately May 5. Granular urea fertilizer was broadcast at 100 lb/A on May 16 using a drop spreader. Wheat and weeds were allowed to grow together until time of treatment application. POST herbicide treatments were applied at a volume of 10 gal/A using a hand-held backpack spray system on May 28 when wheat was in the 3-4 leaf stage. Wild buckwheat and field bindweed were just beginning to vine at time of application.

	Treatment	Rate	Timing	Spring wheat injury			Field bindweed	Wild buckwheat		Test wt	Yield
				May 29	Jun 5	Jun 12	Jun 5	Jun 5	Jun 26	Aug 7	Aug 7
		-lb ai/A-		——%——			—— Control (%) ——			lb/bu	bu/A
1	Untreated			0b	0c	0c	0d	0b	0b	59a	70.3a
2	Thiencarbazone-methyl	0.031	POST	5a	4ab	0c	59abc	94a	99a	57a	70.3a
	Carnivore Herbicide	0.502	POST								
	AMS	0.5	POST								
3	Thiencarbazone-methyl	0.031	POST	7a	4ab	1abc	53bc	95a	98a	58a	72.2a
	Carnivore Herbicide	0.502	POST								
	Olympus	0.009	POST								
	AMS	0.5	POST								
4	Olympus	0.009	PRE	6a	5ab	3a	56abc	95a	98a	56a	70.8a
	Thiencarbazone-methyl	0.031	POST								
	Carnivore Herbicide	0.502	POST								
	AMS	0.5	POST								
5	Olympus	0.009	PRE	8a	7ab	3ab	56abc	95a	100a	57a	72.5a
	Thiencarbazone-methyl	0.031	POST								
	Carnivore Herbicide	0.502	POST								
	Olympus	0.009	POST								
	AMS	0.5	POST								
6	Huskie Complete	0.215	POST	6a	3b	1bc	58abc	95a	98a	58a	69.7a
	AMS	0.500	POST								
7	Huskie Complete	0.215	POST	6a	3ab	1abc	67a	95a	100a	58a	69.5a
	Olympus	0.009	POST								
	AMS	0.5	POST								
8	Olympus	0.009	PRE	5a	8a	4a	62ab	94a	100a	58a	68.7a
	Huskie Complete	0.215	POST								
	AMS	0.5	POST								
9	Olympus	0.009	PRE	6a	4ab	4a	47c	94a	96a	58a	71.7a
	Huskie Complete	0.215	POST								
	Olympus	0.009	POST								
	AMS	0.5	POST								
LSD P=.05				3.7	0.3	0.4	13.5	1.8	4.4	NS	NS
Standard Deviation				2.5	0.2	0.3	9.0	1.3	3.0	1.2	4.86
CV				47.07	34.85	75.89	17.65	1.49	3.41	2.08	6.87
Treatment F				2.944	5.699	2.990	19.564	2542.778	484.074	1.883	0.286
Treatment Prob(F)				0.0192	0.0004	0.0179	0.0001	0.0001	0.0001	0.1101	0.9642

Wheat was evaluated for injury at 2, 9, 16, and 30 days after treatment (DAT). Mild injury, in the form of slight yellowing, was observed in nearly all herbicide treatments and diminished by the 30 DAT evaluation. Field bindweed was suppressed by all treatments at 9 DAT. Wild buckwheat was controlled by all treatments. Wheat was harvested on August 7. No differences in yield, seed moisture, or test weight were observed at harvest. Weed populations were light in this test and did not lead to significant yield losses. Further research should be conducted on different weed populations in order to determine efficacy. It appears that thiencarbazone-methyl, when applied at the 3 to 4 leaf stage in spring wheat is safe and does not lead to yield losses. Further evaluations at different growth stages of spring wheat is needed to determine safety and weed control.

Postemergence options for weed control in Spring Wheat

Caleb Dalley, HREC, Hettinger, ND, 2015

A field trial was conducted to evaluate different postemergence options for weed control in spring wheat. 'Elgin' spring wheat (HRSW) was drilled at 80 lbs/A using a John Deere 1590 no-till drill on April 24, 2015. Starter fertilizer (18-46-0) was applied at planting at a rate of 40 lb/A. Wheat emerged on approximately May 5. Granular urea fertilizer was broadcast at 100 lb/A on May 16 using a drop spreader. Wheat and weeds were allowed to grow together until time of treatment application. Herbicide treatments were applied using a hand-held backpack spray system at a volume of 10 gal/A on May 28 when wheat was in the 3-4 leaf stage. Wild buckwheat and field bindweed were just beginning to vine at time of application.

Treatment	Product rate	—Wheat—		— Field Bindweed —			—Wild Buckwheat—			Test wt	Yield
		Jun 1	Jun 12	Jun 5	Jun 12	Jun 26	Jun 5	Jun 12	Jun 26	Aug 7	Aug 7
	-lb ai/A-	— Injury % —		——— Control % ———						–lbs/bu–	–bu/A–
1 Untreated		0 d	0 e	0 c	0 c	0 d	0 d	0 d	0 c	60 a	58.6 a
2 Thiencarbazone-methyl	0.031	7 a	3 ab	70 ab	65 b	94 ab	94 a	96 a	100 a	59 a	58.2 a
Bromoxynil	0.5										
AMS	0.5										
3 Thiencarbazone-methyl	0.031	6 ab	2 bc	68 b	66 b	88 b	70 c	92 ab	100 a	59 a	58.2 a
Weld Herbicide*	0.47										
AMS	0.5										
4 Thiencarbazone-methyl	0.031	6 ab	2 cd	70 ab	70 ab	91 ab	89 ab	96 a	99 a	60 a	58.4 a
Carnivore Herbicide*	0.502										
AMS	0.5										
5 Thiencarbazone-methyl	0.031	7 a	4 a	70 ab	68 ab	96 a	75 c	96 a	100 a	60 a	59.9 a
WideMatch*	0.187										
2,4-D Ester LV6	0.238										
AMS	0.5										
6 Thiencarbazone-methyl	0.031	5 ab	1 de	70 ab	70 ab	95 a	70 c	93 ab	100 a	59 a	58.4 a
WideMatch	0.187										
MCPA Ester	0.25										
AMS	0.5										
7 Thiencarbazone-methyl	0.031	5 bc	2 cd	69 ab	75 a	96 a	70 c	84 c	100 a	60 a	58.5 a
WideMatch	0.187										
Affinity TankMix*	0.019										
AMS	0.5										
8 Thiencarbazone-methyl	0.031	5 ab	2 bcd	71 a	71 ab	95 a	91 ab	97 a	100 a	59 a	56.5 a
Propoxycarbazone-Na	0.009										
Carnivore Herbicide	0.502										
AMS	0.5										
9 Huskie Complete*	0.215	5 bc	2 bcd	68 b	73 ab	95 a	92 ab	95 a	100 a	59 a	60.4 a
AMS	0.5										
10 Wolverine Advanced*	0.307	3 c	0 e	70 ab	68 ab	65 c	87 b	90 b	71 b	60 a	58.8 a
LSD P=.10		2.1	1.4	3.2	8.5	5.9	5.2	5.5	2.1	0.8	NS
Standard Deviation		1.7	1.2	2.7	7.0	4.9	4.3	4.6	1.7	0.7	2.82
CV		36.54	77.14	4.29	11.26	6.05	5.81	5.43	2.01	1.11	4.81
Treatment F		5.63	3.76	269.68	39.67	149.09	167.36	170.74	1329.2	0.71	0.55
Treatment Prob(F)		0.0002	0.0036	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.6992	0.8243

*Weld herbicide: MCPA, 1.75lb/gal, fluroxypyr, 0.64lb/gal, clopyralid, 0.5lb/gal; Carnivore herbicide: MCPA, 1.67lb/gal, bromoxynil, 1.67lb/gal, fluroxypyr, 0.67lb/gal; WideMatch: clopyralid, 0.75lb/gal, fluroxypyr, 0.75lb/gal; Affinity TankMix: thifensulfuron-methyl, 40%, tribenuron-methyl, 10%; Huskie Complete: thiencarbazone-methyl, 0.042lb/gal, pyrasulfotole, 0.26lb/gal, bromoxynil, 1.46lb/gal; Woverine Advanced: fenoxaprop-p-ethyl, 0.40lb/gal, pyrasulfotole, 0.53lb/gal, bromoxynil, 0.52lb/gal.

Wheat was evaluated for injury at 4, 8, 15, and 29 days after treatment (DAT). Mild injury, in the form of slight yellowing, was observed in nearly all herbicide treatments and diminished by the 29 DAT evaluation. Field bindweed was suppressed by all treatments at 8 and 15 DAT and was controlled 88% or more by all treatments except Wolverine at the 29 DAT evaluation. Wild buckwheat was controlled by all treatments containing Thiencarbazone-methyl as well as Huskie Complete, and was suppressed by the Wolverine treatment at 29 DAT. Wheat was harvested on August 7. No

differences in yield or test weight were observed at harvest. Weed populations were light in this test and did not lead to significant yield losses.

Broadleaf weed control in spring wheat, Carrington, 2014. Greg Endres and Mike Ostlie. The experiment was conducted at the NDSU Carrington Research Extension Center in cooperation with Bayer CropScience. Experimental design was a randomized complete block with three replicates. 'Glenn' HRS wheat was seeded on April 29 in conventionally tilled soil. Herbicide treatments were applied with a CO_2-hand-boom plot sprayer delivering 10 gal/A at 35 psi through 8001 flat fan nozzles to the center 6.7 ft of 10- by 25-ft plots. Treatments were applied on June 8 with 72 F, 50% RH and 3 mph wind to 5-leaf wheat; 1- to 2-inch tall green and yellow foxtail (1-3 leaves); 0.5- to 1-inch tall sheperdspurse and redroot pigweed; 1-inch tall kochia; and 1- to 3-inch tall common lambsquarters and wild buckwheat.

No wheat injury was observed on June 15. Foxtail (green and yellow) control generally was good (range of 78 to 89%) when visually evaluated on June 19 and July 2 (11 and 24 days after treatment, respectively), but dropped to suppression (65 to 73%) at wheat maturity on August 7 (Table). Common lambsquarters, redroot pigweed and wild buckwheat control generally was excellent (88 to 99%) on July 2 and August 7. Kochia control was excellent (91 to 99%) on August 7 with Varro tank mixtures of Carnivore, WideMatch plus 2,4-D ester, WideMatch plus Affinity Tankmix, and Carnivore plus Olympus.

Table.

Herbicide		Weed control[1]														
		19-Jun					2-Jul					7-Aug				
Treatment[2]	Rate	fota	colq	repi	shpu	wibu	fota	colq	repi	KOCZ	wibu	fota	colq	repi	KOCZ	wibu
	fl oz product/A	%														
Untreated check	x	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Varro + Bronate	6.9 + 16	78	96	83	96	96	85	99	99	91	96	72	98	99	72	88
Varro + Weld	6.9 + 20.8	80	87	90	91	91	84	99	96	89	99	73	99	99	69	99
Varro + Carnivore	6.9 + 16	82	99	83	93	99	87	99	98	99	99	69	99	98	99	90
Varro + WideMatch + 2,4-D ester	6.9 + 16 + 8	78	88	85	88	87	78	99	97	91	96	68	99	99	99	99
Varro + WideMatch + MCPA ester	6.9 + 16 + 8	80	87	87	91	88	83	99	95	96	99	69	99	96	86	99
Varro + WideMatch + Affinity Tankmix	6.9 + 16 + 6 oz wt	85	87	94	93	93	89	99	99	95	97	68	99	99	91	99
Varro + Carnivore + Olympus	6.9 + 16 + 0.2 oz wt	79	97	90	91	98	84	99	99	99	99	70	98	99	94	93
Huskie Complete	13.7	81	98	78	99	93	83	99	96	98	99	68	99	98	85	99
Wolverine Advanced	27.4	82	98	83	99	99	79	99	96	90	99	65	99	94	83	93
C.V. (%)		7.1	4.0	8.6	9.8	5.2	7.2	0.0	2.8	7.6	2.1	10.9	1.2	3.2	24.8	9.6
LSD (0.05)		9	6	11	14	8	9	0	4	11	3	12	2	5	33	14

[1]fota=green and yellow foxtail; colq=common lambsquarters; repi=redroot pigweed; shpu=sheperdspurse; wibu=wild buckwheat; and KOCZ=kochia.

[2]All herbicide treatments included ammonium sulfate at 8 lb/A except Wolverine Advanced.

New Pyroxsulam Formulation. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 27 near Fargo. Treatments were applied to 4.5 to 5 leaf wheat, 1 to 2 leaf yellow foxtail, 2 to 5 inch wild buckwheat, and 0.5 to 1.5 inch Venice mallow on June 11 with 70°F, 57% relative humidity, 50% cloud-cover, calm wind and moist soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was on August 20.

Treatment	Rate	6/15 Wht	6/19 Wht	6/19 Yeft	6/19 Wibw	6/19 Vema	6/25 Yeft	6/25 Wibw	6/25 Vema	6/25 Wimu
	oz ai/A	%	%	%	%	%	%	%	%	%
Pxlm&Flas&Flox+NIS+AMS	1.67+0.5%+24	5	5	74	85	86	89	89	88	94
Pxlm&Flas&Flox+2,4-D+AMS	1.67+7+24	4	5	80	89	89	88	89	91	96
Pxlm&Clpy&Flox+NIS+AMS	3.2+0.5%+24	5	5	74	85	85	88	93	91	96
Pxlm&Clpy&Flox+2,4-D+AMS	3.2+7+24	5	5	74	85	86	91	91	95	98
Pxlm&Clpy&Flox+MCPA+AMS	3.2+7+24	4	5	71	85	86	88	90	93	96
Brox&Pyst&Thcz+NIS+AMS	4+0.25%+8	7	5	83	93	83	93	95	94	99
Pxdn+Clpy&Flox	0.86+3	1	0	83	90	90	91	92	92	98
Flcz+Clpy&Flox	0.43+3	2	5	74	86	83	84	89	91	97
Pxdn+Brox&MCPA5	0.86+8	5	5	92	92	90	92	93	92	99
Untreated Check	0	0	0	0	0	0	0	0	0	0
CV		42	0	4	5	4	5	5	4	2
LSD 0.05		2	.	4	5	4	6	6	5	3

Treatment	Rate	7/10 Wht	7/10 Yeft	7/10 Wibw	7/10 Vema	7/10 Wimu	7/29 Yeft	7/29 Wibw	7/29 Vema	8/20 Grain
	oz ai/A	%	%	%	%	%	%	%	%	bu/A
Pxlm&Flas&Flox+NIS+AMS	1.67+0.5%+24	4	91	99	99	99	86	99	99	53
Pxlm&Flas&Flox+2,4-D+AMS	1.67+7+24	5	91	99	99	99	87	99	99	53
Pxlm&Clpy&Flox+NIS+AMS	3.2+0.5%+24	5	93	99	99	99	86	99	99	54
Pxlm&Clpy&Flox+2,4-D+AMS	3.2+7+24	5	92	99	99	99	89	99	99	58
Pxlm&Clpy&Flox+MCPA+AMS	3.2+7+24	4	90	99	99	99	87	99	99	54
Brox&Pyst&Thcz+NIS+AMS	4+0.25%+8	3	94	99	99	99	91	99	99	51
Pxdn+Clpy&Flox	0.86+3	0	99	99	99	99	98	99	99	50
Flcz+Clpy&Flox	0.43+3	3	79	99	99	99	71	99	99	56
Pxdn+Brox&MCPA5	0.86+8	2	99	97	99	99	98	89	94	54
Untreated Check	0	0	0	0	0	0	0	0	0	54
CV		55	2	1	0	0	3	1	1	6
LSD 0.05		2	3	1	.	.	3	1	1	5

Vigorous wheat growth complemented and enhanced weed control of all treatments. All herbicide treeatments except pinoxaden plus clopyralid and fluroxypyr caused minor injury to wheat that persisted through the season. Pinoxaden provided 98% control of yellow foxtail. Thiencarbazone control of foxtail (91%) was slightly better than pyroxsulam (86 to 89%), but flucarbazone control was only 71%. Broadleaf weed control was very consistent across treatments.

Halauxifen premix use in wheat. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded near Fargo on May 30, 2014. Treatments were applied to 5 leaf/2 tiller crops and 2 to 4 leaf Venice mallow, redroot pigweed, and common lambsquarters on July 2 with 78°F, 23% relative humidity 55% cloud cover, 4.2 wind velocity at 315°, and moist soil at 68°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 38 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	WHT 7/5	WHT 7/14	Vema 7/14	Rrpw 7/14	Colq 7/14	WHT 8/1	Vema 8/1	Rrpw 8/1	Colq 8/1
	oz ae/A	%	%	%	%	%	%	%	%	%
Florasulam&Haux+NIS	0.14+0.5%	0	0	82	81	81	0	84	88	98
Florasulam&Haux+NIS	0.29+0.5%	0	0	82	82	82	0	87	94	99
Florasulam&Haux+NIS	0.57+0.5%	0	0	86	89	89	0	91	87	98
Florasulam&Haux+Clpy&Flox	0.14+3	0	0	90	90	90	0	99	99	99
Florasulam&Haux+Clpy&Flox	0.29+6	0	0	90	90	90	0	99	99	99
Florasulam&Haux+Clpy&Flox	0.57+12	0	0	89	90	90	0	99	99	99
Clpy&Flox	12	0	0	84	84	84	0	99	99	99
Quinclorac-F+MSO	4.1+20	0	0	52	45	45	0	85	76	72
Quinclorac-F+MSO	8.3+20	0	0	52	57	52	0	75	72	71
Untreated Check	0	0	0	0	0	0	0	0	0	0
CV		0	0	4	4	4	0	25	3	2
LSD (P=0.05)		0	0	4	4	4	0	3	4	2

Florasulam and halauxifen at the highest rate gave 86 to 89% control of weeds on July 14. Control with lower rates was improved with the addition of clopyralid and fluroxypyr, and these combinations provided 90% control which was greater than control with clopyralid and fluroxypyr alone. Florasulam and halauxifen was very effective against common lambsquarters, but control of Venice mallow and redroot pigweed was improved with clopyralid and fluroxypyr on August 1. Herbicide treatments did not elicit crop response. This area will be seeded with strips of lentil, canola, field pea, flax, and dry bean to evaluate effect of soil residual 10 month after application.

Flax, lentil, soybean, sugarbeet, and field pea were seeded into the study area in 2015 perpendicular to direction of treatment application. Plants were visually inspected five times at intervals of 7 to 10 days after emergence of crops. Visible injury related to herbicide residue in the soil was not observed at any evaluation.

New PGR premix in wheat. Howatt, Roach, and Harrington. Faller hard red spring wheat was seeded near Rogers, North Dakota. Treatments were applied to 5 leaf wheat, 2 to 5 inch kochia, and 1 to 4 inch common lambsquarters on June 8 with 83°F, 43% relative humidity, mostly sunny sky, 3 to 6 mph at 330°, and damp soil at 72°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/22 wht	6/22 koch	6/22 colq	7/6 wht	7/6 koch	7/6 colq	7/23 wht	7/23 koch	7/23 colq
	oz ai/A	%	%	%	%	%	%	%	%	%
NUP-15009+NIS	4.8+0.5%	2	73	75	8	96	97	5	99	99
NUP-15009+NIS	9.5+0.5%	6	75	81	14	95	96	10	99	99
Dica&2,4-D-BM+NIS	4.1+0.5%	6	74	76	13	94	97	11	98	98
Dica&2,4-D-BM+NIS	8.2+0.5%	10	80	87	18	99	99	20	99	99
Flox-C+NIS	3+0.5%	0	72	53	0	97	45	0	99	40
Untreated Check	0	0	0	0	0	0	0	0	0	0
CV		48	4	5	33	3	4	27	1	8
LSD P=.05		3	4	5	4	3	4	3	1	9

NUP-15009 at low or high rate caused less injury to wheat than dicamba and 2,4-D at corresponding use rate. This difference was greater at later evaluation dates, especially for the higher treatment rates. The high rate of dicamba and 2,4-D gave slightly greater control of kochia on June 22 and July 6, but kochia control at final evaluation was nearly complete for all herbicide treatments. Lambsquarters control was excellent for all herbicides except fluroxypyr alone.

Kochia control with new PGR combo. Howatt, Roach, and Harrington. 'Faller' hard red spring wheat was seeded April 4, 2015 near Rogers, North Dakota. Treatments were applied to boot stage wheat and 2 to 8 inch kochia on June 16 with air temperature of 60°F, 73% relative humidity, 100% cloud cover, 1 to 3 mph wind at 45°, and damp soil at 58°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/22 Koch	7/06 Koch	7/23 Wht	7/23 Koch
	oz ae/A	%	%	%	%
NUP-15009+NIS	9.5+0.5%	66	89	2	95
NUP-15009+NIS	14.3+0.5%	70	88	5	96
NUP-15009+NIS	19+0.5%	73	87	11	96
NUP-15009+NIS	28.5+0.5%	74	93	19	98
Dicamba&2,4-D-BM +Fluroxypyr-C+NIS	8.2 +1.5+0.5%	78	88	10	95
Dicamba&2,4-D-BM +Fluroxypyr-C+NIS	12.3 +2.3+0.5%	73	88	14	97
Dicamba&2,4-D-BM+NIS	8.2+0.5%	70	84	6	89
Dicamba&2,4-D-BM+NIS	16.4+0.5%	75	94	11	94
Fluroxypyr-C+NIS	3+0.5%	71	83	1	89
Untreated Check	0	0	0	0	0
CV		5	3	25	3
LSD P=0.05		5	4	3	4

Fluroxypyr alone was included as the commercial standard for kochia control. Herbicide injury to wheat was not noticed at the first evaluation but was obvious on July 23. Injury manited as stunting, upright leaf architecture, and slight stem splaying. Treatments containing dicamba and 2,4-D expressed this injury, and injury was positively associated with herbicide rate. Addition of fluroxypyr increased this injury when comparing similar herbicide rates. A similar rate of NUP-15009 produced less injury than either of the other herbicide combinations. Amount of injury with NUP-15009 increased with each increase of application rate.

The high rate of dicamba and 2,4-D or NUP-15009 provided the best control of kochia July 6, but the herbicide rate used was nearly 75% greater for NUP-15009. Other herbicides gave essentially similar control regardless of herbicide or rate. Fluroxypyr alone was on the low end of this group with 83% control. On July 23, fluroxypyr alone or the low rate of dicamba and 2,4-D gave the least control, 89%. All other herbicide treatments provided similar control with an average of 96%.

Kochia control with new formulations. Howatt, Roach, and Harrington. Faller hard red spring wheat was seeded April 10 near Rogers, North Dakota. Treatments (first 2 reps) were applied to flag/early boot stage wheat, 4 to 16 inch kochia, and 8 to 16 inch common lambsquarters on June 16 with 57°F, 75% relative humidity, 100% cloud with a rainfall beginning, 1 to 2 mph wind at 45°, and damp soil at 58°F. The remaining two reps were treated with newly mixed solutions at the same stage crop and weed stages on June 17 with 59°F, 100% relative humidity, 90% cloud-cover, 1 to 3 mph wind at 360°, and saturated soil. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replications.

Treatment	Rate	6/22 wht	6/22 koch	6/22 colq	7/6 koch	7/6 colq	7/23 koch	7/23 colq
	oz ae/A	%	%	%	%	%	%	%
Pxdn+AGH08032	0.86+24 fl oz	0	79	81	95	95	97	97
Pxdn+AGH15005	0.86+24 fl oz	0	79	85	93	91	93	91
Pxdn+AGH08032+Preference +Interlock	0.86+24 fl oz+0.25% +4	0	79	79	90	92	93	96
Pxdn+AGH15005+Preference +Interlock	0.86+24 fl oz+0.25% +4	0	75	79	92	92	96	96
Pxdn+AGH08032+AGH14039	0.86+24 fl oz+8 fl oz	0	75	78	91	95	93	98
Pxdn+AGH15005+AGH14039	0.86+24 fl oz+8 fl oz	0	70	75	90	93	92	93
Pxdn+AGH15004	0.86+24 fl oz	0	77	82	91	95	96	98
Pxdn+AGH15004+Preference +Interlock	0.86+24 fl oz+0.25% +4	0	75	75	91	93	86	88
Pxdn+AGH15004+AGH14039	0.86+24 fl oz+8 fl oz	0	77	81	94	93	95	97
Pxdn	0.86	0	0	0	0	0	0	0
CV		0	15	16	5	4	7	7
LSD 0.05		.	15	16	5	5	8	9

Herbicides did not cause injury to wheat. Variability within treatment at the first evaluation was due to less control of plants treated during light rain, with difference in ratings of about 15%. But rating of control was quite consistent within treatment by July 6. Addition of adjuvants did not improve control with herbicides.

Control of large Kochia. Howatt, Roach, and Harrington. 'Faller' hard red spring wheat was planted near Rogers North Dakota on April 10. Treatments were applied at two crop stages, the 3 inch treatments were applied to 5 leaf wheat, 2 to 5 inch tall kochia, and 1 to 4 inch tall common lambsquarters on June 8 with 83°F, 43% relative humidity, 59°F dew point, 3 to 6 mph wind at 330°, with slight cloud cover and damp soil at 72°F. Treatments, 6 inch, were applied to early boot wheat, 2 to 10 inch kochia, and 2 to 8 inch common lambsquarters on June 16 with 57°F, 75% relative humidity, 48°F dew point, cloudy sky, 1 to 2 mph wind at 45° with damp soil at 58°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. Light rain began about 15 minutes after application of 6-inch treatments. The experiment was a randomized complete block design with four replicates.

			6/16/15			6/22/15			7/6/15		7/23/15	
Treatment	Rate	Stage	Wht	Kochia	Colq	Wht	Kochia	Colq	Kochia	Colq	Kochia	Colq
R7U12+NIS	1.5+0.25%	3"	2	70	40	0	81	79	85	85	90	94
STD71+NIS	1.4+0.25%	3"	8	70	40	0	84	85	93	94	97	99
STD76+NIS	1.4+0.25%	3"	5	70	40	0	81	76	74	70	90	91
R7U12+NIS	2.1+0.25%	6"				0	60	38	79	35	84	38
STD71+NIS	1.4+0.25%	6"				0	66	53	86	50	85	40
STD72+NIS	1.7+0.25%	6"				0	64	45	86	45	85	40
STD76+NIS	1.9+0.25%	6"				0	69	55	85	79	93	60
Brox&pyst+AMS	3.9+16	3"	2	70	40	0	92	97	99	99	99	99
Brox&pyst+AMS	3.9+16	6"				0	43	40	76	80	79	89
Clpy&flox	3	3"	1	70	40	0	81	78	88	90	92	88
Clpy&flox	4	6"				0	65	59	69	48	92	68
Untreated check	0					0	0	0	0	0	0	0
STD71+NIS	1.9+0.25%	3"	10	70	40	0	83	78	89	93	90	98
STD71+NIS	1.9+0.25%	6"				0	64	45	74	45	73	50
STD71+NIS	2.3+0.25%	6"				0	66	53	70	48	80	45
CV			38	0	0	0	7	12	7	13	6	9
LSD P=0.05			3	.	.	.	6	10	7	12	7	8

Herbicides applied at the 3-inch stage generally gave better initial and late-season weed control than when applied at the 6-inch stage even with higher rates applied at the later stage. This was especially evident for common lambsquarters, which is not as susceptible to fluroxypyr as kochia. Plants that remained in 6-inch treatment plots on July 23 were robust and gaining size, while plants treated at the earlier stage were still inhibited and expressed substantial symptoms. Increasing the rate of STD71 within application timing did not improve control of kochia or lambsquarters. Bromoxynil and pyrasulfotole applied early gave the fastest

control, but STD71 gave similar control to this treatment at later evaluation dates. STD71 applied early generally gave better control than other numbered products.

Wheat response was noted when treated with herbicides at the 3-inch stage. This expressed as slight chlorosis and stunting on June 16. STD71 caused 8 to 10% injury and STD76 caused 5% injury. Response to other herbicides was inconsistent across reps and could not be separated from the untreated. This injury was not observed later in the season and herbicides applied at the 6-inch stage did not result in visible injury.

Wild buckwheat treated with OD SU and Fluroxypyr. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded near Fargo on April 27. Treatments were applied to 4.5 to 5 leaf wheat, 1 to 2 leaf yellow foxtail, 3 to 6 inch wild buckwheat, and 1 to 2 inch Venice mallow on June 11 with 83°F, 40% relative humidity, 58°F dew point, 5% cloud cover, 1 mile or less mph wind at 360°, and moist soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of plots that were 10 by 30 feet. The experiment was a randomized complete block design with four replicates. Harvest for yield was on August 21.

Table 1.

		6/15/15	6/19/15				6/25/15			
Treatment	Rate	Wht	Wht	Yeft	Wibw	Vema	Yeft	Wibw	Vema	Wimu
		%	%	%	%	%	%	%	%	%
R7U12+NIS	1.5+0.25%	4	2	70	84	81	86	86	85	93
STD71+NIS	1.4+0.25%	6	6	78	86	84	90	88	86	95
STD76+NIS	1.4+0.25%	6	7	73	83	80	86	86	90	96
R7U12+NIS	2.1+0.25%	6	6	69	84	83	86	85	85	95
STD72+NIS	1.7+0.25%	6	6	78	88	85	85	87	88	95
STD76+NIS	1.9+0.25%	6	7	73	81	85	88	86	89	96
Brox&pyst+AMS	3.9+16	2	1	76	90	81	89	94	94	97
Clopyralid&flox	3	1	0	23	81	79	35	86	84	94
Untreated check	0	0	0	0	0	0	0	0	0	0
STD71+NIS	1.9+0.25%	7	6	78	88	86	89	88	88	96
STD71+NIS	2.3+0.25%	7	6	79	86	85	89	89	88	96
C.V.		40	45	5	4	4	4	4	3	2
LSD 5%		3	3	4	4	5	4	4	4	2

Injury to wheat was expressed as stunting and mild chlorosis early in the season. Injury generally was consistent across experimental herbicide products at 4 to 7% (Table 1). Slight injury was observed occasionally in wheat treated with registered products but was not consistent enough to separate from the untreated. Injury persisted for 1 week but was not apparent on June 25. As much as 10% stunting was observed again on July 10 (Table 2). On July 23, wheat was leaning in multiple directions within the treated area as if in early stage of lodging, but wheat in plot edges remained upright. Plots were scored from 0 to 10 with 0 for standing straight upright and 10 for lying on the ground. High rates of STD71 caused the most lodging but all plots treated with numbered products caused some degree of leaning. Wheat in plots treated with registered products occasionally demonstrated the same leaning tendency. The combine seemed able to pick up all wheat in the plots, and wheat yield from plots with the most injury was not greatly different from standards. Wheat was so competitive in this year's environment that yield did not suffer in the absence of weed control.

Sulfonylurea herbicides have given minor to moderate yellow foxtail control in previous years depending on precipitation amount and crop competition. In this study both were favorable for foxtail activity resulting in good control. The SU premixes gave 85 to 90% foxtail control at the June 25 evaluation (Table 1). Wheat was so competitive with the later emerging foxtail that even minor foxtail inhibition from clopyralid and fluroxypyr could be distinguished from the untreated plots. Bromoxynil has some activity on small foxtails and pyrasulfotole may affect foxtails because barnyardgrass has been susceptible to the combination in other research. In this study, the combination provided 93% control of yellow foxtail (Table 2).

Control of broadleaf weeds generally was similar across experimental premixes and rates. Bromoxynil and pyrasulfotole gave slightly better control of wild buckwheat and Venice mallow on June 25 because they both cause faster symptomology development than other herbicides (Table 1). But by July 10 all herbicides gave at least 92% control (Table 2). Small differences separated the treatments but did not present practical variation in efficacy. Areas treated with herbicide were essentially free of broadleaf weeds on July 23 regardless of herbicide or rate.

Table 2.

		7/10/15					7/23/15				Aug 21
Treatment	Rate	Wht	Yeft	Wibw	Vema	Wimu	Lodging	Wibw	Vema	Wimu	Yield
		%	%	%	%	%	score	%	%	%	bu/A
R7U12+NIS	1.5+0.25%	1	84	97	96	99	2	99	99	99	53
STD71+NIS	1.4+0.25%	5	80	94	93	99	1	99	99	99	55
STD76+NIS	1.4+0.25%	5	85	98	97	99	2	99	99	99	51
R7U12+NIS	2.1+0.25%	4	85	95	92	99	1	99	99	99	53
STD72+NIS	1.7+0.25%	7	86	98	98	99	2	99	99	99	49
STD76+NIS	1.9+0.25%	8	88	96	96	99	3	99	99	99	48
Brox&pyst+AMS	3.9+16	1	93	99	99	99	1	99	99	99	52
Clopyralid&flox	3	0	60	97	96	98	1	99	99	99	57
Untreated check	0	0	0	0	0	0	0	0	0	0	53
STD71+NIS	1.9+0.25%	10	93	99	99	99	4	99	99	99	53
STD71+NIS	2.3+0.25%	10	95	99	99	99	4	99	99	99	51
C.V.		57	3	1	2	1	32	0	0	0	8
LSD 5%		4	4	2	3	1	1	.	.	.	6

Broadleaf weed control in wheat. Howatt, Roach, and Harrington. Hard red spring wheat was seeded on April 30 near Prosper, North Dakota. Treatments were applied to 4 leaf wheat, 2 to 4 leaf common ragweed and common cocklebur, and flowering wild mustard on June 10 with 68°F, 51% relative humidity, 50% smoke-hazed sky, 4 mph wind at 0°, and dry soil at 65°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment is a randomized complete block design with four replicates. Harvest for yield was August 14.

Treatment	Rate	6/26 Wht	6/26 Wimu	6/26 Cocb	6/26 Corw	7/8 Wht	7/8 Wimu	7/8 Cocb	7/8 Corw	8/14 Grain
	oz ai/A	%	%	%	%	%	%	%	%	bu/A
Pxdn+Flox+MCPA	0.86+2+6	2	89	89	75	0	99	98	90	38
Pxdn+Flox&Dica	0.86+2.6	7	87	92	86	6	99	98	98	42
Pxdn+Clpy&Flox+Thif-sg	0.86+3+0.15	0	92	91	82	0	99	94	96	41
Pxdn+Carf+Flox+NIS	0.86+0.128+1.5+0.25%	0	89	90	64	0	65	86	60	37
Pxdn+Carf+2,4-D+NIS	0.86+0.128+6+0.25%	1	93	86	88	0	99	97	94	39
Pxdn+Brox&MCPA5	0.86+8	0	96	92	81	0	99	97	86	36
Pxdn+Brox&Flox	0.86+7.5	0	97	91	88	0	99	92	84	40
Pxdn+Brox&Pyst+AMS	0.86+3.4+8	0	99	97	99	0	99	94	97	42
Pxdn+Brox&2,4-D	0.86+10	0	99	97	96	0	99	98	87	41
Pxdn+Flas&Flox	0.86+1.5	0	94	91	86	0	99	92	90	38
Pxdn+Flas&MCPA	0.86+6	1	97	85	79	1	99	90	88	40
Pxdn+Flox&Thif&Trib+NIS	0.86+1.8+0.25%	0	95	92	85	0	99	97	93	39
Pxdn+NUP-15009+NIS	0.86+7.1+0.5%	5	92	90	89	4	99	99	98	45
Pxdn	0.86	0	0	0	0	0	0	0	0	34
CV		125	4	3	5	132	2	3	5	11
LSD 0.05		2	5	4	6	1	2	4	6	6

Treatment with dicamba caused 7% injury to wheat June 26. Injury manifested as chlorosis and slight splaying and was also present July 8. This symptom was consistent with treatment including NUP-15009, which produced less severe response at both evaluations. Wild mustard was not effectively controlled by carfentrazone and fluroxypyr. Many treatments provided greater than 95% control of cocklebur July 8, but bromoxynil and 2,4-D acted both quickly and effectively. Bromoxynil and pyrasulfotole provided near complete control of ragweed on both evaluation dates.

Tame buckwheat control. Howat, Roach, and Harrington. 'York' flax and 'Mancun' buckwheat were seeded in bioassay strips on June 12 near Fargo. Treatments were applied to 3 to 4 inch flax and buckwheat, 1 inch Venice mallow, 1 to 3 inch common lambsquarters, and 1 to 2 inch redroot pigweed on June 30 with 65°F, 94% relative humidity, 100% hazy sky, 0 to 1 mph wind at 340°, and dry sky at 64°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	7/13 flax	7/13 tabw	7/13 vema	7/13 colq	7/13 rrpw	7/27 flax	7/27 tabw	7/27 vema	7/27 colq	7/27 rrpw
	oz ai/A	%	%	%	%	%	%	%	%	%	%
Pxdn+Flox+MCPA	0.86+2+6	85	83	79	83	73	96	90	86	98	80
Pxdn+Flox&Dica	0.86+2.6	88	84	83	83	71	97	94	89	91	88
Pxdn+Clpy&Flox+Thif-sg	0.86+3+0.15	85	91	96	94	90	83	96	97	97	98
Pxdn+Carf+Flox+NIS	0.86+0.128+1.5+0.25%	92	97	93	81	94	95	98	94	53	88
Pxdn+Carf+2,4-D+NIS	0.86+0.128+6+0.25%	86	97	96	95	99	66	98	94	95	89
Pxdn+Brox&MCPA5	0.86+8	5	84	88	93	60	0	94	81	97	68
Pxdn+Brox&Flox	0.86+7.5	84	85	89	92	83	38	92	90	88	69
Pxdn+Brox&Pyst+AMS	0.86+3.4+8	78	96	97	99	99	38	94	94	98	99
Pxdn+Brox&2,4-D	0.86+10	10	84	80	96	70	0	84	83	95	73
Pxdn+Flas&Flox	0.86+1.5	92	92	94	58	71	97	98	96	35	85
Pxdn+Flas&MCPA	0.86+6	93	93	88	85	90	97	98	92	91	87
Pxdn+Flox&Thif&Trib+NIS	0.86+1.8+0.25%	87	91	95	98	93	84	97	92	98	98
Pxdn+NUP-15009+NIS	0.86+7.1+0.5%	85	86	84	90	90	91	94	84	99	98
Pxdn	0.86	0	0	0	0	0	0	0	0	0	0
CV		4	3	5	6	6	8	3	5	5	5
LSD 0.05		4	3	6	7	7	7	4	6	6	6

Tame buckwheat is an allergen of concern in some overseas markets. Control of volunteer tame buckwheat is important to maintain good marketing relationship with these buyers. Broadleaf herbicides used in wheat gave effective, but not always complete control of tame buckwheat. Treatments with carfentrazone or pyrasulfotole provided rapid desiccation of tissue and resulted in 96 to 97% control of tame buckwheat 2 weeks after treatment. Treatments with ALS-inhibiting herbicides plus PGR herbicide gave 91 to 93% tame buckwheat control and other treatments gave 86% or less control.

Treatments that included carfentrazone or an ALS-inhibiting herbicide provided near complete control, 97 to 98%, of tame buckwheat 4 weeks after treatment. The only live tissue remaining was the lower portion of the stem and there was not presence of new growth at axillary meristems although turgid stem tissue included these meristem regions. Most other treatments gave 90% or greater control. Bromoxynil and 2,4-D only gave 84% tame buckwheat control at this evaluation.

Adjuvants with Wolverine Advanced. Howatt, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded April 27 near Fargo, North Dakota. Treatments were applied to 5 leaf wheat, 1 to 2 leaf yellow foxtail, 1 to 2 inch redroot pigweed and Venice Mallow, and 4 to 6 inch wild buckwheat on June 11 with 84°F, 32% relative humidity, clear sky, 4 to 6 mph wind at 45°, dry top-/moist sub-soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 20.

Treatment	Rate	6/19 Wht	6/19 Yeft	6/19 Wibw	6/19 Vema	6/19 Rrpw	6/26 Yeft	6/26 Wibw	6/26 Vema	6/26 Rrpw	7/10 Yeft	7/10 Wibw	7/10 Vema	7/10 Rrpw	8/20 Grain
	oz ai/A	%	%	%	%	%	%	%	%	%	%	%	%	%	bu/A
Fenx&Brox&Pyst-AD +UAD1420	2.7 +2.7f fl oz/a	0	66	79	74	75	88	89	86	93	98	99	98	99	68
Fenx&Brox&Pyst-AD +UAD1443+UAD1420	2.7+2 fl oz/100 gal +2.7 fl oz/a	0	74	80	80	76	87	91	93	91	97	99	98	99	65
Fenx&Brox&Pyst-AD +UAD1373+UAD1420	2.7+4 fl oz/a +2.7 fl oz/a	0	75	85	85	81	89	95	95	96	96	99	99	99	69
Fenx&Brox&Pyst-AD +UAD1567+UAD1420	2.7+32 fl oz/100 gal +2.7 fl oz/a	0	74	84	76	76	86	93	89	92	96	99	99	99	63
Fenx&Brox&Pyst-AD +UAD1530+UAD1420	2.7+12.8 fl oz/100 gal +2.7 fl oz/a	0	75	87	83	81	85	91	90	93	96	97	98	99	65
Fenx&Brox&Pyst-AD +UAD1530+UAD1420	2.7+19.2 fl oz/100 gal +2.7 fl oz/a	0	69	85	84	79	89	94	89	91	98	99	98	99	65
Fenx&Brox&Pyst-AD +UAD1548+UAD1420	2.7+32 fl oz/100 gal +2.7 fl oz/a	0	71	85	80	76	88	95	91	94	99	99	98	99	66
Fenx&Brox&Pyst-AD +UAD1354+UAD1420	2.7+32 fl oz/100 gal +2.7 fl oz/a	0	74	86	80	79	89	95	89	90	96	99	98	99	64
Fenx&Brox&Pyst-AD +UAD1371+UAD1420	2.7+4 fl oz/a +2.7 fl oz/a	0	79	86	81	84	90	92	90	94	98	99	96	99	64
CV		0	5	5	4	5	3	2	3	3	2	1	2	0	7
LSD 0.05		.	5	6	5	5	3	3	4	4	2	1	2	.	7

Treatments did not cause injury to wheat and yield was similar across all treatments. Initial control of yellow foxtail with fenoxaprop was improved most with UAD1371; however, control was essentially similar across treatments at subsequent evaluations. Control of wild buckwheat, Venice mallow, and redroot pigweed was generally slightly greater when adjuvant was included, except for July 10 when complete control was achieved by the herbicides even without additional adjuvant. Added adjuvant increased the early response of herbicide symptoms in weeds.

Adjuvants with Imazamox. Howat, Roach, and Harrington. 'Prosper' hard red spring wheat was seeded near Fargo on April 27. Treatments were applied to 3 to 4 leaf wheat, 1 to 3 inch common ragweed and Pennsylvania smartweed, cotyledon to 1 leaf Venice mallow, 4 inch volunteer field pea, 1 to 4 inch field pennycress, 1 to 2 inch common lambsquarters and redroot pigweed, and 1 to 2 leaf foxtail on June 5 with 68°F, 84% relative humidity, 100% cloud-cover, 1 to 6 mph wind at 115°, and dry top-/ moist sub-soil at 60°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/19 Wht	6/19 Fxtl	6/19 Wibw	6/19 Answ	6/19 Colq	6/19 Rrpw	6/19 Vema	7/1 Wht	7/1 Fxtl	7/1 Answ	7/1 Colq	7/1 Rrpw	7/1 Vema
	oz ai/A	%	%	%	%	%	%	%	%	%	%	%	%	%
Imazamox	0.38	2	76	81	85	63	75	74	7	78	88	60	99	48
Imazamox+NIS	0.38+0.25%	2	86	87	90	79	88	80	8	86	90	79	99	69
Imazamox+NPak AMS	0.38+2.5%	2	75	81	81	55	75	76	7	81	95	81	97	70
Immx+NIS+NPak AMS	0.38+0.25%+2.5%	1	86	91	95	85	95	89	4	94	98	96	99	86
Immx+ClassActNG	0.38+2.5%	3	89	90	96	90	94	88	5	95	97	94	99	92
Imazamox+AG13063	0.38+0.5%	1	86	84	93	83	90	84	5	75	80	70	99	61
Imazamox+AG13063	0.38+0.75%	0	84	75	89	74	79	76	5	81	80	64	99	45
Imazamox+AG13063	0.38+1%	3	89	86	91	85	91	85	7	86	96	71	99	63
Imazamox+AG13063	0.38+1.5%	2	85	78	88	71	93	84	5	92	89	86	99	81
Imazamox+AG13063	0.38+2%	4	83	86	91	76	86	83	10	93	94	84	99	83
Imazamox+NIS+UAN	0.38+0.25%+32	5	90	91	93	86	94	88	7	91	94	91	99	88
CV		109	5	5	5	8	5	5	65	5	5	7	1	91
LSD 0.05		3	6	7	6	9	6	5	6	6	6	8	2	10

Control of weeds with imazamox was improved by standard adjuvant packages of NIS+AMS, NIS+UAN, or Class Act NG. AG13063 did not provide as good of an adjuvant package as the standards mentioned across all weeds even at 2%. AG13063 at 1.5% enhanced imazamox control of yellow foxtail similar to standards. Annual smartweed control with imazamox was increased to 96% with 1% AG13063. Although common lambsquarters and Venice mallow control with imazamox was enhanced with AG13063, standard adjuvant packages were more effective at maximizing imazamox control.