Tan Section: Adjuvant and Application Technology Page

Broadleaf Weed Control with Glyphosate and Dicamba in Soybean with PWM Technology.

Kelly Satrom, Dr. Kirk Howatt. 'AG06X7' soybean was seeded near Prosper, North Dakota on May 24. Treatments were applied to V4 soybean, 6 to 12 inch pigweed (primarily redroot) common lambsquarters, and common ragweed on June 27 with 85°F, 46% relative humidity, 5% cloud cover, 3.2 mph wind velocity at 22.5°, and dry soil at 90°F. Treatments were applied with a pulse width modulation sprayer mounted on a Polaris Ranger delivering 15 gpa at 40 psi through various Wilger nozzles to a 12 foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with three replicates.

Treatment		Colq		Pgwd		Corw	
Droplet Size	Speed	14DAT	28DAT	14DAT	28DAT	14DAT	28DAT
µm	km/h	%	%	%	%	%	%
Handboom		96	99	99	99	99	99
250	6	99	98	99	99	99	99
250	12	99	99	96	99	96	99
250	18	99	98	99	98	99	98
400	6	99	99	99	99	99	99
400	12	96	99	96	99	96	99
400	18	96	98	99	98	99	99
600	6	99	98	99	99	99	99
600	12	99	99	99	99	99	99
600	18	99	99	99	99	99	99
750	6	99	99	99	98	99	99
750	12	96	98	99	98	99	99
750	18	99	99	99	98	96	99
Untreated Check		0	0	0	0	0	0
CV		2.96	0.775	2.187	0.975	2.635	0.386
LSD P=0.05		4.53	1.19	3.36	1.49	4.04	0.52

The interaction between droplet size and speed had no effect on control of common lambsquarters, pigweed species, and common ragweed.

Broadleaf Weed Control with Glufosinate and Fomesafen in Soybean with PWM Technology. Kelly Satrom, Dr. Kirk Howatt. 'S04LL37' soybean was seeded near Prosper, North Dakota on May 24. Treatments were applied to V4 soybean, 12 to 14 inch pigweed (primarily redroot), common lambsquarters, and common ragweed on June 27 with 89°F, 55% relative humidity, 5% cloud cover, 3.2 mph wind velocity at 22.5°, and dry soil at 82°F. Treatments were applied with a pulse width modulation sprayer mounted on a Polaris Ranger delivering 15 gpa at 40 psi through various Wilger nozzles to a 12 foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with three replicates.

Treatment		Colq		Pgwd		Corw	
Droplet Size	Speed	14DAT	28DAT	14DAT	28DAT	14DAT	28DAT
µm	km/h	%	%	%	%	%	%
Handboom		99	98	99	98	99	99
250	6	99	98	99	99	99	99
250	12	99	98	99	98	99	99
250	18	99	99	99	99	99	99
400	6	99	98	99	99	99	99
400	12	99	92	99	94	99	99
400	18	99	97	98	96	99	99
600	6	99	95	99	95	99	99
600	12	99	98	99	99	99	99
600	18	99	96	99	96	98	97
750	6	99	98	99	98	99	99
750	12	96	94	99	94	99	99
750	18	99	94	99	91	99	99
Untreated Check		0	0	0	0	0	0
CV		1.514	4.933	0.672	4.711	0.336	0.571
LSD P=0.05		2.33	7.42	1.04	7.09	0.52	0.89

The interaction between droplet size and speed had no effect on control of common lambsquarters, pigweed species, and common ragweed.

Broadleaf Weed Control with Bromoxynil and Pyrasulfotole in Wheat with PWM Technology.

Kelly Satrom, Dr. Kirk Howatt. 'ND Vitpro" wheat was seeded near Prosper, North Dakota on May 22. Treatments were applied to 4 leaf wheat, 6 to 12 inch common lambsquarters and common ragweed on June 27 with 83°F, 70% relative humidity, 75% cloud cover, 3.2 mph wind velocity at 45°, and dry soil at 78°F. Treatments were applied with a pulse width modulation sprayer mounted on a Polaris Ranger delivering 15 gpa at 40 psi through various Wilger nozzles to a 12 foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with three replicates.

Treatment		Colq		Corw	
Droplet Size	Speed	14DAT	28DAT	14DAT	28DAT
µm	km/h	%	%	%	%
Handboom		63	87	65	87
250	6	72	87	57	82
250	12	75	88	68	88
250	18	65	95	58	87
400	6	91	98	89	86
400	12	77	85	65	80
400	18	76	92	68	92
600	6	86	90	71	85
600	12	83	83	63	83
600	18	71	93	55	83
750	6	73	78	67	73
750	12	78	77	63	77
750	18	63	70	50	78
Untreated Check		0	0	0	0
CV		22.641	12.47	23.95	12.482
LSD P=0.05		26.45	16.77	24.14	16.19

Control ratings at 14 DAT with pulse-sprayer treatments were mostly consistent compared to treatments with the handboom which produced droplets near 300µm. Within each droplet size, there is a slight trend for a reduction in control as speed increases.

Compared with the handboom control ratings where similar with pulse-sprayer treatments 28DAT at droplet sizes ranging from 250-600µm. At 28 DAT, the targeted droplet size of 750µm showed reduced control at all three speeds, and showed a trend for control to decrease with increasing speed.

The lowest control values at each droplet size were mostly obtained from the highest speed, but occasionally, the fastest speed was responsible for an increase in a higher level of control, which was only evident in ratings 28DAT.

Broadleaf Weed Control with 2, 4-D, Thifensulfuron, and Tribenuron in Wheat with PWM Technology. Kelly Satrom, Dr. Kirk Howatt. 'ND Vitpro" wheat was seeded near Prosper, North Dakota on May 22. Treatments were applied to 4 leaf wheat, 6 to 12 inch common lambsquarters and common ragweed on June 27 with 71°F, 85% relative humidity, 75% cloud cover, 4.7 mph wind velocity at 45°, and dry soil at 72°F. Treatments were applied with a pulse width modulation sprayer mounted on a Polaris Ranger delivering 15 gpa at 40 psi through various Wilger nozzles to a 12 foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with three replicates.

Treatment		Colq		Corw	
Droplet Size	Speed	14DAT	28DAT	14DAT	28DAT
µm	km/h	%	%	%	%
Handboom		99	99	80	90
250	6	99	98	50	82
250	12	95	97	53	75
250	18	99	98	43	79
400	6	93	99	62	87
400	12	91	99	52	80
400	18	96	98	48	80
600	6	93	98	53	80
600	12	99	97	43	82
600	18	83	95	53	83
750	6	96	98	53	82
750	12	88	98	65	82
750	18	94	99	58	84
Untreated Check		0	0	0	0
CV		6.175	1.903	78.898	8.725
LSD P=0.05		9.07	2.91	24.77	11.14

Compared with the handboom control, which produce droplets near 300µm, pulse-sprayer treatments to common lambsquarters provided mostly similar control. At 14 DAT, all treatments were at an acceptable level on control, which increased by 28DAT

Compared with the handboom control, pulse-sprayer treatments to common ragweed demonstrated significantly worse control ratings. At 14DAT and the smaller droplet sizes, increasing speed decreased control. However at the larger droplet sizes, there is a trend for control to decrease at 12 km/h and then increase again at 18km/h. At 28DAT, increases in speed again reduced control with 250 and 400µm droplets. With 600 and 750µm droplets, speed increased control ratings, but only slightly and the differences were not significant.

Adjuvant enhancement of Saflufenacil. An experiment was established near North Dakota State University campus on September 5. Treatments were applied on 12 to 20 inch flowering common ragweed, lance leaf sage, and redroot pigweed on September 9 with 68°F, 43% relative humidity, 0% cloud cover, 6.8 mph wind velocity at 355°, and slightly moist soil at 60°F. Treatments were applied with a backpack sprayer delivering 17 gpa at 40 psi through 11002 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates, except where noted below.

Treatment	Rate	9/14 Corw	9/14 Vema	9/26 Corw	9/26 Vema	9/26 Colq	9/26 Rrpw
Untreated Check	0	0	0	32	0	37	35
Saflufenacil+NIS	0.36+0.25%	81	65	90	68	59	81
Saflufenacil+MSO	0.36+20	80	85	89	96	57	72
Saflufenacil+WE1569	0.36+0.5%	84	60	90	88	57	82
Saflufenacil+WE1594	0.36+0.5%	75	70	87	78	55	77
Saflufenacil+WE1851	0.36+1%	84	75	89	88	60	75
Saflufenacil+WE1852	0.36+0.5%	81	95	86	92	47	90
Saflufenacil+WE1853	0.36+0.5%	75	75	86	93	51	82
CV		8	.	9	19	28	15
LSD P=.05		8	.	11	21	22	20

Venice mallow rating on September 14 was observations in one replicate. Saflufenacil activity on common ragweed was most rapid with addition of WE1569 or WE1851, which resulted in 84% control 5 days after application. Ragweed control on September 9 ranged from 86 to 90% control with saflufenacil treatments. MSO was a better adjuvant than NIS for saflufenacil control of Venice mallow. WE1852 or WE1853 also resulted in greater than 90% control of mallow. But these adjuvants tended to be on the lower side of enhancement range for saflufenacil control of common lambsquarters. WE1852 resulted in saflufenacil control of pigweed at 90%. There was not a consistent adjuvant for improving control of these species with saflufenacil.

Adjuvants with Glyphosate. Dr. Howatt, Mettler, and Harrington. Flax, quinoa, amaranth and buckwheat were seeded near Hillsboro, North Dakota on May 31. Treatments were applied to 6 to 16 inch flax, 12 to 20 inch tame buckwheat, 9 to 20 inch quinoa, and 10 to 16 inch amaranth on July 5 with 72°F, 63% relative humidity, clear sky, 2 mph wind velocity at 360°, and moist soil at 71°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through 11002 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	7/16 Flax	7/16 Quinoa	7/16 Amth	7/16 Buckwht	8/2 Flax	8/2 Quinoa	8/2 Amth	8/2 Buckwht
	oz ai/A	%	%	%	%	%	%	%	%
Glyt-BP	6	80	83	83	73	83	86	89	83
Glyt-BP+AMS-L	6+2.5%	90	80	88	83	93	90	94	90
Glyt-BP+WC109	6+2.5%	83	87	90	85	88	95	96	95
Glyt-BP+AMS-L+WC225	6+2.5%+0.25%	92	96	93	88	96	98	95	94
Glyt-BP+WC221	6+0.25%	88	92	86	82	95	99	94	88
Glyt-BP+WC221	6+0.5%	92	94	85	85	94	99	91	87
Glyt-BP+WC221	6+0.75%	94	96	94	85	96	98	96	92
Glyt-BP+AMS-L+WC221	6+2.5%+0.25%	87	94	90	88	95	98	94	94
Glyt-BP+AMS-L+WC221	6+2.5%+0.5%	91	96	96	91	92	98	97	96
Glyt-BP+WC305	6+0.5%	82	91	83	82	89	98	90	87
Glyt-BP+WC232	6+0.5%	86	96	93	86	91	98	96	91
Glyt-BP+WC115	6+0.5%	80	90	83	78	85	94	90	88
Glyt-BP+WC232+WC345	6+0.5%+0.75%	87	90	89	82	94	97	95	92
Glyt-BP+WC356+WC232	6+0.5%+0.5%	91	91	87	80	94	97	91	91
Glyt-BP+WC239	6+0.5%	58	37	86	82	73	63	91	91
Glyt-BP+WC301	6+0.5%	91	93	85	86	95	96	92	94
Glyt-BP+WC356+WC221	6+0.5%+0.5%	91	96	92	86	96	98	94	93
Glyt-BP+WC356+WC305	6+0.5%+0.5%	83	94	88	88	87	96	91	96
CV		5	3	4	4	3	2	3	2
LSD P=0.5		6	5	5	5	4	4	4	4

Glyphosate was applied at a low rate of 6 oz ae/A to allow for separation of treatments by adjuvant system. Flax control was improved with addition of AMS, WC221, or WC 301, while control was substantially reduced by inclusion of WC 239. Quinoa control was improved most with WC225, WC221, and WC232, but again WC239 resulted in very low control. Amaranth control was improved by most adjuvant treatments except low rates of WC 221, WC305, WC115, WC239, and WC301. Control of tame buckwheat was improved by all adjuvant treatments with greatest increase resulting from AMS plus WC221. Treatments that included WC221 consistently provided high levels of control, while WC239 antagonized control of flax and quinoa with glyphosate.

Adjuvants with Glyphosate&2,4-D. Dr. Howatt, Mettler, and Harrington. Flax, quinoa, amaranth, and tame buckwheat were seeded by Hillsboro, North Dakota on May 31. Treatments were applied to 12 to 20 inch tame buckwheat, 9 to 16 inch flax, 9 to 20 inch quinoa, and 10 to 16 inch amaranth on July 5 with 72°F, 63% relative humidity, clear sky, 2 mph wind velocity at 360°, and moist soil at 71°F. Treatments were applied with a backpack sprayer delivering 17 gpa at 40 psi through 11002 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	7/16 Flax	7/16 Quinoa	7/16 Amaranth	7/16 Buckwheat	8/2 Flax	8/2 Quinoa	8/2 Amaranth	8/2 Buckwheat
	oz ai/A	%	%	%	%	%	%	%	%
Glyt&2,4-D	16.5	78	93	90	84	83	97	96	96
Glyt&2,4-D+AMS-L	16.5+2.5%	87	95	87	84	96	99	95	97
Glyt&2,4-D+AMS-L+WC112	16.5+2.5%+0.5%	88	93	91	86	96	99	97	98
Glyt&2,4-D+WC109	16.5+2.5%	86	94	92	86	93	99	97	96
Glyt&2,4-D+WC115	16.5+0.5%	73	96	93	87	82	99	97	96
Glyt&2,4-D+AMS-L+WC221	16.5+2.5%+0.25%	88	97	96	93	95	99	97	98
Glyt&2,4-D+WC221	16.5+0.5%	88	97	96	87	96	99	97	96
Glyt&2,4-D+WC239	16.5+0.5%	72	94	93	83	80	98	95	94
Glyt&2,4-D+AMS-L+WC256	16.5+2.5%+3	86	95	93	87	96	99	98	98
Glyt&2,4-D+AMS-L+WC160	16.5+2.5%+3	78	98	96	91	85	99	97	98
CV		3	2	3	3	3	1	1	2
LSD P=0.5		5	3	4	4	4	2	2	3

Initial control with glyphosate and 2,4-D was good to excellent. Control of flax was improved with all adjuvants except WC115, WC239, or WC160. Control of quinoa, amaranth, and tame buckwheat was improved with WC221 or WC160. Therefore, WC221 was the only adjuvant associated with improved control of all species by glyphosate and 2,4-D.

Adjuvants with Tembotrione+Glyphosate. Dr. Howatt, Mettler, and Harrington. Flax, quinoa, amaranth, and buckwheat were seeded near Hillsboro, North Dakota on May 31. Treatments were applied to 9 to 16 inch flax, 12 to 20 inch tame buckwheat, 9 to 20 inch quinoa, 1nd 10 to 16 inch amaranth on July 5 with 72°F, 63% relative humidity, clear sky, 2 mph wind velocity at 360°, and moist soil at 71°F. Treatments were applied with a backpack sprayer delivering 17 gpa at 40 psi through 11002 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	7/16 Flax	7/16 Quinoa	7/16 Amar	7/16 Bucwht	8/2 Flax	8/2 Quinoa	8/2 Amar	8/2 Bucwht
	oz ai/A	%	%	%	%	%	%	%	%
Temb+Glyt-BP	0.87+6	67	53	72	72	78	80	83	86
Temb+Glyt-BP+WC109	0.87+6+2.5%	85	88	87	85	92	96	91	96
Temb+Glyt-BP+WC240+WC079	0.87+6+2.5%+0.5%	78	63	87	80	87	88	93	93
Temb+Glyt-BP+WC240+WC266	0.87+6+2.5%+0.5%	77	68	88	83	82	87	91	93
Temb+Glyt-BP+WC240+WC221	0.87+6+2.5%+0.25%	86	91	92	83	92	95	94	95
Temb+Glyt-BP+WC240+WC221	0.87+6+2.5%+0.5%	91	95	95	87	98	99	97	98
Temb+Glyt-BP+WC221	0.87+6+0.5%	92	94	86	82	97	99	89	91
Temb+Glyt-BP+WC240+WC232	0.87+6+2.5%+0.5%	84	89	94	85	91	94	96	96
Temb+Glyt-BP+WC240+WC250	0.87+6+2.5%+0.25%	75	82	89	82	82	90	94	94
Temb+Glyt-BP+WC240+WC239	0.87+6+2.5%+0.5%	65	77	88	88	78	88	92	95
Temb+Glyt-BP+WC240+WC301	0.87+6+2.5%+0.5%	86	90	93	86	90	95	96	95
Temb+Glyt-BP+WC240+WC68	0.87+6+2.5%+0.5%	85	83	89	84	94	90	94	94
Temb+Glyt-BP+WC240+WC342	0.87+6+2.5%+0.5%	87	91	94	87	92	95	97	96
Temb+Glyt-BP+WC240+WC161	0.87+6+2.5%+0.5%	77	84	87	83	85	90	94	92
CV		4	4	4	6	4	2	2	3
LSD P=0.5		5	5	5	8	6	3	3	4

Tembotrione and glyphosate were applied at low rates to allow separation of treatments by adjuvant system. Control of species with tembotrione and glyphosate was improved with each of the adjuvant systems. Across species, treatments that included WC221 gave the best control.

Adjuvants with Glufosinate. Dr. Howatt, Mettler, and Harrington. Flax, Quinoa, Amaranth, and Buckwheat were seeded near Hillsboro, North Dakota on May 31. Treatments were applied to 4 inch flax, 6 inch quinoa, 6 inch amaranth, and 8 inch tame buckwheat on June 28 with 79°F, 60% relative humidity, clear sky, 3 mph wind velocity at 180°, and dry soil at 79°F. Treatments were applied with a backpack sprayer delivering 17 gpa at 40 psi through 11002 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design.

Treatment	Rate	7/9 Flax	7/9 Quinoa	7/9 Amaranth	7/9 Buckwheat	7/16 Flax	7/16 Quinoa	7/16 Amaranth	7/16 Buckwheat
	oz ai/A	%	%	%	%	%	%	%	%
Gluf	4.7	72	47	62	63	63	37	33	40
Gluf+AMS-L	4.7+56	85	87	78	87	67	77	47	70
Gluf+AMS-L	4.7+112	77	75	78	88	53	57	37	63
Gluf+WC109	4.7+56	86	87	78	86	72	68	53	68
Gluf+WC221+AMS-L	4.7+0.25%+56	87	88	83	87	72	82	68	78
Gluf+WC221	4.7+0.5%	67	60	70	73	43	47	33	37
Gluf+WC221	4.7+0.75%	62	37	57	53	33	30	27	30
Gluf+WC225+AMS-L	4.7+0.25%+56	80	86	72	73	60	72	43	53
Gluf+WC225	4.7+0.5%	78	62	63	65	58	67	40	43
Gluf+WC383+AMS-L	4.7+0.25%+56	7	10	68	62	7	7	40	43
Gluf+WC383	4.7+0.5%	5	8	57	63	0	0	30	40
Gluf+WC395+AMS-L	4.7+0.5%+56	85	83	77	77	67	72	47	58
Gluf+WC396+AMS-L	4.7+0.5%+56	90	90	86	91	77	85	75	83
Gluf+WC239	4.7+0.5%	58	47	65	72	33	30	40	47
Gluf+WC115	4.7+0.75%	85	83	73	78	65	58	43	48
CV		4	8	5	5	12	13	15	12
LSD P=0.5		5	9	6	6	10	12	11	11

All treatments resulted in rapid necrosis of tissue. Plants that did not die sprouted new growth that rapidly replaced previous vegetation. Glufosinate activity was improved with the standard recommendation of 56 oz AMS/A, but 112 oz AMS/A did not improve control over 56 oz. WC 109 gave similar control to AMS. WC221 did not improve glufosinate activity, but WC225 resulted in slightly less activity on all species except quinoa. WC383 had the most adverse effect on glufosinate activity. But WC396 tended to improve control of each species compared with glufosinate plus AMS.

Late season desiccation of broadleaf weeds. Dr. Howatt and Mettler. The experiment was established near North Dakota State University campus on September 5. Treatments were applied to flowering, 4 to 6 inch common ragweed, Venice mallow and redroot pigweed and flowering 6 to 12 inch yellow foxtail on September 5 with 66°F, 43% relative humidity, 0% cloud cover, 6.3 mph wind velocity at 5° and slightly moist soil at 60°F. Treatments were applied with a backpack sprayer delivering 17 gpa at 40 psi through 11002 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates except on 9/14 evalutation included general characterization across replicates.

Treatment	Rate	9/14 Corw	9/14 weeds	9/26 Vema	9/26 Yeft	9/26 Corw
	oz ai/A	%	%	%	%	%
Saflufenacil	0.36	80	60	20	42	90
Saflufenacil+WC079	0.36+0.5%	80	60	22	57	92
Saflufenacil+WC161	0.36+0.5%	80	60	20	64	95
Saflufenacil+WCXXX	0.36+0.5%	80	60	27	52	92
Tembotrione	0.66	0	0	0	35	60
Tembotrione+WC079	0.66+0.5%	0	0	0	35	62
Tembotrione+WC161	0.66+0.5%	0	0	0	42	64
Tembotrione+WCXXX	0.66+0.5%	0	0	0	42	79
Fomesafen	2.8	60	50	12	59	70
Fomesafen+WC079	2.8+0.5%	60	50	25	59	82
Fomesafen+WC161	2.8+0.5%	60	50	20	65	85
Fomesafen+WCXXX	2.8+0.5%	60	50	17	60	77
CV		.	.	57	27	15
LSD P=0.5		.	.	11	20	17

Control of yellow foxtail and common ragweed with saflufenacil had the highest value when WC161 was included as the adjuvant. WCXXX appeared to be the best adjuvant for tembotrione control of common ragweed, but activity on yellow foxtail was very low. WC161 again allowed the highest control values with fomesafen on yellow foxtail and common ragweed.