Yellow Section: Canola, Chickpea, Dry Edible Bean, Dry Pea, Faba Bean, Potato, Sunflower, and Cultural Weed Control

Adjuvant use in SU canola. Dr. Howatt, Mettler, and Harrington. 'C5507' canola was seeded near Fargo on May 11. Treatments were applied to 4 to 5 leaf canola, 1 to 4 inch redroot pigweed, and 1 inch Venice mallow and common lambsquarters on June 12 with 72°F, 44% relative humidity, 0% cloud cover, and 5 mph wind velocity at 67°F and dry soil at 69°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 4 replicates.

Treatment	Rate	6/19 Inj	6/27 Inj	6/27 Rrpw	6/27 Vema	6/27 Colq	7/7 Rrpw	7/7 Vema	7/7 Colq	8/30 Yield
	oz/A	%	%	%	%	%	%	%	%	lb/A
Thif&Trib-D+Act 90	0.23+0.5%	0	10	95	79	89	99	95	99	2020
Thif&Trib-D+Act 90+AMS	0.23+0.5%+12	5	10	95	75	90	99	95	99	2040
Thif&Trib-D+Linkage	0.23+1%	5	10	95	75	90	99	95	99	1940
Thif&Trib-D+MSO+AMS	0.23+1%+12	14	10	95	78	91	98	95	99	1990
Thif&Trib-D+MSO+AMS	0.23+16+12	16	10	95	75	90	99	95	99	1840
Thif&Trib-D+PO+AMS	0.23+1%+12	9	10	95	75	90	99	95	99	2060
Thif&Trib-D+PO+AMS	0.23+16+12	0	10	95	75	90	99	95	99	2090
Thif&Trib-D+Linkage+MSO	0.23+1%+16	7	10	95	75	90	99	95	99	1880
Thif&Trib-D+Renegade+AMS	0.23+16+12	5	10	95	75	90	99	95	99	2110
Thif&Trib-D+Clet+Act 90+AMS	0.23+1+0.5%+12	7	10	96	91	93	99	95	99	1870
Thif&Trib-D+Clet+MSO+AMS	0.23+1+1%+12	8	10	96	81	91	98	95	99	1810
CV		27	0	1	5	2	1	0	0	9
LSD P=.05		3	.	1	5	2	1	.	.	260

Weather was exceptionally dry during establishment and much of the season. Application was delayed from requested growth stage in protocol because of wide development stage related to multiple emergence events caused by inadequate moisture and drought stress. Treatments were applied a couple days after about ¼ inch of precipitation.

Initial canola response to treatments was greatest when MSO was included. Treated plants were compared to untreated plants between plots and at the study margin. Plots were 10 ft wide and the application width just less than 7 ft, so there was at least 2 ft between each treatment area that did not receive spray. Plants were slightly chlorotic across the entire plant and the growing point displayed reddish purple discoloration. Plant growth seemed to be stalled for 2 weeks after application. Plants recovered midseason and eventually reached 4.5 ft tall with no evidence of stunting compared to check strips between plots. Full canopy greatly aided weed control. Flower fill seemed to be about 10% less than plants in plot border strips, but there was no difference among treatments. Flowering started and ended on similar dates across the entire study and check strips.

Yield averaged across the study was 1970 lb/A or 39.4 bu/A (at 11% moisture). The base treatment for compartison in this study was thif&trib-D + Act 90, which is a nonionic surfactant. Canola yield with this treatment was 2020 lb/A. Canola yield with all other treatments was similar to this treatment.

Adjuvant for SU Canola. Dr. Howatt, Mettler, and Harrington. 'C5596' canola was seeded near Fargo on May 11. Treatments were applied to 4 leaf canola, 1 to 4 inch redroot pigweed and 1 inch Venice mallow and common lambsquarters on June 12 with 72°F, 44% relative humidity, 0% relative humidity, 5 mph wind velocity at 67°, and dry 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	6/27 rrpw	6/27 vema	6/27 colq	7/7 rrpw	7/7 vema	7/7 colq
	oz ai/A	%	%	%	%	%	%
Thif&Trib-D	0.18	35	33	33	91	23	25
Thif&Trib-D+Preference	0.18+0.25%	90	75	85	97	95	99
Thif&Trib-D+Preference+AG0213	0.18+0.25%+4	90	75	85	97	95	99
Thif&Trib-D+AG13064	0.18+3	90	75	85	97	95	99
Thif&Trib-D+AG8050	0.18+6.4	90	75	85	97	95	99
Thif&Trib-D+AG14039	0.18+8	90	75	85	97	95	99
Thif&Trib-D+AG14039	0.18+12	90	75	85	97	95	99
Untreated Check	0	0	0	0	0	0	0
CV		3	3	3	2	2	3
LSD P=.05		3	3	3	2	3	3

All adjuvants substantially increased control of weeds with thifensulfuron and tribenuron. There was no difference among treatments with adjuvant for any of the weeds and control was excellent July 7 when the canopy was still relatively open. Once the canopy closed, surviving weeds could not be found. Canola injury was observed consistently across herbicide treatments. This injury was chlorosis and slight purple color at the growing point. Injury persisted until precipitation stimulated growth of canola in all plots. Plant height and development stage were not observed to be affected.

Chickpea tolerance to Tough. (Minot). The objective of the study was to evaluate chickpea tolerance to Tough herbicide applied postemergence in chickpea. 'Frontier' chickpea was planted on May 9. POST treatments were applied on June 12 and June 20. Tough was applied at three rates alone or tank mixed with COC, MSO, or Select.

None of the treatments caused any visible crop injury. There were no differences in yield or test weight for any treatment.

Table. Chickpea tolerance to Tough. (1710)

			Injury			Yield	Test wt.
Treatment	Rate	Timing	Jun-20	Jul-13	Aug-8	Sep-5	Sep-5
			-----	%	-----	lb/A	lb/bu
Untreated			0	0	0	2405	62.4
Tough	0.75 pt	POST	0	0	0	2187	62.5
Tough	1 pt	POST	0	0	0	2422	62.7
Tough	1.5 pt	POST	0	0	0	2312	62.0
Tough[a]	1.5 pt	POST	0	0	0	2314	62.4
Tough[b]	1.5 pt	POST	0	0	0	2437	62.3
Tough + Select[a]	1.5 pt + 6 oz	POST	0	0	0	2240	62.2
Tough + Select[b]	1.5 pt + 6 oz	POST	0	0	0	2308	62.2
Tough + Select[a] / Tough[a]	1.5 pt + 6 oz / 1.5 pt	POST / +8 days	0	0	0	2040	61.9
Tough + Select[a] / Tough[a]	0.75 pt + 6 oz / 0.75 pt	POST / +8 days	0	0	0	2406	62.0
Tough + Select[a] / Tough[a]	1.5 pt + 6 oz / 0.75 pt	POST / +8 days	0	0	0	2335	62.0
LSD (0.05)			NS	NS	NS	NS	NS
CV			0	0	0	7.0	1.2

[a] *Applied with COC (2 pt)*
[b] *Applied with MSO (2 pt)*

Weed control with Tough in chickpea. (Minot). The objective of the study was to evaluate weed control with Tough herbicide applied postemergence in chickpea. 'Frontier' chickpea was planted on May 9. POST treatments were applied on June 12 and June 20. Tough was applied at three rates alone or tank mixed with COC, MSO, or Select.

All treatments generally provided >90% control of kochia and lambsquarters, except for the low rate 0.75 pt. None of the Tough treatments controlled wild buckwheat. While POST treatments provided good control of emerged redroot pigweed, Tough did not provide control of later emerging pigweed. A soil residual herbicide should always be applied preplant or preemergence to help control later flushes.

Table. Weed control with Tough. (1711)

			Weed Control											
			Kochia			Common lambsquarters			Redroot pigweed			Wild buckwheat		
Treatment	Rate	Timing	Jun-20	Jul-13	Aug-8	Jun-20	Jul-13	Aug-8	Jun-20	Jul-13	Aug-8	Jun-20	Jul-13	Aug-8
			%											
Untreated			0	0	0	0	0	0	0	0	0	0	0	0
Tough	0.75 pt	POST	92	86	81	92	81	81	82	62	40	40	20	0
Tough	1 pt	POST	93	99	97	93	99	97	86	67	43	48	27	17
Tough	1.5 pt	POST	94	99	98	92	93	89	90	70	47	58	30	30
Tough[a]	1.5 pt	POST	95	99	96	95	99	99	90	67	50	63	40	37
Tough[b]	1.5 pt	POST	95	93	91	95	94	97	91	68	43	68	33	27
Tough + Select[a]	1.5 pt + 6 oz	POST	95	99	97	95	99	97	91	72	50	70	35	35
Tough + Select[b]	1.5 pt + 6 oz	POST	95	99	96	95	99	96	92	67	43	68	37	33
Tough + Select[a] / Tough[a]	1.5 pt + 6 oz + / 1.5 pt	POST / +8 days	95	99	99	95	99	99	90	70	57	60	30	45
Tough + Select[a] / Tough[a]	0.75 pt + 6 oz / 0.75 pt	POST / +8 days	93	99	98	83	99	97	77	67	43	43	23	15
Tough + Select[a] / Tough[a]	1.5 pt + 6 oz / 0.75 pt	POST / +8 days	95	99	99	93	98	94	90	68	50	63	35	25
LSD (0.05)			2.9	9.0	8.1	8.4	6.8	9.0	3.6	7.5	14	15.6	18.0	23.6

[a] *Applied with COC (1%)*
[b] *Applied with MSO (1%)*

control and soybean injury from early-POST (EPOST) , mid-POST (MPOST) , and late-POST (LPOST) herbicides. Black beans were planted on May 17, 2017. EPOST treatments were applied on June 12, 2017 at 2:00 PM with 85.5 F air, 70 F soil at a four inch depth, 31.9% RH, 20% cloud cover, 5-10 mph NE wind, and adequate soil moisture. Weeds present at the time of EPOST applications were: yeft 1-3" at 20/ft2, corw 2-4" at 5/m2. MPOST treatments were applied on June 20, 2017 at 10:00 aM with 65 F air, 65 F soil at a four inch depth, 41% RH, 40% cloud cover, 5-8 mph NE wind, and adequate soil moisture. Weeds present at the time of MPOST applications were: colq 1-2" at 2-4/yd2, corw 2-4" at 2-4/ft2, yeft 4-8" at 4-8/ft2, rrpw 1-2" at 1-2/yd2, cocb 1-2" at 1-2/yd2, wibw 1-2" at 1-2/yd2, and wimu 2-4" at 2-4/yd2. LPOST treatments were applied on June 29, 2017 at 10:00 AM with 63 F air, 63 F soil at a four inch depth, 75% RH, 90% cloud cover, 0-2 mph NW wind, and adequate soil moisture. Weeds present at the time of LPOST were: colq 1-2" at 1-2/yd2, corw 3-4" at 4-6/ft2, rrpw 6-8" at 2-4/yd2, cocb 1-2" at 1-2/yd2, wibw 1-2" at 1-2/yd2, and wimu 1-2" at 1-2/yd2. Soil characteristics were: 23.1% sand, 52% silt, 24.9% clay, Silt Loam, 4.5% OM, and 7.7 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 at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Sequential micro-rate applications of Basagran with MSO and AMS resulted in 99% control of most weeds besides common ragweed and common cocklebur. Common ragweed control increased with more applications of micro-rate Basagran with MSO and AMS.

Table. Micro-rate Applications of Basagran in DEB (Zollinger, Wirth, Adams).

		Prior to MPOST							Prior to LPOST							28 DA LPOST						
Treatment[1]	Rate	DEB	wimu	rrpw	colq	hans	corw	cocb	DEB	wimu	rrpw	colq	hans	corw	cocb	DEB	wimu	rrpw	colq	hans	corw	cocb
	(Product/A)	-% inj-	-----% control-----						-% inj-	-----% control-----						-% inj-	-----% control-----					
Untreated		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(EPOST) Basagran+MSO+AMS	1.2pt+1.5pt+8.5lb/100gal	0	99	99	99	99	63	96	0	83	82	73	73	53	78	0	82	83	75	75	33	83
(EPOST) Basagran+MSO+AMS (MPOST) Basagran+MSO+AMS	1.2pt+1.5pt+8.5lb/100gal 1.2pt+1.5pt+8.5lb/100gal	0	99	99	99	99	57	95	0	99	99	99	99	57	95	0	99	99	99	99	68	95
(EPOST) Basagran+MSO+AMS	0.56pt+1.5pt+8.5lb/100gal	0	99	99	99	99	53	93	0	99	99	99	99	27	95	0	99	99	99	99	28	95
(EPOST) Basagran+MSO+AMS (MPOST) Basagran+MSO+AMS	0.56pt+1.5pt+8.5lb/100gal 0.56pt+1.5pt+8.5lb/100gal	0	99	99	99	99	53	94	0	99	99	99	99	63	96	0	99	99	99	99	62	96
(EPOST) Basagran+MSO+AMS (MPOST) Basagran+MSO+AMS (LPOST) Basagran+MSO+AMS	0.56pt+1.5pt+8.5lb/100gal 0.56pt+1.5pt+8.5lb/100gal 0.56pt+1.5pt+8.5lb/100gal	0	99	99	99	99	52	93	0	99	99	99	99	86	95	0	99	99	99	99	87	95
LSD		0	0	0	0	0	5	4	0	2	2	2	2	5	6	0	2	2	0	0	5	6

MPOST, and LPOST herbicides. Black beans were planted on May 17, 2017. PRE treatments were applied on May 19, 2017 at 11:00 AM with 60 F air, 62 F soil at a four inch depth, 18% RH, 100% cloud cover, 6-8 mph E wind, and dry soil moisture. EPOST treatments were applied on June 12, 2017 at 1:45 PM with 85.5 F air, 70 F soil at a four inch depth, 31.9% RH, 20% cloud cover, 5-10 mph NE wind, and adequate soil moisture. Weeds present at the time of EPOST applications were: yeft 1-3" at 20/ft2, corw 2-4" at 3/m2. MPOST treatments were applied on June 20, 2017 at 10:00 AM with 65 F air, 65 F soil at a four inch depth, 41% RH, 40% cloud cover, 5-8 mph NE wind, and adequate soil moisture. Weeds present at the time of MPOST applications were: colq 0-1" at 1-2/yd2, corw 0-1" at 1-2/yd2, yeft 1-2" at 4-8/ft2, rrpw 0-1" at 1-2/yd2, cocb 0-1" at 1-2/yd2, wibw 0-1" at 1-2/yd2, and wimu 0-1" at 1-2/yd2. LPOST treatments were applied on June 29, 2017 at 10:00 AM with 63 F air, 63 F soil at a four inch depth, 75% RH, 90% cloud cover, 0-2 mph NW wind, and adequate soil moisture. Weeds present at the time of LPOST were: colq 1-2" at 1-2/yd2, corw 1-2" at 1-2/yd2, yeft 4-6" at 8-10/ft2, rrpw 1-2" at 1-2/yd2, cocb 1-2" at 1-2/yd2, wibw 1-2" at 1-2/yd2, and wimu 1-2" at 1-2/yd2. Soil characteristics were: 23.1% sand, 52% silt, 24.9% clay, Silt Loam, 4.5% OM, and 7.7 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 for PRE application and 11002 TT nozzles for all POST applications all at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Table. Micro-rate Applications in DEB

Treatment	Rate	Prior to MPOST							Prior to LPOST							28 DA LPOST						
		DEB	wimu	rrpw	colq	hans	corw	cocb	DEB	wimu	rrpw	colq	hans	corw	cocb	DEB	wimu	rrpw	colq	hans	corw	cocb
	(Product/A)	-% inj-	% control						-% inj-	% control						-% inj-	% control					
(PRE) Spartan Elite+Permit+Prowl H20	24floz+0.67oz+2pt	0	99	99	99	99	35	32	0	99	99	99	99	30	20	0	99	99	99	99	27	20
(EPOST) Raptor+Basagran+MSO+AMS	4floz+1.2pt+1.5pt+15lb/100gal	0	99	99	99	99	62	99	0	99	99	99	99	65	99	0	99	99	99	99	63	99
(EPOST) Raptor+Basagran+MSO+AMS (MPOST) Basagran+MSO+AMS	4floz+1.2pt+1.5pt+15lb/100gal 1.2pt+1.5pt+15lb/100gal	0	99	99	99	99	86	99	0	99	99	99	99	89	99	0	99	99	99	99	96	99
(EPOST) Raptor+Basagran+MSO+AMS (MPOST) Reflex+MSO+AMS	4floz+1.2pt+1.5pt+15lb/100gal 1pt+1.5pt+15lb/100gal	0	99	99	99	99	62	99	0	99	99	99	99	99	99	0	99	99	99	99	98	99
(EPOST) Raptor+Basagran+MSO+AMS (MPOST) Basagran+Reflex+MSO+AMS	4floz+1.2pt+1.5pt+15lb/100gal 1.2pt+1pt+1.5pt+15lb/100gal	0	99	99	99	99	62	99	0	99	99	99	99	99	99	0	99	99	99	99	99	99
(EPOST) Reflex+MSO+AMS	1pt+1.5pt+15lb/100gal	0	99	99	86	99	99	99	0	99	99	86	99	72	55	0	99	99	86	99	75	57
(EPOST) Reflex+MSO+AMS (MPOST) Raptor+Basagran+MSO+AMS	1pt+1.5pt+15lb/100gal 4floz+1.2pt+1.5pt+15lb/100gal	0	99	99	86	99	99	99	0	99	99	86	99	78	99	0	99	99	86	99	88	99
(EPOST) Basagran+Reflex+MSO+AMS	1.2pt+1pt+1.5pt+15lb/100gal	0	99	99	99	99	99	99	0	99	99	99	99	99	99	0	99	99	99	99	96	99
(EPOST) Basagran+Reflex+MSO+AMS (MPOST) Raptor+Basagran+MSO+AMS	1.2pt+1pt+1.5pt+15lb/100gal 4floz+1.2pt+1.5pt+15lb/100gal	0	99	99	99	99	99	99	0	99	99	99	99	99	99	0	99	99	99	99	99	99
(EPOST) Raptor+Basagra+Reflex +MSO+AMS	4floz+1.2pt+1pt +1.5pt+15lb/100gal	0	99	99	99	99	99	99	0	99	99	99	99	99	99	0	99	99	99	99	99	99
(EPOST) Raptor+Basagra+Reflex +MSO+AMS (MPOST) Basagran+MSO+AMS	4floz+1.2pt+4floz +1.5pt+15lb/100gal 1.2pt+1.5pt+15lb/100gal	0	99	99	99	99	99	99	0	99	77	99	99	86	99	0	99	78	99	99	89	99
(EPOST) Raptor+Basagra+Reflex +MSO+AMS	1floz+0.56pt+4floz +1.5pt+15lb/100gal	0	99	99	72	72	63	63	0	99	99	72	72	60	47	0	99	99	73	73	60	45
(EPOST) Raptor+Basagra+Reflex +MSO+AMS (MPOST) Raptor+Basagra+Reflex +MSO+AMS	1floz+0.56pt+4floz +1.5pt+15lb/100gal 1floz+0.56pt+4floz +1.5pt+15lb/100gal	0	99	99	76	76	74	74	0	99	99	99	99	99	82	0	99	99	99	99	99	72
(EPOST) Raptor+Basagra+Reflex +MSO+AMS (MPOST) Raptor+Basagra+Reflex +MSO+AMS (LPOST)Raptor+Basagra+Reflex +MSO+AMS	1floz+0.56pt+4floz +1.5pt+15lb/100gal 1floz+0.56pt+4floz +1.5pt+15lb/100gal 1floz+0.56pt+4floz +1.5pt+15lb/100gal	0	99	99	69	72	68	69	0	99	99	99	99	99	99	0	99	99	99	99	99	99
LSD		0	0	0	13	2	11	3	0	0	1	13	1	2	3	0	0	1	13	1	3	2

Dry bean response to SA-0660001. Dr. Howatt, Mettler, and Harrington. 'Eclipse' dry bean was seeded near Fargo on June 2. Treatments were soil applied on June 2 with 92°F, 22% relative humidity, 0% cloud cover, 15 plus mph wind velocity at 180° and dry soil at 72°F. Treatments were applied with a backpack sprayer delivering 17 gpa at 40 psi through TT11002 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 Stand	6/23 Inj	6/23 Pgwd	6/23 Colq	7/6 Inj	7/6 Pgwd	7/6 Colq
	oz ai/A	#/2 m	%	%	%	%	%	%
SA-066	7.3	39	11	30	30	24	33	38
SA-066	10.4	39	20	63	63	30	45	56
SA-066	12	38	43	70	69	38	55	56
SA-066	16	36	60	79	78	55	59	71
SA-066+Metolachlor	12+27	40	34	90	87	44	70	73
SA-066+Clomazone	12+5.6	35	63	90	90	38	61	84
Sulfentrazone&Carfentrazone	2.5	40	6	0	0	34	0	0
Untreated Check	0	37	5	0	0	29	0	0
CV		15	15	10	10	24	27	17
LSD P=.05		8	7	8	8	13	16	12

Pigweed was a mixture of redroot pigweed and waterhemp. Environment was very unfavorable for dry bean growth. Injury related to environment was 29% damage on July 6. This resulted from dry soil, lack of precipitation, hail, and jackrabbit feeding. Early injury in several treatments was deformed growth which could be consistent with herbicide damage. Plant stand was not affected by treatment but visible injury to vegetation increased with increasing rate of SA-066. Addition of clomazone increased injury by 20 percentage points compared with a similar rate of SA-066. Weed control increased with higher rate on SA-066, but tankmix with metolachlor gave better weed control while limiting dry bean response. Weed control with sulfentrazone was a surprise and a puzzle because this herbicide typically requires little precipitation for activity compared to other products.

Pinto bean response to low dose rates of dicamba and glyphosate, Carrington, 2016.
(Greg Endres and Mike Ostlie)

The multi-year field study continued (from 2015) at the NDSU Carrington Research Extension Center to examine the response of pinto bean to low dose (drift) rates of dicamba and glyphosate. Experimental design was a randomized complete block with three replications. The experiment was conducted on a dryland, conventionally-tilled Heimdal-Emrick loam soil with 4.2% organic matter and 6.6 pH. 'Lariat' was planted at a rate of 95,000 seeds/acre on May 27, 2016 in 22-inch rows. Herbicide treatments were applied to the center 6.67 ft of 16.5 ft wide (9 rows) by 24 ft length plots with a CO_2-hand-boom plot sprayer delivering 9 gal/A at 35 psi through 8001 flat fan nozzles on July 14 with 60 F, 88% RH and no wind to pre- to early bloom plants. Clarity (dicamba) application rates were targeted at 0.014, 0.14 and 1.4 fl oz/A; Roundup PowerMax (glyphosate) rates were targeted at 0.025, 0.25 and 2.5 fl oz/A; plus herbicide combinations paired at low, medium and high rates. Biomass samples for tissue analysis from the upper 4-to 6-inches of previously treated bean plants were taken on July 25 and on August 4. Hail damage occurred on July 9 resulting in an estimated ≤10% leaf loss to plants in the bud-stage of growth. Plants from two herbicide-treated rows by 12 ft length of treatment numbers 1-3, 5-6 and 8-9 were hand-pulled and placed in windrows on September 19 and seed harvested with a plot combine on September 26 (Table). The balance of treatments (numbers 4, 7 and 10) were hand-pulled and seed harvested on October 14.

Plant injury and herbicide levels in plant tissue generally increased with increasing herbicide rates, especially with the high rates of herbicides (Table). Canopy closure generally declined with increasing herbicide rates. Plant physiological maturity was delayed compared to the untreated check with medium and high rates of dicamba, and the high rate of glyphosate. A killing frost was needed to kill plants previously treated with the high rate of dicamba. Seed yield was similar between the untreated check and herbicide treatments except with the high rate of dicamba, which dramatically reduced seed yield. Very low levels of dicamba were detected in seed with plants treated at the medium and high rates of dicamba. Seed germination 9 and 14 days after planting ranged from 43 to 53% with the high dicamba rate compared to balance of treatments having 87 to 98% germination.

Table.

Treatment		Plant						Seed			Tissue analysis[1]				Seed analysis			
		Biomass reduction (%)		Chlorosis/ necrosis (0-9)[2]		Canopy closure (%)	PM[3]	Yield	TWT		Dicamba1	Glyt1	Dicamba2	Glyt2	Dicamba	Glyt	Germination	
No.	Description[4]	7/22	8/4	7/22	8/4	8/4	Jday	lb/A	lb/bu	seeds/ lb	ppb				ppb		% 9DAP[5]	% 14DAP
1	untreated check	0	0	0	0	72	246	2162	56.2	1184	4	0	0	0	0	0	92	97
2	Clarity L	8	13	0	0	65	246	2366	57.2	1125	41	0	4	4	0	0	87	95
3	Clarity M	18	27	0	1	58	255	2329	57.6	1119	111	0	25	3	2	0	90	95
4	Clarity H	38	58	3	4	45	280	68	x	1307	1278	0	218	0	7	0	43	46
5	RU PM L	0	0	0	0	75	246	2379	57.0	1116	15	5	2	11	0	0	89	96
6	RU PM M	3	0	1	0	77	246	2301	56.6	1163	3	7	0	18	0	0	91	95
7	RU PM H	32	25	3	1	58	275	1941	60.0	1324	3	279	90	70	0	0	91	95
8	Clarity + RU PM L	12	11	0	0	68	246	2189	56.3	1155	32	102	3	4	0	0	94	98
9	Clarity + RU PM M	22	22	0	1	61	259	2548	58.6	910	135	15	26	14	1	0	89	95
10	Clarity + RU PM H	45	65	5	5	38	280	0	x	x	1076	310	352	240	11	0	48	53
C.V. (%)		24.9	26.4	15.7	41.7	7.3	1.0	18.8	1.4	8.6	83.9	94.5	109.3	80.0	67.5	0.0	7.8	5.8
LSD (0.05)		8	10	1	1	8	3	671	1.4	174	386	117	135	50	2	NS	9	5

[1]Tissue analysis sampling dates:Dicamba1 and Glyt1=July 25; Dicamba2 and Glyt2=August 4.

[2]0=none, 9=all tissue affected.

[3]PM=Physiological maturity. 27 degrees occurred on Jday 280 to terminate growth of treatments 4 and 10.

[4]Clarity rates (fl oz/A): L=0.014; M=0.14; H=1.4. Roundup PowerMax rates (fl oz/A): L=0.025; M=0.25; H=2.5.

[5]DAP=Days after planting.

Effect of Select and Assure II application timing on dry pea yield. (Minot). The objective of this study was to evaluate the effect of Select and Assure II application timing on dry pea yield. The Select label states that crop injury can result if applied during flowering. This study was initiated due to complaints in 2015 concerning fully formed pods that contained no seeds (i.e., empty pods). In this study, Select and Assure II were applied to 4-inch peas, 3 days before flowering, early flower, and 2-3 days after early flower.

We conducted this study in 2016 and did not observe empty pods or any effect on yield with any application timing. We repeated this study in 2017 and did observe many empty pods and a severe yield reduction with late applications. Pods and yield were affected slightly with Select applied 3 days before flowering, but were affected severely when applied at early flower or later. Assure II caused only a slight effect on pods and yield. This study shows that it is important to apply a grass herbicide well before flowering.

Title. Effect of graminicide application timing on dry pea yield. (1734)

			Injury			Test wt.	Yield	Protein
Treatment[a]	Rate	Timing[b]	Jul-2	Jul-12	Jul-27			
			-------%-------			lb/bu	lb/A	--%--
Untreated			0	0	0	66.0	1859	25.9
Select	6 oz	4-inch	0	0	0	66.4	2474	24.7
Assure II	8 oz	4-inch	0	0	0	66.3	2038	25.6
Select	6 oz	3 DBF	4	7	3	65.8	1930	27.1
Assure II	8 oz	3 DBF	0	0	2	66.3	1996	24.9
Select	6 oz	Early flower	7	15	14	65.9	1140	29.4
Assure II	8 oz	Early flower	0	0	2	66.0	2006	24.8
Select	6 oz	EF+2-3 days	1	20	22	66.5	942	29.6
Assure II	8 oz	EF+2-3 days	0	6	2	66.0	1880	24.6
LSD (0.05)			1.2	1.5	3.4	NS	765.0	2.0
CV			47.9	16.6	40.3	0.5	24.5	4.5

[a] *All treatments applied with COC (1.25 pt)*

[b] *DBF=days before flowering; EF=early flower*

Fall and Spring Application of Dual and Broadaxe for Downy Brome Control in Spring Field Peas

Caleb Dalley, HREC, Hettinger, ND, 2017

Fall POST treatments were applied on October 28, 2016 to a fallow field heavily infested with downy brome. These fall treatments were evaluated for downy brome control 13 days after treatment (DAT) and again in the spring on May 2, 2017 before planting (186 DAT). At 13 DAT, glyphosate tank-mixed with Dual II Magnum (metolachlor) or Broadaxe XC (sulfentrazone + metolachlor) controlled downy brome 89 to 94%, compared to 80 to 82% with glyphosate alone. When evaluated in the spring before planting, downy brome control was 95 to 99% with glyphosate tank-mixed with Dual II Magnum or Broadaxe, compared to 64 to 66% with glyphosate alone. On May 5, field pea were planted using a John Deere 1590 no-till drill at a rate of 100 lbs/A with a desired plant population of 75 to 80 plants per square meter. Spring POST treatments were applied immediately after planting. Downy brome control was evaluated 21 and 28 DAT (spring POST). At 28 DAT, fall POST tank-mixes of glyphosate with Dual II Magnum or Broadaxe continued to provide 92 to 100% control of downy brome, compared to 48% control for glyphosate alone in the fall. Spring POST tank mixes of glyphosate with Duall II Magnum or Broadaxe controlled downy brome 93 to 97% compared to 86% for a spring only glyphosate application or 90% for a fall and spring application of glyphosate. Extremely dry conditions occurred at Hettinger in 2017. Less than an inch of rainfall occurred during the months of May and June. Due to the dry conditions, pea germination and survival was very low. Stand counts were taken on June 9. Plots treated with fall POST tank-mixes had stand counts of 34 to 38 peas plants per square meter compared to 12 to 25 plants per square meter for spring POST treatments. Pea height was measured on June 21. Pea heights ranged from 20 to 23 cm for fall POST tank-mixes compared to 17 to 22 for spring POST treatments. Dry conditions persisted for the remainder of the cropping season and did not allow for harvesting the peas due to low population and low seed set. However, it was very apparent that fall POST application of metolachlor, with and without sulfentrazone, allowed for better establishment of field pea, even when control of downy brome was similar for fall and spring treatments. It was also apparent that fall application of metolachlor provided much better control of downy brome than glyphosate alone.

Treatment[c]	Rate	Timing	Downy Brome Control[a] 13 DAF[b]	At Spring	28 DAS	Injury 14 DAS	Stand 21 DAE	Height 33 DAE
	oz/A		%				plants/m^2	bu/A
1 Untreated			0 d	0 c	0 d	0 a	0 d	0 e
2 Glyphosate+Broadaxe XC	32+25	Fall	94 a	99 a	98 a	0 a	34 a	20 abc
3 Glyphosate+Broadaxe XC	32+19	Fall	91 ab	96 a	92 ab	0 a	34 a	21 ab
4 Glyphosate+Broadaxe XC+ Dual II Magnum	32+19 10	Fall	92 ab	99 a	95 ab	0 a	36 a	22 a
5 Glyphosate+Broadaxe XC+ Dual II Magnum	32+19 26	Fall	92 ab	97 a	100 a	0 a	36 a	22 a
6 Glyphosate+Dual II Magnum	32+32	Fall	89 b	95 a	94 ab	0 a	38 a	23 a
7 Glyphosate	32	Fall	80 c	64 b	48 c	0 a	10 cd	18 cd
8 Glyphosate	32	Fall+Spring	82 c	66 b	90 ab	0 a	32 ab	22 a
9 Glyphosate+Broadaxe XC	32+25	Spring	0 d	0 c	96 ab	0 a	16 bcd	17 cd
10 Glyphosate+Broadaxe XC	32+19	Spring	0 d	0 c	93 ab	0 a	9 cd	19 bcd
11 Glyphosate+Broadaxe XC+ Dual II Magnum	32+19 16	Spring	0 d	0 c	96 ab	0 a	23 abc	18 cd
12 Glyphosate+Broadaxe XC+ Dual II Magnum	32+10 23	Spring	0 d	0 c	97 a	0 a	13 cd	21.8 a
13 Glyphosate+Dual II Magnum	32+32	Spring	0 d	0 c	94 ab	0 a	12 cd	18.7 bcd
14 Glyphosate	32	Spring	0 d	0 c	86 b	0 a	25 abc	20.4 abc
LSD P=0.05			4.7	7.9	10.1	NS	17.6	2.7
Standard Deviation			3.3	5.5	7.1	0	12.3	1.8
CV			7.5	12.5	8.4	0	54.7	9.1
Treatment F			775	289	60.2	0	4.2	4.1
Treatment Prob(F)			0.0001	0.0001	0.0001	1.0000	0.0002	0.0032

[a]Abbreviations: DAF, days after fall application; DAS, days after spring application; DAE, days after emergence.

[b]Means followed by different letters are significantly different (P=0.05, LSD).

[c]Granular Ammonium Sulfate (AMS) was added to all treatments at a rate of 8.5 lbs/100 gallons spray solution.

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. 'Tabasco' faba bean was planted May 4. PRE and POST herbicides were applied May 5 and June 8, respectively. Soil conditions were very dry for the first five weeks after the PRE application. Only 0.19 and 0.24 inches of rain fell on May 15 and 16, respectively. About 0.34 and 0.72 inches of rain fell on June 9 and June 14, respectively. Overall, we received only about 1/3 of normal rainfall for the season.

None of the PRE herbicides caused any visible crop injury. However, without much rainfall for the first five weeks of the growing season, crop injury risk was reduced. Raptor applied alone POST and Tough caused moderate to severe crop injury. Raptor and Tough reduced plant height 5-7 inches. Raptor and Tough treatments also tended to reduce yield, although yield was quite low and variable due to extremely dry conditions. In contrast, Raptor applied with Basagran caused only slight crop injury.

Table. Faba bean tolerance to herbicides. (1718)

			Injury				Density	Height		Yield	Test wt.
Treatment	Rate	Timing	Jun-3	Jun-20	Jun-28	Jul-13	May-30	Jun-22	Jul-18	Aug-23	Aug-23
			-----%-----				m of row	----cm----		lb/A	lb/bu
Untreated			0	0	0	0	6.8	25.8	55.4	1251	63.9
Sharpen	2 oz	PRE	0	0	0	0	5.8	26.7	53.8	968	63.5
Spartan	4 oz	PRE	0	0	0	0	6.5	25.2	53.6	828	63.5
Spartan + Sharpen	4 oz + 1 oz	PRE	0	0	0	0	6.5	26.6	57.7	1078	63.4
Authority MTZ	12 oz	PRE	0	0	0	0	5.7	25.8	51.5	859	63.3
BroadAxe	25 oz	PRE	0	0	0	0	6.3	27.3	55.3	950	63.3
Metribuzin	0.5 lb	PRE	0	0	0	0	6.1	26.7	53.3	900	63.5
Prowl H2O	3 pt	PRE	0	0	0	0	5.7	26.5	56.1	1045	63.5
Valor	2 oz	PRE	0	0	0	0	6.4	26.8	54.2	1049	63.1
Fierce	3 oz	PRE	0	0	0	0	5.6	23.4	53.0	1045	63.3
Prowl H2O / Basagran[b]	2 pt / 2 pt	PRE / POST	0	4	3	0	6.7	23.5	52.9	974	64.1
Prowl H2O / Raptor[ac]	2 pt / 4 oz	PRE / POST	0	37	50	38	6.3	16.8	46.2	845	65.0
Prowl H2O / Basagran + Raptor[a]	2 pt / 1 pt + 4 oz	PRE / POST	0	6	5	6	6.7	24.8	51.0	1012	63.5
Tough	1.5 pt	POST	0	27	28	36	6.4	19.3	46.2	745	64.0
Prowl H2O	1.5 pt	PRE	0	0	0	0	6.8	24.6	52.3	881	63.7
LSD (0.05)			NS	1.9	4.4	4.1	NS	5.0	NS	NS	0.9
CV			0	23.3	45.6	45.6	9.2	12.1	8.4	19.9	0.9

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

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

[c] *Applied with 28% N (2.5 gal/100 gal)*

2017 UPI Potato Weed Control. Harlene Hatterman-Valenti and Collin Auwarter.

This study was conducted at the Northern Plains Potato Growers Association Irrigated research site near Inkster, ND to evaluate pre-emergence weed control in Russet Burbank potato. Plots were 4 rows by 20 feet arranged in a randomized complete block design with 4 replicates. Seed pieces (2 oz) were planted on 36-inch rows and 12-inch spacing on June 5, 2017. Plots were sprayed on June 16 with a CO_2 pressurized sprayer equipped with 8002 XR flat fan nozzles with a spray volume of 20 GPA and a pressure of 40 psi. Extension recommendations were used for cultural practices throughout the year. Plots were harvested on October 17 and graded into various categories after harvest.

Date:	6/16
Air Temperature (F):	68
Relative Humidity (%):	59
Wind (MPH):	8
Soil Temperature @ 4 Inch (F):	62
Soil Moisture:	Normal
Cloud Cover (%):	5
Next Rain:	3 DAA

Common Lambsquarter, Redroot Pigweed, and Yellow Foxtail Control in Russet Burbank 19 & 28 days after application (DAA).

Treatment	Rate	--------------------19 DAA------------------				-----------------------28 DAA------------------			
		CHEAL	AMARE	PESGL	INJURY	CHEAL	AMARE	PESGL	INJURY
1 Untreated Check		0.0 c	0.0 c	0.0 a	0.0 a	0.0 c	0.0 c	0.0 a	0.0 a
2 Boundary	1.42 lbai/a	97.5 a	97.5 a	100.0 a	0.0 a	96.3 a	96.3 a	100.0 a	0.0 a
3 Boundary	1.83 lbai/a	95.0 a	97.5 a	100.0 a	0.0 a	97.5 a	98.8 a	100.0 a	0.0 a
4 KFD-240-01	1.13 lbai/a	95.0 a	95.0 a	100.0 a	0.0 a	97.5 a	97.5 a	100.0 a	0.0 a
5 KFD-240-01	1.40 lbai/a	96.3 a	97.5 a	100.0 a	0.0 a	98.8 a	97.5 a	100.0 a	0.0 a
6 KFD-240-01	1.69 lbai/a	93.8 a	96.3 a	100.0 a	0.0 a	97.5 a	97.5 a	100.0 a	0.0 a
7 KFD-195-02	1.30 lbai/a	98.8 a	96.3 a	100.0 a	0.0 a	100.0 a	100.0 a	100.0 a	0.0 a
8 Matrix+ Sencor 75DF	1.50 ozwt/a 0.5 lb/a	68.8 b	68.8 b	100.0 a	0.0 a	76.3 b	76.3 b	100.0 a	0.0 a
LSD (P=.05)		7.74	7.34	0.00	0.00	4.37	3.98	0.00	0.00

Yield of Russet Burbank Potatoes.

Treatment	Rate	-----20 Foot Row-----		------------------------------------CWT/A------------------------------------					
		Row B	Row A	0-4 oz	4-6 oz	6-12 oz	>12 oz	Total	>4 oz
1 Untreated Check		52.48 a	42.16 a	60.01 a	70.61 a	155.26 a	20.18 a	306.07 a	246.06 a
2 Boundary	1.42 lbai/a	62.53 a	55.52 a	73.57 a	80.57 a	195.52 a	53.46 a	403.13 a	329.56 a
3 Boundary	1.83 lbai/a	54.03 a	56.23 a	67.16 a	86.80 a	194.29 a	60.01 a	408.27 a	341.11 a
4 KFD-240-01	1.13 lbai/a	53.10 a	46.76 a	67.19 a	74.73 a	158.68 a	38.85 a	339.46 a	272.27 a
5 KFD-240-01	1.40 lbai/a	49.80 a	51.75 a	70.95 a	82.77 a	192.48 a	29.50 a	375.72 a	304.76 a
6 KFD-240-01	1.69 lbai/a	49.23 a	48.90 a	59.52 a	76.27 a	175.16 a	44.09 a	355.05 a	295.53 a
7 KFD-195-02	1.30 lbai/a	57.20 a	51.97 a	68.70 a	72.16 a	180.40 a	56.05 a	377.31 a	308.62 a
8 Matrix Sencor 75DF	1.50 ozwt/a 0.5 lb/a	52.40 a	44.71 a	75.10 a	82.60 a	141.49 a	25.43 a	324.64 a	249.53 a
LSD (P=.05)		14.05	10.38	20.21	28.43	57.27	41.41	75.39	80.60

Tuber Counts and Sizes in 20' of Row in Russet Burbank Potatoes.

Treatment	Rate	--------------------------------20 Foot Row--------------------------------					
		Total	0-4 oz	4-6 oz	6-12 oz	>12 oz	>4 oz
1 Untreated Check		137.5 a	60.8 a	31.0 a	42.5 a	3.3 a	56.445 a
2 Boundary	1.42 lbai/a	165.3 a	69.0 a	34.8 a	53.3 a	8.3 a	58.048 a
3 Boundary	1.83 lbai/a	168.0 a	68.5 a	38.5 a	52.3 a	8.8 a	59.440 a
4 KFD-240-01	1.13 lbai/a	151.8 a	70.8 a	32.8 a	42.3 a	6.0 a	52.705 a
5 KFD-240-01	1.40 lbai/a	167.3 a	76.0 a	36.0 a	51.0 a	4.3 a	53.770 a
6 KFD-240-01	1.69 lbai/a	148.3 a	60.5 a	33.8 a	47.5 a	6.5 a	58.985 a
7 KFD-195-02	1.30 lbai/a	157.3 a	68.8 a	31.8 a	48.5 a	8.3 a	55.593 a
8 Matrix Sencor 75DF	1.50 ozwt/a 0.5 lb/a	151.8 a	73.0 a	36.5 a	38.3 a	4.0 a	51.645 a
LSD (P=.05)		30.51	21.99	12.60	15.72	5.79	10.97

Regardless of the Boundary or KFD-240-01 rate, Boundary, KFD-240-01 and KFD-195-02 provided excellent weed control throughout the season. Matrix tank-mixed with Sencor provided significantly lower control of common lambsquarter and redroot pigweed. KFD-195-02 provided 100% control of all three weed species by the end of the season, while Boundary and KFD-240-01 had slightly less control, however not significant. There was no significant differences with yield even though Boundary KFD-240-01, or KFD-195-02 treatments had marketable yields approximately 50 cwt/a greater than the untreated or Matrix plus Sencor treatment. Tuber counts were similar for all treatments even though the untreated had lower total tuber counts and fewer tuber counts in 4 out of 5 size categories. The Matrix/Sencor treatment had the fewest tubers in the 6-12 oz category.

2017 Desiccation - 6 Treatments. Harlene Hatterman-Valenti and Collin Auwarter.

This study was conducted at the Northern Plains Potato Growers Association dryland research site near Grand Forks, ND to evaluated different adjuvants when added to a common vine desiccant, diquat, on 'Red Norland' potato. Plots were 4 rows by 20 feet arranged in a randomized complete block design with 4 replicates. Seed pieces (2 oz) were planted on 36-inch rows and 12-inch spacing on June 14, 2017. Extension recommendations were used for cultural practices throughout the year. Plots were sprayed on September 6 with a CO_2 pressurized sprayer equipped with 8002 XR flat fan nozzles with a spray volume of 20 GPA and a pressure of 40 psi. Plots were rated on September 13 and 19. Harvesting occurred on October 19 and graded a few weeks later.

Date:	9/6
Air Temperature (F):	61
Relative Humidity (%):	58
Wind (MPH):	4
Soil Moisture:	Normal
Cloud Cover (%):	75
Next Rain:	9 DAA

% Necrosis on Leaves and Stems on 'Red Norland' potato.

Trt No.	Treatment Name	Rate	Rate Unit	7 DAA Leaf	7 DAA Stem	13 DAA Leaf	13 DAA Stem
1	Reglone	1	pt/a	70.0 a	60.0 a	88.8 a	77.5 A
2	Reglone	1	pt/a	66.3 a	55.0 a	93.8 a	82.5 A
	Activate Plus	0.25	% v/v				
3	Reglone	1	pt/a	75.0 a	62.5 a	95.0 a	85.0 A
	AG17054	0.25	% v/v				
4	Reglone	1	pt/a	67.5 a	57.5 a	93.8 a	81.3 A
	AG17055	0.25	% v/v				
5	Reglone	1	pt/a	73.8 a	60.0 a	90.0 a	81.3 A
	AG17056	0.25	% v/v				
6	Untreated			8.0 b	3.8 b	28.8 b	18.8 B
		LSD (P=.05)		19.13	17.47	8.1	9.62

Yield of 'Red Norland' potato.

Treatment	Rate	---20 Foot Row (lbs)---		---CWT/A---					
		Row B	Row A	0-4 oz	4-6 oz	6-10 oz	>10 oz	Total	>4 oz
1 Reglone	1 pt/a	33.18 a	26.66 a	6.57 a	11.35 a	5.24 a	3.49 b	195.50 a	145.80 a
2 Reglone Activate Plus	1 pt/a 0.25 % v/v	35.33 a	31.14 a	7.08 a	15.45 a	6.00 a	2.62 b	226.05 a	174.63 a
3 Reglone AG17054	1 pt/a 0.25 % v/v	32.40 a	34.87 a	7.28 a	15.64 a	6.85 a	5.10 ab	253.12 a	200.24 a
4 Reglone AG17055	1 pt/a 0.25 % v/v	40.85 a	31.78 a	6.57 a	13.01 a	6.89 a	5.31 ab	230.75 a	183.04 a
5 Reglone AG17056	1 pt/a 0.25 % v/v	38.20 a	33.59 a	5.50 a	15.13 a	6.88 a	6.09 ab	243.85 a	203.91 a
6 Untreated		40.82 a	34.93 a	5.74 a	14.14 a	5.97 a	8.55 a	249.70 a	208.02 a
	LSD (P=.05)	8.27	9.41	2.99	5.28	2.68	2.81	68.33	54.76

Tuber Counts of 'Red Norland' potato.

Treatment	Rate	---20 foot row---					
		Row A	0-4 oz	4-6 oz	6-10 oz	>10 oz	>4 oz
1 Reglone	1 pt/a	90.5 a	43.8 a	30.5 a	11.8 a	4.5 B	51.32 a
2 Reglone Activate Plus	1 pt/a 0.25 % v/v	106.5 a	48.5 a	42.0 a	12.5 a	3.5 B	55.18 a
3 Reglone AG17054	1 pt/a 0.25 % v/v	112.3 a	48.5 a	42.8 a	14.5 a	6.5 Ab	56.87 a
4 Reglone AG17055	1 pt/a 0.25 % v/v	103.5 a	47.8 a	34.3 a	14.5 a	7.0 Ab	53.50 a
5 Reglone AG17056	1 pt/a 0.25 % v/v	105.3 a	42.8 a	40.3 a	14.3 a	8.0 Ab	59.65 a
6 Untreated		102.9 a	42.0 a	37.9 a	12.8 a	10.2 A	60.11 a
	LSD (P=.05)	34.28	19.75	13.85	6.10	3.52	9.68

Adding any adjuvant with Reglone did not increase or hasten leaf or stem necrosis. This land had some soil saturation problems from heavy rains early in the season, which may have predisposed plants to be more responsive to desiccants. More statistical separation may have also occurred if the untreated was not included in the necrosis analysis. The grade and yield had little differences among all the treatments. The untreated did have more potatoes larger than 10 oz, an unwanted characteristic for red potatoes. The Reglone alone treatment had the lowest total yield and the fewest amount of total tubers, even though this was not significant, suggesting that this was due to randomization and not the treatment.

17 Desiccation - 8 Treatments. Harlene Hatterman-Valenti and Collin Auwarter.

s study was conducted at the Northern Plains Potato Growers Association non-irrigated research site near Grand Forks, ND to evaluated different adjuvants wl ied to a common vine desiccant, diquat, on 'Red Norland' potato. Plots were 4 rows by 20 feet arranged in a randomized complete block design with 4 replicat ed pieces (2 oz) were planted on 36-inch rows and 12-inch spacing on June 14, 2017. Extension recommendations were used for cultural practices throughout year. Plots were sprayed on September 6 with a CO_2 pressurized sprayer equipped with 8002 XR flat fan nozzles with a spray volume of 20 GPA and a press 10 psi. Plots were rated on September 13 and 19. Harvesting occurred on October 19 and graded a few weeks later.

ate:	9/6
ir Temperature (F):	61
elative Humidity (%):	58
/ind (MPH):	4
oil Moisture:	Normal
loud Cover (%):	75
ext Rain:	9 DAA

% Desiccation on Leaves and Stems on Red Norland potatoes.

Trt No.	Treatment Name	Rate	Rate Unit	7 DAA Leaf	7 DAA Stem	13 DAA Leaf	13 DAA Stem
1	Reglone	1	pt/a	55.3 a	45.0 a	78.8 a	62.5 a
2	Reglone Preference	1 0.25	pt/a % v/v	72.5 a	62.5 a	91.3 a	83.8 a
3	Reglone AG17053	1 0.25	pt/a % v/v	88.3 a	76.3 a	98.8 a	90.0 a
4	Reglone AG13064	1 3	pt/a fl oz/a	72.5 a	61.3 a	97.5 a	86.3 a
5	Reglone Preference Interlock	1 0.25 4	pt/a % v/v fl oz/a	71.3 a	58.8 a	93.8 a	83.8 a
6	Reglone AG8050	1 6.4	pt/a fl oz/a	80.0 a	68.8 a	96.3 a	83.8 a
7	Reglone AG14039	1 6.4	pt/a fl oz/a	81.3 a	70.0 a	97.5 a	86.3 a
8	Untreated			25.0 b	18.8 b	43.8 b	32.5 b
			LSD (P=.05)	28.25	25.25	25.28	22.97

ld of Red Norland potatoes.

t).	Treatment Name	Rate	Rate Unit	---20 foot row (lbs)--- Row B	Row A	CWT/A 0-4 oz	4-6 oz	6-10 oz	>10 oz	Total	>4 oz
1	Reglone	1	pt/a	36.79 a	31.84 a	45.61 a	106.43 a	51.18 a	27.93 a	231.16 a	185.55 a
2	Reglone Preference	1 0.25	pt/a % v/v	29.2 a	25.83 a	50.24 a	84.69 a	29.79 b	22.84 a	187.56 a	137.32 a
3	Reglone AG17053	1 0.25	pt/a % v/v	30.78 a	24.74 a	51.63 a	69.57 a	29.19 b	29.21 a	179.60 a	127.97 a
4	Reglone AG13064	1 3	pt/a fl oz/a	38.10 a	28.94 a	37.46 a	97.08 a	44.22 ab	31.35 a	210.10 a	172.64 a
5	Reglone Preference Interlock	1 0.25 4	pt/a % v/v fl oz/a	36.75 a	30.72 a	48.73 a	102.89 a	42.44 ab	28.95 a	223.01 a	174.27 a
6	Reglone AG8050	1 6.4	pt/a fl oz/a	35.70 a	31.45 a	52.50 a	103.36 a	40.58 ab	31.88 a	228.31 a	175.81 a
7	Reglone AG14039	1 6.4	pt/a fl oz/a	36.88 a	28.46 a	57.50 a	90.71 a	39.08 ab	19.33 a	206.62 a	149.12 a
8	Untreated			36.90 a	31.28 a	36.95 a	93.97 a	41.57 ab	54.57 a	227.06 a	190.11 a
			LSD (P=.05)	7.53	31.28	15.11	32.85	12.45	20.97	49.74	45.16

oer Counts of Red Norland potatoes.

t).	Treatment Name	Rate	Rate Unit	--20 foot row-- Row A	0-4 oz	4-6 oz	6-10 oz	>10 oz	>4 oz
1	Reglone	1	pt/a	108.1 a	48.4 a	39.6 a	15.0 a	5.1 a	55.28 ab
2	Reglone Preference	1 0.25	pt/a % v/v	95.0 a	49.0 a	33.0 a	9.0 b	4.0 a	47.68 ab
3	Reglone AG17053	1 0.25	pt/a % v/v	90.8 a	51.0 a	26.3 a	8.3 b	5.3 a	43.21 b
4	Reglone AG13064	1 3	pt/a fl oz/a	90.8 a	36.5 a	35.8 a	13.0 ab	5.5 a	58.29 a
5	Reglone Preference Interlock	1 0.25 4	pt/a % v/v fl oz/a	102.0 a	45.3 a	39.3 a	12.3 ab	5.3 a	54.99 ab
6	Reglone AG8050	1 6.4	pt/a fl oz/a	106.3 a	48.8 a	40.3 a	11.8 ab	5.5 a	54.74 ab
7	Reglone AG14039	1 6.4	pt/a fl oz/a	102.0 a	53.5 a	34.0 a	11.0 ab	3.5 a	46.42 ab
8	Untreated			93.5 a	38.0	34.3 a	12.3 ab	9.0 a	59.77 a
			LSD (P=.05)	26.31	15.25	12.99	3.69	3.58	9.09

tatoes treated with Reglone alone had the lowest leaf and stem necrosis compared to other Reglone treatments with an adjuvant, even though not significant 7 d 13 DAA. Leaf necrosis was >90% 13 DAA when an adjuvant was added. More statistical separation may have also occurred if the untreated was not include necrosis analysis. Desiccant treatments did not affect yields, as all had a total yield between 180 and 231 CWT/A. All treatments with Reglone had fewer tub he > 10 oz. category resulting in lower yield in that category compared to the untreated. Treatment 7 Reglone + AG14039 had the lowest > 10 oz. yield, a sirable characteristic as these often are unmarketable while tubers < 4 pz. may receive a higher price. Tuber counts were consistent with total yield results, as d between 91 and 108 tubers in a 20-foot row.

2017 Evaluating Glyphosate and Dicamba on Atlantic Potatoes. Harlene Hatterman-Valenti and Collin Auwarter.

This study was conducted at the Northern Plains Potato Growers Association Irrigated research site near Inkster, ND to evaluate Glyphosate and Dicamba on Atlantic potato. Plots were 4 rows by 20 feet arranged in a randomized complete block design with 4 replicates. Seed pieces (2 oz) were planted on 36-inch rows and 12-inch spacing on June 5, 2017. Plots were sprayed on July 18 at the tuber initiation stage with a CO2 pressurized sprayer equipped with 8002 XR flat fan nozzles with a spray volume of 20 GPA and a pressure of 40 psi. Extension recommendations were used for cultural practices throughout the year. Plots were harvested on October 17 and graded into various categories after harvest.

% Injury 10 and 20 DAA from Glyphosate and Dicamba on Atlantic potato.

Treatment		Rate		10 DAA		20 DAA	
				% Injury		% Injury	
1	Untreated Check			0.0	c	0.0	b
2	Glyphosate (PowerMax)	5	fl oz/a	12.5	b	3.8	b
3	Glyphosate (PowerMax)	1	fl oz/a	0.0	c	0.0	b
4	Glyphosate (PowerMax)	0.2	fl oz/a	0.5	c	0.0	b
5	Dicamba (Clarity)	2.825	fl oz/a	16.3	b	11.3	a
6	Dicamba (Clarity)	0.565	fl oz/a	0.0	c	2.5	b
7	Dicamba (Clarity)	0.113	fl oz/a	0.0	c	3.8	b
8	Glyphosate (PowerMax) Dicamba (Clarity)	5 2.825	fl oz/a fl oz/a	36.3	a	15.0	a
9	Glyphosate (PowerMax) Dicamba (Clarity)	1 0.565	fl oz/a fl oz/a	0.0	c	1.3	b
10	Glyphosate (PowerMax) Dicamba (Clarity)	0.2 0.113	fl oz/a fl oz/a	2.5	c	1.3	b
	LSD (P=.05)			7.17		6.13	

Date:	7/18
Air Temperature (F):	65
Relative Humidity (%):	73
Wind (MPH):	3
Soil Moisture:	Normal
Cloud Cover (%):	100
Next Rain:	15 DAA

Yield of Atlantic potato.

Treatment	Rate		-----20 Foot Row-----				---CWT/A---										
			Row B		Row A		0-4 oz		4-6 oz		6-12 oz		>12 oz		Total		>4
Untreated Check			59.08	a	56.60	a	62.223	b	160.56	a	74.41	a	113.76	a	410.96	a	348.74
Glyphosate (PowerMax)	5	fl oz/a	65.10	a	57.24	a	93.768	ab	178.38	a	77.60	a	65.85	a	415.60	a	321.83
Glyphosate (PowerMax)	1	fl oz/a	63.88	a	62.45	a	59.033	b	163.75	a	92.74	a	137.89	a	453.43	a	394.40
Glyphosate (PowerMax)	0.2	fl oz/a	56.63	a	62.46	a	56.140	b	175.29	a	98.54	a	123.47	a	453.46	a	397.31
Dicamba (Clarity)	2.825	fl oz/a	65.18	a	55.71	a	92.580	ab	170.30	a	69.07	a	72.48	a	404.44	a	311.86
Dicamba (Clarity)	0.565	fl oz/a	70.15	a	64.53	a	75.595	ab	204.43	a	90.69	a	97.83	a	468.55	a	392.96
Dicamba (Clarity)	0.113	fl oz/a	77.58	a	55.37	a	63.920	b	157.27	a	72.17	a	108.67	a	402.03	a	338.11
Glyphosate (PowerMax) Dicamba (Clarity)	5 2.825	fl oz/a fl oz/a	64.30	a	51.79	a	110.705	a	164.60	a	60.01	a	40.69	a	376.00	a	265.30
Glyphosate (PowerMax) Dicamba (Clarity)	1 0.565	fl oz/a fl oz/a	61.23	a	55.43	a	68.005	ab	172.29	a	85.68	a	76.47	a	402.44	a	334.44
Glyphosate (PowerMax) Dicamba (Clarity)	0.2 0.113	fl oz/a fl oz/a	64.98	a	50.53	a	71.545	ab	148.56	a	68.39	a	78.38	a	366.88	a	295.33
LSD (P=.05)			22.91		14.06		29.90		46.73		23.79		67.88		102.04		102.18

Tuber Counts and Sizes in 20' of Row in Atlantic potato.

Treatment	Rate		---20 Foot Row---										
			Total		0-4 oz		4-6 oz		6-12 oz		>12 oz		>4 oz
Untreated Check			154.5	a	54.5	b	59.0	a	20.8	a	20.3	a	64.43
Glyphosate (PowerMax)	5	fl oz/a	189.8	a	88.8	ab	66.5	a	23.0	a	11.5	a	52.54
Glyphosate (PowerMax)	1	fl oz/a	159.0	a	52.5	b	57.8	a	26.0	a	22.8	a	67.20
Glyphosate (PowerMax)	0.2	fl oz/a	161.5	a	50.0	b	62.0	a	27.5	a	22.0	a	69.61
Dicamba (Clarity)	2.825	fl oz/a	183.5	a	86.3	ab	64.5	a	19.5	a	13.3	a	53.34
Dicamba (Clarity)	0.565	fl oz/a	186.0	a	65.8	b	76.5	a	26.3	a	17.5	a	65.16
Dicamba (Clarity)	0.113	fl oz/a	151.5	a	55.0	b	57.0	a	20.8	a	18.8	a	63.86
Glyphosate (PowerMax) Dicamba (Clarity)	5 2.825	fl oz/a fl oz/a	195.5	a	105.5	a	64.5	a	17.5	a	8.0	a	45.64
Glyphosate (PowerMax) Dicamba (Clarity)	1 0.565	fl oz/a fl oz/a	159.3	a	58.8	b	63.3	a	24.0	a	13.3	a	63.49
Glyphosate (PowerMax) Dicamba (Clarity)	0.2 0.113	fl oz/a fl oz/a	148.3	a	60.0	b	55.5	a	19.5	a	13.3	a	59.52
LSD (P=.05)			38.06		24.52		18.78		6.39		11.31		10.99

10 DAA the combination with the highest rates of Glyphosate plus Dicamba had a significant effect on potato injury 36%). The high rate of Dicamba (16%) and Glyphosate (13%) also showed significant differences compared to all other treatments. The lowest rates of the tank-mix, Glyphosate and Dicamba showed little injury while the mid-rates showed no signs of injury. 20 DAA showed similar trends with injury, however everything with Dicamba showed symptoms. Some symptoms seen with Glyphosate included yellow at growing point, white flowers (instead of pick), flower delay and slight stunting. Symptoms with Dicamba showed leaf curling, less or no flowering, shorter and leaf epinasty. The tank-mix showed all previous signs while more being more definitive. Yields didn't show a lot of differences. The highest rates of the tank-mix, Glyphosate and Dicamba did have the lowest yield, but not at a significant level. Tuber counts and sizes showed the higher the rate, the greater the amount of smaller potatoes (0-4 oz) and less amounts of market-sized potatoes (>4 oz).

Effect of pyroxasulfone on potato cultivars. Robinson, Brandvik and Ihry. Seven potato cultivars (Bannock russet, Clearwater Russet, Ivory Russet, Lamoka, Russet Burbank, Russet Norkotah, Shepody, and Umatilla Russet) were planted near Park Rapids, MN on May 8, 2017 in plots measuring 12 ft wide x 25 ft long. Soil characteristics were 69% sand, 22% silt, 9% clay with 1.6% organic matter and a pH of 5.8. Treatments were applied on May 23 as a preemergence treatment with shoots 3 to 4 inches below the top of the hill. All treatments were applied to the center of the plots with a 9-ft-wide boom equipped with XR11002 flat fan nozzles calibrated to deliver 15 gallons per acre. Potatoes emerge on June 1, 2017. Plots were rated for crop injury and weed control at 1, 2 and 4 weeks after emergence. Harvest occurred on September 30, 2017. The experiment was a randomized complete block design with 5 treatments receiving rating during the season and 4 treatments harvested.

Crop injury was not an issue at the 3.5 or 7 oz/a rates of pyroxasulfone. The only cultivar that showed a yield loss was Russet Burbank after being treated with 7 oz/a pyroxasulfone. Potato crop safety to pyroxasulfone was good when treatments were applied with shoots at 3 to 4 inches below the top of the hill. Previous work has found that pyroxasulfone applied to emerged plants can cause significant injury during the growing season.

Table 1. Estimated visual ratings of crop injury and control of common lambsquarters and hairy nightshade in Park Rapids, MN 2017.

			Crop Injury			Common lambsquaraters			Hairy night shade		
Treatment	**Rate**	**Cultivar**	6/8/17	6/22/17	6/29/17	6/8/17	6/22/17	6/29/17	6/8/17	6/22/17	6/29/17
	oz/a		%								
Non-treated		Bannock	0	0	0	0	0	0	0	0	0
Zidua	3.5	Bannock	0	0	0	100	99	100	100	100	94
Zidua	7	Bannock	0	0	0	100	98	100	100	100	100
Non-treated		Clearwater	0	0	0	0	0	0	0	0	0
Zidua	3.5	Clearwater	0	0	0	100	96	89	100	100	100
Zidua	7	Clearwater	1	0	0	100	76	92	100	100	100
Non-treated		Ivory Russet	0	0	0	0	0	0	0	0	0
Zidua	3.5	Ivory Russet	0	0	0	100	100	100	100	96	100
Zidua	7	Ivory Russet	0	0	0	100	100	100	100	96	100
Non-treated		Lamoka	0	0	0	0	0	0	0	0	0
Zidua	3.5	Lamoka	1	0	0	100	98	100	100	100	100
Zidua	7	Lamoka	0	0	0	100	94	100	100	100	100
Non-treated		Russet Burbank	0	0	0	0	0	0	0	0	0
Zidua	3.5	Russet Burbank	0	0	0	100	96	100	100	96	96
Zidua	7	Russet Burbank	0	0	0	100	100	100	100	87	100
Non-treated		Russet Norkotah	0	0	0	0	0	0	0	0	0
Zidua	3.5	Russet Norkotah	0	0	0	100	98	100	100	100	96
Zidua	7	Russet Norkotah	0	0	0	100	98	94	100	100	100
Non-treated		Shepody	0	0	0	0	0	0	0	0	0
Zidua	3.5	Shepody	0	0	0	100	100	100	100	99	100
Zidua	7	Shepody	0	0	0	100	99	100	100	100	100
Non-treated		Umatilla	0	0	0	0	0	0	0	0	0
Zidua	3.5	Umatilla	0	0	0	97	97	97	97	100	96
Zidua	7	Umatilla	0	0	0	100	94	98	100	100	100
LSD p=0.05			*ns*	*ns*	*ns*	*2*	*13*	*7*	*2*	*5*	*5*

Table 2. Graded yield (cwt/a) of seven cultivars treated with pyroxasulfone in Park Rapids, MN 2017.

Treatment	Rate	Cultivar	<4 oz	4-6 oz	6-10 oz	10-14 oz	>14 oz	Total yield	Total Marketable	US#1 >4 oz	US#2 >4 oz	>6 oz	>10 oz
	oz/a		cwt/a									%	
Non-treated		Bannock	44	72	131	80	72	398	354	353	1	70	37
Zidua	3.5	Bannock	37	67	147	123	104	477	441	438	3	78	47
Zidua	7	Bannock	33	66	147	106	119	471	438	432	7	79	48
Non-treated		Clearwater	142	145	127	37	7	458	316	313	3	37	10
Zidua	3.5	Clearwater	140	163	141	19	3	467	327	319	8	35	5
Zidua	7	Clearwater	107	152	158	33	11	460	354	347	7	45	10
Non-treated		Ivory Russet	41	89	166	83	60	438	398	391	7	70	31
Zidua	3.5	Ivory Russet	28	58	199	118	77	479	451	439	12	82	41
Zidua	7	Ivory Russet	28	63	181	124	75	471	442	436	6	80	42
Non-treated		Lamoka	54	81	221	128	60	543	490	488	1	75	34
Zidua	3.5	Lamoka	65	101	195	130	63	555	490	489	1	70	35
Zidua	7	Lamoka	42	75	190	144	75	526	484	482	2	78	42
Non-treated		Russet Burbank	72	128	215	105	73	594	522	490	32	66	30
Zidua	3.5	Russet Burbank	63	103	219	129	80	594	531	518	13	72	35
Zidua	7	Russet Burbank	76	113	185	92	51	518	441	421	20	64	28
Non-treated		Russet Norkotah	65	95	219	119	44	542	477	475	2	70	30
Zidua	3.5	Russet Norkotah	59	101	214	149	47	570	511	503	8	72	34
Zidua	7	Russet Norkotah	49	77	209	148	90	573	524	519	5	78	42
Non-treated		Shepody	45	88	163	115	86	497	452	440	12	73	40
Zidua	3.5	Shepody	37	71	168	107	119	502	466	460	6	78	45
Zidua	7	Shepody	44	71	152	140	89	496	452	431	20	77	46
Non-treated		Umatilla	69	111	180	111	63	534	465	455	10	66	33
Zidua	3.5	Umatilla	83	131	204	112	104	633	550	540	11	66	34
Zidua	7	Umatilla	81	115	194	110	77	577	496	489	8	66	32
LSD p=0.05			*27*	*31*	*42*	*35*	*47*	*67*	*68*	*68*	*13*	*10*	*11*

Treatment	Rate	Cultivar	<4 oz	4-6 oz	6-10 oz	10-14 oz	>14 oz	Total yield	Total Marketable	US#1 >4 oz	US#2 >4 oz	>6 oz	>10 oz
	oz/a		Tuber number/a									%	
Non-treated		Bannock	26,281	23,522	27,443	11,326	6,824	95,396	69,115	68,970	145	48	19
Zidua	3.5	Bannock	19,312	18,876	26,136	14,956	8,422	87,701	68,389	67,808	581	57	27
Zidua	7	Bannock	16,553	18,586	25,991	12,632	9,438	83,200	66,647	65,921	726	58	27
Non-treated		Clearwater	81,748	46,464	26,862	5,082	726	160,882	79,134	78,553	581	21	4
Zidua	3.5	Clearwater	78,989	50,530	29,185	2,759	290	161,753	82,764	81,312	1,452	20	2
Zidua	7	Clearwater	58,370	45,738	32,234	4,356	1,016	141,715	83,345	82,328	1,016	28	4
Non-treated		Ivory Russet	23,377	28,459	33,686	11,326	5,663	102,511	79,134	78,263	871	50	17
Zidua	3.5	Ivory Russet	17,134	19,602	41,818	17,134	7,550	103,237	86,104	85,232	871	65	24
Zidua	7	Ivory Russet	16,117	19,457	35,574	16,553	6,679	94,380	78,263	77,392	871	63	25
Non-treated		Lamoka	30,782	25,410	44,141	17,279	5,808	123,420	92,638	92,492	145	54	19
Zidua	3.5	Lamoka	38,188	32,525	39,930	17,569	6,098	134,310	96,122	95,977	145	47	18
Zidua	7	Lamoka	23,813	24,539	38,333	20,038	7,260	113,982	90,169	89,879	290	58	24
Non-treated		Russet Burbank	41,382	40,366	43,705	14,084	6,824	146,362	104,980	102,076	2,904	44	14
Zidua	3.5	Russet Burbank	37,558	34,074	46,077	17,811	7,550	143,070	105,512	104,350	1,162	50	18
Zidua	7	Russet Burbank	41,092	33,396	35,719	12,052	4,937	127,195	86,104	83,780	2,323	42	14
Non-treated		Russet Norkotah	37,026	29,330	42,544	15,827	4,211	128,938	91,912	91,621	290	49	16
Zidua	3.5	Russet Norkotah	34,993	31,508	42,979	19,602	4,646	133,729	98,736	97,574	1,162	50	18
Zidua	7	Russet Norkotah	28,895	23,813	41,963	20,038	8,422	123,130	94,235	93,509	726	57	23
Non-treated		Shepody	24,974	27,588	31,654	15,101	7,696	107,012	82,038	80,441	1,597	51	21
Zidua	3.5	Shepody	20,183	21,780	33,977	14,665	10,890	101,495	81,312	80,586	726	59	25
Zidua	7	Shepody	25,120	21,635	30,782	18,731	8,131	104,399	79,279	76,230	3,049	55	26
Non-treated		Umatilla	42,253	37,752	38,623	15,827	6,389	140,844	98,591	97,429	1,162	43	16
Zidua	3.5	Umatilla	47,045	41,237	41,382	14,665	9,438	153,767	106,722	104,980	1,742	43	16
Zidua	7	Umatilla	45,012	34,703	38,188	14,230	7,115	139,247	94,235	93,364	871	43	16
LSD p=0.05			15,584	10,019	11,203	5,732	4,480	28,896	20,907	20,933	1,413	15	14

Effect of pyroxasulfone tank mixtures on Russet Burbank and Umatilla Russet. Robinson, Brandvik and Ihry. Russet Burbank and Umatilla Russet were planted near Park Rapids, MN on May 5, 2017 in plots measuring 12 ft wide x 25 ft long. Soil characteristics were 76% sand, 18% silt, 8% clay with 1.6% organic matter and a pH of 6.4. Treatments were applied on May 24 as a preemergence treatments with shoots approximately 3 to 4 inches below the top of the hill. All treatments were applied to the center of the plots with a 9-ft-wide boom equipped with XR11002 flat fan nozzles calibrated to deliver 15 gallons per acre. Potatoes emerge on May 30, 2017. Plots were rated for crop injury and weed control at 1, 2 and 4 weeks after emergence. Harvest occurred on September 29, 2017. The experiment was a randomized complete block design with 5 treatments receiving rating during the season and 4 treatments harvested.

Crop injury was the worst when Outlook, Dual or sulfentrazone were included in the treatment. Weed control was relatively good with most treatments. Herbicide control of weeds improved total yield for all treatments compared to the non-treated check. Combining Matrix, Dual or metribuzin seemed to benefit production.

Table 4. Estimated visual ratings of crop injury of Umatilla russet and Russet Burbank. Weed control ratings of common lambsquarters and Eastern black nightshade a 1, 2 and 4 weeks after emergence at Park Rapids, MN 2017.

	Treatment	Rate		Umatilla Russet			Russet Burbank			**Common lambsquaraters**			**Eastern black nighshade**		
				Crop Injury			**Crop Injury**			Weed control					
				6/8/17	6/22/17	6/29/17	6/8/17	6/22/17	6/29/17	6/8/17	6/22/17	6/29/17	6/8/17	6/22/17	6/29/17
				%											
1	Non-treated			0	0	0	0	0	0	0	0	0	0	0	0
2	Zidua	3.5	FL OZ/A	0	0	0	0	0	0	96	100	92	100	100	100
3	Zidua	3.5	FL OZ/A	1	2	1	1	2	1	100	98	98	100	100	100
	Matrix	1.5	OZ/A												
4	Zidua	3.5	FL OZ/A	7	0	1	7	0	1	100	95	94	100	100	100
	Outlook	21	OZ/A												
5	Zidua	3.5	FL OZ/A	0	1	2	0	1	2	100	100	100	100	100	100
	Metribuzin	0.5	LB/A												
6	Zidua	3.5	FL OZ/A	0	0	0	0	0	0	100	90	100	100	100	100
	Metribuzin	0.33	LB/A												
7	Zidua	3.5	FL OZ/A	0	1	0	0	1	0	100	100	100	100	100	100
	Metribuzin	0.33	LB/A												
	Prowl H20	2	PT/A												
8	Zidua	3.5	FL OZ/A	7	0	0	7	0	0	100	100	100	100	100	100
	Metribuzin	0.33	LB/A												
	Outlook	16	OZ/A												
9	Zidua	3.5	FL OZ/A	8	0	1	8	0	1	100	97	94	100	100	100
	Dual EC	1	PT/A												
10	Metribuzin	0.5	LB/A	6	0	0	6	0	0	100	97	98	100	100	100
	Dual EC	1	PT/A												
	Reflex	12	OZ/A												
11	Sulfentrazone	2	OZ/A	8	0	2	8	0	2	96	90	85	100	98	97
LSD at p=0.05				*4*	*ns*	*ns*	*4*	*ns*	*ns*	*3*	*9*	*10*	-	*2*	*2*

Table 5. Yield of Russet Burbank potato (cwt/a) as affected by various herbicide preemergence treatments in Park Rapids, MN 2017.

	Treatment	Rate		<4 oz	4-6 oz	6-10 oz	10-14 oz	>14 oz	Total yield	Total Marketable	US#1 >4 oz	US#2 >4 oz	>6 oz	>10 oz
				cwt/a									%	
1	Non-treated check			142	139	53	13	0	346	205	202	2	18	3
2	Zidua	3.5	FL OZ/A	92	143	212	66	11	523	431	426	6	55	14
3	Zidua	3.5	FL OZ/A	88	152	249	60	32	582	493	490	3	59	16
	Matrix	1.5	OZ/A											
4	Zidua	3.5	FL OZ/A	76	143	191	69	22	501	425	421	4	56	18
	Outlook	21	OZ/A											
5	Zidua	3.5	FL OZ/A	73	138	182	73	24	491	417	413	4	57	19
	Metribuzin	0.5	LB/A											
6	Zidua	3.5	FL OZ/A	76	151	196	54	5	482	405	403	3	53	12
	Metribuzin	0.33	LB/A											
7	Zidua	3.5	FL OZ/A	74	144	204	88	14	524	450	450	0	58	20
	Metribuzin	0.33	LB/A											
	Prowl H20	2	PT/A											
8	Zidua	3.5	FL OZ/A	77	168	203	65	16	528	452	449	3	54	15
	Metribuzin	0.33	LB/A											
	Outlook	16	OZ/A											
9	Zidua	3.5	FL OZ/A	94	180	214	81	16	585	491	482	9	54	17
	Dual EC	1	PT/A											
10	Metribuzin	0.5	LB/A	91	161	213	66	13	543	452	449	3	54	14
	Dual EC	1	PT/A											
	Reflex	12	OZ/A											
11	Sulfentrazone	2	OZ/A	68	137	176	84	18	484	416	408	7	56	20
LSD at p=0.05				*19*	*ns*	*50*	*ns*	*ns*	*ns*	*84*	*83*	*ns*	*8*	*ns*

Table 6. Tuber number per plot of Russet Burbank potato as affected by various herbicide preemergence treatments in Park Rapids, MN 2017.

	Treatment	Rate		<4 oz	4-6 oz	6-10 oz	10-14 oz	>14 oz	Total yield	Total Marketable	US#1 >4 oz	US#2 >4 oz	>6 oz	>10 oz
				Tuber number/a									%	
1	Non-treated check			78,989	48,932	22,361	3,340	436	154,057	75,068	74,633	436	11	2
2	Zidua	3.5	FL OZ/A	52,127	46,028	44,141	9,002	1,016	152,315	100,188	99,172	1,016	41	12
3	Zidua	3.5	FL OZ/A	49,949	49,078	52,272	8,422	3,340	163,060	113,111	112,675	436	44	12
	Matrix	1.5	OZ/A											
4	Zidua	3.5	FL OZ/A	42,253	46,028	40,946	9,438	2,323	140,989	98,736	98,155	581	44	15
	Outlook	21	OZ/A											
5	Zidua	3.5	FL OZ/A	42,108	45,012	38,188	9,874	2,468	137,650	95,542	94,961	581	43	16
	Metribuzin	0.5	LB/A											
6	Zidua	3.5	FL OZ/A	44,286	47,916	41,818	7,550	436	142,006	97,720	97,284	436	40	11
	Metribuzin	0.33	LB/A											
7	Zidua	3.5	FL OZ/A	42,398	46,754	42,689	12,342	1,452	145,636	103,237	103,237	0	47	18
	Metribuzin	0.33	LB/A											
	Prowl H20	2	PT/A											
8	Zidua	3.5	FL OZ/A	44,576	54,450	43,270	9,002	1,597	152,896	108,319	107,593	726	41	13
	Metribuzin	0.33	LB/A											
	Outlook	16	OZ/A											
9	Zidua	3.5	FL OZ/A	52,853	58,080	46,174	11,326	1,597	170,029	117,176	116,015	1,162	42	15
	Dual EC	1	PT/A											
10	Metribuzin	0.5	LB/A	50,965	51,836	45,302	9,148	1,307	158,558	107,593	107,158	436	40	12
	Dual EC	1	PT/A											
	Reflex	12	OZ/A											
11	Sulfentrazone	2	OZ/A	42,931	47,045	40,704	11,084	1,791	143,554	100,624	99,656	968	44	17
LSD at p=0.05				*12,428*	*ns*	*14,035*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*8*	*7*

Table 7. Yield of Umatilla russet potato (cwt/a) as affected by various herbicide preemergence treatments in Park Rapids, MN 2017.

	Treatment	Rate		<4 oz	4-6 oz	6-10 oz	10-14 oz	>14 oz	Total yield	Total Marketable	US#1 >4 oz	US#2 >4 oz	>6 oz	>10 oz
				cwt/a									%	
1	Non-treated check			114	146	136	36	7	440	326	320	6	40	10
2	Zidua	3.5	FL OZ/A	77	143	217	79	28	543	467	463	3	59	19
3	Zidua	3.5	FL OZ/A	86	156	256	78	33	609	523	512	11	60	18
	Matrix	1.5	OZ/A											
4	Zidua	3.5	FL OZ/A	77	165	246	74	23	585	508	497	11	58	16
	Outlook	21	OZ/A											
5	Zidua	3.5	FL OZ/A	74	149	204	97	56	579	505	502	3	61	26
	Metribuzin	0.5	LB/A											
6	Zidua	3.5	FL OZ/A	83	150	228	116	39	616	533	513	20	62	25
	Metribuzin	0.33	LB/A											
7	Zidua	3.5	FL OZ/A	88	167	243	94	41	633	545	537	8	60	21
	Metribuzin	0.33	LB/A											
	Prowl H20	2	PT/A											
8	Zidua	3.5	FL OZ/A	89	157	241	57	25	568	479	469	10	57	14
	Metribuzin	0.33	LB/A											
	Outlook	16	OZ/A											
9	Zidua	3.5	FL OZ/A	82	165	201	83	44	574	493	484	9	57	22
	Dual EC	1	PT/A											
10	Metribuzin	0.5	LB/A	87	136	234	102	18	577	490	486	4	61	21
	Dual EC	1	PT/A											
	Reflex	12	OZ/A											
11	Sulfentrazone	2	OZ/A	82	141	212	98	64	597	515	507	8	62	27
LSD at p=0.05				*ns*	*ns*	*48*	*ns*	*ns*	*80*	*89*	*86*	*ns*	*12*	*ns*

Table 8. Tuber number per plot of Umatilla russet potato as affected by various herbicide preemergence treatments in Park Rapids, MN 2017.

	Treatment	Rate		<4 oz	4-6 oz	6-10 oz	10-14 oz	>14 oz	Total yield	Total Marketable	US#1 >4 oz	US#2 >4 oz	>6 oz	>10 oz
				Tuber number/a									%	
1	Non-treated check			65,630	48,206	29,476	5,082	726	149,120	83,490	82,328	1,162	27	7
2	Zidua	3.5	FL OZ/A	42,979	46,464	46,028	10,745	2,759	148,975	105,996	105,706	290	47	16
3	Zidua	3.5	FL OZ/A	48,642	50,239	53,724	10,745	3,049	166,399	117,757	116,160	1,597	47	15
	Matrix	1.5	OZ/A											
4	Zidua	3.5	FL OZ/A	43,996	54,014	51,546	10,164	2,178	161,898	117,902	116,450	1,452	47	14
	Outlook	21	OZ/A											
5	Zidua	3.5	FL OZ/A	42,253	47,916	42,689	13,504	5,372	151,734	109,481	109,045	436	49	21
	Metribuzin	0.5	LB/A											
6	Zidua	3.5	FL OZ/A	48,061	48,497	48,206	16,117	3,630	164,512	116,450	114,127	2,323	51	22
	Metribuzin	0.33	LB/A											
7	Zidua	3.5	FL OZ/A	48,497	53,579	50,965	12,923	3,920	169,884	121,387	120,516	871	47	17
	Metribuzin	0.33	LB/A											
	Prowl H20	2	PT/A											
8	Zidua	3.5	FL OZ/A	49,949	50,820	51,110	8,131	2,323	162,334	112,385	110,788	1,597	43	12
	Metribuzin	0.33	LB/A											
	Outlook	16	OZ/A											
9	Zidua	3.5	FL OZ/A	45,593	53,143	42,108	11,326	4,211	156,380	110,788	109,336	1,452	44	17
	Dual EC	1	PT/A											
10	Metribuzin	0.5	LB/A	49,368	43,850	49,223	14,230	1,742	158,413	109,045	108,174	871	50	19
	Dual EC	1	PT/A											
	Reflex	12	OZ/A											
11	Sulfentrazone	2	OZ/A	46,464	45,448	44,722	13,794	6,098	156,526	110,062	109,045	1,016	51	22
LSD at p=0.05				*ns*	*ns*	*10,023*	*ns*	*2,725*	*ns*	*16,089*	*16,140*	*ns*	*15*	*11*

Effect of tank mixtures with ethalfluralin on Russet Burbank potato production. Robinson, Brandvik and Ihry. Russet Burbank were planted near Park Rapids, MN on May 5, 2017 in plots measuring 12 ft wide x 25 ft long. Soil characteristics were 76% sand, 18% silt, 8% clay with 1.6% organic matter and a pH of 6.4. Treatments were applied on May 24 as a preemergence treatments with shoots approximately 3 to 4 inches below the top of the hill. All treatments were applied to the center of the plots with a 9-ft-wide boom equipped with XR11002 flat fan nozzles calibrated to deliver 15 gallons per acre. Potatoes emerge on May 30, 2017. Plots were rated for crop injury and weed control at 1, 2, 4 and 6 weeks after emergence. Harvest occurred on September 29, 2017. The experiment was a randomized complete block design with 5 treatments receiving rating during the season and 4 treatments harvested.

Crop injury was slight, except for Boundary at 1 week after emergence the metolachlor (Dual) liked caused some injury. Weed control was relatively good with most treatments. Compared to the non-treated check, herbicides improved total yield of all treatments.

Table 9. Visual estimates of crop injury, common lambsquarters and eastern black nightshade weed control following tank mixtures with Sonalan on Russet Burbank potato in Park Rapids, MN 2017.

Treatment		Crop Injury (%)				Common lambsquarters control (%)				Eastern Black Nightshade control (%)			
		8-Jun	22-Jun	29-Jun	18-Jul	8-Jun	22-Jun	29-Jun	18-Jul	8-Jun	22-Jun	29-Jun	18-Jul
1	Non-treated	0	0	0	0	0	0	0	0	0	0	0	0
2	Eptam 3.5 pt/a + Sonalan 2 pt/a	0	0	0	0	100	95	87	97	84	93	88	100
3	Eptam 4 pt/a + Sonalan 2 pt/a	0	0	0	0	100	100	98	100	88	87	84	100
4	Sonalan 2 pt/a + TriCor 1.5 pt/a	0	0	0	0	100	94	100	100	92	95	98	100
5	Sonalan 2 pt/a + TriCor 1.5 pt/a + Eptam 3.5 pt/a	0	0	4	0	100	100	100	100	93	93	96	100
6	Eptam 3.5 pt/a + TriCor 1.5 pt/a	1	0	0	0	100	100	100	100	100	91	98	100
7	Sonalan 2 pt/a + Linex 1.5 pt/a	0	0	0	0	100	96	98	100	100	100	100	100
8	Sonalan 2 pt/a + Eptam 3.5 pt/a + Linex 1.5 pt/a	2	0	0	0	100	95	98	100	99	95	100	100
9	Boundary 2 pt/a	16	2	0	0	100	100	100	100	98	100	95	100
10	Prowl 2 pt/a	0	1	0	0	82	99	99	100	93	100	100	100
	LSD p=0.05	*2*	*2*	*ns*	-	*10*	*0*	*9*	*3*	*22*	*39*	*11*	-

Table 10. Effects of tank mixtures with Sonalan on Russet Burbank potato yield in Parks Rapids, MN 2017.

	Treatment	<4 oz	4-6 oz	6-10 oz	10-14 oz	>14 oz	Total yield	Total marketable	US#1 >4 oz	US#2 > 4 oz	>6 oz	> 10 oz
		cwt/a									%	
1	Non-treated	108	130	118	36	16	407	299	280	19	42	12
2	Eptam 3.5 pt/a + Sonalan 2 pt/a	79	153	190	65	33	519	440	431	9	55	19
3	Eptam 4 pt/a + Sonalan 2 pt/a	77	145	197	76	27	522	445	435	10	58	20
4	Sonalan 2 pt/a + TriCor 1.5 pt/a	75	146	176	72	28	497	422	412	10	56	20
5	Sonalan 2 pt/a + TriCor 1.5 pt/a + Eptam 3.5 pt/a	80	147	202	77	30	536	456	449	8	58	20
6	Eptam 3.5 pt/a + TriCor 1.5 pt/a	83	158	197	73	8	520	436	430	7	53	16
7	Sonalan 2 pt/a + Linex 1.5 pt/a	69	133	191	64	16	473	404	398	6	58	17
8	Sonalan 2 pt/a + Eptam 3.5 pt/a + Linex 1.5 pt/a	91	161	180	69	29	531	439	423	16	52	18
9	Boundary 2 pt/a	71	148	219	86	37	561	490	480	10	61	22
10	Prowl 2 pt/a	70	138	210	91	22	531	461	444	18	61	21
	LSD p=0.05	*ns*	*ns*	*35*	*ns*	*ns*	*59*	*52*	*55*	*ns*	*9*	*ns*

Table 11. Tuber number per plot of Russet Burbank potato as affected by various herbicide preemergence treatments in Park Rapids, MN 2017.

	Treatment	<4 oz	4-6 oz	6-10 oz	10-14 oz	>14 oz	Total yield	Total marketable	US#1 >4 oz	US#2 > 4 oz	>6 oz	> 10 oz
		Tuber number/a									%	
1	Non-treated	66,792	45,157	27,443	5,227	1,307	145,926	79,134	77,246	1,888	24	5
2	Eptam 3.5 pt/a + Sonalan 2 pt/a	45,738	48,061	39,640	8,567	3,194	145,200	99,462	98,155	1,307	36	8
3	Eptam 4 pt/a + Sonalan 2 pt/a	40,511	42,834	38,768	9,874	2,468	134,455	93,944	92,202	1,742	38	9
4	Sonalan 2 pt/a + TriCor 1.5 pt/a	38,188	39,785	31,799	8,567	2,323	120,661	82,474	81,312	1,162	36	9
5	Sonalan 2 pt/a + TriCor 1.5 pt/a + Eptam 3.5 pt/a	45,157	46,028	41,818	10,309	2,614	145,926	100,769	100,043	726	38	9
6	Eptam 3.5 pt/a + TriCor 1.5 pt/a	42,979	47,190	38,478	9,438	726	138,811	95,832	94,816	1,016	35	7
7	Sonalan 2 pt/a + Linex 1.5 pt/a	36,881	40,075	37,897	8,567	1,452	124,872	87,991	86,830	1,162	39	8
8	Sonalan 2 pt/a + Eptam 3.5 pt/a + Linex 1.5 pt/a	49,804	49,804	36,445	9,293	2,759	148,104	98,300	96,558	1,742	32	8
9	Boundary 2 pt/a	40,220	47,045	45,738	11,471	3,485	147,959	107,738	105,996	1,742	42	11
10	Prowl 2 pt/a	41,237	44,722	45,012	12,632	2,178	145,781	104,544	102,221	2,323	41	10
	LSD p=0.05	*16,013*	*ns*	*9,698*	*ns*	*ns*	*ns*	*17,469*	*ns*	*ns*	*7*	*ns*

sunflower damage from PRE herbicides. Sunflowers were seeded on May 15, 2017. PRE treatments were applied on May 15, 2017 at 3:30 PM with 80 F air, 59 F soil, 23% RH, 75% cloud cover, 2-4 mph ENE wind, and adequate soil moisture. Soil characteristics were: 23.1% sand, 52% silt, 24.9% clay, Silt Loam, 4.5% OM, and 7.7 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. PRE Herbicides in Sunflower (Zollinger, Wirth, Adams).

		14 DA Emergence				28 DA Emergence						56 DA Emergence					
Treatment[1]	Rate	snfl	wimu	rrpw	colq	snfl	wimu	rrpw	colq	wibw	vima	snfl	wimu	rrpw	colq	wibw	vima
	(Product/A)	-% inj-	----% control----			-% inj-	-------------% control-------------					-% inj-	---------% control---------				
Authority Supreme	5.8floz	0	88	90	87	0	85	92	95	83	77	0	90	92	95	83	78
Authority Supreme	8.5floz	0	87	95	95	0	70	78	90	72	65	0	78	87	92	75	73
Spartan Elite	19floz	0	87	73	73	0	78	95	95	73	65	0	78	95	95	73	65
Spartan Elite	23floz	0	77	77	77	0	78	75	73	65	63	0	78	77	75	72	65
Spartan Charge	5.1floz	0	65	65	65	0	63	78	85	47	68	0	63	78	85	45	68
Zidua	2oz	0	47	38	38	0	22	35	35	22	23	0	22	33	33	22	23
LSD		0	12	15	14	0	4	10	5	5	6	0	4	9	3	4	6

Cover Crop Safety Following Wheat Herbicide Application: Update

Mike Ostlie, Caleb Dalley, Kirk Howatt, and Brian Jenks

In 2016 and 2017 a herbicide residual study was conducted across four locations covering much of the diversity of environments in North Dakota: Carrington, Fargo, Hettinger, and Minot. The goal of the study was to determine which cover crops were safe to plant following wheat. Wheat herbicides were chosen that are known to have residual activity that may be injurious to cover crops that are planted in the same season. Total, nine herbicides were applied and eight cover crops were planted into each herbicide strip. Treatments were replicated three times at each location. Wheat herbicides were applied in late May or early June, and cover crops were planted within two weeks of wheat harvest, which was mid-August in 2016 and late August or early September in 2017. Treatments were rated for phytotoxicity and reduced stand. Data were compiled across locations. The highest injury rating across all locations was added to a table. For ease, the data were categorized by the level of injury. If a treatment combination caused less than 20% injury at every location, it was categorized as low risk. If a treatment combination caused between 21 and 50% injury at even a single location, it was categorized as medium risk. If there was more than 50% injury at any location it was labeled high risk.

Herbicide safety varied by location, as expected. Carrington had the most incidences of increased injury. In some environments all treatment combinations were safe. Oats, barley, and field peas were the most tolerant cover crops to the herbicides that were studied (Table 1). The brassica species (radish, turnip, and dwarf essex rape) were the most sensitive group of plants. Three combinations received high risk ratings 1) field pea and Widematch, 2) lentil and Widematch, and 3) Clarity (dicamba) and turnip. Numbers 2 and 3 were rated as high risk on more than one occasion. Those two combinations would not be recommended.

Due to environmental variability from year to year and field to field, some combinations may be higher or lower risk in a particular location and season. Factors that reduce injury risk include high soil organic matter content, high rainfall, tillage, low pH, and others. Table 1 is meant to be a guide. When planting following conditions favorable to herbicide breakdown, cover crop injury risk is reduced. In most instances, combinations listed as medium risk had low levels of injury in all but one environment.

Table 1. Risk of cover crop injury based on highest damage recorded between five ND locations in 2016 and 2017

Herbicide	Radish	Turnip	Beet	Field Pea	Lentil	Flax	Oats	Barley	arf Essex Rape
Widematcl	MR	MR	.	HR	HR	LR	LR	LR	MR
Huskie	LR	LR	0	LR	MR	MR	LR	LR	MR
Everest 2.0	MR	MR	0	LR	MR	LR	LR	LR	MR
Supremacy	LR	LR	.	LR	LR	LR	LR	LR	LR
Quelex	MR	MR	.	LR	LR	LR	LR	LR	LR
Powerflex	LR	LR	0	LR	MR	MR	LR	LR	MR
Goldsky	MR	MR	.	LR	LR	MR	LR	LR	LR
Varro	MR	LR	3	LR	LR	LR	LR	MR	LR
Clarity	MR	HR	0	LR	MR	MR	LR	MR	MR
2,4-D	MR	LR	.	LR	LR	LR	LR	LR	MR

2017 Weed Ecology Research Summary, Dr. Greta Gramig

1) Major activities completed: Experiments conducted: Field experiments were established to investigate impacts of hay mulch and arbuscular mycorrhizal fungi (AMF) inoculant on onion, table beet, winter squash, and sugar snap pea yield in an organic vegetable production system. These experiments were located in Dickinson and Absaraka, ND. 'Mycogrow' AMF inoculant (Fungi Perfecti, LLC, Olympia, WA) was applied in a water solution at a rate of 7.4 g L-1 to half the plots after planting crops. This inoculant contained AMF species Glomus intraradices, Glomus mosseae, Glomus aggregatum, and Glomus etunicatum. Hay mulch from square bales was applied after crop emergence in a layer that was approximately 15 cm deep. Weeds were removed from all plots on a timely basis, so yield differences among treatments were due to factors other than crop-weed competition.

2) Data collected: Weed density and weed seedbank density were quantified. Time required for weed removal was recorded. Neither site was irrigated but rainfall was fairly frequent at both sites. Both sites were fertilized with chicken (Absaraka) or cow (Dickinson) manure to prior to planting. Soil from each plot was tested for N-P-K and although variation across plots was great, nutrients were present in adequate amounts for vegetable production. Peas were harvested every two to three days during July. Beets were harvested mid-August. Onions were harvested in mid-September and squash were harvested in mid-October. Soil cores were collected from each plots and sent to Cornell for soil health analysis that included assessment of wet aggregate stability, active carbon, and soil respiration.

3) Summary statistics and discussion of results: The hay mulch almost completely suppressed weed emergence whereas weed pressure in the bare plots was considerable. Bare plots required substantially more weeding time than the mulched plots. Over time (from 2015 to 2017) weed seedbank density decreased at the Absaraka site for both mulched and tilled plots, but the effect was much more pronounced among the mulched plots. At the Dickinson site, from 2015 to 2017, weed seedbank density remained the same for mulched plots, but increased substantially for tilled plots. At the Absaraka site, crop grown in mulched plots produced greater yield than crop grown without mulch under conventional tillage. At Dickinson, most crops failed due to a combination of drought and damage caused by rodents. Only the onion crop at Dickinson was harvested for yield, and similar to the Absaraka site, mulched onions produced greater yield than onions grown without mulch under conventional tillage. At Absaraka, wet aggregate stability increased over time (from 2015 to 2017) for mulched plots, but remained the same for tilled plots. At Dickinson, wet aggregate stability increased over time for both mulched and tilled plots, but the effect was much more pronounced for mulched plots. At Absaraka, active carbon increased over time in mulched plots only. At Dickinson, active carbon decreased over time regardless of tillage/mulch. At both sites, soil respiration was greater for mulched plots than for tilled plots. AMF inoculation did not impact any measures of crop yield, weed community extent, or soil health indicators.

4) Key outcomes or other accomplishments realized: Via presentations of research results at scientific meetings, researchers learned about the key results produced by this research. Via talks at field days, farmers, gardeners, and extension personnel learned about the results of this research.

Winter Rye in Soybeans: What You Need to Know

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Research has been conducted at the CREC since 2014 involving the rye and soybean cropping system. The concept for the system is that winter rye would be planted the fall prior to soybeans. The rye would then be terminated so that soybean production is maximized. This system provides some key benefits to soybeans. The top three reasons, in order of benefit, are 1) reducing soil erosion, 2) weed suppression, including glyphosate-resistant weeds, and 3) soil water management in saline soils. Improving soil health would be a component of several the above goals, but could also encompass increasing diversity and assisting with reducing tillage. If you are a livestock producer, extending grazing periods would fit on that list as well. Before growing rye, you need to understand many of the same concepts as you would with a cash crop. Below is a set of guidelines that will get you off to a good start.

Variety selection: With rye, like any other crop, variety matters. The success or failure of this system may come down to variety alone. Many times an available rye variety may not be known. A VNS (variety not stated) variety can still provide some of the key benefits to your system, particularly in regards to preventing erosion. Rye variety matters most for weed management or grazing. Weed suppression is tied very strongly to biomass production. The more biomass produced, the better the weed control (which is also good for grazing). At the CREC, the varieties Hancock and ND Dylan have provided high levels of kochia suppression (up to 70% under heavy kochia pressure). Variety maturity may be another consideration if the goal is to harvest the rye (ie hay) prior to planting. Make sure the selected variety is hardy for north climates. If soil erosion is the primary goal, winter wheat or winter triticale may be alternative options if they are easier to acquire.

Weed suppression: Rye provides selective weed suppression, much like herbicides. The full spectrum of suppressed weeds is not yet known. At the CREC, we've seen high levels of suppression of kochia, green and yellow foxtail, and common lambsquarters. Other areas of the country have reported moderate suppression of common ragweed and pigweed species and high levels of suppression of horseweed. Rye has little or no effect on several legume or mint species. This is why soybeans do well with rye. Soybeans, dry beans, field peas, black medic, and lanceleaf sage have been observed growing with rye with no apparent adverse effects. As discussed above, some varieties are better than others at providing weed suppression. Typically, rye does not prevent weed emergence. There may be less weeds present, but the biggest effect is that rye stunts weeds. Kochia has been observed remaining less than 2" tall up until rye reaches anthesis. Once rye reaches anthesis, the weed suppression disappears and the weeds will begin to grow as normal.

Planting date: Rye has a wide range of possible planting dates. Optimum time of planting for biomass production is going to be mid-to late September, but can be extended into the fall until near soil freeze-up. This provides the opportunity to seed rye after corn harvest. The disadvantage of planting late is that there is less biomass and the rye is less vigorous and matures later. Higher seeding rats would be recommended for late plantings.

Seeding rate: Seeding rate will vary greatly depending on your goals. If weed suppression is a high priority then higher seeding rates and stand uniformity are needed. When there are gaps in rye stand, there will be more weeds. Because of this, aerial seeding is not the best seeding method for weed management. We typically use 60 lb (~1 bu/a) seeding rate for weed control. If reducing erosion is the highest priority, the seeding rate is much more flexible. Lower rates can be used and aerial seeding could be considered. Some have used as low as 30 lb/a with reasonable success for the latter goals. Aerial seeding typically requires higher seeding rates as there is lower establishment. Once again, when rye is planted earlier in the year, lower seeding rates could be used as there will be more tillers and more vigorous spring growth.

Termination method: Rye can be terminated several ways. Glyphosate has shown to be one of the more reliable options for termination. Use a minimum of 1 lb ae/a of glyphosate to prevent escapes. Other effective options in soybeans would be Select/Assure II (or generics) as long as rye has not reached the boot stage. After the boot stage Group 1 herbicides will not be effective on rye. Raptor can be effective on rye until rye heading, but there is a higher chance for escapes than glyphosate due to high inherent genetic variability to Raptor efficacy. Using a crimper roller can be as effective as many of the herbicides, but timing is very critical. Rye rolled prior to anthesis will surely recover. A land roller alone will not terminate rye. If using a land roller, pair with a herbicide application. Mowing or haying could also be considered but again, removal prior to anthesis will result in poor termination. Tillage can be used to terminate rye, but it would be the most risky method. Escapes are likely with tillage and it removes most of the benefits that rye would provide. In 2017 there were also incidents of heavy seed corn maggot pressure due to rye residue being buried.

Termination timing: This question is the most difficult to answer as it varies by year. Some years, we've seen rye and soybeans co-exist together up until rye anthesis, when the soybeans are likely planted and emerged. In other years, that same treatment has resulted in complete soybean failure in test plots. The driving factor in that difference in response is soil moisture. In years of good spring moisture, the two crops can grow as well as if there was only a single crop. In 2016 and 2017 (very dry springs), terminating rye at or after soybean planting resulted in lower soybean yields. The problem is that if rye is terminated too early, you will lose many of the benefits of rye. Weed suppression disappears within 1 week without rye growth or stubble. On the other hand, rye plus a single glyphosate application at anthesis can provide season-long weed control some years due to a living mulch effect. Keep in mind that the more advanced the growth stage of rye, the more moisture is used. Early maturing varieties tend to accumulate biomass earlier in the season. Terminating rye two weeks prior to soybean planting is generally a safe practice, even more so when paired with early soybean planting dates.

Crop response to dust control product POST. Dr. Howatt, Mettler, and Harrington. 'Glenn' hard red spring wheat, 'DKL69059CR' canola, mixed variety of oats, 'Richlea' lentil, '8N270CLDM' sunflower, and 'ND2-24081' soybean were seeded near Fargo on May 24. Treatments were applied to plants 6 to 10 inches tall on July 14 with 65°F, 79% relative humidity, 0% cloud cover, 5 mph wind velocity at 135° and dry soil at 64°F. Treatments were applied with a backpack sprayer at 50 psi through 11004 TT nozzles in an area the length of 6.7 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	7/20 wht	7/20 oat	7/20 can	7/20 len	7/20 sun	7/20 soy
	Gal/1000 sq ft	%	%	%	%	%	%
Road Oil	11.1	35	38	18	23	20	21
Road Oil	5.6	12	15	8	6	15	9
Road Oil	1.12	8	9	6	5	9	6
Untreated Check	0	0	0	0	0	0	0
CV		23	24	21	35	22	29
LSD P=.05		5	6	3	5	4	4

Treatment	Rate	8/01 wht	8/01 oat	8/01 can	8/01 len	8/01 sun	8/01 soy
	Gal/1000 sq ft	%	%	%	%	%	%
Road Oil	11.1	40	48	28	16	15	20
Road Oil	5.6	16	13	8	10	10	10
Road Oil	1.12	8	7	6	4	8	6
Untreated Check	0	0	0	0	0	0	0
CV		38	46	38	31	45	26
LSD P=.05		10	12	6	4	6	4

Injury manifested as bronzing of tissue and mild necrosis in extreme rates on grass crops. Appearance of tissue glistened as if oil remained on the tissue indefinitely. Only the highest rate included here caused injury that would be of concern for yield response. This could not be evaluated with small subplot areas of this trial designed as an initial investigation. The rate is small compared to likely incidental exposure from application to roads. Catastrophic exposure from accident would affect a very small area.

A similar experiment was established to evaluate effect of Road Oil PRE with these species. Rates were greater than investigated here. Plants did not show adverse effect to Road Oil, up to 22.2 gal/1000sq ft, in that experiment (data not shown because all injury ratings were zero).