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Preemergence weed control alternatives in barley. (Minot). The objective of this study was to evaluate barley tolerance to herbicides applied preemergence. The purpose is to find other herbicides that may be used in barley to control annual grasses where Group 1 resistance is a problem. Barley was planted on May 15 and herbicides were applied on May 16. We received the following rain events (≥ 0.10 in). April and May were quite dry months, while June rainfall was plentiful and well-spaced. July and August were generally dry as well.

May 18	0.15	June 1	0.61	July 3	0.37
May 27	0.28	June 2	0.21	July 10	0.44
May 29	0.12	June 10	0.96	July 19	0.41
		June 11	0.13		
		June 14	0.83		
		June 16	0.36		
		June 23	0.14		
		June 24	0.91		
		June 29	0.61		

Slight to moderate injury symptoms were observed with all treatments. Injury symptoms persisted longer with Zidua, Pre-Pare, Outlook, and Fierce. However, there were no statistical differences in height (July 24), yield, or test weight. There was considerable variability in crop growth due to the dry soil conditions.

Table: Preemergence weed control alternatives in barley. (1808)

			Injury				Height	Yield	Test wt.
Treatment	Rate	Timing	Jun-6	Jun-22	Jul-7	Jul-31	Jul-24	Aug-14	Aug-14
			----------%----------				-cm-	-bu/A-	-lb/bu-
Untreated			0	0	0	0	92	61	46.6
Zidua	3 oz	PRE	18	43	39	32	84	55	46.9
Warrant	1.5 qt	PRE	8	8	2	1	93	72	47.8
Dual II Magnum	1.67 pt	PRE	13	16	13	8	93	66	47.3
Pre-Pare	0.3 oz	PRE	48	52	36	31	90	66	47.0
Prowl H2O	3 pt	PRE	12	9	4	2	94	73	47.1
Valor	2 oz	PRE	21	14	9	7	93	72	46.9
Outlook	18 oz	PRE	15	18	15	13	88	61	47.4
Fierce	3 oz	PRE	25	27	17	15	94	66	47.0
LSD (0.05)			6.1	16.9	20.2	15.9	NS	NS	NS
CV								11.5	

Barley PRE evaluation for green foxtail management. Ostlie

A barley weed control study was conducted in 2018 near Carrington, ND to evaluate potential PRE options for Group 1 resistant green foxtail control. Treatments were applied the day of planting and received an activating rainfall within 24 hours. Barley variety was Tradition seeded at 1.25m PLS/a.

Table 1. Barley performance and green foxtail control following PRE herbicide application.

Treatment	Stand	Heading	Green foxtail	Phytotoxicity	Harvest Moisture	Test Weight	Yield
	Plants/a	days to	21 DAT	21 DAT	%	lb/bu	bu/a
Untreated	1137827.4	47.5	0.0	0.0	9.7	50.2	99.8
Zidua	1111194.3	48.3	13.8	0.0	9.6	49.9	96.1
Warrant	1089000.0	47.8	15.0	0.0	9.8	50.1	99.4
Dual II Magnum	1114153.5	47.8	36.3	0.0	9.6	50.7	107.5
Pre-Pare	1136347.8	48.3	46.3	0.0	9.7	50.6	114.8
Prowl H2O	1072724.2	47.8	18.8	0.0	9.9	49.9	110.2
Valor	1183695.7	48.0	18.8	0.0	10.1	50.2	105.3
Outlook	1143745.9	48.0	42.5	0.0	9.4	50.6	110.1
Fierce	1083081.5	48.3	27.5	0.0	9.6	50.5	105.2
LSD (0.05)	NS	NS	15.4	.	0.4	0.7	9.3
Planted 5/7	Variety: Tradition						
Harvested: 8/6							
Previous crop: flax							

Barley stand and maturity were not affected by any of the treatments, nor was any phytotoxicity documented noted. Some differences were detected in harvested product. Notably, yield was less with some treatments, largely correlating with poor management of green foxtail, and higher yields recorded with better management. Green foxtail control was marginal at best, but could work in conjunction with an aggressive POST herbicide strategy. None of the tested products are currently labeled in barley, but some products show enough promise to warrant label consideration.

Response of Oats to Preemergence and Postemergence applied Herbicides at Hettinger, ND

Caleb Dalley, HREC, Hettinger, ND 2018

A trial was conducted to evaluate herbicide with potential use in oats for preemergence and postemergence applications. Oats 'Hytest' were planted on May 23, 2018 at a rate of 60 lbs/A at a depth of 2 inches using a John Deere 1590 no-till drill. Starter fertilizer (18-46-0) was applied in furrow during planting at a rate of 40 lb/A (7 lb N and 18 lb P2O5/A). Immediately after planting paraquat (Gramoxone @ 32 oz/A) was applied to control emerged weeds. Prior to planting, urea fertilizer (46-0-0) was applied at a rate of 150 lbs/A (69 lb N/A) and glyphosate was applied (Cornerstone 5 Plus @ 32 oz/A) to control winter annual weeds. Preemergence herbicide treatments were applied on May 24 using a tractor-mounted research plot sprayer at a spray volume of 10 gallons per acre. Oats emerged on May 30. Early postemergence treatments were applied on June 4 (at the 1-leaf oat stage) and late postemergence treatments were applied on June 14 (at the 4-leaf oat stage). Oats were evaluated for injury at 18, 26, 36, and 50 days after the PRE application timing. The only injury observed to oats was with the postemergence application of Armezon, with bleaching injury being greater at the late POST application timing. Oats were harvested on August 31. Even with significant injury, there were no significant differences in oat yield or test weight. Oat yield ranged from 67 to 83 bushel per acre. The numerically lowest yield occurred following the late POST application of Armezon and the POST application of Zidua. Further evaluation of these herbicides is needed to verify safety for use in oats, but there appears to be potential for additional herbicides that could be utilized in oats.

Table. Oat response to preemergence and postemergence herbicide application at Hettinger, ND

			18 DAT	26 DAT	36 DAT	50 DAT	Yield	Test
Treatment	Rate	Timing	% control				Bu/A	Lb/Bu
1Untreated			0b	0c	0b	0b	74	36
2Zidua	3oz/a	PRE	0b	0c	0b	0b	82	35
3Warrant	1.5qt/a	PRE	0b	0c	0b	0b	82	37
4Dual II Magnum	1.67pt/a	PRE	0b	0c	0b	0b	78	35
5Prowl	3pt/a	PRE	0b	0c	0b	0b	76	37
6Outlook	18oz/a	PRE	0b	0c	3b	0b	78	35
7Zidua	3oz/a	EPOST	0b	0c	0b	0b	67	35
8Warrant	1.5qt/a	EPOST	0b	0c	0b	0b	76	34
9Dual II Magnum	1.67pt/a	EPOST	0b	0c	0b	0b	83	35
10Prowl	3pt/a	EPOST	0b	0c	0b	0b	83	35
11Outlook	18oz/a	EPOST	0b	0c	0b	0b	79	36
12Armezon COC	1oz/a 1% v/v	EPOST	14a	9b	0b	3b	77	37
13Armezon COC	1oz/a 1% v/v	LPOST	—	28a	46a	30a	67-	36
LSD P=.05			0.60	1.24	2.89	3.46	16.6	2.359
Treatment F			361.000	329.379	160.611	47.254	0.852	1.248
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001	0.5995	0.2903

Means followed by same letter or symbol do not significantly differ (P=.05, LSD)
Oats were planted on May 23, 2018 at Hettinger, ND.
Abbreviations: PRE, preemergence; EPOST, early postemergence; LPOST, late postemergence
Herbicides were applied on May 24 (PRE), June 4 (EPOST, 1-leaf oats), and June 14 (LPOST, 4-leaf oats)

Spring wheat response to the herbicide pyroxasulfone at Hettinger, ND

Caleb Dalley, HREC, Hettinger, ND 2018

A trial was established to evaluate spring wheat response to the herbicide pyroxasulfone (Zidua SC) when applied PRE (after planting), DPRE (after wheat germination, but before emergence), and EPOST (soon after wheat has emerged). Spring wheat 'Elgin' was planted on May 21, 2018 at 100 lb/A at a depth of 1.5 inches using a John Deere 1590 no-till drill. Starter fertilizer (18-46-0) was applied in furrow at planting at 40 lb/A. Urea fertilizer (46-0-0) was broadcast applied prior to planting at 150 lb/A (69 lb N/A). The field was treated with glyphosate (Cornerstone 5 Plus @ 32 oz/A plus AMS @ 17 lb/100 gal) prior to planting to control emerged annual weeds. Plots were maintained weed free for the entire growing season. Herbicide treatments were applied using a research plot sprayer at an application volume of 10 gallons per acre. PRE treatments were applied the day after wheat was planted. The DPRE treatments were applied on May 24, three days after planting when wheat coleoptiles were 0.5 inches in length and had not yet emerged. Wheat emerged on May 27. EPOST treatments were applied on June 4 to wheat in the 1-leaf growth stage. In between planting and wheat emergence, 0.19 inches of rainfall occurred. An additional 0.4 inches of rainfall occurred after crop emergence, but prior to the EPOST application. Wheat was evaluated for injury on June 21 and no injury was observed for any herbicide treatment regardless of application timing. Wheat height (the longest extended leaf) was measured on June 28 and no differences in wheat height were found regardless of herbicide treatment or treatment timing. Wheat was harvest on August 30. No differences in wheat yield were found regardless of herbicide treatment or treatment timing. The herbicide Zidua is currently registered for use at rates of 1.25 to 4 oz/A when applied DPRE or EPOST to spring wheat in North Dakota.

Table. Spring wheat response to pyroxasulfone (Zidua SC) applied preemergence, delayed preemergence, and early-postemergence at Hettinger, ND

	Rate		injury 31 DAP	height 37 DAP	Yield	Test
Treatment	—oz/A—	Timing	%	cm	bu/A	lb/bu
1Zidua SC	1.75	PRE	0	44	26.6	55
2Zidua SC	2.5	PRE	0	46	28.8	55
3Zidua SC	3.25	PRE	0	46	29.8	55
4Zidua SC	4.0	PRE	0	45	28.7	55
5Zidua SC	1.75	DPRE	0	46	28.8	55
6Zidua SC	2.5	DPRE	0	45	28.3	55
7Zidua SC	3.25	DPRE	0	46	25.2	54
8Zidua SC	4.0	DPRE	0	44	26.8	55
9Zidua SC	1.75	EPOST	0	45	26.2	54
10Zidua SC	2.5	EPOST	0	46	28.9	55
11Zidua SC	3.25	EPOST	0	44	25.2	55
12Zidua SC	4.0	EPOST	0	44	26.1	54
13Untreated			0	46	26.0	55
LSD P=.05			.	2.5	4.64	1.5
Treatment F			0.000	0.836	0.956	0.622
Treatment Prob(F)			1.0000	0.6144	0.5057	0.8092

Abbreviations: DAP, days after planting; PRE, preemergence treatments were applied on May 22 (the day after planting); DPRE, delayed preemergence treatments were applied on May 24 (3 days after planting); EPOST, early-postemergence treatments were applied on June 4 (14 days after planting).

Foxtail barley control with fall vs. spring-applied Olympus. (Minot). The objective of this study was to evaluate foxtail barley control with Olympus and Roundup applied in the fall compared to spring. Fall treatments were applied September 28, 2017. Spring wheat was planted May 17. Preemergence (PRE) treatments were applied May 22. Postemergence (POST) treatments were applied June 15.

Glyphosate applied fall or spring provided excellent foxtail barley control. Olympus alone applied fall and spring provided about 47% control by the August evaluation. Spring-applied Metribuzin tank mixed with Roundup resulted in severe antagonism and poor foxtail barley control.

Table. Foxtail barley control with Olympus. (1823)

			Weed Control			
			Foxtail barley			
Treatment[b]	Rate	Timing	May-14	May-29	Jun-15	Aug-2
			----------%----------			
Untreated			0	0	0	0
Oly + Gly[a] / Oly + NIS	0.2 oz + 32 oz / 0.2 oz + 0.25%	Fall / 4-lf wheat	100	100	100	100
Oly + Gly[a] / Oly + NIS	0.4 oz + 32 oz / 0.2 oz + 0.25%	Fall / 4-lf wheat	100	100	100	100
Oly + Gly[a] / HC + Oly[a]	0.2 oz + 32 oz / 13.7 oz + 0.2 oz	Fall / 4-lf wheat	100	100	100	100
Oly + Gly[a] / HC + Oly[a]	0.4 oz + 32 oz / 13.7 oz + 0.2 oz	Fall / 4-lf wheat	100	100	100	100
Gly[a]	32 oz	Fall	100	100	100	99
Gly[a]	32 oz	PRE	0	78	98	99
Oly + NIS / HC + Oly[a]	0.4 oz + 0.25% / 13.7 oz + 0.2 oz	Fall / 4-lf wheat	17	13	12	47
Gly[a] / Gly[a]	22 oz / 22 oz	Fall / PRE	100	100	100	97
Gly[a] + Metribuzin	22 oz + 0.33 lb pr	Fall	64	60	50	28
LSD (0.05)			3.5	4.3	3.1	5.9

[a] *Applied with AMS (2.5 gal)*

[b] *Oly=Olympus; Gly=Roundup WeatherMax; HC=Huskie Complete*

Residual grass Activity with Propoxycarbazone. Howatt, Mettler, and Harrington. 'Glenn' hard red spring wheat was seeded near Valley City North Dakota on May 16. Preemergence treatments were applied to 3 leaf tillering downy brome on May 16 with 85°F, 23% relative humidity, clear sky, 5 mph wind velocity at 270°, and damp soil at 52°F. Post treatments were applied to 3 leaf wheat and headed downy brome on June 4 with 87°F, 22% relative humidity, 2% cloud cover, 3 to 5 mph wind velocity at 315°, and dry soil at 75°F. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Growth Stage	6/4 Wht	6/4 Dobr	6/12 Dobr	6/17 Dobr	7/1 Dobr	7/17 Dobr
	oz ai/A		%	%	%	%	%	%
Untreated Check	0		0	0	0	0	0	0
Glyt-4.5/Thcz+Trib-sg+Flox	16/0.07+0.1+1.5	PRE/3L	0	96	99	98	98	98
Glyt-4.5/Thcz+Prcz+Trib-sg+Flox	16/0.07+0.14+0.1+1.5	PRE/3L	0	97	99	99	99	99
Glyt-4.5+Prcz/Thcz+Trib-sg+Flox	16+0.14/0.07+0.1+1.5	PRE/3L	0	96	99	99	99	99
Glyt-4.5+Prcz/ Thcz+Prcz+Trib-sg+Flox	16+0.14/ 0.07+0.14+0.1+1.5	PRE/ 3L	0	97	99	97	97	97
Glyt-4.5/Brox&Pyst&Thcz	16/3	PRE/3L	0	94	99	98	98	98
Glyt-4.5/Brox&Pyst&Thcz+Prcz	16/3+0.14	PRE/3L	0	97	99	99	99	99
Glyt-4.5+Prcz/Brox&Pyst&Thcz	16+0.14/3	PRE/3L	0	96	99	98	98	98
Glyt-4.5+Prcz/Brox&Pyst&Thcz+Prcz	16+0.14/3+0.14	PRE/3L	0	95	99	99	99	99
Glyt-4.5	16	PRE	0	96	99	98	98	98
CV			0	1	0	1	1	1
LSD P=0.5%			.	2	.	1	1	1

Glyphosate provided very effective control of downy brome at seeding. Plots were monitored for new emergence of downy brome but none emerged. There was not emergence of other weeds either, regardless of PRE treatment. The POST treatments were applied according to wheat growth stage to monitor residual control into late season, but emergence was not observed in any treatment, including the untreated.

Wild Oat Control in Wheat. Dr. Howatt and Mettler. 'ND Vitpro' Wheat was seeded on May 4. Treatments were applied to 3 leaf wheat, 2 to 3 leaf wild oat, and 1 leaf green and yellow foxtail on May 31 with 68°F, 88% relative humidity, 50% cloud cover, 6.5 mph wind velocity at 360°, and moist soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/14 Wht	6/14 Wioa	6/14 Fxtl	6/28 Wioa
	oz ai/A	%	%	%	%
Flcz-3+Brox&MCPA+BB	0.32+8+1%	0	75	71	86
Prcz+Brox&MCPA+BB	0.42+8+1%	0	60	30	35
Pxlm+Brox&MCPA+BB	0.21+8+1%	0	66	50	65
Pxlm&Flas&Flox+BB	1.68+1%	0	69	55	66
Pxlm&Clpy&Flox+BB	3.2+1%	0	65	55	74
Pxlm&Flox+Thif-sg+BB	2.1+0.2+1%	0	70	62	79
Thcz+Brox&MCPA+BB	0.07+8+1%	0	66	55	69
Brox&Pyst&Thcz+UAN	3+16	0	69	65	72
Fenx+Brox&MCPA	1.32+8	0	67	70	61
Fenoxaprop&Brox&Pyst	5.4	0	76	85	84
Clodinfop NG+Brox&MCPA	0.8+8	0	81	81	92
Pxdn+Brox&MCPA	0.86+8	0	80	86	95
Pxdn&Fenx-AB+Brox&MCPA	1.28+8	0	87	92	98
Brox&MCPA (untreated)	8	0	0	0	0
CV		.	5	5	8
LSD P=.05		0	5	7	8

Herbicides did not result in wheat response. The premix pinoxaden and fenoxaprop gave near 90% control of both grasses June 14. For the group 2 herbicides, flucarbazone gave more than 70% control of wild oat and foxtails. This treatment gave 86% wild oat control on June 28, but clodinafop or pinoxaden resulted in better than 90% control.

Grass Control in Wheat. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 4. Treatments were applied to 3 leaf wheat, 2 to 3 leaf wild oat, 1 leaf yellow foxtail, and 3 to 5 leaf wild buckwheat on May 31 with 68°F, 88% relative humidity, 100% cloud cover, 5 mph wind velocity at 360°, and moist soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/8 Wht	6/8 Wioa	6/8 Yeft	6/8 Wibw	6/14 Wioa	6/14 Yeft	6/14 Wibw	6/28 Wioa	7/12 Wioa	8/3 Yield
	oz ai/A	%	%	%	%	%	%	%	%	%	bu/A
Untreated Check	0	0	0	0	0	0	0	0	0	0	1
Pxdn&Fenx-AB	1.28	0	62	72	0	89	89	0	98	99	11
Thcz+NIS	0.07+0.25%	0	42	42	71	70	66	86	85	80	6
Pxlm&Flas&Flox+NIS	1.68+0.25%	0	42	45	71	70	64	87	80	75	5
Flcz-3+AMS+NIS	0.42+16+0.25%	0	45	42	77	71	71	86	92	85	6
Prcz&Mess+AMS+NIS	0.2+24+0.25%	0	47	37	25	67	42	25	88	90	6
Pxdn	0.86	0	57	52	0	85	85	0	99	98	10
Fenx	1	0	47	45	0	79	76	0	94	97	5
CV		0	9	15	9	3	5	21	3	3	2
LSD P=0.5		.	6	6	4	3	5	11	4	4	3

Herbicides did not result in wheat response. The premix of pinoxaden and fenoxaprop resulted in more rapid symptom development than either herbicide alone and much more activity than the group 2 herbicides. By June 14, there was essentially no difference between the premix of pinoxaden and fenoxaprop and pinoxaden alone, but fenoxaprop gave a level lower of weed control and another step down had the group 2 herbicides. In July, group 1 herbicides provided 97 to 99% control of wild oat, propoxycarbazone and mesosulfuron gave 90% and the other group 2 herbicides were 85% control or less.

Thiencarbazone control of wild oat. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 4. Treatments were applied to 3 leaf wheat, 2 to 3 leaf wild oat, 1 leaf green and yellow foxtail, and 3 to 5 leaf wild buckwheat on May 31 with 68°F, 88% relative humidity, 90% cloud cover, 6.5 mph wind velocity at 360°, and moist soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/8 Wht	6/8 Wioa	6/8 Fxtl	6/8 Wibw	6/21 Wioa	6/21 Fxtl	7/23 Wioa	7/23 Grft
	oz ai/A	%	%	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0	0	0
Thcz+Brox&MCPA	0.07+8	5	40	57	85	81	64	79	80
Thcz+Clpy&Flox&MCPA	0.07+6.5	5	40	52	72	79	66	80	84
Thcz+Brox&MCPA&Flox	0.07+8	5	40	52	87	80	69	75	84
Thcz+Clpy&Flox+MCPA ester	0.07+3+4	5	40	52	75	79	67	81	86
Thcz+Clpy&Flox+Thif-sg+Trib-sg	0.07+3+0.24+0.06	5	40	60	77	79	74	81	88
Thcz+Prcz+Brox&MCPA&Flox	0.07+0.14+8	5	40	52	85	79	70	77	87
Brox&Pyst&Thcz	3	0	40	50	94	79	70	82	81
Fenx&Brox&Pyst	5.4	0	40	60	89	79	92	89	70
CV		0	0	19	8	5	11	4	6
LSD P=0.5		.	.	14	9	5	10	4	6

Treatments with the Varro formulation of thiencarbazone resulted in 5% chlorosis that was not present by June 21. However, thiencarbazone in premix as Huskie Complete did not cause chlorosis. Wild oat control on June 8 was very consistent across herbicide treatments including the treatment that contained fenoxaprop. Foxtail control was very variable within treatment, resulting in values that could not be separated because of the large LSD. On June 21, wild oat control with all herbicide treatments was consistent with values near 80%, while fenoxaprop excelled in foxtail control compared with thiencarbazone treamtents. Fenoxaprop provided almost 90% control of wild oat in July while thiencarbazone gave around 80% control. At this evaluation, foxtail heads enabled separate evaluation of green and yellow foxtail. Yellow foxtail was essentially controlled by all treatments. New emergence of green foxtail in fenoxaprop treatment more so than thiencarbazone treatments led to lower control rating.

Grass control with Pyroxsulam. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 4. The treatments were applied to 3 leaf wheat, 2 to 3 leaf wild oat, and 1 leaf green and yellow foxtail on May 31 with 66°F, 88% relative humidity, 100% cloud cover, 6.5 mph wind velocity at 360°, and moist soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/8 Wht	6/8 Wioa	6/8 Yeft	6/14 Wioa	6/14 Yeft	6/28 Wioa	7/23 Wioa
	oz ai/A	%	%	%	%	%	%	%
Untreated	0	0	0	0	0	0	0	0
Pxlm&Flas&Flox+AMS+NIS	1.68+24+0.5%	0	45	50	71	71	80	84
Pxlm&Flox+AMS+NIS	2.1+24+0.5%	0	50	45	70	70	83	84
Pxlm&Flox+2,4-D ester+AMS	2.1+5.6+24	0	45	45	71	70	85	84
Pxlm&Clpy&Flox+AMS+NIS	3.2+24+0.5%	0	45	45	70	70	81	80
Pxlm&Clpy&Flox+2,4-D ester +AMS	3.2+5.6 +24	0	50	50	70	74	86	84
Brox&Pyst&Thcz	3	0	40	45	70	74	89	87
Pinoxaden+Clpy&Flox+AMS	0.86+3+24	0	57	50	86	90	98	97
Flcz-3+Clpy&Flox+AMS+NIS	0.44+3+24+0.25%	0	45	45	75	74	95	93
cv		0	17	15	2	6	4	3
LSD (0.05)		.	9	9	2	5	4	3

Herbicides did not result in wheat response. Herbicide symptoms had not progressed very far 1 week after application. By June 14, the faster action of pinoxaden relative to group 2 herbicides was noted on both species. But there was no practical difference among the pyroxsulam treatments. Control of wild oat with pinoxaden or flucarbazone reached the mid-90s by the end of June. Control with thiencarbazone was 89%, and pyroxsulam treatments gave 86% control or less.

Adjuvants with Pyroxsulam for Wild Oat. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 4. Treatments were applied to 3 to 4 leaf wheat, 3 to 4 leaf wild oat, and 1 leaf yellow foxtail on June 4 with 77°F, 44% relative humidity, 20% cloud cover, 2 to 6 mph wind velocity at 225°, and dry soil at 66°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 by30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/12 Wht	6/12 Wioa	6/12 Yeft	6/18 Wioa	6/18 Yeft	6/28 Wioa
	oz ai/A	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0
PxIm&Clpy&Flox	3.2	0	60	50	50	52	70
PxIm&Clpy&Flox+AMS-L	3.2+56	0	60	50	64	55	80
PxIm&Clpy&Flox+Preference+AMS-L	3.2+0.25%+56	0	60	50	67	65	79
PxIm&Clpy&Flox+AG16134+AMS-L	3.2+0.25%+56	0	60	50	70	64	83
PxIm&Clpy&Flox+AG17047+AMS-L	3.2+0.25%+56	0	60	50	71	65	79
PxIm&Clpy&Flox+AG13064+AMS-L	3.2+3+56	0	60	50	70	65	82
PxIm&Clpy&Flox+AG16134+AG13064+AMS-L	3.2+0.25%+3+56	0	60	50	52	47	85
PxIm&Clpy&Flox+AG8050+AMS-L	3.2+6.4+56	0	60	50	55	45	81
PxIm&Clpy&Flox+CANG	3.2+2.5%	0	60	50	52	47	83
CV		0	0	0	7	10	5
LSD P=0.5		.	.	.	6	8	5

Herbicide treatments did not elicit response in wheat. Wild oat and yellow foxtail control with pyroxsulam was improved with four adjuvant systems: Preference, AG16134, AG17047, or AG13064.

Adjuvants with Flucarbazone for Wild Oat Control. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 4. Treatments were applied to 3 to 4 leaf wheat and wild oat and 1 leaf yellow foxtail on June 4 with 77°F, 44% relative humidity, 20% cloud cover, 2 to 6 mph wind velocity at 225°, and dry soil at 66°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	6/12 Wht	6/12 Wioa	6/12 Yeft	6/18 Wioa	6/18 Yeft	6/28 Wioa
	oz ai/A	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0
Flcz-3	0.32	0	37	27	43	41	65
Flcz-3+Preference	0.32+0.25%	0	50	40	55	47	76
Flcz-3+AG16134	0.32+0.25%	0	50	40	57	51	75
Flcz-3+AG17047	0.32+0.25%	0	50	40	64	55	76
Flcz-3+AG13064	0.32+3	0	50	40	60	52	72
Flcz-3+AG16134+AG13064	0.32+0.25%+3	0	50	40	64	55	79
Flcz-3+Preference+AG13064	0.32+0.25%+3	0	50	40	64	55	77
Flcz-3+AG8050	0.32+6.4	0	50	40	47	32	70
Flcz-3+AG14039	0.32+6.4	0	50	40	52	42	76
Flcz-3+AG14039	0.32+12	0	50	40	55	40	80
CV		0	3	4	9	12	6
LSD P=0.5		.	2	2	7	8	6

Herbicide treatments did not result in wheat response. Each adjuvant treatment except AG8050 improved control of wild oat with flucarbazone by as many as 15 percentage points. This adjuvant resulted in less foxtail control with flucarbazone than with flucarbazone alone. Foxtail control was improved with AG16134, AG17047, AG13064, and AG16134.

Wild Oat Control with Flucarbazone Premix. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 4. Treatments were applied to 3 leaf wheat, 2 to 3 leaf wild oat, 1 leaf yellow foxtail, and 3 to 5 leaf wild buckwheat on May 31 with 68°F, 88% relative humidity, 100% cloud cover, 6.5 mph wind velocity at 360°, and moist soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/8 Wht	6/8 Wioa	6/8 Yeft	6/8 Wibw	6/14 Wioa	6/14 Yeft	6/14 Wibw	6/21 Wioa	6/21 Yeft	7/12 Wioa
	oz ai/A	%	%	%	%	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0	0	0	0	0
X2682aa+AMS+NIS	5.9+11+0.25%	0	45	45	76	70	74	91	80	74	72
X2682aa+Pxdn+AMS+NIS	5.9+0.64+11+0.25%	0	52	47	92	79	86	94	80	81	87
X2682aa+Thcz+AMS+NIS	5.9+0.03+11+0.25%	0	47	52	92	72	77	95	79	80	76
X2682aa+Pxlm+AMS+NIS	5.9+0.21+11+0.25%	0	45	50	90	71	79	94	79	79	80
X2682aa+Thif-sg+Trib-sg+AMS+NIS	5.9+0.1+0.1+11+0.25%	0	50	47	89	70	71	95	80	71	74
X2682aa+Brox&Pyst+AMS+NIS	5.9+2.97+11+0.25%	0	45	42	95	70	72	95	72	65	71
X2682aa+MCPA ester+AMS+NIS	5.9+4+11+0.25%	0	42	42	90	70	77	92	79	76	76
X2682aa+2,4-D ester+AMS+NIS	5.9+4+11+0.25%	0	42	42	90	70	75	95	76	66	70
X2682aa+Clpy+AMS+NIS	5.9+1.9+11+0.25%	0	42	42	89	70	74	95	76	70	74
X2682aa+Flox+AMS+NIS	5.9+2.24+11+0.25%	0	42	45	94	70	71	95	76	71	69
X2682aa+Brox-2+AMS+NIS	5.9+4+11+0.25%	0	47	55	92	70	77	95	71	66	69
X2682aa+Brox&Bcpy+CoAct+NIS	5.9+3+0.91+0.25%	0	45	47	94	67	67	92	64	62	69
Brox&Pyst&Thcz+AMS+NIS	3+11+0.25%	0	42	42	90	66	71	94	66	62	64
Pxlm&Clpy&Flox+AMS+NIS	3.2+11+0.25%	0	45	42	81	69	64	95	64	64	62
Pxdn+CoAct+NIS	0.86+0.91+0.25%	0	45	52	20	84	90	0	87	95	89
CV		0	11	12	5	4	4	82	71	68	69
LSD P=0.5		.	7	7	6	4	4	2	5	6	7

Herbicide treatments did not elicit response in wheat. Tankmixes improved X2682 control of wild buckwheat. This could be expected for most mixtures that included broadleaf herbicides, but addition of pinoxaden also resulted in better buckwheat control. This possibly indicated the need for investigation of adjuvants to improve activity of X2682. Pinoxaden increased the control of grasses as expected, but benefit of adding another group 2 grass herbicide was not as pronounced.

Foxtail control in wheat. Dr. Howatt and Mettler. 'ND Vitpro' hard red spring wheat was seeded near Fargo on May 14. Treatments were applied to 2 to 3 leaf wheat and yellow foxtail on June 7 with 76°F, 48% relative humidity, 30% cloud cover, 4.3 mph wind velocity at 135°, 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	622 Wht	6/22 Yeft	7/6 Yeft
	oz ai/A	%	%	%
Flcz-3+Brox&MCPA+BB	0.42+8+1%	0	81	87
Pxlm+Brox&MCPA+BB	0.21+8+1%	0	74	82
Pxlm&Flax&Flox+BB	1.68+1%	0	86	92
Pxlm&Clpy&Flox+BB	3.2+1%	0	81	92
Thcz+Brox&MCPA+BB	0.07+8+1%	0	91	94
Brox&Pyst&Thcz+UAN	3+16	0	86	94
Fenoxaprop+Brox&MCPA	1+8	0	81	91
Fenx&Brox&Pyst	5.4	0	92	97
Clodinfop NG+Brox&MCPA	0.8+8	0	91	92
Pinoxaden+Brox&MCPA	0.86+8	0	97	98
Pinoxaden&Fenx-AB+Brox&MCPA	1.28+8	0	95	98
Brox&MCPA	8	0	0	0
CV		0	4	3
LSD P=.05		.	5	3

Herbicides did not cause response in wheat. Pinoxaden provided the highest value of control on June 22, but pinoxaden and fenoxaprop gave similar control. Fenoxaprop gave 81% control but the premix of fenoxaprop and bromoxynil and pyrasulfotole achieved 92% control. This difference carried through to July but the separation was smaller and both treatments surpassed 90% control. Premixes of pyroxsulam with broadleaf herbicide gave much better control than the tankmix of pyroxsulam plus bromoxynil and MCPA. There was no difference between thiencarbazone premix or tankmix treatments in July.

Grass Control in Wheat. Dr. Howatt and Mettler. 'ND Vitpro' wheat was seeded near Fargo on May 14. Treatments were applied to 3 leaf wheat, 2 to 3 leaf yellow foxtail, 3 to 4 inch redroot pigweed and common lambsquarters on June 7 with 74°F, 47% relative humidity, 40% cloud cover, 8.5 mph wind velocity at 165°, and dry soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Treatments without broadleaf herbicide were treated to remove pigweed and lambsquarters between the two evaluations to limit their interference. Treatments that demonstrated broadleaf activity were not sprayed to be able to evaluate the treatment effect on these weeds.

Treatment	Rate	6/15 Wht	6/15 Yeft	6/15 Rrpw	6/15 Colq	6/22 Wht	6/22 Yeft	6/22 Rrpw	6/22 Colq	7/6 Yeft	8/14 Yield
	oz ai/A	%	%	%	%	%	%	%	%	%	bu/A
Untreated Check	0	0	0	0	0	0	0	57	62	0	30
Pxdn&Fenx-AB	1.28	0	89	0	0	0	98	65	66	98	47
Thcz+NIS	0.07+0.25%	3	69	75	65	0	87	92	89	96	48
Pxlm&Flas&Flox+NIS	1.68+0.25%	4	62	70	62	0	84	95	93	93	44
Flcz-3+AMS+NIS	0.42+16+0.25%	0	61	74	60	0	79	91	85	90	41
Prcz&Mess+AMS+NIS	0.2+24+0.25%	3	50	70	60	0	66	95	94	77	41
Pxdn	0.86	0	90	0	0	0	96	76	79	98	49
Fenx	1	0	82	0	0	0	96	81	76	99	49
CV		74	5	5	8	0	3	6	6	2	
LSD P=0.5		1	4	2	4	.	4	7	7	3	10

Pinoxaden, fenoxaprop, and flucarbazone did not cause response in wheat. Other herbicides caused mild chlorosis on June 15 that was not apparent on June 22. Thiencarbazone gave fair control of pigweed and lambsquarters on June 15 that together gave better control than other treatments. By June 22, broadleaf control among the four treatments was similar except flucarbazone gave less control of lambsquarters than the other three with broadleaf herbicides. Treatments with pinoxaden provided better control of yellow foxtail than other herbicides at 90%. Fenoxaprop gave 82% control, but the others (all group 2 herbicides) were less than 70% control. Propoxycarbazone and mesosulfuron didn't even achieve 70% control by June 22. The group 2 herbicides lagged in control through the entire season, but thiencabazone was similar to pinoxaden or fenoxaprop in July. Pyroxsulam and flucarbazone gave 93 and 90% control, respectively.

Grass and broadleaf weed control in spring wheat, Carrington, 2018.
Greg Endres and Mike Ostlie.

The field experiment was conducted at the NDSU Carrington Research Extension Center in cooperation with Bayer CropScience to examine weed efficacy and crop tolerance with Varro and broadleaf herbicide tank mixtures. Experimental design was a randomized complete block with three replicates. 'Glenn' HRS wheat was seeded on May 4 in conventionally tilled soil with corn as previous crop in 2017. Herbicide treatments were applied with a CO_2-hand-boom plot sprayer delivering 10 gal/A at 35 psi through 8001 flat fan nozzles to the center 6.7 ft of 10- by 25-ft plots. Treatments were applied on May 29 with 74 F, 55% RH and 5 mph wind to 3-leaf wheat, 3- to 4-leaf yellow and green foxtail, and 1- to 2-inch tall common lambsquarters.

No visual wheat plant response (foliage chlorosis/necrosis or biomass reduction) was noted on June 6 [eight days after treatment (DAT)]. Visual evaluation 24 DAT (June 22) indicated excellent (91-93%) foxtail control with Varro plus Carnivore or Carnivore plus Olympus, with other treatments providing 81-87% control (table). Foxtail control evaluated 55 DAT (July 23; wheat maturity) reached 88% with Varro plus Carnivore, with other treatments providing 73-80% control. All treatments provided excellent (98-99%) common lambsquarters control 24 and 55 DAT except Wolverine Advanced (87-88%).

Table.

			Weed control[1]				
Herbicide			6-Jun	22-Jun		23-Jul	
Number	Treatment[2]	Rate	fota	fota	colq	fota	colq
		fl oz product/A	%				
1	Untreated check	x	0	0	0	0	0
2	Varro + Bromac	6.9 + 16	75	85	98	78	99
3	Varro + Weld	6.9 + 18	77	84	98	74	99
4	Varro + Carnivore	6.9 + 16	77	93	98	88	99
5	Varro + WideMatch + MCPA amine	6.9 + 16 + 8	76	87	99	79	99
6	Varro + WideMatch + Affinity TM	6.9 + 16 + 0.6 oz wt	80	81	99	73	99
7	Varro + Carnivore + Olympus	6.9 + 16 + 0.2 oz wt	72	91	98	79	98
8	Huskie Complete + AMS	13.7 + 8 oz wt	76	86	99	80	99
9	Wolverine Advanced	27.4	78	82	87	77	88
C.V. (%)			4	8	5	9	5
LSD (0.05)			5	11	7	11	7

[1]fota=yellow and green foxtail; colq=common lambsquarters.

Thiencarbazone control of Foxtail. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 14. Treatments were applied to 2 to 3 leaf wheat, 2 to 3 leaf green and yellow foxtail, and 2 inch Venice mallow on June 7 with 74°F, 47% relative humidity, 40% cloud cover, 4.8 mph wind velocity at 165°, and dry soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 14.

Treatment	Rate	6/15 Wht	6/15 Fxtl	6/15 Vema	6/27 Wht	6/27 Fxtl	6/27 Vema	7/30 Grft	7/30 Yeft	8/14 Yield
	oz ai/A	%	%	%	%	%	%	%	%	bu/A
Untreated Check	0	0	0	0	0	0	0	0	0	31
Thcz+Brox&MCPA	0.07+8	4	72	82	0	94	94	93	95	46
Thcz+Clpy&Flox&MCPA	0.07+6.5	4	72	69	0	95	93	97	98	43
Thcz+Brox&MCPA&Flox	0.07+8	4	71	89	0	96	93	94	97	46
Thcz+Clpy&Flox+MCPA ester	0.07+3+4	4	71	75	0	95	96	96	98	47
Thcz+Clpy&Flox+Thif-sg+Trib-sg	0.07+3+0.24+0.06	5	75	75	0	96	96	96	98	44
Thcz+Prcz+Brox&MCPA&Flox	0.07+0.14+8	5	70	85	0	96	97	96	97	44
Brox&Pyst&Thcz	3	3	69	85	0	95	98	93	95	46
Fenx&Brox&Pyst	5.4	0	81	91	0	96	98	99	91	49
CV		22	5	5	0	2	3	2	2	8
LSD P=.05		1	5	6	.	3	3	2	2	5

All treatments that included thiencarbazone resulted in mild stunting and chlorosis of 5% or less. Foxtail control was more rapid with fenoxaprop than thiencarbazone, which was expected because of differences in site of action. By June 27 foxtail control was consistent across all herbicide treatments at 94 to 96%. Once foxtail heads emerged, ratings were given for each species, but across four replicates there was little observed difference in control of green or yellow foxtail. Fenoxaprop seemed to be more effective on green foxtail while thiencarbazone tended to have higher rating for yellow foxtail.

Grass control with pyroxsulam. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 14. Treatments were applied to 3 leaf wheat, 2 to 3 leaf yellow foxtail, 2 to 3 inch redroot pigweed, and 1 to 2 inch common lambsquarters on June 7 with 73°F, 45% relative humidity, 40% cloud cover, 9.6 mph wind velocity at 165°, and dry soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/15 Wht	6/15 Yeft	6/15 Rrpw	6/15 Colq	6/22 Wht	6/22 Yeft	6/22 Rrpw	6/22 Colq	7/6 Yeft
	oz ai/A	%	%	%	%	%	%	%	%	%
Untreated	0	1	0	0	0	0	0	0	0	0
Pxlm&Flas&Flox+AMS+NIS	1.68+24+0.5%	3	75	84	75	1	87	95	90	97
Pxlm&Flox+AMS+NIS	2.1+24+0.5%	5	71	85	76	2	82	92	89	98
Pxlm&Flox+2,4-D ester+AMS	2.1+5.6+24	5	75	89	81	1	84	96	95	96
Pxlm&Clpy&Flox+AMS+NIS	3.2+24+0.5%	5	74	81	74	3	88	96	95	94
Pxlm&Clpy&Flox+2,4-D ester+AMS	3.2+5.6+24	5	80	89	82	2	85	95	95	96
Pxlm+Clpy&Flox&MCPA+AMS+NIS	0.21+8.5+24+0.125%	5	75	87	80	2	87	95	92	97
Brox&Pyst&Thcz	3	4	67	82	76	0	85	98	96	96
Pinoxaden+Clpy&Flox+AMS	0.86+3+24	0	94	90	84	0	98	98	94	99
Flcz-3+Clpy&Flox+AMS+NIS	0.44+3+24+0.25%	0	71	81	70	0	80	95	82	96
CV		19	3	4	6	142	3	2	3	1
LSD P=0.5		1	3	5	6	2	4	2	4	2

Chlorosis of wheat resulting from treatments that included pyroxsulam persisted until June 22. Pyroxsulam provided better control of yellow foxtail on June 15 than thiencarbazone and most treatments were better than flucarbazone as well. Foxtail control on June 22 was 80 to 87% across group 2 herbicides, but pinoxaden provided the best control at 98%. By July, all herbicides gave at least 94% control of foxtail.

Adjuvants with Pyroxsulam for Yellow Foxtail. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 14. Treatments were applied to 4 leaf wheat, 3 leaf yellow foxtail, 2 leaf Venice mallow, 1 to 6 inch common lambsquarters, and 1 to 5 inch redroot pigweed on June 7 with 75°F, 55% relative humidity, 80% cloud cover, 9.3 mph wind velocity at 135°, and moist soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/15 Wht	6/15 Yeft	6/15 Rrpw	6/15 Colq	6/15 Vema	6/22 Wht	6/22 Yeft	7/6 Yeft
	oz ai/A	%	%	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0	0	0
Pxlm&Clpy&Flox	3.2	3	75	84	71	72	1	80	91
Pxlm&Clpy&Flox+AMS-L	3.2+56	3	72	82	74	71	2	84	90
Pxlm&Clpy&Flox+Preference+AMS-L	3.2+0.25%+56	3	71	80	75	75	2	85	93
Pxlm&Clpy&Flox+AG16134+AMS-L	3.2+0.25%+56	3	71	84	72	75	1	87	94
Pxlm&Clpy&Flox+AG17047+AMS-L	3.2+0.25%+56	3	74	84	72	71	2	85	95
Pxlm&Clpy&Flox+AG13064+AMS-L	3.2+3+56	3	71	86	76	76	1	87	95
Pxlm&Clpy&Flox+AG16134+AG13064+AMS-L	3.2+0.25%+3+56	3	74	84	79	80	1	87	92
Pxlm&Clpy&Flox+AG8050+AMS-L	3.2+6.4+56	3	74	84	75	77	3	91	94
Pxlm&Clpy&Flox+ClassActNG	3.2+2.5%	3	74	84	72	71	2	91	93
CV		0	4	4	5	4	95	4	1
LSD P=0.5		.	4	4	5	4	2	4	2

Adjuvants did not increase the wheat response to pyroxsulam. Adjuvants did not alter the control of redroot pigweed. Herbicide control of lambsquarters and Venice mallow was improved with the combination of AG16134 plus AG13064 plus liquid AMS, although each of these alone or in two-way combinations did not affect broadleaf weed control. Control of yellow foxtail with herbicide was not improved June 15, but later evaluations in the season placed slight increase in control of up to 4 percentage points with addition of several adjuvant treatments.

Adjuvants with Flucarbazone for Yellow Foxtail Control. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 14. Treatments were applied to 2 leaf wheat, 2 to 3 leaf yellow foxtail, 1 inch Venice mallow, and 2 to 4 inch common lambsquarters on June 7 with 75°F, 49% relative humidity, 90% cloud cover, 4.7 mph wind velocity at 165°, and dry soil at 72°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/15 Wht	6/15 Yeft	6/15 Colq	6/15 Vema	6/22 Wht	6/22 Yeft	7/6 Yeft
	oz ai/A	%	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0	0
Flcz-3	0.43	1	71	59	71	0	67	91
Flcz-3+Preference	0.43+0.25%	0	71	59	66	1	79	93
Flcz-3+AG16134	0.43+0.25%	1	70	57	66	1	80	94
Flcz-3+AG17047	0.43+0.25%	4	75	66	74	3	77	94
Flcz-3+AG13064	0.43+3	4	72	64	70	3	82	92
Flcz-3+AG16134+AG13064	0.43+0.25%+3	4	76	67	71	1	84	94
Flcz-3+Preference+AG13064	0.43+0.25%+3	4	75	64	74	4	81	93
Flcz-3+AG8050	0.43+6.4	4	64	57	65	2	85	93
Flcz-3+AG14039	0.43+6.4	3	70	61	67	0	82	91
Flcz-3+AG14039	0.43+12	4	75	69	70	1	89	94
CV		68	4	8	4	175	4	2
LSD P=0.5		3	4	6	4	4	4	2

Several adjuvants resulted in more herbicide injury than was caused by flucarbazone alone. This response was noted at the second evaluation but was not different from flucarbazone for most adjuvant treatments. Flucarbazone plus Preference and AG13064 maintained 4% wheat response as stunting and chlorosis through June but was not detected in July. The high rate of AG14039 increased flucarbazone control of lambsquarters to 69%, but none of the adjuvant systems enhanced control of Venice mallow. AG8050 reduced control of Venice mallow with flucarbazone to 65% and also resulted in only 64% control of foxtail on June 15. By June 22, all adjuvants improved control of foxtail with flucarbazone. The most benefit was observed with the high rate of AG14039. In July, differences were identified but all herbicide treatments gave 91 to 94% control of yellow foxtail.

Grass Control with Flucarbazone Premix. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 14. Treatments were applied to 3 leaf wheat, 2 to 3 leaf yellow foxtail, 2 to 3 inch redroot pigweed, and 1 to 2 inch common lambsquarters on June 7 with 73°F, 45% relative humidity, 40% cloud cover, 9.8 mph wind velocity at 165°, and dry soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design.

Treatment	Rate	6/15 Wht	6/15 Yeft	6/15 Rrpw	6/15 Colq	6/22 Wht	6/22 Yeft	7/6 Yeft
	oz ai/A	%	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0	0
X2682aa+AMS+NIS	5.9+11+0.25%	0	69	84	76	0	71	84
X2682aa+Pxdn+AMS+NIS	5.9+0.64+11+0.25%	0	79	85	81	0	88	98
X2682aa+Thcz+AMS+NIS	5.9+0.03+11+0.25%	0	71	84	79	0	90	96
X2682aa+Pxlm+AMS+NIS	5.9+0.21+11+0.25%	7	76	85	82	0	87	93
X2682aa+Thif-sg+Trib-sg+AMS+NIS	5.9+0.1+0.1+11+0.25%	0	74	81	75	0	81	89
X2682aa+Brox&Pyst+AMS+NIS	5.9+2.97+11+0.25%	0	72	91	90	0	70	81
X2682aa+MCPA ester+AMS+NIS	5.9+4+11+0.25%	0	71	86	84	0	76	86
X2682aa+2,4-D ester+AMS+NIS	5.9+4+11+0.25%	0	74	89	81	0	76	90
X2682aa+Clpy+AMS+NIS	5.9+1.9+11+0.25%	0	71	84	79	0	74	86
X2682aa+Flox+AMS+NIS	5.9+2.24+11+0.25%	0	70	85	80	0	76	87
X2682aa+Brox-2+AMS+NIS	5.9+4+11+0.25%	0	74	89	84	0	70	85
X2682aa+Brox&Bcpy+CoAct+NIS	5.9+3+0.91+0.25%	0	84	94	90	0	96	95
Brox&Pyst&Thcz+AMS+NIS	3+11+0.25%	0	74	89	89	0	95	93
Pxlm&Clpy&Flox+AMS+NIS	3.2+11+0.25%	0	74	81	76	0	81	94
Pxdn+Brox&MCPA+CoAct+NIS	0.86+3+0.91+0.25%	0	94	89	87	0	98	99
CV		83	3	4	5	0	4	2
LSD P=0.5		1	3	5	5	.	4	3

Only the numbered formulation plus pyroxsulam resulted in wheat chlorosis, but the symptom was not observed at the second evaluation. X2682 plus bromoxynil and bicyclopyrone gave better foxtail control than X2682 alone on June 15 even though the added herbicide is primarily for broadleaf control. This treatment consistently out-performed other X2682 plus broadleaf mixtures throughout the season. This combination also gave exceptional benefit for broadleaf control relative to other mixtures.

Control of Volunteer Corn with Wheat Herbicides. Dr. Howatt and Mettler. DKC38-04RIB corn was seeded near Fargo on June 1 to simulate volunteer corn in wheat. Treatments were applied to V2 to V3 corn, 6 inch wheat, 6 to 12 inch mustard, 1 inch redroot pigweed, and cotyledon Venice mallow on June 19 with 89°F, 33 % relative humidity, 70% cloud cover, 5 mph wind velocity at 66°, and dry soil at 79°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	7/5 Vol Corn	7/16 Vol Corn
	oz ai/A	%	%
Quizalofop+PO	0.67+24	99	99
Fenoxaprop	1.32	99	99
Fenoxaprop	0.67	98	99
Clodinfop NG	0.8	99	99
Pinoxaden	0.86	16	42
Thif&Flox+BB	1.6+1%	42	39
Flcz-3+BB	0.32+1%	98	99
Pxlm+BB	0.21+1%	87	76
Immx+BB	0.5+1%	94	98
CV		5	9
LSD P=.05		6	11

Quizalofop was used as the standard as control of volunteer corn was known to be exceptional. Fenoxaprop and clodinafop provided complete control of corn. Pinoxaden, which typically controls annual grasses, had minimal activity on volunteer corn. Plants were stunted but none of the plants died. Flucarbazone and imazamox gave at least 94% control of corn while pyroxsulam ultimately gave 76% control. Thiencarbazone was not included in this trial because products are registered for use in corn that include three times the rate of thiencarbazone compared with wheat herbicides.

Dichlorprop Evaluation for Antagonism of Wild Oat Control. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 4. Treatments were applied to 3 leaf wheat, 2 to 3 leaf wild oat, and 1 leaf yellow foxtail on May 31 with 60°F, 88% relative humidity, 100% cloud cover, 6.5 mph wind velocity at 360°, and moist soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 03.

Treatment	Rate	6/14 Wht	6/14 Wioa	6/14 Fxtl	6/28 Wioa	7/12 Wioa	8/03 Yield
	oz ai/A	%	%	%	%	%	bu/A
Untreated Check	0	0	0	0	0	0	7
2,4-D-LV4+Fenx	8+1.32	0	75	74	85	89	12
2,4-D-LV4+Fenx	16+1.32	0	76	75	90	87	13
2,4-D-LV4+Fenx+Thif-sg+Trib-sg	16+1.32+0.32+0.08	0	72	67	82	79	11
2,4-D-LV4+Pxdn	16+0.86	0	84	86	99	98	13
2,4-D-LV4+Pxdn+Thif-sg+Trib-sg	16+0.86+0.32+0.08	0	81	76	99	99	15
Dichlorprop+Fenx	8+1.32	0	82	77	97	98	14
Dichlorprop+Fenx	16+1.32	0	82	81	97	97	16
Dichlorprop+Fenx+Thif-sg+Trib-sg	16+1.32+0.32+0.08	0	76	75	93	93	13
Dichlorprop+Pxdn	16+0.86	0	89	89	99	99	20
Dichlorprop+Pxdn+Thif-sg+Trib-sg	16+0.86+0.32+0.08	0	85	82	98	99	20
Fenx	1.32	0	86	86	97	97	17
Pxdn	0.86	0	85	89	99	99	16
CV		0	3	6	2	2	23
LSD P=0.5		.	3	6	3	3	5

2,4-D was used as a standard for the antagonistic response of some broadleaf herbicides on control of grasses with group 1 herbicides. Thifensulfuron and tribenuron also antagonize group 1 herbicides. Fenoxaprop has been susceptible to these interactions while pinoxaden has not been antagonized as often.

Yellow foxtail control with fenoxaprop was antagonized by 2,4-D and further antagonized by thifensulfuron and tribenuron for a total loss of nearly 20 percentage points. 2,4-D alone did not reduce control of foxtail with pinoxaden, but the addition of thifensulfuron and tribenuron with 2,4-D gave 76% control instead of 89% control with pinoxaden alone. Similar relationships were found in this study for dichlorprop on foxtail.

Initial wild oat control with fenoxaprop was less when dichlorprop was added, but control remained above 80% unless thifensulfuron and tribenuron also were included. Fenoxaprop control was not antagonized by dichlorprop on June 28 or July 12, unless thifensulfuron and tribenuron also were included to result in a low of 93% control.

Pinoxaden was not antagonized by dichlorprop or dichlorprop plus thifensulfuron and tribenuron.

Dichlorprop Evaluation for Antagonism of Foxtail Control. Dr. Howatt and Mettler. 'ND Vitpro' wheat was seeded near Fargo on May 14. Treatments were applied to 4 leaf wheat and 3 leaf yellow foxtail on June 7 with 75°F, 54% relative humidity, 80% cloud cover, 8.5 mph wind velocity at 135°, and moist soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/22 Wht	6/22 Yeft	7/6 Yeft	7/23 Yeft
	oz ai/A	%	%	%	%
Untreated Check	0	0	0	0	0
2,4-D-LV4+Fenx	8+0.8	0	75	92	86
2,4-D-LV4+Fenx	16+0.8	0	84	89	84
2,4-D-LV4+Fenx+Thif-sg+Trib-sg	16+0.8+0.32+0.08	0	85	91	81
2,4-D-LV4+Pxdn	16+0.86	0	97	98	98
2,4-D-LV4+Pxdn+Thif-sg+Trib-sg	16+0.86+0.32+0.08	0	93	98	94
Dichlorprop+Fenx	8+0.8	0	95	97	95
Dichlorprop+Fenx	16+0.8	0	91	94	91
Dichlorprop+Fenx+Thif-sg+Trib-sg	16+0.8+0.32+0.08	0	85	92	90
Dichlorprop+Pxdn	16+0.86	0	97	98	99
Dichlorprop+Pxdn+Thif-sg+Trib-sg	16+0.86+0.32+0.08	0	95	96	96
Fenx	0.8	0	94	96	97
Pxdn	0.86	0	99	99	99
CV		0	3	2	3
LSD P=0.5		.	4	3	4

2,4-D was used as a standard for the antagonistic response of some broadleaf herbicides on control of grasses with group 1 herbicides. Thifensulfuron and tribenuron also antagonize group 1 herbicides. Fenoxaprop has been susceptible to these interactions while pinoxaden has not been antagonized as often.

Fenoxaprop control of foxtail was 10 to 15 percentage points less with 2,4-D than alone on July 23, but the addition of thifensulfuron and tribenuron didn't reduce control much further. 2,4-D didn't affect foxtail control with pinoxaden, but adding thifensulfuron and tribenuron to the mixture resulted in 94% control.

Dichlorprop at the low rate didn't affect foxtail control with fenoxaprop, but the high rate resulted in drop in control of 6 percentage points. Adding thifensulfuron and tribenuron to this mixture did not affect control and the value was still 90%. Dichlorprop did not result in less foxtail control with pinoxaden, even when thifensulfuron and tribenuron were also added.

Dichlorprop Control of Kochia. Dr. Howatt, Mettler, and Harrington. Wheat was seeded near Valley City, ND. Treatments were applied to 4 leaf wheat and 1 to 6 inch kochia in heavy population on June 4 with 89°F, 21% relative humidity, 2% cloud cover, 3 to 5 mph wind velocity at 315°, and dry soil at 75°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	6/17 Kochia	7/1 Kochia	7/17 Kochia
	oz ai/A	%	%	%
Pxdn+Clpy&Flox	0.86+3	57	64	82
Pxdn+Flox-C	0.86+2	65	75	87
Pxdn+Brox&2,4-D&Flox	0.86+8	70	81	76
Pxdn+2,4-D-LV4	0.86+8	27	27	15
Pxdn+dichlorprop	0.86+8	80	81	85
Pxdn+dichlorprop	0.86+16	76	89	92
Pxdn+Brox&Pyst	0.86+3	89	79	76
CV		5	7	6
LSD P=0.5		5	7	6

The rapid necrosis caused by bromoxynil and pyrasulfotole resulted in 89% control on June 17, but plants that were not completely desiccated produced new tissue observed at July evaluations. Dichlorprop produced more rapid plant response than fluroxypyr, resulting in near 80% control compared with 65% for fluroxypyr. Fluroxypyr control of kochia reached 87% by July 17. At this evaluation, dichlorprop control was 85 to 92% depending on rate.

Talinor Control of Broadleaf Weeds Location 1. Dr. Howatt and Mettler. 'ND Vitpro' wheat was seeded near Valley City, North Dakota on May 23. Treatments were applied to 4 leaf wheat and 1 to 6 inch kochia at excessively high population on June 4 with 89°F, 21% relative humidity, 2% cloud cover, 3.5 mph wind velocity at 315°, and dry soil at 75°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 except kochia and yield that have four replicates.

Treatment	Rate	6/12 Wht	6/12 KOCZ	6/17 KOCZ	7/1 KOCZ	7/14 KOCZ
	oz ai/A	%	%	%	%	%
Pxdn	0.86	0	0	0	0	0
Pxdn+CoAct+Brox&Bcpy+PO	0.86+0.92+3+1%	0	79	82	81	82
Pxdn+Brox&Pyst+NIS	0.86+3.4+0.25%	0	75	81	80	81
Pxdn+Clpy&Flox	0.86+3	0	60	64	70	87
Pxdn+Thif-sg+Trib-sg+Clpy&Flox+NIS	0.86+0.24+0.06+3+0.25%	0	64	70	75	90
Pxdn+Clpy&Flox&MCPA	0.86+8	0	62	67	76	90
Pxdn+Brox&2,4-D&Flox	0.86+10	0	77	82	79	80
CV		0	3	4.	5	4
LSD P=0.5		.	3	4	5	5

Herbicides did not result in wheat injury. Treatments that included bromoxynil caused rapid leaf necrosis resulting in 75 to 80% control on June 12. Other treatments included sites of action that are slower to cause desiccation and gave less than 65% control. But the slower-acting treatments translocate through the plant and ultimately gave better control, near 90%. Even though the last treatment included fluroxypyr, the rapid action of bromoxynil likely reduced translocation of fluroxypyr to growing points allowing plants to recover more by July 14 with new, active tissue. Plants treated with clopyralid and fluroxypyr had not broken through the treatment effect by this date and were still distorted masses of brittle, yellow tissue.

Narrowleaf hawksbeard control in durum. (Minot). The objective of this study was to evaluate postemergence narrowleaf hawksbeard control in durum with Talinor compared to Huskie, WideMatch, and Affinity TM. Durum was planted May 14 and herbicide treatments were applied June 8 to 3- to 4-leaf durum.

Talinor, Huskie, and Affinity TM + WideMatch provided excellent control of narrowleaf hawksbeard (99%). WideMatch applied alone provided only 63% control at the July evaluation. Thus, WideMatch should always be applied with an SU herbicide like Affinity or Express to adequately control narrowleaf hawksbeard.

Table. Narrowleaf hawksbeard control in durum wheat. (1820)

			Weed Control	
			Narrowleaf Hawksbeard	
Treatment	Rate	Timing	Jun-20	Jul-11
			------%------	
Untreated			0	0
Talinor + COC + Coact+	13.7 oz + 1% + 2.75 oz	POST	92	99
Huskie + NIS	11 oz + 0.25%	POST	94	99
WideMatch	16 oz	POST	79	63
Affinity TM + WideMatch + NIS	0.6 oz + 16 oz + 0.25%	POST	91	99
LSD (0.05)			3.7	4.8

Soybean Control with Wheat Herbicides. Dr. Howatt and Mettler. The experiment was established near Fargo on May 24. Treatments were applied to an area with no crop to 1st trifoliolate dicamba-resistant soybean on June 13 with 80°F, 25% relative humidity, 10% cloud cover, 5 to 7 mph wind velocity at 225°, and damp soil at 78°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 Soybean	7/11 Soybean	7/23 Soybean
	oz ai/A	%	%	%
2,4-D ester	4	45	42	37
Dicamba	1	0	0	0
Fluroxypyr	1.5	74	84	85
Clopyralid	1.5	87	97	99
Halauxifen&Fla+NIS	0.15+0.25%	64	40	30
Thif-sg+NIS	0.2+0.25%	5	0	0
Trib-sg+NIS	0.2+0.25%	76	45	35
Flcz-3+BB	0.32+1%	84	90	84
Pxlm+BB	0.21+1%	89	98	98
Thcz+BB	0.07+1%	81	89	79
Carf+NIS	0.128+0.25%	17	7	2
Bromoxynil	3	73	58	39
Brox&Pyst	3.4	84	84	75
CoAct+Brox&Bcyp+PO	0.91+3+1%	95	93	87
CV		8	8	7
LSD P=.05		7	7	6

Dicamba was not expected to provide control because the area was seeded with dicamba-resistant soybean. Thifensulfuron did not cause much injury but tribenuron gave moderate suppression. Pyroxsulam or clopyralid provided the best control of soybean. Bromoxynil and pyrasulfotole or bicyclopyrone gave substantial desiccation by June 27, but plants started to recover by July 23. Wheat canopy would likely have shaded out remaining survivors. Wheat canopy possibly would have been enough to eliminate plants that remained in fluroxypyr, flucarbazone, or thiencarbazone treatments as well. There were more plants remaining but vigor was poor.

Soybean Control with Wheat Herbicides Location 2. Dr. Howatt and Mettler. The experiment was established near North Dakota State University campus on May 15. Treatments were applied to an area with no crop to 1st to 2nd trifoliolate soybean on June 13 with 84°F, 25% relative humidity, 10% cloud cover, 5 to 6 mph wind velocity at 225°, and damp soil at 79°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 Soybean
	oz ai/A	%
2,4-D ester	4	70
Dicamba	1	56
Fluroxypyr	1.5	82
Clopyralid	1.5	80
Halauxifen&Fla+NIS	0.15+0.25%	42
Thif-sg+NIS	0.2+0.25%	12
Trib-sg+NIS	0.2+0.25%	55
Flcz-3+BB	0.32+1%	74
Pxlm+BB	0.21+1%	86
Thcz+BB	0.07+1%	75
Carf+NIS	0.128+0.25%	17
Bromoxynil	3	60
Brox&Pyst	3.4	76
CoAct+Brox&Bcyp+PO	0.91+3+1%	88
CV		8
LSD P=.05		7

Pyroxsulam or bromoxynil and bicyclopyrone provided similar control near 90%. Fluroxypyr or clopyralid gave about 80% control and several treatments gave control in the 70s. Dicamba, while implicated in widespread off-target damage at exceptionally low rates, only gave 56% control in this trial. Full effect of dicamba would take longer than the 2 weeks that had elapsed in this trial.

Talinor Control of Broadleaf Weeds. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 16. Treatments were applied to 4 to 5 leaf wheat, 1 to 8 inch common lambsquarters and redroot pigweed, and 1 to 3 leaf Venice mallow on June 13 with 79°F, 38% relative humidity, 10% cloud cover, 7 to 8 mph wind velocity at 225°, and damp soil at 72°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with three replicates.

Treatment	Rate	6/20 Wht	6/20 Pgwd	6/20 Colq	6/20 Vema	6/27 Pgwd	6/27 Colq	6/27 Vema	7/12 Pgwd	7/12 Colq	7/12 Vema	7/23 Pgwd	7/23 Colq	7/23 Vema	8/10 Yield
	oz ai/A	%	%	%	%	%	%	%	%	%	%	%	%	%	bu/A
Pxdn	0.86	0	0	0	0	0	0	0	0	0	0	0	0	0	26
Pxdn+CoAct+Brox&Bcpy +PO	0.86+0.92+3 +1%	0	78	73	70	94	92	92	94	92	91	94	93	93	32
Pxdn+Brox&Pyst+NIS	0.86+3.4+0.25%	0	80	78	70	92	94	91	96	96	91	96	96	94	34
Pxdn+Clpy&Flox	0.86+3	0	72	68	63	84	63	68	85	73	80	92	73	82	25
Pxdn+Thif-sg+Trib-sg +Clpy&Flox+NIS	0.86+0.24+0.06 +3+0.25%	0	85	84	73	92	87	78	96	97	91	96	99	94	28
Pxdn+Clpy&Flox&MCPA	0.86+8	0	83	86	80	93	92	89	96	98	90	93	98	92	28
Pxdn+Brox&2,4-D&Flox	0.86+10	0	85	85	77	92	92	86	91	98	87	94	98	85	24
CV		0	5	4	5	4	3	5	3	2	5	3	3	3	20
LSD P=0.5		.	6	5	6	5	4	7	4	3	6	4	4	4	10

Herbicides did not cause injury to wheat. Bromoxynil and bicyclopyrone or pyroxasulfone provided more rapid control of weeds than other treatments that resulted in greater than 90% control of all species present by 2 weeks after application. Clopyralid and fluroxypyr did not give good control of lambsquarters or Venice mallow, but addition of sulfonylurea herbicides or MCPA brought overall control above 90% by the middle of July.

Talinor Control of Broadleaf Weeds Location 2. Dr. Howatt and Mettler. 'ND Vitpro' wheat was seeded near Prosper, North Dakota on May 23. Treatments were applied to 4 leaf wheat, 3 inch common lambsquarters, 4 inch common cocklebur, 2 inch common ragweed, waterhemp, and redroot pigweed on June 13 with 80°F, 25% relative humidity, clear sky, 7 mph wind velocity at 180°, and dry soil at 80°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	6/20 Wht	6/20 Cocb	6/20 Corw	6/20 Colq	6/20 Rrpw	6/20 Wahe	6/27 Wht	6/27 Cocb	6/27 Corw	6/27 Colq	6/27 Rrpw	6/27 Wahe
	oz ai/A	%	%	%	%	%	%	%	%	%	%	%	%
Pxdn	0.86	0	0	0	0	0	0	0	0	0	0	0	0
Pxdn+CoAct+Brox&Bcpy+PO	0.86+0.92+3+1%	6	88	90	88	90	82	5	99	99	98	99	96
Pxdn+Brox&Pyst+NIS	0.86+3.4+0.25%	2	91	92	93	91	88	0	99	99	99	99	97
Pxdn+Clpy&Flox	0.86+3	1	78	77	78	57	27	0	98	96	91	75	63
Pxdn+Thif-sg+Trib-sg +Clpy&Flox+NIS	0.86+0.24+0.06 +3+0.25%	1	85	77	82	85	57	0	96	90	90	93	78
Pxdn+Clpy&Flox&MCPA	0.86+8	0	85	82	82	82	63	0	98	87	93	96	85
Pxdn+Brox&2,4-D&Flox	0.86+10	0	95	92	95	88	78	0	99	96	98	96	78
CV		139	2	4	5	7.	14	0	2	2	2	3	6
LSD P=0.5		3	3	6	6	9	14	.	2	3	3	4	7

Treatment	Rate	7/11 Cocb	7/11 Corw	7/11 Colq	7/11 Rrpw	7/11 Wahe	7/23 Cocb	7/23 Corw	7/23 Colq	7/23 Rrpw	7/23 Wahe	8/17 Yield
	oz ai/A	%	%	%	%	%	%	%	%	%	%	bu/A
Pxdn	0.86	0	0	0	0	0	0	0	0	0	0	21
Pxdn+CoAct+Brox&Bcpy+PO	0.86+0.92+3+1%	98	99	99	99	96	99	99	99	98	98	32
Pxdn+Brox&Pyst+NIS	0.86+3.4+0.25%	99	98	99	99	98	99	98	99	99	99	42
Pxdn+Clpy&Flox	0.86+3	99	97	96	88	82	98	98	96	92	85	37
Pxdn+Thif-sg+Trib-sg +Clpy&Flox+NIS	0.86+0.24+0.06 +3+0.25%	99	98	98	93	87	99	98	99	97	88	37
Pxdn+Clpy&Flox&MCPA	0.86+8	99	97	99	96	92	98	98	99	96	94	42
Pxdn+Brox&2,4-D&Flox	0.86+10	98	95	99	96	93	98	95	99	98	96	35
CV		1	2	2	2	2	1	2	1	2	3	
LSD P=0.5		1	2	2	3	3	1	3	2	3	4	

Several treatments caused mild wheat injury of 6% or less. Only wheat treated with bromoxynil and bicyclopyrone showed injury on June 27, but injury was not observed in July. Bromoxynil and bicyclopyrone or pyrasulfotole provided excellent control of all weeds present, including waterhemp.

Broadleaf control in wheat. Dr. Howatt and Mettler. 'ND Vitpro' hard red spring wheat was seeded near Fargo on May 14. Treatments were applied to 3 to 4 leaf wheat, 2 to 4 inch wild buckwheat, and 1 inch redroot pigweed. 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	6/18 Wht	6/18 Rrpw	6/18 Wibw	7/1 Rrpw	7/1 Wibw
	oz ai/A	%	%	%	%	%
Pxdn+Clpy&Flox	0.86+3	0	88	90	92	98
Pxdn+2,4-D&Dica&Flox	0.86+9.5	0	94	93	97	96
Pxdn+Clpy&Flox&MCPA	0.86+8	0	91	89	96	95
Pxdn+Clpy&Flox+Thif-sg	0.86+2+0.2	0	96	94	99	97
Pxdn+Carf+2,4-D+NIS	0.86+0.128+4+0.25%	0	97	92	99	95
Pxdn+Carf+Dica+NIS	0.86+0.128+1+0.25%	0	95	89	98	91
Pxdn+Halauxifen&Flas+NIS	0.86+0.15+0.25%	0	93	92	94	96
Pxdn+Brox&MCPA	0.86+8	0	89	89	92	93
Pxdn+Brox&Pyrasulfotole	0.86+3.4	0	97	96	98	97
Pxdn+CoAct+Brox&Bcpy+PO	0.86+0.91+3+1%	0	97	96	98	95
Pxdn+Thifsg+Tribsg+MCPA+NIS	0.86+0.24+0.06+4+0.25%	0	97	94	98	98
Pxdn+Thifsg+Tribsg+2,4-D+NIS	0.86+0.15+0.15+4+0.25%	0	97	95	99	98
Pxdn+Brox&MCPA&Flox	0.86+10	0	94	92	97	96
Pxdn (Untreated)	0.86	0	0	0	0	0
CV		0	2	3	2	2
LSD P=.05		.	3	3	3	3

Treatments did not induce symptoms on wheat. Clopyralid and fluroxypyr or bromoxynil and MCPA were the only treatments to give less than 90% control of pigweed on June 18. These two treatments remained the least effective to pigweed although control eventually reached 92% in July. Carfentrazone and dicamba gave 91% control of buckwheat in July. Bromoxynil and MCPA also was on the lower end of activity with 93% control, while all other treatments provided 95 to 98% control of buckwheat.

Broadleaf control in wheat Loc 2. Dr. Howatt and Mettler. 'ND Vitpro' hard red spring wheat was seeded near Fargo on May 16. Treatments were applied to 4 to 5 leaf wheat, 1 to 10 inch redroot pigweed and waterhemp, and 1 to 8 inch common lambsquarters. 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	6/20 Wht	6/20 Pgwd	6/20 Colq	7/5 Wht	7/5 Pgwd	7/5 Colq
	oz ai/A	%	%	%	%	%	%
Pxdn+Clpy&Flox	0.86+3	0	58	72	0	72	89
Pxdn+2,4-D&Dica&Flox	0.86+9.5	7	82	82	6	99	99
Pxdn+Clpy&Flox&MCPA	0.86+8	0	67	80	3	84	98
Pxdn+Clpy&Flox+Thif-sg	0.86+2+0.2	0	85	82	0	97	99
Pxdn+Carf+2,4-D+NIS	0.86+0.128+4+0.25%	9	88	88	2	98	99
Pxdn+Carf+Dica+NIS	0.86+0.128+1+0.25%	28	87	83	78	89	96
Pxdn+Halauxifen&Flas+NIS	0.86+0.15+0.25%	0	75	68	6	73	95
Pxdn+Brox&MCPA	0.86+8	0	58	70	9	67	98
Pxdn+Brox&Pyrasulfotole	0.86+3.4	0	85	83	0	98	99
Pxdn+CoAct+Brox&Bcpy+PO	0.86+0.91+3+1%	0	85	87	7	95	98
Pxdn+Thifsg+Tribsg+MCPA+NIS	0.86+0.24+0.06+4+0.25%	0	82	83	6	95	97
Pxdn+Thifsg+Tribsg+2,4-D+NIS	0.86+0.15+0.15+4+0.25%	0	83	80	7	94	98
Pxdn+Brox&MCPA&Flox	0.86+10	0	75	80	2	88	97
Pxdn (Untreated)	0.86	0	0	0	0	0	0
CV		30	7	6	49	6	2
LSD P=.05		2	8	7	7	8	3

Wheat showed visible symptoms to three treatments on June 20. 2,4-D and dicamba and fluroxypyr resulted in slight stunting and chlorosis that could be attributed to the rate of dicamba in the mixture. Past work with this formulation has shown that the fluroxypyr seems to reduce the degree of injury but has not eliminated the potential of seeing a response. Carfentrazone and 2,4-D resulted in necrotic lesions that were typical of carfentrazone activity. There was not as much necrotic spotting of wheat with carfentrazone and dicamba, but rather intense stunting, washed out green color, and some stem curvature. Symptoms reached 78% injury in July. Other trials with this treatment did not demonstrate a similar synergy of injury between the tankmix components so a mixing error that provided a high rate of dicamba is a likely cause. Other injury ratings of wheat were slightly shorter wheat and occasionally mild chlorosis.

Symptoms were slow to develop with all treatments. Pigweed control was less than 75% with clopyralid and fluroxypyr, halauxifen and florasulam, and bromoxynil and MCPA on July 5. Several treatments provided 94% control or better of pigweeds. Clopyralid and fluroxypyr gave 89% control of lambsquaters, while all other treatments provided at least 95% control.

Broadleaf weed control with halauxifen. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 14. Treatments were applied to 3 to 4 leaf wheat, 3 inch wild buckwheat and redroot pigweed, and 1 inch Venice mallow, and 1 leaf green foxtail on June 4 with 74°F, 38% relative humidity, 10% cloud cover, 8 plus mph wind velocity at 225°, and dry soil at 66°F. All treatments included pinoxaden to manage grasses present. 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	6/18 Wht	6/18 Rrpw	6/18 Wibw	6/18 Vema	7/1 Rrpw	7/1 Wibw	7/1 Vema	7/30 Rrpw	7/30 Wibw	7/30 Vema	7/30 Grft
	oz ai/A	%	%	%	%	%	%	%	%	%	%	%
Untreated Check		0	0	0	0	0	0	0	0	0	0	99
Clpy&Flox+Haux&Flas+AMS +NIS	3+0.15+24 +0.25%	0	94	94	96	99	99	99	98	99	99	91
Clpy&Flox+Thif-sg+Thif-sg+AMS +NIS	3+0.1+0.1+24 +0.25%	0	96	93	96	99	97	99	99	99	99	88
Clpy&Flox+Thif-sg+Trib-sg+AMS +NIS	3+0.24+0.06+24 +0.25%	0	97	96	96	98	98	99	99	99	99	76
Clpy&Flox	3	0	86	92	92	94	97	97	96	99	99	95
Flox&Flas	1.5	0	95	91	94	98	97	98	99	99	99	94
Brox&Pyst+AMS	3.5+24	0	96	95	97	98	96	96	99	99	99	87
Clpy&Flox&MCPA	8.5	0	93	92	93	97	97	97	98	99	98	96
Haux&Flas+AMS+NIS	0.15+24+0.25%	0	92	93	95	95	97	97	98	99	99	94
Haux&Flas+Thif-sg+Trib-sg+AMS +NIS	0.15+0.1+0.1+24 +0.25%	0	96	95	97	99	99	99	99	99	99	89
CV		0	2	2	2	1	1	1	1	0	0	4
LSD P=0.5		.	2	3		2	2	1	1	.	0	5

Herbicides did not result in injury to wheat. All broadleaf herbicide treatments gave exceptional control of weeds present. Nearly all ratings were above 90% by 2 weeks after application. Antagonism of pinoxaden activity was present with several combinations. Thifensulfuron and tribenuron were among the most antagonistic. Bromoxynil and pyrasulfotole also reduced green foxtail control with pinoxaden to 87%.

Broadleaf weed control with Halauxifen location 2. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Prosper, North Dakota on May 23. Treatments were applied to 4 leaf wheat, 5 leaf common cocklebur, 2 inch common lambsquarters, redroot pigweed, and waterhemp, and 1 inch common ragweed on June 13 with 72°F, 50% relative humidity, clear sky, 6 mph wind velocity at 225°, and wet soil at 65°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/27 Wht	6/27 Cocb	6/27 Corw	6/27 Colq	6/27 Rrpw	6/27 Wahe	7/11 Cocb	7/11 Corw
Untreated Check	0	0	0	0	0	0	0	0	0
Clpy&Flox+Haux&Flas+AMS+NIS	3+0.15+24+0.25%	0	95	91	93	91	80	99	99
Clpy&Flox+Thif-sg+Thif-sg+AMS+NIS	3+0.1+0.1+24+0.25%	0	97	95	95	93	80	99	99
Clpy&Flox+Thif-sg+Trib-sg+AMS+NIS	3+0.24+0.06+24+0.25%	0	98	93	94	94	72	99	99
Clpy&Flox	3	0	96	91	92	87	70	99	99
Flox&Flas	1.5	0	93	88	72	78	62	99	98
Brox&Pyst+AMS	3.5+24	0	99	96	98	96	93	99	99
Clpy&Flox&MCPA	8.5	0	98	94	94	95	90	99	98
Haux&Flas+AMS+NIS	0.15+24+0.25%	0	98	94	89	96	89	98	98
Haux&Flas+Thif-sg+Trib-sg+AMS+NIS	0.15+0.1+0.1+24+0.25%	0	99	94	96	96	90	99	99
CV		0	1	3	5	4	8	0	1
LSD P=0.5		.	2	4	7	6	10	1	1

Treatment	Rate	7/11 Colq	7/11 Rrpw	7/11 Wahe	8/2 Cocb	8/2 Corw	8/2 Colq	8/2 Rrpw	8/2 Wahe
Untreated Check	0	0	0	0	0	0	0	0	0
Clpy&Flox+Haux&Flas+AMS+NIS	3+0.15+24+0.25%	98	97	89	99	99	98	97	89
Clpy&Flox+Thif-sg+Thif-sg+AMS+NIS	3+0.1+0.1+24+0.25%	99	98	89	99	99	99	98	89
Clpy&Flox+Thif-sg+Trib-sg+AMS+NIS	3+0.24+0.06+24+0.25%	98	97	84	99	99	98	97	84
Clpy&Flox	3	96	96	82	99	99	96	96	82
Flox&Flas	1.5	90	97	84	99	98	90	97	84
Brox&Pyst+AMS	3.5+24	99	99	99	99	99	99	99	99
Clpy&Flox&MCPA	8.5	99	98	96	99	98	99	98	96
Haux&Flas+AMS+NIS	0.15+24+0.25%	98	98	95	98	98	98	98	95
Haux&Flas+Thif-sg+Trib-sg+AMS+NIS	0.15+0.1+0.1+24+0.25%	99	99	89	99	99	99	99	89
CV		2	2	6	0	1	2	2	6
LSD P=0.5		3	3	8	1	1	3	3	8

Herbicide treatments did not result in wheat response. Bromoxynil and pyrasulfotole provided rapid activity and even gave 93% control of waterhemp 2 weeks after application. Fluroxypyr and florasulam gave less control of each species than other herbicides and only 62% control of waterhemp. By July, near complete control of cocklebur, lambsquarters, ragweed, and redroot pigweed was achieved with all herbicide treatments. Ratings in August directly mirrored the evaluation in July.

Adjuvants for Halauxifen. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 14. Treatments were applied to 3 leaf wheat, 1 inch Venice mallow and common lambsquarters, 2 to 4 inch wild buckwheat, 1 to 3 inch wild mustard, 2 inch redroot pigweed, and 1 to 2 leaf yellow foxtail on June 4 with 75°F, 38% relative humidity, clear sky, 5 plus wind velocity at 235°, and dry soil at 66°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	6/12 Wht	6/12 Wibw	6/12 Rrpw	6/12 Vema	6/18 Rrpw	6/18 Wibw	6/18 Vema	7/1 Rrpw	7/1 Wibw	7/1 Vema
	oz ai/A	%	%	%	%	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0	0	0	0	0
Haux&Flas	0.15	0	81	81	84	89	96	95	93	97	98
Haux&Flas+Preference	0.15+0.25%	0	89	85	87	94	92	95	92	96	97
Haux&Flas+AG16134	0.15+0.25%	0	90	85	87	92	95	96	96	99	99
Haux&Flas+AG17047	0.15+0.25%	0	87	81	85	91	96	95	94	98	98
Haux&Flas+AG13064	0.15+3	0	86	81	82	93	97	96	92	96	98
Haux&Flas+AG16134+AG13064	0.15+0.25%+3	0	84	75	82	88	93	96	89	96	99
Haux&Flas+Preference+AG13064	0.15+0.25%+3	0	86	81	86	89	95	95	94	98	99
Haux&Flas+AG8050	0.15+6.4	0	89	80	89	89	95	95	90	97	98
Haux&Flas+AG14039	0.15+6.4	0	86	80	86	93	96	94	93	99	99
Haux&Flas+AG14039	0.15+12	0	89	81	86	93	96	95	91	98	98
CV		0	3	5	4	4	2	2	3	1	1
LSD P=0.5		.	3	6	5	5	2	2	4	2	1

Herbicide treatments did not elicit response in wheat. Adjuvants improved control of wild buckwheat on June 12 but did not affect control of pigweed or Venice mallow. Adjuvants did not influence weed control with halauxifen and florasulam at later evaluations.

Adjuvants for Halauxifen location 2. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Prosper, North Dakota on May 23. Treatments were applied to 4 leaf wheat, 2 inch common lambsquarters and common ragweed, and 0.5 inch waterhemp on June 13 with 70°F, 50% relative humidity, clear sky, 6 mph wind velocity at 225°, and wet soil at 65°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/20 Wht	6/20 Colq	6/20 Corw	6/27 Corw	6/27 Colq	7/11 Corw	7/11 Colq	7/11 Wahe
	oz ai/A	%	%	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0	0	0
Haux&Flas	0.15	0	27	37	85	70	98	86	90
Haux&Flas+Preference	0.15+0.25%	0	53	72	90	87	98	97	94
Haux&Flas+AG16134	0.15+0.25%	0	53	75	90	80	99	96	94
Haux&Flas+AG17047	0.15+0.25%	0	53	73	94	90	99	99	95
Haux&Flas+AG13064	0.15+3	0	53	77	92	89	99	97	97
Haux&Flas+AG16134+AG13064	0.15+0.25%+3	0	53	72	94	87	99	92	93
Haux&Flas+Preference+AG13064	0.15+0.25%+3	0	53	70	93	91	99	98	95
Haux&Flas+AG8050	0.15+6.4	0	63	77	94	95	99	98	93
Haux&Flas+AG14039	0.15+6.4	0	60	77	95	92	99	96	96
Haux&Flas+AG14039	0.15+12	0	63	77	91	83	99	98	97
CV		0	12	7	3	5	1	3	4
LSD P=0.5		.	10	7	4	6	1	5	5

Herbicide treatments did not result in wheat response. Adjuvants greatly increased the speed of halauxifen and florasulam symptom development in lambsquarters and ragweed, essentially doubling control ratings on June 20. On June 27, inclusion of adjuvant increased control with herbicide by 5 to 10 percentage points in ragweed and 10 to 25 points in lambsquarters. Ragweed control was not affected in July, but control without adjuvant was 98%. Adjuvants still benefited herbicide control of lambsquarters and a similar response was observed for waterhemp.

Waterhemp Control with Flucarbazone. Dr. Howatt, Mettler, and Harrington. 'ND Vitpro' wheat was seeded near Fargo on May 16. Treatments were applied to 4 to 5 leaf wheat, 1 to 10 inch common lambsquarters and redroot pigweed, and 1 to 3 leaf Venice mallow on June 13 with 79°F, 39% relative humidity, 10% cloud cover, 7 to 8 mph wind velocity at 225°, and damp soil at 72°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	6/20 Wht	6/20 Pgwd	6/20 Colq	6/20 Vema	6/27 Wht	6/27 Pgwd	6/27 Colq	6/27 Vema
	oz ai/A	%	%	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0	0	0
X2682aa+AMS+NIS	5.9+11+0.25%	0	75	66	65	0	79	71	80
X2682aa+Pxdn+AMS+NIS	5.9+0.64+11+0.25%	0	75	60	62	0	84	85	81
X2682aa+Thcz+AMS+NIS	5.9+0.03+11+0.25%	0	71	67	64	0	88	81	84
X2682aa+Pxlm+AMS+NIS	5.9+0.21+11+0.25%	6	79	75	65	0	87	94	81
X2682aa+Thif-sg+Trib-sg+AMS+NIS	5.9+0.1+0.1+11+0.25%	0	75	70	65	0	87	94	80
X2682aa+Brox&Pyst+AMS+NIS	5.9+2.97+11+0.25%	0	81	77	74	0	91	92	87
X2682aa+MCPA ester+AMS+NIS	5.9+4+11+0.25%	0	84	80	71	0	87	95	82
X2682aa+2,4-D ester+AMS+NIS	5.9+4+11+0.25%	0	80	74	61	0	91	94	84
X2682aa+Clpy+AMS+NIS	5.9+1.9+11+0.25%	0	76	72	66	0	86	89	81
X2682aa+Flox+AMS+NIS	5.9+2.24+11+0.25%	4	77	75	66	0	85	85	82
X2682aa+Brox-2+AMS+NIS	5.9+4+11+0.25%	0	76	74	67	0	82	93	87
X2682aa+Brox&Bcpy+CoAct+NIS	5.9+3+0.91+0.25%	0	85	79	71	0	93	96	95
Brox&Pyst&Thcz+AMS+NIS	3+11+0.25%	0	79	80	66	0	89	95	82
Pxlm&Clpy&Flox+AMS+NIS	3.2+11+0.25%	4	81	72	75	0	86	81	82
Pxdn+Brox&Bcpy+CoAct+NIS	0.86+3+0.91+0.25%	0	81	76	71	0	91	96	89
CV		60	5	7	6	0	4	3	2
LSD P=0.5		1	5	7	6	.	4	4	4

Table 1 continued

Treatment	Rate	7/5 Pgwd	7/5 Colq	7/5 Vema	7/23 Pgwd	7/23 Colq	7/23 Vema
	oz ai/A	%	%	%	%	%	%
Untreated Check	0	0	0	0	0	0	0
X2682aa+AMS+NIS	5.9+11+0.25%	94	92	95	95	97	95
X2682aa+Pxdn+AMS+NIS	5.9+0.64+11+0.25%	92	88	93	95	97	95
X2682aa+Thcz+AMS+NIS	5.9+0.03+11+0.25%	93	89	94	95	97	95
X2682aa+Pxlm+AMS+NIS	5.9+0.21+11+0.25%	93	90	95	95	97	95
X2682aa+Thif-sg+Trib-sg+AMS+NIS	5.9+0.1+0.1+11+0.25%	92	92	95	95	97	95
X2682aa+Brox&Pyst+AMS+NIS	5.9+2.97+11+0.25%	96	98	97	95	97	95
X2682aa+MCPA ester+AMS+NIS	5.9+4+11+0.25%	95	95	94	95	97	95
X2682aa+2,4-D ester+AMS+NIS	5.9+4+11+0.25%	96	96	90	95	97	95
X2682aa+Clpy+AMS+NIS	5.9+1.9+11+0.25%	92	94	95	95	97	95
X2682aa+Flox+AMS+NIS	5.9+2.24+11+0.25%	93	92	97	95	97	95
X2682aa+Brox-2+AMS+NIS	5.9+4+11+0.25%	91	93	95	95	97	95
X2682aa+Brox&Bcpy+CoAct+NIS	5.9+3+0.91+0.25%	96	98	98	95	97	95
Brox&Pyst&Thcz+AMS+NIS	3+11+0.25%	96	98	93	95	97	95
Pxlm&Clpy&Flox+AMS+NIS	3.2+11+0.25%	93	90	97	95	97	95
Pxdn+Brox&Bcpy+CoAct+NIS	0.86+3+0.91+0.25%	96	98	96	95	97	95
CV		3	4	3	0.0	0.0	0.0
LSD P=0.5		4	5	4	.	.	.

Only three treatments resulted in wheat response and the injury was mild chlorosis on June 20. Two of the treatments included pyroxsulam. Wheat symptoms were not observed on June 27. While there were differences in weed control in June, none of the treatments stood out as exceptionally better or worse than the general response. By July 5, herbicide treatments generally gave 90% control or better. By July, treatments with bromoxynil and bicyclopyrone or pyroxasulfone provided more complete desiccation of tissue than other treatments, which is consistent with differences in sites of action.

Wheat Response to Glyphosate-4.5 at 4L. Dr. Howatt and Mettler. 'ND Vitpro' hard red spring wheat was seeded near Fargo on May 12. Treatments were applied to 4 to 5 leaf wheat on June 13 with 72°F, 53% relative humidity, 4 to 5 mph wind velocity at 280°, and damp soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 8. Stockglyt was a solution of 10 mL glyphosate (4.5)+90 mL H_2O.

Treatment	Rate	6/27 Wht	7/11 Wht	8/8 Yield
	oz ae/A	%	%	bu/A
Stockglyt+NIS+AMS	0.025+0.25%+12	0	0	49
Stockglyt+NIS+AMS	0.05+0.25%+12	1	0	48
Stockglyt+NIS+AMS	0.1+0.25%+12	8	7	38
Stockglyt+NIS+AMS	0.15+0.25%+12	22	27	21
Stockglyt+NIS+AMS	0.2+0.25%+12	55	61	11
Stockglyt+NIS+AMS	0.25+0.25%+12	71	80	7
Stockglyt+NIS+AMS	0.3+0.25%+12	81	87	2
Stockglyt+NIS+AMS	0.35+0.25%+12	90	94	0
Control				46
CV		8	6	12
LSD P=.05		5	4	4

Glyphosate at 0.1 oz ae/A (0.5 to 1% field rate) resulted in noticeable but mild injury of less than 10% at vegetative stages. But this treatment resulted in more than 20% less yield than lower rates. Small increases in glyphosate rate resulted in great increases in injury at vegetative stages and subsequent diminished yields.

Wheat Response to Glyphosate-4.5 at 4L Location 2. Dr. Howatt and Mettler. ND Vitpro hard red spring wheat was seeded near North Dakota State University campus on May 15. Treatments were applied to 4 to 5 leaf wheat, 1 to 10 inch common mallow and redroot pigweed on June 13 with 73°F, 59% relative humidity, 10% cloud cover, 2 mph wind velocity at 315°, and damp soil at 68°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 10. Stockglyt = 10mL Glyt 4.5+90 mL H_2O.

Treatment	Rate	6/24 Wht	7/11 Wht	8/10 Yield
	oz ae/A	%	%	bu/A
Stockglyt+NIS+AMS	0.025+0.25%+12	0	0	32
Stockglyt+NIS+AMS	0.05+0.25%+12	1	0	40
Stockglyt+NIS+AMS	0.1+0.25%+12	4	0	44
Stockglyt+NIS+AMS	0.15+0.25%+12	9	4	38
Stockglyt+NIS+AMS	0.25+0.25%+12	40	25	29
Stockglyt+NIS+AMS	0.3+0.25%+12	55	45	26
Stockglyt+NIS+AMS	0.35+0.25%+12	67	59	25
Control				50
CV		11	17	22
LSD P=.05		4	5	11

Glyphosate at 0.15 oz ae/A (0.8 to 1.2% field rate) resulted in noticeable but mild injury of less than 10% at vegetative stages. But this treatment resulted in more than 20% less yield than the untreated. Small increases in glyphosate rate resulted in great increases in injury at vegetative stages and subsequent diminished yields.

Wheat Response to glyphosate-4.5 at 4L Location 3. Dr. Howatt and Mettler. ND Vitpro hard red spring wheat was seeded near Prosper North Dakota on May 23. Treatments were applied to 4 leaf wheat, 3 inch common cocklebur, 2 inch common lambsquarters and 3 inch pigweed on June 13 with 70°F, 50% relative humidity, 0% cloud cover, 3.2 mph wind velocity at 225°, and wet soil at 65°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11001 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates. Harvest for yield was August 17. Stockglyt=10 mL glyphosate 4.5 + 90 mL H_2O.

Treatment	Rate	6/27 Wht	7/11 Wht	8/17 Yield
	oz ae/A	%	%	bu/A
Stockglyt+NIS+AMS	0.025+0.25%+12	0	0	54
Stockglyt+NIS+AMS	0.05+0.25%+12	0	0	54
Stockglyt+NIS+AMS	0.1+0.25%+12	0	0	55
Stockglyt+NIS+AMS	0.15+0.25%+12	7	5	52
Stockglyt+NIS+AMS	0.2+0.25%+12	18	13	44
Stockglyt+NIS+AMS	0.25+0.25%+12	27	18	47
Stockglyt+NIS+AMS	0.3+0.25%+12	67	47	44
Stockglyt+NIS+AMS	0.35+0.25%+12	77	50	38
C.V.		12	38	11
LSD P=0.5		5	11	10

Glyphosate at 0.15 oz ae/A (0.8 to 1.2% field rate) resulted in noticeable but mild injury of less than 10% at vegetative stages. But contrary to other trials with this protocol, yield was not less than for wheat at lower rates. Glyphosate at 0.2 oz/A resulted in nearly 20% injury during early evaluation, and this corresponded with 20% less yield than lower rates. Small increases in glyphosate rate resulted in great increases in injury at vegetative stages. Yield was reduced by just more than 30% rather than 50% or 100% as in other trials this year.

Chemical desiccation of wheat. Dr. Howatt and Mettler. 'Vitpro' hard red spring wheat and 'Tioga' durum were seeded in three different areas near Fargo on May 22. Treatment information is as follows:

Area treated	Stage	Date 2018	Air °F	RH %	Cloud cover %	Wind velocity mph	Wind direction °	Soil moisture	Soil °F
Wht	Soft dough	8/3	74	61	20	4	180	dry	74
WhtB	Soft to hard dough 60 to 70%	8/8	76	59	80	3.9	270	dry	74
Durum	Soft to hard dough 80 to 85%	8/14	65	81	75	3.9	0	damp	67

All treatments were applied with a backpack sprayer delivering 17 gpa at 40 psi through 11002 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiments were a randomized complete block design with 3 replicates.

Treatment	Rate	3 DAT 8/6 Wht	7 DAT 8/10 Wht	14 DAT 8/17 Wht	2 DAT 8/10 WhtB	6 DAT 8/14 WhtB	2 DAT 8/14 Durum
	oz ai/A	%	%	%	%	%	%
Untreated Check	0	59	84	96	86	94	91
Glyt-4.5+AMS	12+24	70	94	99	85	97	96
Gluf+AMS	9.4+48	80	96	99	90	98	97
Diquat+NIS	6+0.25%	76	92	99	91	98	97
Saff+MSO+AMS	0.36+1%+24	57	84	96	86	94	93
Sodium Chlorate+MSO	96+1%	67	91	97	89	96	95
CV		7	1	1	3	1	1
LSD P=.05		7	2	1	6	2	2

Glufosinate or diquat provided rapid and strong desiccation of wheat and durum. Glyphosate gave similar level of desiccation to glufosinate or diquat but it took a few more days to reach similar levels. Sodium chlorate gave less desiccation but benefit was observed. Wheat desiccation with saflufenacil was not different from the untreated.

Wheat and durum response to desiccation. Ostlie

A desiccation study was established in 2018 to compare cereal desiccation options. Wheat and durum were planted on May 14. Treatments were applied when cereal crops appeared largely ripe, but sooner than recommended in order to pick up greater treatment differences. Plots were harvested 7 days after application.

Table 1. Wheat response to desiccants.

Treatment	Head	Stem	Head	Stem	Moisture	Test Weight	Yield	Germ
	0 DAT	0 DAT	7 DAT	7 DAT	%	lb/bu	bu/a	%
check	68.8	60.0	92.5	92.3	20.1	56.1	58.5	79.0
Glyphosate + NIS + AMS	70.0	60.0	99.0	99.0	16.9	56.7	58.2	75.0
Glufosinate + AMS	62.5	51.3	99.0	98.0	17.0	55.5	56.3	70.5
Reglone + NIS	66.3	56.3	97.0	96.8	18.7	55.9	63.2	60.0
Valor + MSO	63.8	55.0	88.8	90.0	25.9	56.1	63.6	61.0
Brine	68.8	57.5	96.0	98.0	19.4	56.0	58.6	75.5
LSD (0.05)	6.5	NS	2.4	6.3	4.1	2.5	7.1	10.2

Table 2. Durum response to desiccants.

Treatment	Head	Stem	Head	Stem	Moisture	Test Weight	Yield	Germ %
	0 DAT	0 DAT	7 DAT	7 DAT	%	lb/bu	bu/a	bu/a
check	56.3	57.5	81.3	88.8	31.5	62.8	66.0	55.8
Glyphosate + NIS + AMS	71.3	71.3	99.0	99.0	21.1	61.4	59.5	61.8
Glufosinate + AMS	66.3	70.0	96.0	98.0	23.1	61.5	59.8	67.0
Reglone + NIS	67.5	68.8	94.8	98.0	24.8	60.9	62.7	54.0
Valor + MSO	70.0	68.8	85.0	87.5	24.0	61.9	64.1	62.3
Brine	70.0	72.5	94.8	97.0	22.2	59.5	59.5	55.0
LSD (0.05)	14.2	13.5	8.3	7.9	10.3	3.0	8.1	NS

Both crops experienced rapid natural dry down following application timing. For both wheat and durum, Valor did not improve dry down rate. Variability in maturity prevented much treatment separation beyond that, with the exception that brine had efficacy was reduced compared to glyphosate and glufosinate. Grain moisture differed only between glyphosate and check treatments in durum. Germination was measured with Reglone and Valor causing lower germination than the check in wheat. No germination differences were detected in durum.