Yellow Section: Alfalfa, Cover Crops, Canola, Dry Bean, Dry Pea, Faba Bean, Flax, Lentil, Onion, Safflower, Sunflower, and Turf

Alfalfa response to Acetochlor. Howatt, Roach, and Harrington. DK 4015 RR alfalfa was seeded near Prosper ND on May 16. Preemergence treatments were applied May 16 with 60°F, 54% relative humidity, 15% cloud cover, 7 to 10 mph wind velocity at 45°, and dry topsoil at 50°F. Treatments (4-Tri) were applied to 3 to 5 trifoliolate alfalfa, 1 to 4 leaf yellow foxtail, 5 leaf wild oat, 2 to 6 leaf wild mustard, and 4 to 6 leaf common cocklebur on June 17 with 71°F, 97% relative humidity, 100% cloud cover, 5 to 10 mph wind velocity at 35°, and damp topsoil at 70°F. Treatments (10 DAC) were applied to cut alfalfa, 3 to 6 inch common lambsquarters, 1 to 2 leaf wild oat, yellow foxtail, and redroot pigweed on August 8 with 78°F, 75% relative humidity, clear sky, 1 to 2 mph wind velocity at 270°, and damp topsoil at 69°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.

		Growth	June 7				June 24				
Treatment	Rate	Stage	alfalfa	yeft	rrpw	wimu	alfalfa	yeft	wioa	rrpw	wimu
Glyt-4.5+AMS-PB	18+5%	4-Tri	0	0	0	0	0	99	99	99	99
Acet-3/Glyt-4.5+AMS-PB	18/18+5%	PRE/4-Tri	6	90	87	23	0	99	99	99	99
Acet-3/Glyt-4.5+AMS-PB	36/18+5%	PRE/4-Tri	16	97	81	48	0	99	99	99	99
Glyt-4.5+Acet-3+AMS-PB	18+18+5%	4-Tri	0	0	0	0	0	99	99	99	99
Glyt-4.5+Acet-3+AMS-PB	18+36+5%	4-Tri	0	0	0	0	0	99	99	99	99
Glyt-4.5+AMS-PB/Acet-3+Glyt-4.5+AMS-PB	18+5%/18+18+5%	4-Tri/10 DAC	0	0	0	0	0	99	99	99	99
Glyt-4.5+AMS-PB/Acet-3+Glyt-4.5+AMS-PB	18+5%/36+18+5%	4-Tri/10 DAC	0	0	0	0	0	99	99	99	99
Clethodim M+Imazamox+MSO+NIS	1.5+0.75+1.5%+1%	4-Tri	0	0	0	0	5	74	73	75	78
Acet-3+Imazamox+NIS	18+0.75+1%	4-Tri	0	0	0	0	0	63	60	70	73
Untreated Check	0		0	0	0	0	0	0	0	0	0
CV			42	6	65	129	0	3	2	1	3
LSD P=.05			1	2	16	13	.	4	2	2	3

		Growth	July 6					July 25	July 28	Aug 1	Aug 8	Sept 14
Treatment	Rate	Stage	yeft	wioa	rrpw	wimu	colq	alfalfa	g/m²	alfalfa	alfalfa	g/m²
Glyt-4.5+AMS-PB	18+5%	4-Tri	99	99	88	99	78	0	1009	0	0	1241
Acet-3/Glyt-4.5+AMS-PB	18/18+5%	PRE/4-Tri	99	99	95	99	83	0	1132	0	0	1259
Acet-3/Glyt-4.5+AMS-PB	36/18+5%	PRE/4-Tri	99	99	97	98	80	0	1061	0	0	1284
Glyt-4.5+Acet-3+AMS-PB	18+18+5%	4-Tri	99	99	94	99	80	0	1205	0	0	1244
Glyt-4.5+Acet-3+AMS-PB	18+36+5%	4-Tri	99	99	94	98	81	0	1036	0	0	1181
Glyt-4.5+AMS-PB/Acet-3+Glyt-4.5+AMS-PB	18+5%/18+18+5%	4-Tri/10 DAC	99	99	92	96	66	0	788	0	0	1322
Glyt-4.5+AMS-PB/Acet-3+Glyt-4.5+AMS-PB	18+5%/36+18+5%	4-Tri/10 DAC	99	99	93	99	76	0	870	0	0	1240
Clethodim M+Imazamox+MSO+NIS	1.5+0.75+1.5%+1%	4-Tri	94	95	83	95	92	0	1086	0	0	1151
Acet-3+Imazamox+NIS	18+0.75+1%	4-Tri	85	81	89	85	99	0	684	0	0	1045
Untreated Check	0		0	0	0	0	99	0	578	0	0	389
CV			1	2	4	2	16	0	18	0	0	21
LSD P=.05			1	3	5	3	19	.	250	.	.	342

Acetochlor did not cause visible injury to alfalfa regardless of application pre-emergence, to plants with four trifoliolate leaves, or to regrowth after harvest. Visible injury to alfalfa was not present during evaluation at additional dates in August and September.

Cover Crop Safety Following Wheat Herbicide Applications

Mike Ostlie, Kirk Howatt, Caleb Dalley, and Ezra Aberle

In 2016 a study was conducted at three locations, Carrington, Fargo, and Hettinger, to determine the potential risk of planting various cover crops following a wheat cash crop treated with residual herbicides. The goal of the study was to assist wheat producers with making decisions about which cover crops might be safe and which ones are not after wheat harvest. Herbicide labels do not provide enough information to determine cover crop safety as crop rotation intervals are intended to identify crop damage to cash crops which would carry economic implications, whereas a successful cover crop can withstand some damage or stand loss. Many cover crops are also not listed in crop rotation intervals. Using similar crops to determine risk can be a guide but often even similar species (ie canola and dwarf essex rape) may have different responses to herbicide residuals.

In this study 9 herbicide treatments were used, plus and non-treated check, during the wheat growing season. These were herbicides that may have residual activity at the time of cover crop planting and represent a group of commonly used active ingredients in wheat. After wheat harvest 9 cover crops were planted across each herbicide treatment for a total of 99 treatment combinations with three replicates at each of the three locations. Plots were rated for visual injury three times throughout the fall until frost killed the cover crops. Each treatment combination was given a visual score. For clarity, the scores were converted to a rating system. Low risk (LR)=0-20% injury, Medium risk (MR)=21-50% injury and high risk (HR)=51-100% injury. This system was used with the assumption that up to a 20% stand loss or injury would be acceptable for a cover crop and anything over 50% stand loss or damage would be a failure.

Of the three locations, Carrington had the most injury (Table 1), even though it received more rainfall than the other sites (9" during the study period). In Carrington oats and field peas were the most tolerant to the chosen herbicides. Supremacy was the only product used that did not cause injury to any cover crop. All other products cause some degree of injury to the cover crops though generally injury was in the 20% range which still qualifies as MR. Dwarf essex rape and radishes were most often affected by an herbicide (5 herbicides each). The only situation considered a failure was planting turnips after dicamba application. Even with this degree of damage to many crops, a cover cropping scenario could still be worked out with all herbicides used in this study as there were several safe options for each product.

The other locations had very little injury across treatment combinations. The exception was that in Hettinger, the herbicide Widematch caused very high levels of damage to lentils and moderate amounts of damage to field peas and turnips. All products were rated as LR in Fargo. When combined across locations (Table 2) most of the product combinations appear safe since even the Carrington MR ratings were fairly low in actual percent damage. Unfortunately this means that it will be difficult to rely on a standard safety rating across locations. Rainfall and soil type ultimately affect how long herbicide residues persist in the soil and each year will likely result in a different set of results. The most prudent thing for now may be to use the worse-case scenario for each treatment combination when making cover crop decisions. The datasets presented may not cover the full scope of possible responses to each treatment combination and so they can only be used as a loose guide until further study is completed. This study will be replicated in 2017 to gain further insight into cover crop response.

Table 1. Cover crop injury risk following wheat herbicide application at Carrington, ND in 2016

Herbicide	Radish	Turnip	Field Pea	Lentil	Flax	Oats	Barley	Dwarf Essex Rape
Widematch	MR	LR	LR	LR	LR	LR	LR	MR
Huskie	LR	LR	LR	MR	MR	LR	LR	MR
Everest 2.0	LR	LR	LR	MR	LR	LR	LR	MR
Supremacy	LR	LR	LR	LR	LR	LR	LR	LR
Powerflex	LR	LR	LR	MR	MR	LR	LR	MR
Goldsky	MR	LR	LR	LR	MR	LR	LR	LR
Varro	MR	LR	LR	LR	LR	LR	MR	LR
Clarity	MR	HR	LR	MR	MR	LR	MR	LR
2,4-D	MR	LR	LR	LR	LR	LR	LR	MR

Low Risk; LR = 0-20%
Medium Risk; MR = 21-50%
High Risk; HR = >50%

Table 2. Cover crop injury risk averaged across Carrington, Fargo, and Hettinger in 2016

Average	**across locations**								
Herbicide	Radish	Turnip	Beets	Field Pea	Lentil	Flax	Oats	Barley	dwarf essex ra
Widematch	LR	MR	.	MR	HR	LR	LR	LR	LR
Huskie	LR	LR	LR	LR	LR	LR	LR	LR	LR
Everest 2.0	LR	LR	LR	LR	LR	LR	LR	LR	LR
Supremacy	LR	LR	.	LR	LR	LR	LR	LR	LR
Powerflex	LR	LR	LR	LR	MR	LR	LR	LR	LR
Goldsky	MR	LR	.	LR	LR	LR	LR	LR	LR
Varro	LR	LR	LR	LR	LR	LR	LR	LR	LR
Clarity	LR	MR	LR	LR	LR	LR	LR	LR	LR
2,4-D	LR	LR	.	LR	LR	LR	LR	LR	LR

Low Risk; LR = 0-20%
Medium Risk; MR = 21-50%
High Risk; HR = >50%

Cover-crop response to wheat herbicide residue. Howatt, Roach, and Harrington. Treatments were applied to an area without crop, cotyledon Venice mallow, and 1 to 3 leaf yellow foxtail on June 2 with 71°F, 37% RH, 15% cloud cover, 2 mph wind velocity at 270°, and dry soil at 63°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. Plots were kept relatively free of weeds during the growing season with herbicides. Cover crops were direct-seeded without tillage for seedbed preparation near Fargo on August 31. The experiment was a randomized complete block design with four replicates.

		September 28										Nov 9
Treatment	Rate	Turnip	Rape seed	Radish	Lentil	Flax	Sugar beet	Barley	Oat	Field pea	Sun-flower	All
	oz/A	%	%	%	%	%	%	%	%	%	%	%
Dicamba	4	0	0	0	0	0	0	0	1	0	3	0
Clopyralid	2	0	0	0	0	0	0	0	16	0	3	0
Imazamox	0.75	0	0	0	0	0	0	0	2	0	0	0
Flucarbazone2.0	0.44	0	0	0	8	2	0	0	15	0	0	0
Propoxycarbazone	0.42	0	3	0	0	0	2	0	12	1	0	0
Thiencarbazone	0.21	0	0	0	3	0	3	0	8	2	6	0
Pyroxsulam-TM	0.26	0	0	0	0	0	0	0	7	0	3	0
Brox&Pyrasulfotole	3.4	0	0	0	2	0	0	1	4	0	3	0
Brox&Bicyclopyrone	4	0	0	0	0	0	0	2	8	0	1	0
Mets&Thif&Flox	1.38	0	0	0	0	0	3	0	7	2	2	0
Untreated Check	0	0	0	0	0	0	0	0	0	0	0	0
CV		0	663	0	442	663	345	488	80	403	206	0
LSD		.	2	.	7	2	3	2	8	3	5	0

Very seldom could visible injury be detected on cover crops. Oat was the exception. Clopyralid, flucarbazone and propoxycarbazone caused death to as much as 10% of the plants with other plants exhibiting stunting or curved growth. Several other herbicides resulted in death of a few plants but mostly stunting. By November evaluation, oat had compensated for gaps in canopy and overall vegetation vigor and amount appeared similar to the untreated.

Cover-crop response to row crop herbicide residue. Dr. Kirk Howatt, Ronald Roach, and Janet Harrington. Treatments were applied to an area without crop, cotyledon Venice mallow and 1 to 3 leaf yellow foxtail on June 02 with 70°F, 37% relative humidity, 15% cloud-cover, and dry soil at 63°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. Cover crops were seeded near Fargo on August 31. Plots were kept relatively free of weeds during the growing season with herbicides. Cover crops were direct-seeded without tillage for seedbed preparation near Fargo on August 31. The experiment was a randomized complete block design with four replicates.

		September 28									
Treatment	Rate	Turnip	Rape seed	Radish	Lentil	Flax	Sugar beets	Barley	Oat	Field pea	Sun flower
	oz/A	%	%	%	%	%	%	%	%	%	%
Rimsulfuron	0.4	21	26	3	0	5	0	0	16	0	3
Pendimethalin	23	0	0	3	0	5	0	2	13	0	0
Atrazine	6	0	0	0	0	19	0	2	12	0	0
Metribuzin	6	0	0	0	0	0	0	3	13	0	1
Fomesafen	4	49	34	58	0	0	0	1	16	0	13
Saflufenacil	1.08	0	0	0	0	0	0	3	11	2	0
Sulfentrazone	4	20	23	45	0	2	0	2	36	0	1
Flumioxazin	1.5	90	53	59	0	5	0	6	13	0	0
Pyroxasulfone	3.4	20	21	7	0	3	5	3	40	0	0
Acetochlor	30	0	0	3	0	1	0	3	19	0	0
Topramezone	0.26	20	30	9	0	0	0	0	5	5	0
Untreated Check	0	0	0	0	0	0	0	0	0	0	0
CV		106	125	97	0	297	693	163	65	564	525
LSD=0.05		28	28	21	.	14	4	5	15	4	11

Flumioxazin almost killed all turnip and substantially reduced the stand of rapeseed and radish. Fomesafen also caused severe stand loss to these crops. Rimsulfuron, sulfentrazone, pyroxasulfone, and topramezone caused stunting of these crops without much stand loss. Slight stand loss was observed in oat with all herbicides. Pyroxasulfone and sulfentrazone caused the greatest injury to oat.

Damage to turnip, rapeseed, and radish caused by flumioxazin or fomesafen was still evident November 9; however, other plots had enough growth and compensation of remaining plants such that biomass appeared similar to the untreated.

IT1402 effect on herbicide injury in Canola. Howatt, Roach, and Harrington. 'DKL 70-50CR' canola was seeded May 17 near Fargo, North Dakota. Treatments were applied to 4 leaf canola on June 17 with 72°F, 100% relative humidity, 100% cloud cover, 2 to 3 mph wind velocity at 90°, and dry topsoil at 71°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. Plots were weeded by hand to remove effect of competition. Harvest for yield was on August 25.

Treatment	Rate	6/20 Canola	6/24 Canola	6/27 Canola	7/6 Canola	7/18 Canola	8/8 Canola	8/16 Canola	8/25 Moisture	8/25 Yield
	oz/A	%	%	%	%	%	%	%	%	lb/A
Glyphosate	18	0	0	0	0	0	0	0	13.6	1513
Glyphosate+IT1402	18+8	0	0	0	0	0	0	0	13.1	1537
Glyphosate+IT1402	18+16	0	0	0	0	0	0	0	13.1	1570
Untreated Check	0	0	0	0	0	0	0	0	12.4	1663
CV		0	0	0	0	0	0	0	11	9
LSD P=.05		-	-	-	-	-	-	-	2	219

Injury was not detected in any plot attributed to herbicide application. Therefore, benefit or detriment of including IT1402 could not be evaluated from vegetative evaluations. Reproductive stages of bolting, flower initiation, flowering duration, pod development and number, and maturation/drying were not noted to differ among treatments. There was a slight tendency for inclusion of IT1402 to have more similar moisture content and seed yield produced to the untreated check than glyphosate applied alone, which had the highest numerical seed moisture and lowest yield (adjusted for moisture).

PRE application of generic sulfentrazone compared to Spartan for the control of waterhemp in dry bean. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Fargo, ND to evaluate waterhemp control and dry bean injury to sulfentrazone PRE applications. Navy and pinto bean were planted on May 6, 2016. PRE treatments were applied the same day at 9:15 AM with 83 F air, 60 F soil at a four inch depth, 27% RH, 10% cloud cover, 2-4 mph W wind, and adequate soil moisture. Soil characteristics were: 4.6% sand, 40% silt, 55.4% clay, silty clay, 6.6% OM, and 7.5 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa through TT 11002 at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

As rate of herbicide increased, as did the waterhemp control. At higher rates, waterhemp control using Spartan remained fairly consistent from 28 DAA to 56 DAA while waterhemp control using HAI Sulfentrazone gradually decreased from 28 DAA to 56 DAA. Blanket herbicide performed similarly to Spartan at 6 fl oz/A.
The addition of Parallel PCS increased waterhemp control when tank-mixed with both Spartan and HAI Sulfentrazone. The tank-mix of HAI Sulfentrazone and Parallel PCS increased waterhemp control more than the tank-mix of Spartan and Parallel PCS.

Table. PRE application of generic sulfentrazone compared to Spartan for the control of waterhemp in dry bean (Zollinger, Wirth, Adams).

		28 DAA			42 DAA			56 DAA		
Treatment	Rate	Navy	Pinto	Wahe	Navy	Pinto	Wahe	Navy	Pinto	Wahe
	(Product/A)	----% inj----		-% control-	----% inj----		-% control-	----% inj----		-% control-
HAI Sulfentrazone	3floz	0	0	55	0	0	55	0	0	53
Spartan	3floz	0	0	53	0	0	33	0	0	32
HAI Sulfentrazone	4floz	0	0	77	0	0	67	0	0	65
Spartan	4floz	0	0	77	0	0	70	0	0	68
HAI Sulfentrazone	5floz	0	0	77	0	0	67	0	0	63
Spartan	5floz	0	0	78	0	0	78	0	0	77
HAI Sulfentrazone	6floz	0	0	93	0	0	80	0	0	78
Spartan	6floz	0	0	96	0	0	92	0	0	90
Blanket	6floz	0	0	95	0	0	92	0	0	90
HAI Sulfentrazone+ Parallel PCS	3floz+ 13.54floz	0	0	88	0	0	85	0	0	83
Spartan+Parallel PCS	3floz+13.54floz	0	0	75	0	0	73	0	0	72
HAI Sulfentrazone+ Parallel PCS	5floz+ 22.47floz	0	0	87	0	0	85	0	0	83
Spartan+Parallel PCS	5floz+22.47floz	0	0	77	0	0	73	0	0	72
LSD (0.05)		0	0	9	0	0	11	0	0	8

EPOST Eptam followed by LPOST other herbicides to control common ragweed in DEB. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Mayville, ND to evaluate Eptam applied as an EPOST followed by LPOST applications of other herbicides to control common ragweed. EPOST treatments were applied on May 30, 2016 at 9:30 AM with 78 F air, F soil at a four inch depth, 38% RH, 30% cloud cover, 1-2 mph NW wind, and moist soil moisture. Weeds present at the time of EPOST applications were: colq 1-6" at 10/ft2, shep 10-12" at 1-3/yd2, wibw 1-4" at 1-2/yd2, and corw 0-3" at 4-10/ft2. POST treatments were applied on June 8, 2016 at 10:00 AM with 78 F air, 59 F soil at a four inch depth, 40% RH, 40% cloud cover, 3-5 mph SW wind, and moist soil moisture. Weeds present at the time of POST applications were: colq 1-3" at 20-40/yd2, corw 2-6" at 40-50/yd2, fipc 12-24" at 1/yd2, and yeft 14-18" at 1-3/yd2. Soil characteristics were: 80.2% sand, 12.9% silt, 6.9% clay, Clay Loamy Sand, 2% OM, and 6.7 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa through 11002 TT nozzles for EPOST and 11002 TTI nozzles for POST; both timings at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Table. EPOST Eptam followed by LPOST other herbicides to control common rageweed in DEB (Zollinger, Wirth, Adams).

Treatment	Rate	7 DAA Corw	14 DAA Corw	28 DAA Corw
	(Product/A)	----------% control----------		
(EPOST) Eptam	1pt	0	0	0
(EPOST) Eptam	2pt	0	0	0
(EPOST) Eptam	3pt	0	0	0
(EPOST) Basagran+MSO	2pt+1.5pt	45	45	45
(EPOST) Eptam (LPOST) Basagran+MSO	1pt 2pt+1.5pt	43	43	43
(EPOST) Eptam (LPOST) Basagran+MSO	2pt 2pt+1.5pt	53	58	58
(EPOST) Eptam (LPOST) Basagran+MSO	3pt 2pt+1.5pt	53	53	53
(EPOST) Permit+MSO	0.67oz+1.5pt	20	32	52
(EPOST) Eptam (LPOST) Permit+MSO	1pt 0.67oz+1.5pt	20	32	65
(EPOST) Eptam (LPOST) Permit+MSO	2pt 0.67oz+1.5pt	20	30	68
(EPOST) Eptam (LPOST) Permit+MSO	3pt 0.67oz+1.5pt	23	33	70
(EPOST) Reflex+MSO	0.75pt+1.5pt	72	72	73
(EPOST) Eptam (LPOST) Reflex+MSO	1pt 0.75pt+1.5pt	62	72	75
(EPOST) Eptam (LPOST) Reflex+MSO	2pt 0.75pt+1.5pt	85	85	85
(EPOST) Eptam (LPOST) Reflex+MSO	3pt 0.75pt+1.5pt	89	89	89
LSD (0.05)		5	5	5

POST DEB herbicides tankmixed with Eptam to control common ragweed. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Mayville, ND to evaluate the effect POST Eptam tankmixed with other DEB herbicides has on common ragweed. POST treatments were applied on June 8, 2016 at 10:00 AM with 78 F air, 59 F soil at a four inch depth, 40% RH, 40% cloud cover, 3-5 mph SW wind, and moist soil moisture. Weeds present at the time of POST applications were: colq 14-18" at 35-45/yd2, shep 6-14" at 6-10/yd2, wibw 4-6" at 3-6/yd2, corw 2-4" at 8-12yd2, and yeft 4-6" 10-12/yd2. Soil characteristics were: 80.2% sand, 12.9% silt, 6.9% clay, Clay Loamy Sand, 2% OM, and 6.7 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa through 11002 TTI nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Table. POST DEB herbicides tankmixed with Eptam to control common rageweed (Zollinger, Wirth, Adams).

Treatment	Rate	7 DAA Corw	14 DAA Corw	28 DAA Corw
	(Product/A)	----------% control----------		
Eptam	1pt	0	0	0
Eptam	2pt	0	0	0
Eptam	3pt	0	0	0
Basagran+MSO	2pt+1.5pt	22	22	22
Basagran+Eptam+MSO	2pt+1pt+1.5pt	32	32	32
Basagran+Eptam+MSO	2pt+2pt+1.5pt	32	32	32
Basagran+Eptam+MSO	2pt+3pt+1.5pt	32	32	32
Permit+MSO	0.67oz+1.5pt	0	20	50
Permit+Eptam+MSO	0.67oz+1pt+1.5pt	0	25	60
Permit+Eptam+MSO	0.67oz+2pt+1.5pt	0	25	63
Permit+Eptam+MSO	0.67oz+3pt+1.5pt	0	35	65
Reflex+MSO	0.75pt+1.5pt	72	72	72
Reflex+Eptam+MSO	0.75pt+1pt+1.5pt	82	82	82
Reflex+Eptam+MSO	0.75pt+2pt+1.5pt	82	82	82
Reflex+Eptam+MSO	0.75pt+3pt+1.5pt	85	85	85
LSD (0.05)		2	2	3

Field Pea and Dry Bean Injury to Dicamba and Glyphosate Drift

Mike Ostlie and Greg Endres

In 2015 and 2016 trials were established to measure the risk that dicamba and glyphosate drift pose to field pea and dry bean crops. Dicamba in particular will see increased use in the next several years due to the introduction of dicamba-resistant crops. The labeled products for these new crops will be a mixture of glyphosate and dicamba which is formulated for reduced drift potential. Yet, drift will still be a concern with dicamba along with the possibility of sprayer contamination. This new herbicide mixture is expected to be approved for use in 2017.

Field peas and dry beans were identified as high injury risk crops from dicamba. These crops were tested at application rates ranging from 0.4-17% of typical commercial rates to assess drift (or sprayer contamination) damage to the crops. Crop yield was the primary indicator for crop damage but visual injury ratings were taken 10 and 20 days after treatment (DAT). Also at 10 and 20 DAT leaf samples were collected from all plots and sent to an analytical lab (South Dakota Agricultural Labs) to test the concentration of glyphosate and dicamba in the plants. This was done to determine an injury threshold that may translate to a reduced yield at the end of the season. Treatments were applied to crops at their most sensitive growth stage (beginning bloom), to measure maximum damage to the crop.

Field peas were relatively tolerant of both glyphosate and dicamba applications (Table 1). Yield was only affected with the highest rate of the combination of the two products. Visual injury for both products was also low with a maximum of 13% damage occurring, which can be difficult to detect in field peas and largely consisted of increased tendril curling and growth rate. Detected herbicide residues were low with a maximum of 12 ppb, which is too low to demonstrate any causality from the herbicide application. And in fact, there were virtually no significant relationships between herbicide residue (or visual injury levels) and yield. The exception is that dicamba residues had a moderate relationship (0.49) to yield loss with the combination of glyphosate and dicamba, however when dicamba was applied alone there was no relationship between residue levels and yield (0.02). Dicamba was a better predictor of injury than glyphosate in general, but again the level of total residue detected was too low to confidently use to estimate yield loss. The conclusion would be that field peas were tolerant of the application rates used in this experiment with damage only occurring with the highest use rates of glyphosate and dicamba.

Dry beans responded much different than field peas. Dry beans exhibited often severe injury symptoms from the tested rates in this experiment (Table 2). Visual injury levels reach ~35% with the highest rates of dicamba alone and in combination with glyphosate. Yield were affected even more than visual symptoms suggested. Yields were reduced to an average of 20% of the untreated check when dicamba was applied at its highest rate. Adding glyphosate to dicamba trended toward more severe injury than dicamba alone (though no statistical difference). One of the causes of yield loss was delayed maturity (data not shown). In both years, a killing frost was required to allow the beans to mature when treated with the highest rates of dicamba. This resulted in a nearly 3 week difference in harvest dates across treatments.

Herbicide residue levels were much higher with the dry beans than field peas. Residue levels reached 2500 ppb with dicamba and 1600 ppb with glyphosate. These levels should be sufficient to measure causality, however, the highest detected concentrations often do not correspond to the highest application rates. Once again, the relationships between ppb and yield are only moderate at best across herbicide dose. Dicamba ppb poorly correlated with yield 10 DAT but had a better relationship to yield 20 DAT (0.18 vs 0.48). Glyphosate residue was more predictive of yield 10 DAT than 20 DAT (0.51 vs 0.43). Overall, by 20 DAT dicamba residues had a better relationship to yield than glyphosate but glyphosate was more predictive than dicamba at 10 DAT. Overall, without the visual injury and yield information, the herbicide residue data would not mean much in this study, representing a challenging situation to producers who may have been affected by drift.

How to collect samples for pesticide residue analysis

Here are a few comments that should be made regarding how to collect leaf samples for lab submission. In our trial the top 4" were collected from many plants to get a total of 40g per product that was tested (glyphosate + dicamba = 80g total needed). This represents that part of the plant that is most vigorously growing and would be the most affected by herbicides. In order to ensure an accurate test, samples should be collected from an area that has not been affected by an herbicide. Samples should then be collected from an area with only minor damage, followed by areas with more damage. Between each sampling group, be sure to change gloves to make sure there is no contamination between groups. Send the samples to the lab as quickly as possible to prevent the leaves from molding or deteriorating. Samples should be taken soon after injury is evident.

You also have to know which product to test for. Labs have a unique test that they use for each herbicide and so it will cost twice as much to check for two herbicides and three times as much to test for three herbicides; so you have to have an idea about which product caused damage. Once you get the results back it is important to know that a single test result does not mean anything. You have to compare test results from healthy parts of the field to results from the affected areas. This is because many lab procedures may show that a product is present when it may actually be something called "background noise" from the equipment which means that even plants never exposed to an herbicide may appear to have a herbicide concentration present. Tests will come back as either ppm (parts per million) or ppb (parts per billion). What does this mean? Again, that number on its own does not explain much as there is no standard concentration that will or will not cause plant injury, which is why you can only compare an affected plant to a healthy one.

In our studies, we have found that visual injury is a more conclusive method to determine herbicide injury than testing plants for herbicide residue. Herbicide residue information would be better suited as information used to substantiate visual evidence of injury rather than as a stand-alone method for showing injury. As seen in the results injury can occur with very little residue detected, but at the same time no injury may occur even though high residue levels are seen. Overall, there was a relationship between the amount of product applied and the amount detected in the leaves, but it was not strong enough to prove causality.

Table 1. Field pea yield, injury, and leaf residue levels following dicamba and glyphosate applications

Treatment	Rate	Phytotoxicity 10 DAT	Phytotoxicity 20 DAT	Residue Level 10 DAT Dicamba	Residue Level 10 DAT Glyphosate	Residue Level 20 DAT Dicamba	Residue Level 20 DAT Glyphosate	Yield	Protein
	fl oz/a	%	%	ppb	ppb	ppb	ppb	bu/a	%
Check		0	0	0	0	0	0	44.1	29.74
Dicamba	0.05	1.3	0	0	0	0	0	43.8	29.62
Dicamba	0.25	1.3	1.3	4.3	0	0.7	0	44.0	29.81
Dicamba	0.5	4	3.8	4.3	0	5.0	0	45.3	29.84
Glyphosate	0.1	1.3	1.3	0	0	0	0	43.4	29.89
Glyphosate	0.5	1.5	2.5	0	3	0	0	45.7	30.13
Glyphosate	1	6.9	5.5	0	0	0	0	42.9	29.92
Glyphosate + dicaml	0.1 + 0.05	0.5	0.3	0	9.4	0	0	44.9	29.85
Glyphosate + dicaml	0.5 + 0.25	4.6	4.5	5.2	0	2.7	0	43.8	29.81
Glyphosate + dicaml	1 + 0.5	13.4	11.5	8.8	12	3.8	0	39.4	29.90
LSD (0.05)		2.7	2.3	3.3	NS	3.5	0	5.2	NS

Table 2. Dry bean yield, injury, and leaf residue levels following dicamba and glyphosate applications

Treatment	Rate	Phytotoxicity 10 DAT	Phytotoxicity 20 DAT	Residue Level 10 DAT Dicamba	Residue Level 10 DAT Glyphosate	Residue Level 20 DAT Dicamba	Residue Level 20 DAT Glyphosate	Yield
	fl oz/a	%	%	ppb	ppb	ppb	ppb	lb/a
Check		0	0	0	0	0	0	1801
Dicamba	0.05	5	2.5	9.3	0	123	0	1551
Dicamba	0.25	19.1	17.5	39	11.3	2536	1.6	1440
Dicamba	0.5	31.6	33	550.7	374.1	1317	43.4	408
Glyphosate	0.1	7.8	5.8	21.9	21	647	7.7	1537
Glyphosate	0.5	23.3	21.6	119.1	1674.6	888	226.9	994
Glyphosate	1	17.5	13.8	0	762.1	170	72.1	1218
Glyphosate + dicamk	0.1 + 0.05	13.3	12.5	9.8	379	95	165.9	1506
Glyphosate + dicamk	0.5 + 0.25	34.1	30.5	157.5	851.7	1336	54.6	927
Glyphosate + dicamk	1 + 0.5	26.6	29.5	416.9	1031.9	809	252.1	380
LSD (0.05)		15.7	20.1	387	930	2015.2	160	798

Simulated glyphosate and dicamba drift on dry pea. (Minot). The objective of the study was to determine the impact of low rates (simulated drift) glyphosate and dicamba on dry pea. The study was conducted in 2014 and 2015. The dicamba rates were adjusted slightly in 2015 since no effect was observed at 0.005 and 0.05 oz in 2014. Two untreated treatments were included each year. Spartan + Prowl were applied PRE and Basagran + Select applied POST to control weeds.

In 2014, glyphosate and dicamba treatments were applied just prior to flowering on July 2 when dry peas were 16-19 inches tall. The first replication of the study was severely impacted by disease and therefore the data in Table 1 below is an average of two replications. Glyphosate and dicamba applied at the two lower rates did not cause visible crop injury and did not affect dry pea yield or test weight. Glyphosate and dicamba applied individually at the high rate caused some visible crop injury, but did not affect yield or test weight. However, glyphosate + dicamba applied as a tank mix at the high rate caused significant crop injury and reduced yield and test weight.

In 2015, glyphosate and dicamba treatments were applied just prior to flowering on June 23. No visible injury was observed with the glyphosate treatments and there was no effect on yield (Table 2). Slight visible injury was observed at 0.275 and 0.5 oz dicamba. There was a very slight yield reduction with 0.275 oz dicamba, but a more significant yield reduction at 0.5 oz. Very little injury was observed and no yield reduction with the low rate of glyphosate + dicamba combined. However, there was a significant yield reduction with the tank mix at the two higher rates.

In 2016, glyphosate and dicamba treatments were applied just prior to flowering on June 17. No visible injury or yield loss was observed with glyphosate applied alone (Table 3). Slight to moderate visible injury was observed at 0.275 and 0.5 oz dicamba. There was a yield reduction with 0.5 fl oz dicamba. There was moderate to severe injury and yield loss with the combination of glyphosate + dicamba at the two higher rates.

Thus, there appears to be a greater effect on dry pea when glyphosate and dicamba are tank mixed compared to either product applied alone.

Table 1. Simulated glyposate and dicamba drift on dry pea in 2014. (1409)						
		Dry pea				
		Injury		Height	Yield	Test wt.
Treatment[a]	Rate/A	Jul-11	Aug-08	Jul-18	Aug-19	Aug-19
		--------%--------		cm	lb/A	lb/bu
Untreated		0	0	76	3777	66.5
Glyphosate	0.01 oz	0	0	82	4201	66.3
Glyphosate	0.1 oz	0	0	78	3618	65.7
Glyphosate	1 oz	5	10	76	4054	65.9
Dicamba	0.005 oz	0	0	78	3673	65.9
Dicamba	0.05 oz	0	0	78	3982	66.0
Dicamba	0.5 oz	25	12	75	3814	65.2
Glyphosate + Dicamba	0.01 oz + 0.005 oz	0	0	76	3918	66.4
Glyphosate + Dicamba	0.1 oz + 0.05 oz	0	0	74	3907	65.7
Glyphosate + Dicamba	1 oz + 0.5 oz	40	50	71	651	58.4
Untreated		0	0	77	4441	66.2
LSD (0.05)		3.3	3.8	7.9	970.9	1.1
CV		30.6	33.8	6.1	12.0	0.7
[a]*All treatments applied Pre-flower July 2*						

Table 2. Simulated glyphosate and dicamba drift on dry pea in 2015. (1509)							
		Dry pea					
		Injury		Height		Yield	Test wt
Treatment	Rate	Jul-3	Jul-13	Jul-06	Jul-13	Aug-10	Aug-10
		-------%-------		-------cm-------		lb/a	lb/bu
Untreated		0	0	95	108	4067	63.8
Glyphosate	0.1 oz	0	0	91	108	4132	64.1
Glyphosate	0.55 oz	0	0	93	109	4077	63.7
Glyphosate	1 oz	0	0	92	108	4030	63.8
Dicamba	0.05 oz	1	0	96	113	4101	63.7
Dicamba	0.275 oz	4	4	91	107	3947	63.8
Dicamba	0.5 oz	8	6	92	109	3677	64.1
Glyphosate + Dicamba	0.1 oz + 0.05 oz	1	1	93	105	4516	64.2
Glyphosate + Dicamba	0.55 oz + 0.275 oz	14	7	96	109	3298	64.3
Glyphosate + Dicamba	1 oz + 0.5 oz	21	11	85	102	2851	64.3
Untreated		0	0	97	108	4583	63.7
LSD (0.05)		2.1	1.2	NS	NS	553	NS
CV		33.6	31.9	6.5	5.4	9.7	0.6
[a]*All treatments applied Pre-flower Jun 23*							

Table 3. Simulated glyphosate and dicamba drift on dry pea in 2016. (1609)								
		Dry pea						
		Injury		Height		Protein	Yield	Test wt.
Treatment	Rate/A	Jun-27	Jul-7	Jul-1	Jul-7	Aug-18	Aug-16	Aug-16
	fl oz	-------%-------		-------cm-------		---%---	lb/A	lb/bu
Untreated		0	0	58	62	25.0	2868	66.2
Glyphosate	0.1	0	0	57	62	25.0	2805	66.0
Glyphosate	0.55	0	0	55	59	24.9	2726	67.0
Glyphosate	1	0	0	55	56	24.6	2731	66.2
Dicamba	0.05	1	1	58	64	24.7	2777	65.9
Dicamba	0.275	16	7	55	58	25.3	2702	66.6
Dicamba	0.5	32	14	54	54	26.1	2468	66.2
Glyphosate + Dicamba	0.1 + 0.05	4	2	55	62	25.1	2714	65.9
Glyphosate + Dicamba	0.55 + 0.275	29	16	56	58	25.2	2391	66.2
Glyphosate + Dicamba	1 + 0.5	59	34	49	54	26.5	1912	65.6
Untreated		0	0	56	61	24.4	2835	66.2
LSD (0.05)		5.3	4.7	4.3	5.1	1.03	420.8	0.94
CV		29.2	48.5	5.4	6.01	2.8	11.1	1.0

Dry pea tolerance to Spartan plus Sharpen tank mixes. (Minot). The objective of the study was to evaluate dry pea tolerance to Spartan plus Sharpen tank mixes applied preemergence (PRE). 'Blue moon' dry pea was planted May 4. All herbicide treatments were applied PRE on May 7.

Dry pea injury varied across the three replications (reps) due to soil variability. It was not uncommon to see minimal dry pea injury in one rep, but moderate injury in another rep. Soil variability also resulted in yield variability and a high coefficient of variation (CV). We know that dry pea will be more sensitive in lighter soils with high pH and low organic matter. Dry pea injury did increase with higher rates, but did not appear to increase excessively where Spartan and Sharpen were tank mixed. In other studies, we have observed better weed control with this tank mix. This tank mix was recently approved in a supplemental label.

Table. Dry pea tolerance to Spartan plus Sharpen tank mixes. (1639)

			Dry pea							
			Density	Height		Injury			Yield	Test wt.
Treatment[a]	Rate	Timing	Jun-9	Jun-20	Jul-19	Jun-10	Jun-25	Jul-19	Aug-16	Aug-16
			m of row	------cm------		----------%----------			lb/A	lb/bu
Untreated			10.8	31	58	0	0	0	2420	66.8
Glyphosate + Spartan[b]	22 oz + 3 oz	PRE	10.0	29	59	21	20	18	2440	67.0
Glyphosate + Spartan[b]	22 oz + 6 oz	PRE	10.3	31	57	28	26	23	2442	67.8
Glyphosate + Spartan + Sharpen[b]	22 oz + 3 oz + 1 oz	PRE	9.7	34	64	15	19	13	2631	67.9
Glyphosate + Spartan + Sharpen[b]	22 oz + 3 oz + 2 oz	PRE	10.8	31	59	19	24	16	2321	67.3
Glyphosate + Spartan + Sharpen[b]	22 oz + 6 oz + 2 oz	PRE	10.1	30	61	25	32	25	2334	67.9
Glyphosate + Spartan + Sharpen[b]	22 oz + 6 oz + 4 oz	PRE	10.0	25	59	34	39	25	2670	67.1
Glyphosate + Sharpen[b]	22 oz + 3 oz	PRE	9.7	35	57	17	28	18	2257	67.9
Glyphosate + Sharpen[b]	22 oz + 6 oz	PRE	9.3	34	59	24	39	23	2071	68.0
Glyphosate + Prowl H2O	22 oz + 2 pt	PRE	9.8	36	53	2	2	2	2002	67.4
LSD (0.05)			NS	NS	NS	15.9	NS	NS	NS	NS
CV			15.0	12.5	9.3	50.1	74.4	9.3	21.7	0.8

[a] *All treatments applied with AMS (2.5 gal)*

[b] *Applied with MSO (1.5 pt)*

Faba bean tolerance to herbicides. (Minot). The objective of the study was to evaluate faba bean tolerance to preemergence (PRE) and postemergence (POST) herbicides. Faba beans were planted May 4. Treatments were applied PRE and POST on May 4 and June 7, respectively. Faba beans were about 4-6 inches tall at the POST application.

Very little crop injury was observed with Prowl or Sharpen applied PRE. Only slight crop injury was observed with Varisto applied POST. Sharpen and Varisto provided some horseweed suppression (56-85%).

Table. Faba bean tolerance to herbicides. (1641)									
			Faba bean						Weed Control
			Injury				Yield	Test wt.	Horseweed
Treatment	Rate	Timing	May-24	Jun-16	Jun-27	Jul-29	Oct-14	Oct-14	Jul-29
			----------------%			----------------	lb/A	lb/bu	------%------
Untreated			0	0	0	0	20	65.8	0
Prowl H2O	32 oz	PRE	0	0	0	0	19	65.8	0
Prowl H2O	48 oz	PRE	0	2	2	0	18	65.4	0
Sharpen	2 oz	PRE	0	0	0	0	19	65.6	62
Sharpen	4 oz	PRE	0	3	4	4	20	65.6	85
Varisto[a]	11 oz	POST	0	7	8	0	24	65.5	56
Varisto[a]	22 oz	POST	0	12	16	2	20	65.5	76
LSD (0.05)			NS	2.5	3.2	1.5	NS	NS	15.2
CV			0	40.1	42.1	104.4	18.7	0.8	21.4
[a] *Applied with MSO (1%) + AMS (2.5 gal)*									

Faba bean tolerance to PRE and POST herbicides. (Minot). The objective of the study was to evaluate faba bean tolerance to preemergence (PRE) and postemergence (POST) herbicides. Faba beans were planted May 2. PRE and POST treatments were applied May 4 and June 7, respectively. Faba beans were 4-5 inches tall at the POST application.

Basagran caused only slight crop injury soon after application. Raptor applied alone caused moderate to severe stunting, although plants recovered somewhat over time. In contrast, only slight injury was observed where Raptor was tank mixed with Basagran. Raptor applied alone resulted in reduced crop yield.

Table. Faba bean tolerance to PRE and POST herbicides. (1618)

			Faba bean					
			Injury				Yield	Test wt.
Treatment	Rate	Timing	May-24	Jun-16	Jul-2	Jul-29	Sep-16	Sep-16
			%				bu/A	lb/bu
Untreated			0	0	0	0	52	65.7
Sharpen	2 oz	PRE	0	5	3	1	51	66.0
Spartan	4 oz	PRE	0	2	2	0	57	65.2
Spartan + Sharpen	4 oz + 1 oz	PRE	0	5	3	1	61	66.2
Authority MTZ	12 oz	PRE	0	3	1	0	58	65.8
BroadAxe	25 oz	PRE	0	9	4	1	48	66.3
Metribuzin	0.5 lb	PRE	0	8	3	1	54	65.8
Prowl H2O	3 pt	PRE	0	0	0	0	54	65.4
Valor	2 oz	PRE	0	3	3	2	60	65.8
Fierce	3 oz	PRE	0	5	2	1	68	66.2
Prowl H2O / Basagran[a]	2 pt / 2 pt	PRE/POST	0	12	8	3	58	65.8
Prowl H2O / Raptor[b]	2 pt / 4 oz	PRE/POST	0	38	60	28	45	66.3
Prowl H2O / Basagran + Raptor[c]	2 pt / 1 pt + 4 oz	PRE/POST	0	12	10	4	58	65.9
Prowl H2O	1.5 pt	PRE	0	0	0	0	58	66.0
LSD (0.05)			NS	5.5	4.7	4.9	11.2	NS
CV			0	44.9	39.7	100	12	0.74

[a] *Applied with COC (1.5 pt)*
[b] *Applied with MSO + 28% N (1.5 pt + 2.5 gal/100 gal)*
[c] *Applied with MSO (1.5 pt)*

Flax Tolerance to Pre and Postemergence application of the Herbicide Pyroxasulfone

Caleb Dalley, HREC, Hettinger, ND, 2016

A field trial was conducted to evaluate flax tolerance to the herbicide pyroxasulfone. Flax was planted at a rate of 30 lb/A on May 5, 2016 using a John Deere 1590 no-till drill at a depth of 1.5 inches into wheat stubble. Starter fertilizer (18-46-0) was applied at a rate of 40 lbs/A at planting. Prior to planting, urea was broadcast applied at a rate of 100 lbs/A (46 lbs N). Preemergence treatments were applied on the same day of planting using a tractor mounted research sprayer at a volume of 10 gal/A using compressed CO2 as a propellant. Glyphosate was applied (0.75 lbs ae/A) across all treatments except the untreated control to control emerged weeds. Flax emergence occurred on May 16. Postemergence applications were made on June 6 (21 days after flax emergence) using the same methods previously described. Flax was harvested on August 1 using a Kincaid research plot combine with a 5 foot header. Injury was evaluated 7, 16, and 36 days after flax emergence (DAE). Injury was slight to none and was not significant during any of the evaluations taken and flax height was not reduced by any of the herbicide treatments when measure 36 DAE. Lack of rainfall following planting reduced exposure of the flax to the PRE herbicides applied and may not be representative of what would be expected during a year with average or above average rainfall. PRE burndown with glyphosate was effective at controlling weeds present. Few annual weeds emerged following the burndown, likely because of the dry conditions, and no evaluation for weed control could be taken. Flax yields were reduced only in the untreated plots, which were heavily infested with downy brome and tumble mustard. Yields were low due to the dry conditions at Hettinger this year. Additional trials should be conducted to further evaluate safety of pyroxasulfone in flax to increase confidence in crop safety.

Treatment	Rate	Flax injury 7 DAE	Flax injury 16 DAE	Flax injury 36 DAE	Flax Height	Test wt Aug 10	Yield Aug 10
		%	%	%	-cm-	-lbs/bu-	-lbs/A-
1 Pyroxasulfone	1.48 oz/a	1 bc	0 a	0 a	36.0 a	56 a	766.8 a
2 Pyroxasulfone	2.1 oz/a	0 c	0 a	0 a	34.9 a	55 a	805.1 a
3 Pyroxasulfone	3.45 oz/a	4 ab	0 a	0 a	34.9 a	55 a	667.7 ab
4 Spartan	6 oz/a	4 abc	0 a	0 a	35.3 a	56 a	687.5 ab
Pyroxasulfone	1.03 oz/a						
5 Spartan	6 oz/a	4 ab	0 a	2 a	35.2 a	54 a	599.1 ab
Pyroxasulfone	1.64 oz/a						
6 Spartan	6 oz/a	6 a	0 a	4 a	32.5 a	56 a	522.9 b
Pyroxasulfone	2.05 oz/a						
7 Spartan	6 oz/a	3 abc	0 a	1 a	33.4 a	55 a	693.1 ab
Section 2 EC	8.04 oz/a						
8 Untreated check		0	0	0	30.1 a	55 a	249.7 c
9 Hand weeded check		0	0	0	33.7 a	56 a	660.2 ab
LSD P=.10		3.5	NS	NS	3.53	NS	240
Standard Deviation		2.9	0.0	0.0	2.92	1.2	199
CV		120	0.0	0.0	8.59	2.12	31.6
Treatment F		2.282	0.000	0.000	1.561	0.786	2.738
Treatment Prob(F)		0.0565	1.000	1.000	0.0001	0.6251	0.0267

Lentil Tolerance to Pre and Postemergence application of the Herbicide Pyroxasulfone

Caleb Dalley, HREC, Hettinger, ND, 2016

A field trial was conducted to evaluate lentil tolerance to the herbicide pyroxasulfone. Lentil were planted at a rate of 75 lb/A on May 4, 2016 using a John Deere 1590 no-till drill. During planting, 40 lbs of starter fertilizer (18-46-0) and pea/lentil inoculant were applied in the planting drill. Preemergence treatments were applied on the same day as planting. Glyphosate (0.75 lb ae/A) was also applied to the entire trial site after planting to control emerged weeds. Herbicides were applied using a tractor mounted research sprayer at a volume of 10 gallons per acre using flat fan nozzles and compressed CO2 as a propellant. The site of this trial in Hettinger experienced below average rainfall for the summer months which limited both the injury of herbicide treatments to lentil and weed control from these treatments. During May there was 1.04 inches of rain recorded; in June there was 0.87 inches of rain; in July there was 0.81 inches of rain. Most rainfall occurred in amounts of less than 0.2 inches and only one daily rainfall totaled greater than 0.5 inches. Due to low rainfall, few annual weeds emerged following planting with the primary weed present in the trial after planting being field bindweed, although there was a scattered population of kochia and wild buckwheat. No herbicide treatment was effective at controlling any of these weeds, partly due to less than ideal incorporation of the herbicides due to low rainfall. Lentil were harvested on August 1. All treatments yielded less lentil than the hand weeded control. Yields were very low due to the dry summer and averaged less than 900 lbs per acre for most treatments. Additional trials evaluating lentil response to pyroxasulfone should be conducted to develop firm conclusions concerning its safety.

Treatment	Rate	Lentil injury 7 DAE	Lentil injury 16 DAE	Lentil injury 36 DAE	Lentil Height	Test wt Aug 10	Yield Aug 10
		%	%	%	-cm-	-lbs/bu-	-lbs/A-
1 Pyroxasulfone	1.5 oz/a	0 a	0 a	0 a	21 a	56 a	872 b
2 Pyroxasulfone	2.1 oz/a	0 a	0 a	0 a	21 a	54 a	838 b
3 Pyroxasulfone	3.5 oz/a	0 a	0 a	0 a	22 a	53 a	879 b
4 Prowl H2O	51 oz/a	0 a	0 a	0 a	22 a	49 a	902 b
Pyroxasulfone	1.0 oz/a						
5 Prowl H2O	51 oz/a	0 a	0 a	0 a	21 a	53 a	867 b
Pyroxasulfone	1.7 oz/a						
6 Prowl H2O	51 oz/a	0 a	0 a	0 a	22 a	53 a	851 b
Pyroxasulfone	2 oz/a						
7 Prowl H2O	51 oz/a	0 a	0 a	0 a	22 a	56 a	954 b
Pursuit	2 oz/a						
8 Untreated check		0	0	0	22 a	56 a	899 b
9 Hand weeded check		0	0	0	23 a	55 a	1086 a
LSD P=.10		NS	NS	NS	NS	4.0	127.49
Standard Deviation		0.0	0.0	0.0	0.87	3.2	105.39
CV		0.0	0.0	0.0	4.0	5.97	11.64
Treatment F		0.000	0.000	0.000	1.546	2.358	2.067
Treatment Prob(F)		1.000	1.000	1.000	0.1937	0.0724	0.0808

Options for PRE Weed Control in Lentil

Caleb Dalley, HREC, Hettinger, ND, 2016

A field trial was conducted to evaluate lentil tolerance and weed control with herbicides applied preplant and preemergence. Lentil were planted on May 4, 2016 at a rate of 75 lbs/A using a John Deere 1590 no-till drill. Lentil were planted no-till into wheat stubble. Pea/lentil inoculant was applied to the planting drill during planting along with starter fertilizer (18-46-0) at a rate of 40 lb/A. Preplant herbicide application (treatment 10) was applied on May 3, 2010 using a tractor-mounter research sprayer using a spray volume of 10 gal/A with compressed CO2 as the propellant. PRE herbicide treatments were applied on May 4, 2016 using the same methods as described previously. Lentil emerged on May 16. In May of 2016, just over one inch of rainfall occurred, mostly in small increments that were ineffective at activating and incorporating PRE herbicides. The first rainfall with an accumulation of more than 0.15 inches was on May 30, when 0.46 inches of rain fell at Hettinger. The remaining summer months were also dry, with less than four inches of accumulated rainfall between May 1 and August 1. This resulted in reduced survival, growth, and yield of lentil, but also reduced weed emergence in plots as well. Weeds present at planting were all controlled effectively with glyphosate. Few weeds beyond field bindweed emerged and grew after planting. No injury was observed for any of the treatments applied preplant or preemergence at evaluations taken 19 and 28 days after planting. Lentil was harvested on August 1 using a Kincaid plot harvester with a 5 foot header. Lentil seed moisture ranged from 11 to 14% and was adjusted to 12% moisture when calculating yields. Lentil yield ranged from 56 lbs/A in the untreated control to 1067 lbs/A in lentil treated with BAS 85800H (4.5 oz/A). In herbicide treated lentil, the lowest yield occurred in lentil treated PRE with Zidua at 3 oz/A (824 lbs/A), however, the highest rate of Zidua SC (6.25 oz/A) yielded similar (953 lbs/A) to the treatment with the highest yield. Lentil treated with Prowl H2O preplant yielded more than lentil treated PRE with Prowl. Due to dry conditions, further research is needed to determine crop safety and herbicide efficacy with PRE herbicides in lentil.

Treatment	Rate	Timing	Lentil injury 7 DAE	Lentil injury 16 DAE	Test wt	Yield	Yield
			——%——		-lbs/bu-	-bu/A-	-lbs/A-
1 Roundup PowerMAX	22 fl oz/a	PRE	0 b	1 bc	38 a	13.7 c	824 d
Zidua	3 oz wt/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
2 Roundup PowerMAX	22 fl oz/a	PRE	1 b	0 c	56 a	15.8 abc	956 a-d
Zidua SC	2.5 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
3 Roundup PowerMAX	22 fl oz/a	PRE	0 b	0 c	58 a	15.6 abc	930 a-d
Zidua SC	3.75 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
4 Roundup PowerMAX	22 fl oz/a	PRE	0 b	0 c	55 a	15.8 abc	942 a-d
Zidua SC	5 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
5 Roundup PowerMAX	22 fl oz/a	PRE	0 b	0 c	53 a	16.0 abc	953 a-d
Zidua SC	6.25 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
6 Roundup PowerMAX	22 fl oz/a	PRE	0 b	3 bc	56 a	14.8 bc	892 bcd
Sharpen	0.75 fl oz/a	PRE					
Pursuit	2 fl oz/a	PRE					
Methylated Seed Oil	16 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
7 Roundup PowerMAX	22 fl oz/a	PRE	0 b	0 c	57 a	16.1 abc	977 abc
Sharpen	0.75 fl oz/a	PRE					
Prowl H2O	1.054 fl oz/a	PRE					
Methylated Seed Oil	16 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
8 Roundup PowerMAX	22 fl oz/a	PRE	0 b	0 c	54 a	17.1 ab	1040 a
Bas 85800H	3 fl oz/a	PRE					
Methylated Seed Oil	16 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
9 Roundup PowerMAX	22 fl oz/a	PRE	0 b	0 c	56 a	17.6 a	1067 a
Bas 85800H	4.5 fl oz/a	PRE					
Methylated Seed Oil	16 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
10 Roundup PowerMAX	22 fl oz/a	PRE	6 a	14 a	56 a	14.7 bc	860 cd
Prowl H2O	32 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
11 Roundup PowerMAX	22 fl oz/a	PREPLA	0 b	5 b	56 a	17.6 a	1062 a
Prowl H2O	32 fl oz/a	PREPLA					
Ammonium Sulfate	5.67 lb/100 gal	PREPLA					
12 Roundup PowerMAX	22 fl oz/a	PRE	0 b	0 c	57 a	17.4 a	1038 ab
Outlook	14 fl oz/a	PRE					
Ammonium Sulfate	5.67 lb/100 gal	PRE					
13 Untreated Check			0 b	0 c		0.9 d	56 e
LSD P=.10			1.7	4.2	NS	2.4	149
Standard Deviation			1.4	3.5	9.0	2.01	124
CV			269	205	16.6	13.53	13.95
Treatment F			4.821	4.847	1.396	18.714	17.791
Treatment Prob(F)			0.0001	0.0001	0.2311	0.0001	0.0001

Weed control with SA066 in lentil. Howatt, Roach, Harrington. 'Richlea' lentil were seeded near Fargo on May 17. Treatments were applied on May 16 with 52°F, 74% relative humidity, 15% cloud cover, 5 to 7 mph wind velocity at 45°, and dry topsoil at 50°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. Evaluation of wild oat control included two replicates only.

		May 27	June 9					June 20				
Treatment	Rate	Lentil	Lentil	Wioa	Yeft	Wimu	Answ	Lentil	Wioa	Yeft	Wimu	Answ
	oz/A	%	%	%	%	%	%	%	%	%	%	%
Sulfentrazone	3	0	16	30	60	83	83	16	10	48	28	79
Flumioxazin	1.5	0	29	25	68	84	66	40	35	35	66	10
Flumioxazin&Pyroxasulfone	2.25	0	38	20	85	84	79	50	15	56	73	10
Pyroxasulfone	1.7	0	13	0	88	69	71	18	0	68	33	0
Pendimethalin	16	0	5	0	58	43	48	16	10	70	15	13
Metolachlor	24	0	15	10	76	38	50	20	35	71	30	15
Metribuzin	6	0	33	68	80	90	78	20	83	63	80	33
SA066	11.5	0	5	30	38	69	48	6	25	45	66	15
SA066	23	0	33	30	61	85	88	13	35	65	79	38
Untreated Check	0	0	0	0	0	0	0	0	0	0	0	0
CV		0	32	35	11	9	10	36	42	14	17	61
LSD P=.05		.	9	17	10	8	9	10	23	11	11	19

Injury to lentil was present following herbicide treatment. The low rate SA066 proposed to be the standard application rate caused less injury than other herbicides. This rate gave moderate control of weeds relative to other herbicides but did not excel in control of any weed species present in the study. The high rate of SA066 produced injury to lentil similar to many soil-applied herbicides and also provided good general control compared with other options.

Treatments with flumioxazin caused the most injury to lentil, 40 to 50%. Optimum control varied by species. Metribuzin provided 83% control of wild oat. Pyroxasulfone, pendimethalin, and metolachlor gave near 70% control of yellow foxtail. Metribuzin and the high rate of SA066 provided about 80% control of wild mustard. And sulentrazone provided by far the best control of annual smartweeds at 79%.

Weed Control in Onion (Oakes, ND) - H. Hatterman-Valenti and C. Auwarter.

This study was conducted at the Oakes Irrigation Research Facility near Oakes, North Dakota to compare various season-long weed control strategies to the untreated in onion. 'Calibra', 'Mondella', 'Sedona', and 'Red Bull' were planted April 30 with 18" centers and a planting population of 250,000 seeds/ac. PRE treatments (Appl. Code A) were applied May 9, 9 days after planting (DAP). Preemergence herbicides applied at 75% radicle emergence (Appl. Code B) occurred on May 12. POST applications occurred when onion were at the one-leaf stage (Appl. Code C), 1.5-leaf stage (Appl. Code D), 2-3-leaf stage (Appl. Code E), and 4-leaf stage (Appl. Code F) on May 23, June 2, June 16, and June 28, respectively. All herbicides were applied with a CO_2 backpack sprayer and a hand-boom equipped with XR8002 nozzles delivering 20 GPA at 40 PSI.

Weed Control and Injury.

Trt No.	Treatment Name	Rate (lb ai/a)	Appl Code	Colq control 6/2/2016		onion injury 6/2/2016		Colq control 6/16/2016	
1	K485	30 g/a	B	45.0	b-e	0.0	a	2.5	cd
	Buctril	0.25	E						
	Buctril	0.125	G						
2	K485	45 g/a	B	72.5	abc	0.0	a	11.3	bcd
	Buctril	0.25	E						
	Buctril	0.125	G						
3	K495	60 g/a	B	81.3	ab	0.0	a	22.5	bcd
	Buctril	0.25	E						
	Buctril	0.125	G						
4	K485	90 g/a	B	83.8	ab	0.0	a	37.5	bc
	Buctril	0.25	E						
	Buctril	0.125	G						
5	K485	30 g/a	B	99.5	a	0.0	a	95.0	a
	prowl	1	B						
	Buctril	0.375	G						
6	K485	60 g/a	B	97.8	a	0.0	a	93.8	a
	Prowl	0.5	B						
	Buctril	0.125	G						
7	K485	60 g/a	B	97.0	a	0.0	a	95.0	a
	Prowl	0.5	B						
	GoalTender	0.094	D						
	GoalTender	0.125	D						
	Buctril	0.125	E						
	Buctril	0.25	G						
8	K485	60 g/a	B	78.8	abc	0.0	a	67.5	a
	Nortron	0.125	B						
	GoalTender	0.094	D						
	GoalTender	0.125	D						
	Buctril	0.125	E						
	Buctril	0.25	G						
9	K485	60 g/a	B	58.8	a-d	0.0	a	21.3	bcd
	GoalTender	0.094	E						
	Buctril	0.125	E						

	GoalTender	0.094	G						
	Buctril	0.25	G						
10	K485		B	32.5	cde	0.0	a	10.0	bcd
	GoalTender	0.094	D						
	GoalTender	0.125	D						
	Buctril	0.125	E						
	Buctril	0.25	G						
11	K485		B	17.5	de	0.0	a	15.0	bcd
	GoalTender	0.094	D						
	GoalTender	0.125	D						
	Buctril	0.125	E						
	Buctril	0.25	G						
12	K485		B	12.5	de	0.0	a	12.5	bcd
	GoalTender	0.094	D						
	GoalTender	0.125	D						
	Buctril	0.125	E						
	Buctril	0.25	G						
13	K485		B	45.0	b-e	0.0	a	33.8	bcd
	GoalTender	0.094	D						
	GoalTender	0.125	D						
	Buctril	0.125	E						
	Buctril	0.25	G						
14	GoalTender	0.0625	D	12.5	de	0.0	a	23.8	bcd
	GoalTender	0.125	D						
	Buctril	0.0625	E						
	Buctril	0.25	G						
15	Nortron	0.25	B	37.5	b-e	0.0	a	26.0	bcd
	GoalTender	0.0625	D						
	GoalTender	0.125	D						
	Buctril	0.0625	E						
	Buctril	0.25	G						
16	Nortron	0.25	B	40.0	b-e	0.0	a	12.5	bcd
	GoalTender	0.0625	D						
	GoalTender	0.125	D						
	Buctril	0.0625	E						
17	Nortron	0.25	B	32.5	cde	0.0	a	40.0	b
	Buctril	0.0625	E						
	Buctril	0.25	G						
	Buctril	0.0625	E						
18	Prowl	0.5	B	95.0	a	0.0	a	76.3	a
	Buctril	0.375	G						
19	Prowl	0.5	B	94.5	a	0.0	a	75.0	a
	Buctril	0.375	G						
20	untreated			7.5	e	0.0	a	0.0	d
LSD (P=.05)				29.3		0.0		21.5	

Calibra Yield.

Trt No.	Count 0-1"		Grams 0-1"		Count 1-2.25"		Grams 1-2.25"		Count 2.25-3"		Grams 2.25-3"		Count 3-4"		Grams 3-4"		Count Total		Grams Total		Pounds Total		CWT Acre	
1	0.0	a	0.0	a	1.3	b	96.9	bc	1.3	b	175.0	b	1.0	b	287.5	b	3.5	bc	559.4	bc	1.2	bc	59.6	bc
2	0.0	a	0.0	a	3.5	b	94.8	bc	0.3	b	25.0	b	0.0	b	0.0	b	3.8	bc	119.8	c	0.3	c	12.8	c
3	0.0	a	0.0	a	7.3	ab	280.0	abc	1.0	b	107.9	b	0.0	b	0.0	b	8.3	abc	387.9	bc	0.9	bc	41.4	bc
4	0.3	a	2.0	a	3.0	b	113.0	bc	2.0	b	275.0	b	0.0	b	0.0	b	5.3	abc	390.0	bc	0.9	bc	41.6	bc
5	0.0	a	0.0	a	3.5	b	187.1	abc	5.5	ab	794.0	ab	2.8	a	587.4	b	11.8	abc	1568.5	b	3.5	b	167.2	b
6	0.0	a	0.0	a	9.0	ab	486.1	ab	5.0	ab	650.0	ab	0.3	b	52.3	b	14.3	abc	1188.4	bc	2.6	bc	126.7	bc
7	0.0	a	0.0	a	4.5	ab	284.5	abc	7.8	a	1137.5	a	3.8	a	957.8	a	16.0	ab	2379.8	a	5.2	a	253.7	a
8	0.0	a	0.0	a	3.8	b	195.4	abc	4.0	ab	540.8	ab	0.5	b	150.0	b	8.3	abc	886.1	bc	2.0	bc	94.5	bc
9	0.0	a	0.0	a	5.3	ab	200.0	abc	0.5	b	50.5	b	0.0	b	0.0	b	5.8	abc	250.5	bc	0.6	bc	26.7	bc
10	1.8	a	11.0	a	9.8	ab	365.5	abc	1.0	b	150.0	b	0.3	b	30.8	b	12.8	abc	557.3	bc	1.2	bc	59.4	bc
11	2.8	a	16.9	a	9.0	ab	263.0	abc	2.8	b	375.0	b	0.0	b	0.0	b	14.5	abc	654.9	bc	1.4	bc	69.8	bc
12	2.8	a	16.1	a	8.0	ab	233.5	abc	0.8	b	100.0	b	0.0	b	0.0	b	11.5	abc	349.6	bc	0.8	bc	37.3	bc
13	0.3	a	1.9	a	8.0	ab	237.4	abc	0.3	b	23.3	b	0.0	b	0.0	b	8.5	abc	262.5	bc	0.6	bc	28.0	bc
14	0.0	a	0.0	a	2.3	b	49.3	bc	0.0	b	0.0	b	0.0	b	0.0	b	2.3	bc	49.3	c	0.1	c	5.3	c
15	1.5	a	8.8	a	5.0	ab	160.0	bc	2.0	b	325.0	b	0.8	b	183.3	b	9.3	abc	677.0	bc	1.5	bc	72.2	bc
16	0.8	a	5.9	a	0.5	b	5.9	c	0.0	b	0.0	b	0.0	b	0.0	b	1.3	bc	11.8	c	0.0	c	1.3	c
17	1.0	a	5.6	a	15.0	a	625.9	a	4.0	ab	497.4	ab	0.0	b	0.0	b	20.0	a	1128.9	bc	2.5	bc	120.4	bc
18	2.5	a	17.6	a	6.8	ab	224.6	abc	0.3	b	25.5	b	0.0	b	0.0	b	9.5	abc	267.8	bc	0.6	bc	28.5	bc
19	1.3	a	7.8	a	5.3	ab	129.1	bc	0.0	b	0.0	b	0.0	b	0.0	b	6.5	abc	136.9	c	0.3	c	14.6	c
20	0.0	a	0.0	a	0.0	b	0.0	c	0.0	b	0.0	b	0.0	b	0.0	b	0.0	c	0.0	c	0.0	c	0.0	c
LSD (P=.05)	2.4		14.5		6.5		260.5		3.2		456.1		1.3		339.3		8.5		788.1		1.7		84.0	

The area was heavily infested with common lambsquarters with few other weed species present. Only treatments that included Prowl could provide adequate (≥85%) common lambsquarters control, but even those treatments could not reduce weed competition enough to produce colossal sized onion (4-inch diameters). For 'Calibra', treatment 7 with KIH485 at 60 g/a and Prowl preemergence followed by Goal Tender early at 3 fl oz/a and Goal Tender 4 fl oz/a + Buctril 8 fl oz/a at the onion 2-leaf stage and Buctril 16 fl oz/a at the 4-leaf stage had the highest yield, which was almost double the next highest yield with treatment 5.

Mondella Yield.

Trt No.	Count 0-1"	Grams 0-1"	Count 1-2.25"	Grams 1-2.25"	Count 2.25-3"	Grams 2.25-3"	Count 3-4"	Grams 3-4"	Count Total	Pounds Total	CWT Acre
1	0.8 a	5.9 a	2.5 cd	111.9 bc	2.0 bc	312.5 b	0.0 c	0.0 c	5.3 bc	0.9 bcd	45.9 bcd
2	0.0 a	0.0 a	7.3 a-d	319.1 bc	1.0 c	100.0 b	0.0 c	0.0 c	8.3 abc	0.9 bcd	44.7 bcd
3	0.5 a	2.4 a	12.3 a-d	574.3 abc	1.8 bc	178.0 b	0.0 c	0.0 c	14.5 abc	1.7 bcd	80.5 bcd
4	0.3 a	1.9 a	3.5 cd	150.0 bc	1.3 c	150.0 b	0.0 c	0.0 c	5.0 bc	0.7 cd	32.2 cd
5	0.5 a	3.9 a	5.0 bcd	224.4 bc	9.8 ab	1132.5 b	2.5 b	588.1 b	17.8 abc	4.3 b	207.8 b
6	0.0 a	0.0 a	6.0 bcd	352.5 bc	9.5 ab	1025.0 b	1.0 c	242.4 c	16.5 abc	3.6 bcd	172.7 bcd
7	0.0 a	0.0 a	4.3 cd	310.3 bc	14.3 a	2062.5 a	5.0 a	1137.5 a	23.5 ab	7.7 a	374.2 a
8	0.3 a	2.0 a	10.3 a-d	527.9 abc	7.0 bc	878.0 b	1.0 c	235.4 c	18.5 abc	3.6 bc	175.2 bc
9	1.0 a	5.8 a	6.0 bcd	235.9 bc	0.3 c	35.9 b	0.0 c	0.0 c	7.3 abc	0.6 cd	29.6 cd
10	0.5 a	3.0 a	17.8 abc	741.0 ab	4.3 bc	475.0 b	0.0 c	0.0 c	22.5 ab	2.7 bcd	130.0 bcd
11	1.0 a	8.0 a	16.8 a-d	650.6 abc	4.3 bc	459.6 b	0.0 c	0.0 c	22.0 ab	2.5 bcd	119.2 bcd
12	2.3 a	11.6 a	19.3 abc	625.3 abc	0.8 c	88.1 b	0.0 c	0.0 c	22.3 ab	1.6 bcd	77.3 bcd
13	1.8 a	12.3 a	21.3 ab	810.0 ab	1.3 c	150.0 b	0.0 c	0.0 c	24.3 ab	2.1 bcd	103.7 bcd
14	0.0 a	0.0 a	0.0 d	0.0 c	0.0 c	0.0 b	0.0 c	0.0 c	0.0 c	0.0 d	0.0 d
15	0.5 a	2.5 a	7.5 a-d	306.3 bc	3.8 bc	475.0 b	0.3 c	50.6 c	12.0 abc	1.8 bcd	89.0 bcd
16	0.8 a	3.3 a	3.0 cd	87.3 bc	0.0 c	0.0 b	0.0 c	0.0 c	3.8 bc	0.2 cd	9.6 cd
17	0.5 a	3.6 a	22.8 a	1025.1 a	3.8 bc	437.5 b	0.0 c	0.0 c	27.0 a	3.2 bcd	156.3 bcd
18	2.0 a	11.9 a	21.5 ab	646.6 abc	0.5 c	37.5 b	0.0 c	0.0 c	24.0 ab	1.5 bcd	74.2 bcd
19	1.5 a	6.5 a	19.0 abc	573.5 abc	0.3 c	23.3 b	0.0 c	0.0 c	20.8 ab	1.3 bcd	64.3 bcd
20	0.0 a	0.0 a	0.0 d	0.0 c	0.0 c	0.0 b	0.0 c	0.0 c	0.0 c	0.0 d	0.0 d
LSD (P=.05)	1.5	9.1	9.7	401.0	5.0	653.5	0.7	185.5	11.6	2.0	95.3

For 'Mondella', treatment 7 with KIH485 at 60 g/a and Prowl preemergence followed by Goal Tender early at 3 fl oz/a and Goal Tender 4 fl oz/a + Buctril 8 fl oz/a at the onion 2-leaf stage and Buctril 16 fl oz/a at the 4-leaf stage also had the highest yield, but this yield was 120 cwt/a great than 'Calibra'. Again the next highest yielding treatment was treatment 5 at approximately 208 cwt/a.

Sedona Yield.

Trt No.	Count 0-1"	Grams 0-1"	Count 1-2.25"	Grams 1-2.25"	Count 2.25-3"	Grams 2.25-3"	Count 3-4"	Grams 3-4"	Count Total	Pounds Total	CWT Acre
1	0.5 a	6.9 a	6.5 a	336.6 a	0.5 c	50.0 d	0.0 b	0.0 b	7.5 ab	0.9 c-f	42.0 c-f
2	0.8 a	4.0 a	5.3 a	231.4 a	2.3 bc	312.5 cd	0.0 b	0.0 b	8.3 ab	1.2 c-f	58.4 c-f
3	0.5 a	3.6 a	7.0 a	356.3 a	1.5 bc	187.5 cd	0.0 b	0.0 b	9.0 ab	1.2 c-f	58.4 c-f
4	0.0 a	0.0 a	4.3 a	205.6 a	0.5 c	67.4 d	0.3 b	59.3 b	5.0 ab	0.7 c-f	35.4 c-f
5	0.0 a	0.0 a	3.5 a	209.5 a	5.3 b	887.5 b	1.0 b	248.4 b	9.8 ab	3.0 bc	143.4 bc
6	0.0 a	0.0 a	8.8 a	536.4 a	5.3 b	700.0 bc	1.3 b	321.3 b	15.3 ab	3.4 b	166.1 b
7	0.0 a	0.0 a	3.5 a	214.3 a	11.0 a	1775.0 a	3.8 a	1056.0 a	18.3 a	6.7 a	324.7 a
8	0.3 a	1.6 a	9.3 a	425.3 a	3.8 bc	522.8 bcd	1.0 b	236.8 b	14.3 ab	2.6 bcd	126.5 bcd
9	0.5 a	5.3 a	5.8 a	302.6 a	0.5 c	62.5 d	0.0 b	0.0 b	6.8 ab	0.8 c-f	39.5 c-f
10	1.0 a	6.6 a	11.8 a	522.9 a	3.8 bc	506.9 bcd	0.3 b	51.1 b	16.8 a	2.4 b-e	115.9 b-e
11	2.0 a	12.0 a	13.0 a	557.3 a	2.5 bc	275.0 cd	0.0 b	0.0 b	17.5 a	1.9 b-f	90.0 b-f
12	2.3 a	13.4 a	14.3 a	493.9 a	0.8 bc	75.0 d	0.0 b	0.0 b	17.3 a	1.3 c-f	62.1 c-f
13	2.0 a	14.5 a	11.0 a	496.9 a	1.5 bc	220.3 cd	0.3 b	71.3 b	14.8 ab	1.8 b-f	85.6 b-f
14	0.0 a	0.0 a	0.0 a	0.0 a	0.0 c	0.0 d	0.0 b	0.0 b	0.0 b	0.0 f	0.0 f
15	0.5 a	3.4 a	8.0 a	256.0 a	2.0 bc	226.0 cd	0.0 b	0.0 b	10.5 ab	1.1 c-f	51.7 c-f
16	0.3 a	2.5 a	1.8 a	64.0 a	0.0 c	0.0 d	0.0 b	0.0 b	2.0 ab	0.1 ef	7.1 ef
17	1.0 a	8.5 a	14.8 a	563.3 a	0.8 bc	90.9 d	0.0 b	0.0 b	16.5 ab	1.5 b-f	70.6 b-f
18	1.5 a	10.9 a	11.8 a	325.4 a	0.3 c	23.9 d	0.0 b	0.0 b	13.5 ab	0.8 c-f	38.4 c-f
19	1.8 a	14.1 a	8.5 a	218.8 a	0.0 c	0.0 d	0.0 b	0.0 b	10.3 ab	0.5 def	24.8 def
20	0.0 a	0.0 a	0.0 a	0.0 a	0.0 c	0.0 d	0.0 b	0.0 b	0.0 b	0.0 f	0.0 f
LSD (P=.05)	1.8	12.8	8.1	406.6	2.7	349.1	0.9	238.9	9.2	1.3	63.2

For 'Sedona', treatment 7 with KIH485 at 60 g/a and Prowl preemergence followed by Goal Tender early at 3 fl oz/a and Goal Tender 4 fl oz/a + Buctril 8 fl oz/a at the onion 2-leaf stage and Buctril 16 fl oz/a at the 4-leaf stage also had the highest yield, but this yield (324.7 cwt/a) was in between 'Mondella' and 'Calibra'. The next highest yielding treatment was treatment 6 at approximately 166 cwt/a.

Red Bull Yield.

Trt No.	Count 0-1"	Grams 0-1"	Count 1-2.25"	Grams 1-2.25"	Count 2.25-3"	Grams 2.25-3"	Count 3-4"	Grams 3-4"	Count Total	Pounds Total	CWT Acre
1	1.3 a	7.9 a	0.5 bc	21.5 c	1.5 b	200.0 b	0.8 c	156.6 c	4.0 cd	0.9 c	41.2 c
2	0.5 a	2.4 a	6.3 bc	271.4 abc	0.5 b	50.0 b	0.0 c	0.0 c	7.3 bcd	0.7 c	34.5 c
3	1.0 a	7.4 a	8.8 abc	360.3 abc	0.3 b	25.0 b	0.0 c	0.0 c	10.0 a-d	0.9 c	41.9 c
4	0.0 a	0.0 a	3.0 bc	155.3 abc	1.3 b	175.0 b	0.0 c	0.0 c	4.3 cd	0.7 c	35.2 c
5	1.5 a	111.3 a	5.3 bc	497.6 abc	5.8 b	912.1 b	3.3 b	731.0 b	15.8 abc	5.0 b	240.1 b
6	0.0 a	0.0 a	9.5 abc	522.5 abc	6.3 b	712.5 b	0.5 c	119.9 c	16.3 abc	3.0 bc	144.5 bc
7	0.0 a	0.0 a	5.0 bc	312.8 abc	11.5 a	1662.5 a	5.5 a	1285.6 a	22.0 a	7.2 a	347.7 a
8	0.3 a	5.0 a	6.0 bc	324.4 abc	4.3 b	517.5 b	1.0 c	215.0 c	11.5 a-d	2.3 c	113.2 c
9	0.3 a	2.3 a	2.5 bc	126.5 bc	0.0 b	0.0 b	0.0 c	0.0 c	2.8 cd	0.3 c	13.7 c
10	1.8 a	12.4 a	18.0 a	747.3 a	2.5 b	247.9 b	0.3 c	64.5 c	22.5 a	2.4 c	114.3 c
11	2.3 a	15.8 a	10.8 abc	349.1 abc	1.5 b	175.0 b	0.5 c	95.6 c	15.0 abc	1.4 c	67.8 c
12	0.8 a	2.8 a	10.3 abc	320.9 abc	0.5 b	62.5 b	0.0 c	0.0 c	11.5 a-d	0.9 c	41.2 c
13	2.0 a	15.1 a	17.8 a	712.1 ab	1.0 b	102.1 b	0.0 c	0.0 c	20.8 ab	1.8 c	88.4 c
14	0.0 a	0.0 a	0.0 c	0.0 c	0.0 b	0.0 b	0.0 c	0.0 c	0.0 d	0.0 c	0.0 c
15	0.3 a	2.1 a	5.5 bc	207.1 abc	3.3 b	425.0 b	0.8 c	186.3 c	9.8 a-d	1.8 c	87.5 c
16	0.3 a	2.3 a	3.8 bc	104.6 c	0.0 b	0.0 b	0.0 c	0.0 c	4.0 cd	0.2 c	11.4 c
17	0.5 a	3.5 a	17.3 a	737.9 a	5.0 b	620.8 b	0.0 c	0.0 c	22.8 a	3.0 bc	145.2 bc
18	1.5 a	8.8 a	17.8 a	566.3 abc	1.5 b	175.0 b	0.0 c	0.0 c	20.8 ab	1.7 c	80.0 c
19	1.5 a	11.6 a	12.0 ab	374.8 abc	0.3 b	24.0 b	0.0 c	0.0 c	13.8 a-d	0.9 c	43.8 c
20	0.0 a	0.0 a	0.0 c	0.0 c	0.0 b	0.0 b	0.0 c	0.0 c	0.0 d	0.0 c	0.0 c
LSD (P=.05)	2.0	71.2	6.6	337.4	4.5	619.2	1.4	348.6	8.1	1.7	83.7

For 'Red Bull', treatment 7 with KIH485 at 60 g/a and Prowl preemergence followed by Goal Tender early at 3 fl oz/a and Goal Tender 4 fl oz/a + Buctril 8 fl oz/a at the onion 2-leaf stage and Buctril 16 fl oz/a at the 4-leaf stage also had the highest yield. 'Red Bull', but this yield (347.7 cwt/a) was in between 'Mondella' and 'Sedona'. The next highest yielding treatment was treatment 5 at approximately 240 cwt/a.

The pre-applications of DCPA and ethofumesate didn't injure onion (37 DAA), while the post-applications all had some injury after the third application. Micro-rate treatments without oxyfluorfen at this time had less injury and bromoxynil at 0.031 lb/A had less injury then 0.062 lb/A. The Buctril treatments had less injury than the Broclean treatments. When ccomparing treatment 2 (Buctril) versus treatment 13 (Broclean), treatment 4 (Buctril) vs treatment 14 (Broclean), treatment 7 (Buctril) vs treatment 15 (Broclean) and treatment 10 (Buctril) vs treatment 16 (Broclean); the biggest difference in injury was shown between treatments 2 and 13. Both received 0.031 lb/A bromoxynil for 2 applications, fb 0.0625 lb/A with 6.3% onion injury for Broclean and only 1.3% onion injury for Buctril. DCPA controlled COLQ better than ethofumesate, while ethofumesate had better control of RRPW than DCPA 37 DAA. Stand counts were taken 40 DAP, just prior to the third application. No differences were observed.

Sedona onions had the highest yield among the four cultivars fb Crocket, Talon, and Patterson. Even though there was more onion injury in the Broclean treatments, these treatments had a higher yield overall than the Buctril treatments. The highest yielding treatment over all four cultivars was treatment 16 with Sedona onions at 666 cwt/A. This treatment consisted of bromoxynil (Broclean) at 0.0625 lb/A applied twice fb bromoxynil (Broclean) at 0.0625 lb/A and oxyfluorfen at 0.0625 lb/A applied twice. This treatment resulted in a top seven yield among the four cultivars of onion. In comparison, the Buctril treatment 10 ranked in the middle among all treatments for total onion yield averaged over all cultivars. The most consistent treatment was treatment 6; pre-application of DCPA and two additional applications of the grower standard use rate of bromoxynil and oxyfluorfen at the 5- and 9-leaf stages. The untreated consistently yielded at the bottom even though it received the two standard bromoxynil and oxyfluorfen applications at the 5- and 9-leaf stages, because the weeds were too big to fully control.

Having oxyfluorfen mixed with bromoxynil in the first three applications compared to only bromoxynil increased yields with all four cultivars (treatments 3 vs 2). Comparing treatments 10 and 11, where an application of bromoxynil at 0.0625 lb/A was added for treatment 11, showed a yield increase with all four cultivars. Treatment 10 had 2 applications of bromoxynil at 0.0625 lb/A and 2 applications of bromoxynil at 0.0625 lb/A plus oxyfluorfen at 0.0625 lb/A. Treatment 11 added a third application of bromoxynil at 0.0625 lb/A in the middle fb 2 applications of bromoxynil at 0.0625 lb/A plus oxyfluorfen at 0.0625 lb/A.

Safflower tolerance to Spartan. (Minot). The objective of this study was to evaluate safflower tolerance to Spartan applied preemergence (PRE) at various rates. The study was conducted at two locations. At "Site 1", safflower was planted on May 3 in the morning and herbicides were applied later that afternoon. Site 1 was irrigated as needed throughout the season. At "Site 2", safflower was planted April 21 and herbicide treatments were applied PRE on May 3. Site 1 was conducted in a conventional tillage system, while Site 2 was conducted under a no-till system. A fungicide was sprayed at Site 2, but not at Site 1. Safflower yield and quality were reduced at Site 1 due to disease. At Site 2, safflower stand and development were hindered and injury increased where old wheat residue was heavy. Safflower injury was light to severe and increased with Spartan rate, but visible injury symptoms decreased over time. Yield was somewhat variable at both locations as indicated by the high coefficient of variation (CV).

Spartan is not currently registered for use in safflower; however, FMC is considering registering it for 2017. If registered, the label will carry an indemnification statement indicating growers will use the product at their own risk. We have observed that safflower tends to grow out of injury caused by Spartan, especially when rainfall is plentiful. Farmers must know their soil characteristics to identify the correct Spartan rate to use.

Table 1. Safflower tolerance to Spartan. (Site 1 - 1652)

			Safflower								
			Density	Injury				Height	Height	Yield	Oil
Treatment	Rate	Timing	Jun-2	Jun-3	Jun-17	Jul-15	Aug-30	Jun-22	Aug-1	Sep-27	Sep-27
			m of row	--------------------%--------------------				cm	cm	lb/A	---%---
Untreated			8.1	0	0	0	0	54.8	82.3	1680	26.1
Spartan	1 oz	PRE	9.8	10	7	0	0	56.1	84.0	1716	25.3
Spartan	2 oz	PRE	8.5	18	15	0	0	53.8	86.7	1486	25.5
Spartan	3 oz	PRE	8.2	25	24	1	1	46.3	81.9	1590	26.4
Spartan	4 oz	PRE	8.8	35	30	4	1	47.4	85.9	1611	25.6
Spartan	6 oz	PRE	8.8	54	54	5	3	42.4	84.5	1435	24.7
Prowl H2O	2 pt	PRE	10.3	10	6	0	0	55.0	80.3	1776	25.7
LSD (0.05)			NS	5.5	8.3	1.3	1.3	5.8	NS	NS	NS
CV			12.1	17.2	29.0	67.7	131.8	7.7	3.8	16.0	3.9

*Soil characteristics: Silty loam, pH 8.1, OM 2.3%

Table 2. Safflower tolerance to Spartan. (Site 2 - 1653)

			Safflower							
			Density	Injury				Height	Yield	Oil
Treatment	Rate	Timing	Jun-2	Jun-3	Jun-17	Jul-5	Jul-27	Jul-21	Sep-29	Sep-29
			m of row	--------------------%--------------------				cm	lb/A	----%----
Untreated			5.3	0	0	0	0	58.8	1420	33.9
Spartan	1 oz	PRE	6.0	7	5	2	0	60.0	1636	33.7
Spartan	2 oz	PRE	5.7	17	13	7	3	58.5	1709	34.1
Spartan	3 oz	PRE	5.4	25	20	11	7	62.3	2001	34.4
Spartan	4 oz	PRE	5.2	56	55	38	22	57.3	1653	34.7
Spartan	6 oz	PRE	6.3	51	44	30	19	58.0	1266	34.7
Prowl H2O	2 pt	PRE	5.8	7	5	1	0	57.3	1618	33.6
LSD (0.05)			NS	8.9	15.6	12.0	6.8	NS	NS	NS
CV			25.2	25.7	51.9	64.2	63.7	5.8	21.1	1.8

*Soil characteristics: Loam, pH 8.1, OM 2.5%

Safflower Tolerance and Weed Control Efficacy with PRE Herbicides

Caleb Dalley, HREC, Hettinger, ND, 2016

Safflower was planted into no-till wheat stubble on May 4, 2016 using a John Deere 1590 no-till drill. At planting 40 lbs/A of starter fertilizer (18-46-0) was added to the planting drill. Prior to seeding, urea fertilizer (46-0-0) was broadcast applied at a rate of 75 lbs/A. Herbicide treatments were applied on May5, the day after planting, using a tractor-mounted research sprayer at a 10 gal/A spray volume using flat fan nozzles and compressed CO2 as a propellant. Glyphosate (Roundup PowerMAX) was tank-mixed with all herbicide treatments (22 oz/A) plus AMS (5.8 lb/100 gal). The month after planting was dryer than average with just over one inch of rainfall, most of which occurred in small increments with only one rainfall greater than 0.15 inches when 0.46 inches of rain fell on May 30, at 26 days after planting. The small amounts of rain resulted in poor PRE weed control and also resulted in reduced stand of safflower. Dry conditions continued through the summer months, with 1.04, 0.87, 1.5, 1.71 inches of rainfall in May, June, July, and August, respectively, which was less than half of average rainfall for these months. Low rainfall reduced safflower growth and ultimately seed yield.

At planting, weeds present included prickly lettuce, tumble mustard, and downy brome. All were effectively controlled with herbicide treatments applied after planting. Safflower tolerance to herbicide treatments was evaluated at 20, 27, and 39 days after treatment. The only herbicide treatments that caused significant injury were ones containing sulfentrazone. Injury with these treatments included yellow or chlorotic spotting of younger leaves. PRE control of wild buckwheat and wild oat were evaluated 39 days after treatment and were poor due to lack of incorporation of herbicides at planting due to low rainfall. Safflower was harvested on September 6 using a Kincaid plot harvester. Yield was reduced comparing safflower treated with Zidua at 2 oz/A compared with Spartan Charge. All other herbicide treatments were similar in yield. Yield in the untreated control was reduced 85% compared with the hand weeded control. This year's trial would suggest that Zidua is safe for application in safflower. Outlook also appeared to be safe for PRE application to safflower at both rates tested. However, due to the lower than average rainfall for 2016, further evaluations are needed to confirm the safety of these herbicide in safflower. There was a slight reduction in yield and some visual injury observed for Spartan Charge (carfentrazone + sulfentrazone), however, yield was not less than the hand-weeded control.

Treatment	Rate	Safflower injury 7 DAE	Safflower injury 14 DAE	Safflower injury 26 DAE	Test wt	Yield
		%	%	%	-lbs/bu-	-lbs/A-
1 Prowl H2O	32 oz/A	0 b	2 bcd	0 b	41 bc	1207 ab
2 Zidua	2 oz/A	0 b	2 bc	0 b	42 ab	1341 a
3 Zidua SC	3.25 oz/A	1 ab	3 abc	0 b	41 bc	1219 ab
4 Zidua SC	7 oz/A	1 ab	1 bcd	0 b	41 bc	1280 ab
5 Zidua SC	10.6 oz/A	3 a	1 bcd	5 b	42 abc	1185 ab
6 Outlook	10 oz/A	0 b	1 cd	0 b	42 ab	1330 ab
7 Outlook	20 oz/A	0 b	0 d	0 b	43 a	1336 ab
8 Spartan	3.5 oz/A	2 a	9 a	5 b	41 bc	1190 ab
9 Spartan Charge	4.4 oz/A	2 a	4 ab	16 a	40 c	1004 b
10 Check (Weed Free)		0 b	0 d	0 b	41 bc	1111 ab
11 Untreated		0 b	0 d	0 b	12 d	170 c
LSD P=.10		2.2	6.8	6.8	1.3	336
Standard Deviation		0.3	0.4	5.6	1.1	280
CV		189	103.7	234.8	46.79	24.9
Treatment F		1.915	2.968	3.203	271.6	5.654
Treatment Prob(F)		0.0841	0.0107	0.0082	0.0001	0.0001

Safflower Variety Susceptibility to Spartan Herbicide Injury

Clair Keene and Caleb Dalley

This study was conducted to evaluate safflower varietal differences in susceptibility to Spartan (sulfentrazone, Group 14) herbicide injury. Safflower was grown at the Williston REC under dryland conditions.

Safflower variety susceptibility to Spartan injury **WREC, ND 2016**

Safflower variety	Herbicide	Rate	Visual injury 3 WAE†	Visual injury 5 WAE	Weed control 5 WAE	Plant height 6 WAE	Plant height 10 WAE	Yield	Test weight	Oil content
			(%)*	(%)	(%)	(in)	(in)	(lb/a)	(lb/bu)	(%)
Cardinal	Spartan	2 oz/a	38	14	61	15	20	1627	42.4	34.6
Cardinal	Spartan	3.5 oz/a	50	24	71	16	20	1802	42.4	34.6
Cardinal	Spartan	5 oz/a	55	25	69	14	21	1583	43.6	35.7
Cardinal	Weed free‡		29	15	100	15	20	1936	42.8	35.4
Hybrid 1601	Spartan	2 oz/a	56	29	54	15	20	1120	37.4	36.7
Hybrid 1601	Spartan	3.5 oz/a	79	56	71	14	20	1276	37.5	37.2
Hybrid 1601	Spartan	5 oz/a	85	72	83	13	21	1291	37.5	38.1
Hybrid 1601	Weed free		46	21	100	16	20	1694	37.1	37.4
Hybrid 9049	Spartan	2 oz/a	55	26	69	16	18	1661	42.2	31.6
Hybrid 9049	Spartan	3.5 oz/a	66	36	72	14	18	1453	42.1	31.9
Hybrid 9049	Spartan	5 oz/a	79	54	79	15	18	1379	41.6	32.3
Hybrid 9049	Weed free		29	11	100	16	18	1800	42.6	31.0
MonDak	Spartan	2 oz/a	43	20	57	16	18	1366	40.6	35.1
MonDak	Spartan	3.5 oz/a	56	24	74	15	18	1380	40.6	35.3
MonDak	Spartan	5 oz/a	74	36	74	14	18	1385	41.2	35.5
MonDak	Weed free		31	19	100	16	19	1775	40.9	34.8
NutraSaff	Spartan	2 oz/a	49	21	53	15	19	949	37.7	47.5
NutraSaff	Spartan	3.5 oz/a	65	28	74	14	19	1052	38.0	47.6
NutraSaff	Spartan	5 oz/a	73	46	79	13	20	1201	38.2	45.5
NutraSaff	Weed free		51	18	100	14	19	1463	37.9	47.4

Location: WREC, dryland

Planted: 5-4-2016

Harvested: 9-15-2016

Herbicide applied: 5-5-2016

Soil pH=6.5-6.6; OM=1.7-2.0%

Soil type: Williams-Bowbells loam

Applied fertilizers in lb/a: N=80; P_2O_5=32; K_2O=0

†WAE = weeks after emergence

*Scale: 0 = no injury observed, 100 = severe injury observed

‡Weed free plots received 32 fl oz/ a Dual II Magnum + hand weeding

Visual ratings of injury taken at 3 weeks after emergence show increasing injury levels with increasing Spartan rate for all varieties. Hybrid 1601 and Hybrid 9049 exhibited high levels of injury at all Spartan rates. By 5 weeks after emergence, all varieties showed a decrease in injury symptoms. Cardinal and MonDak had the lowest injury ratings and appear to exhibit some tolerance to Spartan. As at 3 weeks, Hybrid 1601 showed a strong injury response to increasing Spartan rate. NutraSaff had low injury ratings at the 2 and 3.5 oz/a rates at 5 weeks but exhibited substantial injury at the 5 oz/a rate.

Weed control ratings taken at 5 weeks after emergence show a consistent increase in weed control when increasing the Spartan rate from 2 to 3.5 oz, but not when increasing from 3.5 to 5 oz. We suggest that this is due to higher crop injury at the 5 oz rate which negatively impacted canopy closure and permitted late-emerging weeds to establish in-crop. The predominate weed species at the site were green foxtail, stinkgrass, and Russian thistle. Small amounts of common lambsquarters and pigweed were also present. Spartan did an excellent job of controlling lambsquarters and pigweed at all rates. Russian thistle control was fair to good at the 2 oz rate and good to excellent at the at the 3.5 and 5 oz rates. By late June, the 2 oz Spartan rate exhibited poor to fair grass control while the 3.5 and 5 oz rates showed fair to good control of grassy weeds.

Plant heights responded only somewhat to Spartan rate with a slight decrease in height with increasing Spartan rate observed for Hybrid 1601, MonDak, and NutraSaff at 6 weeks after emergence. By 10 weeks after emergence, plant height was consistent across herbicide treatments for each variety.

ANOVA results indicate that variety and herbicide treatment both significantly influenced safflower yield ($P < 0.001$ for both) and there was no interaction between the two factors. Results suggest that the 3.5 oz rate of Spartan may have provided a compromise between weed control and crop injury; however, yield from this treatment was not statistically different from yields observed in the 2 and 5 oz treatments. Cardinal consistently exhibited the lowest injury and also produced the highest yield.

Table 1. Yield as influenced by variety.

Safflower variety	Yield (lb/a)	
Cardinal	1737	a
Hybrid 9049	1573	ab
MonDak	1476	bc
Hybrid 1601	1345	cd
NutraSaff	1166	d

Table 2. Yield as influenced by herbicide treatment.

Herbicide	Rate	Yield (lb/a)	
Weed free / Dual II Magnum	32 oz/a	1734	a
Spartan	3.5 oz/a	1392	b
Spartan	5 oz/a	1368	b
Spartan	2 oz/a	1345	b

PRE applications in sunflower. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Valley City, ND to evaluate weed control and sunflower injury from PRE herbicides. Sunflower was planted on May 4, 2016. PRE treatments were applied on May 5, 2016 at 9:45 AM with 76 F air, 58 F soil at a four inch depth, 39% RH, 25% cloud cover, 4-6 mph W wind, and adequate soil moisture. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa through 11002 TTI nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Table. PRE applications in sunflower (Zollinger, Wirth, Adams).

		28 DAA					56 DAA				
Treatment	Rate	Snfl	Rrpw	Colq	Ebns	Mael	Snfl	Rrpw	Colq	Ebns	Mael
	(Product/A)	-% inj-	---------% control--------				-% inj-	---------% control--------			
Spartan	4floz	0	99	99	99	38	0	99	99	99	37
Shutdown	3.85floz	0	99	99	99	37	0	99	99	99	35
Spartan Charge	4.5floz	0	99	99	99	37	0	99	99	99	35
Spartan Charge	5.75floz	0	99	99	99	28	0	99	99	99	27
Spartan Elite	23floz	0	99	99	99	38	0	99	99	99	37
Spartan Elite	26floz	0	99	99	99	27	0	99	99	99	25
Shutdown+Mocasssin	3.85floz+18floz	0	99	99	99	27	0	99	99	99	25
Shutdown+Satellite	3.85floz+32floz	0	99	99	99	27	0	99	99	99	25
Anthem Flexx	4.5floz	0	99	99	99	28	0	99	99	99	27
Authority Supreme	5.4floz	0	99	99	99	28	0	99	99	99	27
LSD (0.05)		0	0	0	0	3	0	0	0	0	3

Creeping Charlie control with herbicides. Kirk Howatt, Ronald Roach, and Janet Harrington. Treatments were applied to an established grass area with a 3 year established creeping Charlie stand on October 12 near Absaraka, North Dakota. Conditions were 55°F, 33% relative humidity, 100% cloud cover, 1 mph average wind velocity at 135°, and dry soil at 48°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 three replicates.

Treatment	Rate	October 28 Creeping Charlie
	oz/A	%
2,4-D	16	63
2,4-DP+MSO	16+32	37
Dicamba	2	23
Fluroxypyr	2	40
Quen+Suen+2,4-D+Dica	24.6	50
Triclopyr	4	33
Quinoclorac+MSO	4+32	33
Halauxifen&Florasulam+NIS+AMS	0.3+0.25%+11	33
Carfentrazone&2,4-D&MCPP&Dicamba	6.4	87
MCPA&Dicamba	28.8	30
Triclopyr&Sulfentrazone&2,4-D&Dicamba	18.4	58
2,4-D&MCPP&Dicamba	26	40
Untreated Check	0	37
CV		16
LSD		12

The greatest control, 87%, was obtained with a premix of carfentrazone, 2,4-D, MCPP, and dicamba. Creeping Charlie tissue was predominantly brown at evaluation and mostly desiccated. This is typical carfentrazone speed and symptomology. However, typical fast action of carfentrazone could reduce the long-term benefit of the other components, all PGR herbicides. Rapid damage from carfentrazone could reduce translocation of the other herbicides and release axillary meristems that don't have translocated PGR present to inhibit growth.

2,4-D alone gave 63% control. Plant tissue was browning but was not as desiccated as with the previously described treatment. Treatments that included 2,4-D tended to give better control than other treatments. And the treatment with carfentrazone gave better control than treatments with sulfentrazone, a similar herbicide with less rapid contact action. Low temperature events resulted in injury rating of 37% to the untreated plants. Many herbicides did not cause more injury than the untreated. Evaluation and additional treatment will continue in the spring.