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2,4-D-Dic with adjuvants. Zollinger, Richard K., Angela J. Kazmierczak, and Devin A. Wirth. An experiment was conducted near Hillsboro, ND to evaluate the efficacy of Liberty with different adjuvants. Flax, amaranth, Quinoa (*Chenopodium*), and tame buckwheat were planted on May 23, 2012. POST treatments were applied on June 27, 2012 at 9:45 am with 82.3 F air, 76.3 F soil at a four inch depth, 74% relative humidity, 50% cloud cover, 3 to 5 mph S wind, adequate soil moisture, excellent plant vigor, and no dew present. 2.9% sand, 75.5% silt, 21.6% clay, silt loam texture, 4.9% OM and 6.2 pH. Plant height and density at time of application was 6 to 10 inch (10 to 12/ft^2) flax, 6 to 10 inch (1 to 12/yd^2) amaranth, 6 to 14 inch (5 to 15 yd^2) quinoa, and 8 to 14 inch (10 to 15/ft^2) tame buckwheat. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 11001 Turbo TeeJet nozzles. The experiment had a randomized complete block design with three replicates per treatment.

The addition of an NIS and drift retardant gave the best weed control in Brash. Raising the rate from 1.5pt/A to 2pt/A gave the best weed control in AGH 1102. Adding an NIS and drift retardant to AGH 1102 lowered weed control in quinoa and tame buckwheat. (Dept of Plant Sciences, North Dakota State University, Fargo).

Table. 2,4-D-Dic. with adjuvants. (Zollinger, Kazmierczak, Wirth)

		14 DAT				28 DAT			
		Flax	Amar	Quin	Tabw	Flax	Amar	Quin	Tabw
Treatments	Rate	----------	% Control		----------	----------	% Control		----------
Brash	1.5pt	35	70	60	60	38	80	70	70
Brash+Preference+Interlock	1.5pt+0.25%v/v+4fl oz	72	96	82	73	72	99	96	83
AGH1102	1.5pt	53	80	67	62	55	81	93	75
AGH1102+Preference+Interlock	1.5pt+0.25%v/v+4fl oz	60	92	63	60	50	93	93	65
Brash	2pt	65	93	73	72	70	95	98	92
AGH1102	2pt	72	96	82	73	75	98	96	83
LSD (0.05)		6	8	4	4	4	5	4	4

2, 4-D with adjuvants. Zollinger, Richard K., Angela J. Kazmierczak, and Devin A. Wirth. An experiment was conducted near Hillsboro, ND to evaluate the efficacy of Liberty with different adjuvants. Flax, amaranth, Quinoa (*Chenopodium*), and tame buckwheat were planted on May 23, 2012. POST treatments were applied on June 27, 2012 at 10:00 am with 83.1 F air, 76.3 F soil at a four inch depth, 78% relative humidity, 50% cloud cover, 3 to 5 mph S wind, adequate soil moisture, excellent plant vigor, and no dew present. 2.9% sand, 75.5% silt, 21.6% clay, silt loam texture, 4.9% OM and 6.2 pH. Plant height and density at time of application was 6 to 10 inch (15 to 20/ft^2) flax, 6 to 14 inch (5 to 15/yd^2) amaranth, 10 to 18 inch (10 to 15 yd^2) quinoa, and 12 to 20 inch (10 to 15/ft^2) tame buckwheat. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 11001 Turbo TeeJet nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatments were to be sprayed when all weeds reached 6-12". Most quinoa and tame buckwheat species were taller than preferred. The greatest phototoxicity came from AGH 09008. The addition of an NIS helped the efficacy of the quinoa and tame buckwheat by increasing retention on the "hard to wet" surface of quinoa. (Dept of Plant Sciences, North Dakota State University, Fargo).

Table. 2,4-D with adjuvants. (Zollinger, Kazmierczak, Wirth).

		14 DAT				28 DAT			
		Flax	Amar	Quin	Tabw	Flax	Amar	Quin	Tabw
Treatments	Rate	----------	% Control		----------	----------	% Control		----------
AGH 02007	0.67pt	55	53	57	57	62	58	67	68
2,4-D LV6	0.67pt	50	50	50	43	40	55	85	50
2,4-D amine	1pt	37	35	43	50	37	42	68	47
AGH 09008	1pt	65	82	72	62	45	72	87	63
AGH 09008+Preference+Interlock	1pt+0.25%v/v+4fl oz	62	60	60	52	52	70	95	72
LSD(0.05)		8	6	7	7	8	3	7	7

Liberty with adjuvants. Zollinger, Richard K., Angela J. Kazmierczak, and Devin A. Wirth. An experiment was conducted near Hillsboro, ND to evaluate the efficacy of liberty with different adjuvants. Flax, amaranth, Quinoa (*Chenopodium*), and tame buckwheat were planted on May 23, 2012. POST treatments were applied on June 25, 2012 at 10:00 am with 75.4 F air, 68.3 F soil at a four inch depth, 43% relative humidity, 10% cloud cover, 2 to 4 mph SE wind, adequate soil moisture, excellent plant vigor, and no dew present. 2.9% sand, 75.5% silt, 21.6% clay, silt loam texture, 4.9% OM and 6.2 pH. Plant height and density at time of application was 6 to 8 inch (15 to 20/ft^2) flax, 4 to 6 inch (5 to 15/yd^2) amaranth, 10 to 14 inch (15 to 20 yd^2) quinoa, and 10 to 14 inch (15 to 20/ft^2) tame buckwheat. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through 11002 Turbo TeeJet nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatments were to be sprayed when all weeds reached 6-8". Most quinoa and tame buckwheat species were taller preferred. The weed control from Liberty was greatest when Destiny HC plus AMS or a PO plus AMS was added. This data shows that AMS is the most important adjuvant to use with glufosinate (Liberty) and that petroleum and MSO adjuvants which greatly enhance lipophilic herbicides do not enhance glufosinate. Other data not shown shows that AMS at 3 lb/A is the minimum rate and more should be used especially with poor water quality (high concentration of antagonistic salts in spray water). (Dept of Plant Sciences, North Dakota State University, Fargo).

Table. Liberty with adjuvants. (Zollinger, Kazmierczak, Wirth).

Treatment	Rate	14 DAT				28 DAT			
		Flax	Amar	Quin	Tabw	Flax	Amar	Quin	Tabw
	(Product/A)	% Control				% Control			
Liberty	22fl oz	60	27	20	25	60	27	20	25
Liberty+AMS	22fl oz+3lb	89	58	62	57	89	48	52	47
Liberty+NIS	22fl oz+0.25%v/v	87	57	62	55	86	33	53	58
Liberty+PO	22fl oz+1qt	72	45	37	38	72	38	30	32
Liberty+MSO	22fl oz+1.25pt	60	45	15	38	50	35	12	58
Liberty+Destiny HC	22fl oz+1pt	70	68	47	48	70	62	37	50
Liberty+NIS+AMS	22fl oz+0.25%v/v+3lb	85	53	72	72	82	50	52	63
Liberty+PO+AMS	22fl oz+1qt+3lb	87	72	42	75	86	62	33	73
Liberty+MSO+AMS	22fl oz+1.25pt+3lb	65	62	28	77	53	42	27	75
Liberty+Destiny HC+AMS	22fl oz+1pt+3lb	83	68	65	78	82	62	45	75
LSD (0.05)		6	7	8	9	6	6	7	6

R-11 replacements. Zollinger, Richard K., Angela J. Kazmierczak, and Devin A. Wirth. An experiment was conducted near Hillsboro, ND to evaluate the efficacy of different R-11 replacements. Flax, amaranth, Quinoa (*Chenopodium*), and tame buckwheat were planted on May 23, 2012. POST treatments were applied on June 29, 2012 at 9:50 am with 86 F air, 72.3 F soil at a four inch depth, 46% relative humidity, 0% cloud cover, 2 to 4 mph W wind, adequate soil moisture, excellent plant vigor, and no dew present. 2.9% sand, 75.5% silt, 21.6% clay, silt loam texture, 4.9% OM and 6.2 pH. Plant height and density at time of application was 6 to 10 inch (15 to 20/ft^2) flax, 6 to 10 inch (5 to 15/yd^2) amaranth, 18 to 24 inch (5 to 15 yd^2) quinoa, and 18 to 24 inch (15 to 20/ft^2) tame buckwheat. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 11001 Turbo TeeJet nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatments were to be sprayed when all weeds reached 12-20". Flax and amaranth were smaller than required and quinoa and tame buckwheat were taller than preferred. As an R-11 replacement, WE 1279 gave the best weed control overall. The greatest phytotoxicity in flax occurred when WE 1279 was added to Roundup PowerMax. The new formulations gave better weed control when added to Touchdown HiTech, an unloaded formulation of glyphosate. (Dept of Plant Sciences, North Dakota State University, Fargo).

Table. R-11 replacements. (Zollinger, Kazmierczak, Wirth).

Treatment[1]	Rate	14 DAT				28 DAT			
		Flax	Amar	Quin	Tabw	Flax	Amar	Quin	Tabw
	(Product/A)	----------% Control----------				----------% Control----------			
Touchdown HiTech	7.2fl oz	10	27	8	15	10	62	7	23
Touchdown HiTech+WE1386	7.2fl oz+1%v/v	42	88	45	43	42	83	45	42
Touchdown HiTech+WE1010	7.2fl oz+1%v/v	40	78	37	37	43	94	45	42
Touchdown HiTech+WE1203	7.2fl oz+1%v/v	25	55	17	20	25	67	25	27
Touchdown HiTech+WE1279	7.2fl oz+1%v/v	60	87	55	42	60	90	68	52
Buccaneer	12fl oz	17	63	10	17	17	72	12	22
Buccaneer+WE1386	12fl oz+0.5%v/v	32	63	35	25	32	63	38	38
Buccaneer+WE1010	12fl oz+0.5%v/v	43	83	38	28	50	83	52	38
Buccaneer+WE1203	12fl oz+0.5%v/v	22	60	17	20	22	60	20	32
Buccaneer+WE1279	12fl oz+0.5%v/v	69	92	50	40	72	93	48	43
Buccaneer Plus	12fl oz	22	60	12	20	30	70	15	32
Buccaneer Plus+WE1386	12fl oz+0.25%v/v	28	83	22	23	27	83	30	32
Buccaneer Plus+WE1010	12fl oz+0.25%v/v	23	57	25	37	27	67	38	40
Buccaneer Plus+WE1203	12fl oz+0.25%v/v	18	63	22	27	23	78	25	32
Buccaneer Plus+WE1279	12fl oz+0.25%v/v	28	47	22	25	30	57	32	35
Roundup PowerMax	8fl oz	35	72	18	22	38	77	30	30
Roundup PowerMax+WE1386	8fl oz+0.25%v/v	42	42	28	27	37	68	32	30
Roundup PowerMax+WE1010	8fl oz+0.25%v/v	38	82	43	33	42	83	45	38
Roundup PowerMax+WE1203	8fl oz+0.25%v/v	22	60	15	18	23	70	20	30
Roundup PowerMax+WE1279	8fl oz+0.25%v/v	72	87	42	37	83	93	48	42
LSD (0.05)		7	8	10	7	7	10	10	6

Glyphosate formulations with adjuvants. Zollinger, Richard K., Angela J. Kazmierczak, and Devin A. Wirth. An experiment was conducted near Hillsboro, ND to evaluate weed efficacy of different formulations of glyphosate with different adjuvants. Flax, amaranth, Quinoa (*Chenopodium*), and tame buckwheat were planted on May 23, 2012. POST NIS (treatments 1-21) treatments were applied on June 28, 2012 at 8:55 am with 73.2 F air, 72 F soil at a four inch depth, 54% relative humidity, 0% cloud cover, 3 to 5 mph W wind, adequate soil moisture, excellent plant vigor, and no dew present. Plant height and density at time of application was 8 to 12 inch (10 to 15/ft^2) flax, 6 to 12 inch (1 to 10/yd^2) amaranth, 10 to 24 inch (5 to 15 yd^2) quinoa, and 10 to 24 inch (15 to 20/ft^2) tame buckwheat. An experiment was conducted to evaluate weed efficacy of different NuFarm glyphosate formulations. POST NIS (treatments 22-26) treatments were applied on June 28, 2012 at 10:20 am with 78 F air, 72 F soil at a four inch depth, 53% relative humidity, 0% cloud cover, 3 to 5 mph W wind, adequate soil moisture, excellent plant vigor, and no dew present. Plant height and density at time of application was 5 to 10 inch (5 to 10/ft^2) flax, 6 to 10 inch (5 to 10/yd^2) amaranth, 18 to 24 inch (5 to 10 yd^2) quinoa, and 18 to 24 inch (10 to 15/ft^2) tame buckwheat. Soil characteristics were: 2.9% sand, 75.5% silt, 21.6% clay, silt loam texture, 4.9% OM and 6.2 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 11001 Turbo TeeJet nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatments were to be sprayed when all weeds reached 12-20". Flax and amaranth were smaller than desired and quinoa and tame buckwheat were taller than desired. Some weed species are hard-to-wet, such as, flax, quinoa (lambsquarters), and tame buckwheat. Some weed species are easy-to-wet, such as amaranth (pigweed species). Surfactants may increase spray droplet retention (stickers) and thereby increase control. Wide differences are seen in control of hard-to-wet species with addition of NIS. Some surfactants increase control of a no-load glyphosate formulation (Touchdown Hi-Tech) while others provide little herbicide enhancement. Using an effective surfactant (R-11) with partial- or full-adjuvant load glyphosate formulations does not always result in increased herbicide activity. It appears that the surfactant used in the glyphosate formulation may reduce then enhancing effect of the active surfactant. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate formulations with adjuvants. (Zollinger, Kazmierczak, Wirth).

Treatment[1]	Rate	14 DAT				28 DAT			
		Flax	Amar	Quin	Tabw	Flax	Amar	Quin	Tabw
	(Product/A)	----------% Control----------				----------% Control----------			
1. Tchdwn Htch	7.2fl oz	8	25	5	22	25	25	17	30
2. Tchdwn Htch+R-11	7.2fl oz+0.5%v/v	47	80	47	53	47	93	47	53
3. Tchdwn Htch+R-11	7.2fl oz+1%v/v	68	88	65	63	80	91	73	65
4. Tchdwn Htch+Activator 90	7.2fl oz+0.5%v/v	15	40	8	30	22	52	15	42
5. Tchdwn Htch+Activator 90	7.2fl oz+1%v/v	22	65	15	32	25	72	18	40
6. Tchdwn Htch+Preference	7.2fl oz+0.5%v/v	25	78	32	27	25	82	32	35
7. Tchdwn Htch+Preference	7.2fl oz+1%v/v	30	80	33	37	30	77	37	47
8. Credit 41 Extra	12fl oz	35	80	18	28	37	80	20	35
9. Credit 41 Extra+R-11	12fl oz+0.25%v/v	40	58	27	35	47	55	33	35
10. Credit 41 Extra+R-11	12fl oz+0.5%v/v	52	72	35	28	53	70	38	30
11. Credit 41 Extra+N-Pac AMS	12fl oz+1%v/v	70	83	12	32	72	82	17	38
12. Credit 41 Extra	24fl oz	83	92	43	43	87	94	42	47
13. NUP-12039	12fl oz	27	42	7	25	32	52	10	28
14. NUP-12039+R-11	12fl oz+0.25%v/v	28	75	25	33	28	75	27	35
15. NUP-12039+R-11	12fl oz+0.5%v/v	40	90	40	40	38	90	40	43
16. NUP-12039+N-Pac AMS	12fl oz+1%v/v	33	83	8	33	35	95	8	38
17. NUP-12039	24fl oz	37	75	20	42	40	83	25	55
18. RUPM	8fl oz	30	83	32	38	33	83	32	40
19. RUPM+R-11	8fl oz+0.25%v/v	57	80	42	35	63	80	42	40
20. RUPM+R-11	8fl oz+0.5%v/v	37	83	55	40	40	83	45	45
21. RUPM	16fl oz	85	83	70	65	88	88	72	70
22. NUP-09037	12fl oz	22	22	13	27	23	80	20	47
23. NUP-09037+R-11	12fl oz+0.25%v/v	35	38	27	27	38	90	30	42
24. NUP-09037+R-11	12fl oz+0.5%v/v	43	38	30	40	42	82	42	50
25. NUP-09037+N-Pac AMS	12fl oz+1%v/v	52	87	32	40	52	93	35	53
26. NUP-09037	24fl oz	73	70	62	53	73	93	65	57
LSD (0.05)		8	8	9	12	8	9	9	11

[1] Tchdwn Htch = Touchdown HiTech (Glyphosate) ; RUPM = Roundup PowerMax (glyphosate)

Hydrophilic and lipophilic herbicides with adjuvants. Zollinger, Richard K., Angela J. Kazmierczak, and Devin A. Wirth. An experiment was conducted near Hillsboro, ND to evaluate the efficacy of glyphosate plus oil adjuvants. Flax, amaranth, Quinoa (*Chenopodium*), and tame buckwheat were planted on May 23, 2012. POST treatments were applied on June 28, 2012 at 11:00 am with 82 F air, 73 F soil at a four inch depth, 35% relative humidity, 0% cloud cover, 3 to 5 mph W wind, adequate soil moisture, excellent plant vigor, and no dew present. 2.9% sand, 75.5% silt, 21.6% clay, silt loam texture, 4.9% OM and 6.2 pH. Plant height and density at time of application was 6 to 10 inch (10 to 15/ft^2) flax, 6 to 12 inch (10 to 15/yd^2) amaranth, 18 to 24 inch (10 to 15 yd^2) quinoa, and 18 to 24 inch (10 to 15/ft^2) tame buckwheat. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 11001 Turbo TeeJet nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatments were to be sprayed when all weeds reached 12-20". Flax and amaranth were smaller than required and quinoa and tame buckwheat were taller than preferred. The greatest phytotoxicity occurred when using an HSOC with a surfactant plus AMS. HSOC's are emulsifiable oil (PO or MSO) based products containing 20-50% surfactant and a minimum of 50% oil. HSOC adjuvants enhance oil soluble herbicides and do not antagonize glyphosate. This was true with MSO-HSOC adjuvants like Destiny HC, which enhanced the herbicide combination well when added with S+AMS adjuvants like Class Act Flex or Class Act NG. Class Act Flex has a higher surfactant to AMS ratio than Class Act NG, which helped retention and deposition of the herbicides. Regrowth was noticed 28 days after treatment, especially in the amaranth and quinoa. It was concluded that the saflufenacil, a contact herbicide, gave the weed species a quick kill which may have prevented the glyphosate from translocating throughout the plant. (Dept of Plant Sciences, North Dakota State University, Fargo).

Table. Hydrophillic and lipophillic herbicides with adjuvants. (Zollinger, Kazmierczak, Wirth)

		14 DAT				28 DAT			
		Flax	Amar	Quin	Tabw	Flax	Amar	Quin	Tabw
Treatments	Rate	% Control				% Control			
Touchdown HiTech	7.2fl oz	15	37	0	30	28	73	7	35
Touchdown HiTech+Sharpen+N-Pac AMS	7.2fl oz+0.5fl oz+2.5%v/v	15	77	3	45	25	88	8	45
Touchdown HiTech+Sharpen+Class Act NG	7.2fl oz+0.5fl oz+2.5%v/v	60	67	47	58	65	83	55	63
Touchdown HiTech+Sharpen+Prime Oil+N-Pac AMS	7.2fl oz+0.5fl oz+1%v/v+2.5%v/v	27	23	25	33	37	28	28	38
Touchdown HiTech+Sharpen+Superb HC+Class Act NG	7.2fl oz+0.5fl oz+1pt+2.5%v/v	33	42	50	48	45	37	48	57
Touchdown HiTech+Sharpen+Superb HC+Class Act Flex	7.2fl oz+0.5fl oz+1pt+2%v/v	72	83	73	58	78	70	70	60
Touchdown HiTech+Sharpen+Class Act Flex+Interlock	7.2fl oz+0.5fl oz+2%v/v+4fl oz	42	40	43	50	52	42	55	68
Touchdown HiTech+Sharpen+MSO+N-Pac AMS	7.2fl oz+0.5fl oz+1%v/v+2.5%v/v	52	72	68	58	53	38	50	53
Touchdown HiTech+Sharpen+Destiny HC+Class Act NG	7.2fl oz+0.5fl oz+1pt+2.5%v/v	72	94	78	82	75	75	62	77
Touchdown HiTech+Sharpen+Destiny HC+Class Act Flex	7.2fl oz+0.5fl oz+1pt+2%v/v	78	96	90	88	83	92	78	86
Touchdown HiTech+Sharpen+AG12035	7.2fl oz+0.5fl oz+2.5%v/v	52	62	65	62	53	43	52	63
Touchdown HiTech+Sharpen+AG11016	7.2fl oz+0.5fl oz+1.5%v/v	65	75	75	68	63	63	75	65
LSD (0.05)		7	7	9	10	8	27	12	10

Glyphosate and Dicamba with adjuvants. Zollinger, Richard K., Angela J. Kazmierczak, and Devin A. Wirth. An experiment was conducted near Mayville, ND to evaluate the efficacy of glyphosate and dicamba with different adjuvants. POST treatments were applied on June 1, 2012 at 9:00 am with 67 F air, 59.2 F soil at a four inch depth, 31% relative humidity, 50% cloud cover, 4 to 6 mph NW wind, adequate soil moisture, and no dew present. Soil characteristics were: 16.5% sand, 74.6% silt, 8.9% clay, silt loam texture, 3.3% OM and 6.7 pH. Weed species present at the time of POST application were 2 to 4 inch (10 to 15/ft^2) common ragweed and 1 to 6 inch (15 to 25/yd^2) common lambsquarters. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through 11002 AIXR nozzles. The experiment had a randomized complete block design with three replicates per treatment.

This experiment was conducted at a site with documented glyphosate resistant common ragweed. Some weed species are hard-to-wet, such as, flax, quinoa (lambsquarters), and tame buckwheat. Some weed species are easy-to-wet, such as amaranth (pigweed species). Surfactants may increase spray droplet retention (stickers) and thereby increase control. Most treatments below indicted by a number are a glyphosate:dicamba mixture. Addition of a NIS (Activator 90) generally resulted in greater control of lambsquarters and ragweed. (Dept of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate and Dicamba with adjuvants. (Zollinger, Kazmierczak, Wirth)

		14 DAT			28 DAT		
		Rrpw	Colq	Corw	Rrpw	Colq	Corw
Treatments[1]	Rate	% Control			% Control		
RUWM	21.3fl oz	99	80	20	99	72	20
MON 76769	24fl oz	99	47	20	99	43	20
MON 76769+Activator 90	24fl oz+0.25%v/v	99	47	20	99	47	20
RUWM+Clarity	21.3fl oz+12fl oz	90	82	88	99	78	78
RUWM+Clarity+Activator 90	21.3fl oz+12fl oz+0.25%v/v	99	95	77	99	98	82
MON 76754	36fl oz	98	62	66	87	67	70
MON 76754+Activator 90	36fl oz+0.25%v/v	99	83	84	99	98	73
MON 76741	36fl oz	99	84	79	93	78	80
MON 76741+Activator 90	36fl oz+0.25%v/v	96	92	80	99	95	89
MON 76757	36fl oz	99	72	70	87	77	77
MON 76757+Activator 90	36fl oz+0.25%v/v	95	95	80	99	95	82
RUWM+Clarity	28.4fl oz+16fl oz	99	90	82	99	92	83
MON 76754	48fl oz	98	96	89	99	96	89
MON 76754+Activator 90	48fl oz+0.25%v/v	99	96	78	99	97	83
MON 76741	48fl oz	94	78	77	99	85	82
MON 76741+Activator 90	48fl oz+0.25%v/v	99	96	80	99	97	83
MON 76757	48fl oz	99	95	95	99	90	93
MON 76757+Activator 90	48fl oz+0.25%v/v	96	98	90	99	99	92
LSD (0.05)		6	18	16	3	10	6

[1] RUWM = Roundup WeatherMax (glyphosate)

Glyphosate with water conditioners. Zollinger, Richard K., Angela J. Kazmierczak, and Devin A. Wirth. An experiment was conducted near Hillsboro, ND to evaluate the efficacy of glyphosate with different water conditioners. Flax, amaranth, Quinoa (*Chenopodium*), and tame buckwheat were planted on May 23, 2012. POST treatments were applied on June 28, 2012 at 12:20 pm with 85.6 F air, 75 F soil at a four inch depth, 15% relative humidity, 0% cloud cover, 3 to 5 mph S wind, adequate soil moisture, excellent plant vigor, and no dew present. 2.9% sand, 75.5% silt, 21.6% clay, silt loam texture, 4.9% OM and 6.2 pH. Plant height and density at time of application was 5 to 10 inch (10 to 15/ft^2) flax, 6 to 14 inch (10 to 15/yd^2) amaranth, 18 to 24 inch (10 to 15 yd^2) quinoa, and 18 to 24 inch (10 to 15/ft^2) tame buckwheat. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 11001 Turbo TeeJet nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatments were to be sprayed when all weeds reached 12-20". Flax and amaranth were smaller than required and quinoa and tame buckwheat were taller than preferred. All treatments applied with hard water at 1000 ppm of Ca + Mg. AMADS or monocarbamide dihydrogen sulfate is a urea + sulfuric acid complex and a component in several Acidic AMS Replacement adjuvants (see adjuvants compendium in ND Weed Control Guide). AMADS adjuvants lower spray solution pH to approximately 2.0 which is below the pKa of most POST herbicides. At low spray water pH, glyphosate and most herbicide molecules will have a neutral or slightly ionic charge resulting in less binding of antagonistic salts (Ca, Mg, Na, others). AMADS reduces bicarbonate in water and CO2. Sulfuric acid instantly converts to sulfate in water. Reduced glyphosate rates were used to prevent total species control and to detect adjuvant effects. As such, the amount of surfactant coming only from the glyphosate formulation was limited and it would be expected that treatments with additional surfactant added would show greatest phytoxicity. The objective of this study was to determine the amount of AMADS necessary to provide equivalent weed control to glyphosate + NIS + AMS. Brimstone at 2%v/v was required to provide similar phytotoxicity as glyphosate + NIS + AMS on flax and tame buckwheat but 1% v/v was required for amaranth and quinoa. Treatments with Roundup PowerMax (full surfactant load) general showed greater weed control while treatments with Buccaneer (partial surfactant load) showed the lowest weed control due primarily to less surfactant provided by the Buccaneer glyphosate formulation. (Dept of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate with water conditioners. (Zollinger, Kazmierczak, Wirth).

Treatment	Rate	14 DAT				28 DAT			
		Flax	Amar	Quin	Tabw	Flax	Amar	Quin	Tabw
	(Product/A)	----------% Control----------				----------% Control----------			
Buccaneer	12fl oz	20	27	15	13	17	67	17	28
Buccaneer Plus	12fl oz	17	28	10	12	20	72	13	28
Roundup PowerMax	8fl oz	23	32	20	22	25	70	33	32
Buccaneer+AMS	12fl oz+8.5lb/100gal	40	87	18	25	67	90	33	42
Buccaneer Plus+AMS	12fl oz+8.5lb/100gal	63	88	28	38	72	92	32	47
Roundup PowerMax+AMS	8fl oz+8.5lb/100gal	70	94	40	38	75	85	50	43
Buccaneer+AMS	12fl oz+17lb/100gal	38	58	15	28	50	83	22	40
Buccaneer Plus+AMS	12fl oz+17lb/100gal	40	88	22	33	62	93	22	40
Roundup PowerMax+AMS	8fl oz+17lb/100gal	70	85	33	35	90	95	55	45
Buccaneer+R-11+AMS	12fl oz+0.25%v/v+8.5lb/100gal	62	93	37	37	77	93	65	47
Buccaneer Plus+R-11+AMS	12fl oz+0.25%v/v+8.5lb/100gal	38	67	28	25	70	83	43	47
Roundup PowerMax+R-11+AMS	8fl oz+0.25%v/v+8.5lb/100gal	67	90	43	32	88	92	65	40
Buccaneer+Brimstone	12fl oz+0.5%v/v	40	42	32	22	58	70	53	32
Buccaneer Plus+Brimstone	12fl oz+0.5%v/v	30	55	32	23	33	77	70	35
Roundup PowerMax+Brimstone	8fl oz+0.5%v/v	27	43	27	22	28	68	47	33
Buccaneer+Brimstone	12fl oz+1%v/v	33	78	42	22	40	85	68	35
Buccaneer Plus+Brimstone	12fl oz+1%v/v	47	40	32	22	53	82	63	37
Roundup PowerMax+Brimstone	8fl oz+1%v/v	43	77	47	28	42	88	78	40
Buccaneer+Brimstone	12fl oz+2%v/v	35	68	30	23	40	73	55	32
Buccaneer Plus+Brimstone	12fl oz+2%v/v	40	73	40	37	67	88	67	47
Roundup PowerMax+Brimstone	8fl oz+2%v/v	70	90	73	43	83	90	88	50
LSD (0.05)		8	8	11	8	10	9	9	8

Super Kix and Brimestone water conditioners. Zollinger, Richard K., Angela J. Kazmierczak, and Devin A. Wirth. An experiment was conducted near Hillsboro, ND to evaluate the efficacy of Roundup PowerMax plus Sharpen plus Super Kix and Brimestone water conditioners. Flax, amaranth, Quinoa (*Chenopodium*), and tame buckwheat were planted on May 23, 2012. POST treatments were applied on June 29, 2012 at 9:15 am with 86 F air, 72.3 F soil at a four inch depth, 46% relative humidity, 0% cloud cover, 2 to 4 mph W wind, adequate soil moisture, excellent plant vigor, and no dew present. 2.9% sand, 75.5% silt, 21.6% clay, silt loam texture, 4.9% OM and 6.2 pH. Plant height and density at time of application was 6 to 10 inch (10 to 15/ft^2) flax, 6 to 14 inch (10 to 15/yd^2) amaranth, 18 to 24 inch (10 to 15 yd^2) quinoa, and 18 to 24 inch (10 to 15/ft^2) tame buckwheat. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 11001 Turbo TeeJet nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Treatments were to be sprayed when all weeds reached 12-20". Flax and amaranth were smaller than required and quinoa and tame buckwheat were taller than preferred. Pesticides were applied with hard water at 1000 ppm of Ca + Mg. Brimstone is an AMADS or monocarbamide dihydrogen sulfate. It is a urea + sulfuric acid complex and a component in several Acidic AMS Replacement adjuvants (see adjuvants compendium in ND Weed Control Guide). Super Kix is a blend of methylated seed oil, UAN solution and a non-ionic surfactant. Roundup Powermax and Sharpen mixed with Super Kix at 40 fl oz and Brimstone at 2% v/v gave the best weed control on all weed species. Weed control was directly correlated to the amount of each adjuvant added. (Dept of Plant Sciences, North Dakota State University, Fargo).

Table. Super Kix and Brimstone water conditioners. (Zollinger, Kazmierczak, Wirth).

Treatment	Rate	14 DAT				28 DAT			
		Flax	Amar	Quin	Tabw	Flax	Amar	Quin	Tabw
	(Product/A)	----------% Control----------				----------% Control----------			
RUPM+Sharpen +Super Kix+Brimstone	8fl oz+0.5fl oz +30fl oz+0.5%v/v	23	33	40	45	33	22	40	43
RUPM+Sharpen +Super Kix+Brimstone	8fl oz+0.5fl oz +40fl oz+0.5%v/v	33	43	47	63	33	48	62	60
RUPM+Sharpen +Brimstone	16fl oz+0.75fl oz +1%v/v	32	48	48	47	53	48	85	60
RUPM+Sharpen +Super Kix	16fl oz+0.75fl oz +40fl oz	25	77	48	58	43	68	68	67
RUPM+Sharpen +AMS+Super Spread MSO	16fl oz+0.75fl oz +8.5lb/100gal+1pt	43	72	45	55	48	58	55	65
RUPM+Sharpen +AMS+Super Kix	16fl oz+0.75fl oz +8.5lb/100gal+30fl oz	47	73	45	53	48	65	75	65
RUPM+Sharpen +AMS+Super Kix	16fl oz+0.75fl oz +8.5lb/100gal+40fl oz	63	73	45	60	75	57	72	75
RUPM+Sharpen +Super Kix+Brimstone	16fl oz+0.75fl oz +30fl oz+0.25%v/v	32	62	42	50	50	52	65	65
RUPM+Sharpen +Super Kix+Brimstone	16fl oz+0.75fl oz +30fl oz+0.5%v/v	33	65	48	58	40	55	65	67
RUPM+Sharpen +Super Kix+Brimstone	16fl oz+0.75fl oz +30fl oz+1%v/v	58	87	57	65	65	72	77	78
RUPM+Sharpen +Super Kix+Brimstone	16fl oz+0.75fl oz +30fl oz+2%v/v	68	82	58	62	75	80	77	75
RUPM+Sharpen +Super Kix+Brimstone	16fl oz+0.75fl oz +40fl oz+0.25%v/v	30	62	52	57	47	65	70	67
RUPM+Sharpen +Super Kix+Brimstone	16fl oz+0.75fl oz +40fl oz+0.5%v/v	38	77	53	58	45	65	70	67
RUPM+Sharpen +Super Kix+Brimstone	16fl oz+0.75fl oz +40fl oz+1%v/v	43	72	50	55	55	57	72	65
RUPM+Sharpen +Super Kix+Brimstone	16fl oz+0.75fl oz +40fl oz+2%v/v	80	87	58	67	88	87	82	78
LSD (0.05)		8	9	5	5	8	9	4	6

2,4-D efficacy with various droplet sizes. Howatt, Roach, Ciernia, and Harrington. Buckwheat, flax, amaranth, and quinoa were seeded near Fargo. Treatments were applied to 18 inch flowering buckwheat, 6 inch flax, 6 to 8 inch amaranth and common lambsquarters (which grew in place of quinoa), 4 to 6 leaf volunteer sunflower, and flowering wild mustard on July 3 with 90°F, 58% relative humidity, 40% cloud cover, dry soil and 82°F. Treatments were applied with a sprayer, mounted on a 4X4 ATV, delivering 10 gpa 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.

		Droplet	July 18							
Treatment	Rate	size	Colq	Rrpw	Wimu	Vema	Amar	Flax	Tabw	Sufl
	oz ae/A		%	%	%	%	%	%	%	%
2,4-D amine	8	F	60	60	65	50	80	40	75	70
2,4-D amine+AG02013	8+4	F	60	60	65	50	80	40	75	70
2,4-D amine	8	M	60	60	65	50	80	40	75	70
2,4-D amine+AG02013	8+4	M	60	60	65	50	80	40	75	70
2,4-D amine	8	C	60	60	65	50	80	40	75	70
2,4-D amine+AG02013	8+4	C	60	60	65	50	80	40	75	70
2,4-D amine	8	XC	60	60	65	50	80	40	75	70
2,4-D amine+AG02013	8+4	XC	60	60	65	50	80	40	75	70
2,4-D amine	8	UC	60	60	65	50	80	40	75	70
2,4-D amine+AG02013	8+4	UC	60	60	65	50	80	40	75	70
CV										
LSD (P=0.05)										

Treatments could not be visually separated in this study. Previous work indicated substantial loss of control as droplet size was adjusted to be larger than medium for 2,4-D amine. Evaluation on August 7 did not separate treatments either but control of common lambsquarters was 99%, redroot pigweed was 90%, Venice mallow was 25%, amaranth was 95%, flax was 30%, buckwheat was 40%, and sunflower was 93%. AG02013 did not affect control of any species with 2,4-D amine.

Dicamba efficacy with various droplet sizes. Howatt, Roach, Ciernia, and Harrington. Buckwheat, flax, amaranth, and quinoa were seeded near Fargo. Treatments were applied to 18 inch flowering buckwheat, 6 inch flax, 6 to 8 leaf amaranth and quinoa, 4 to 6 leaf volunteer sunflower, and flowering wild mustard on July 3 with 90°F, 58% relative humidity, 40% cloud cover, 4 mph wind at 40°, and dry soil at 82°F, Treatments were applied with a sprayer, mounted on a 4X4 ATV, delivering 10 gpa 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	Droplet size	July 18					
			Amar	Wimu	Vema	Flax	Tabw	Sufl
	oz ae/A		%	%	%	%	%	%
Dicamba	2	F	45	50	0	29	46	61
Dicamba+AG02013	2+4	F	40	48	0	53	54	61
Dicamba	2	M	45	50	0	39	53	64
Dicamba+AG02013	2+4	M	50	55	0	55	58	63
Dicamba	2	C	38	40	0	30	48	61
Dicamba+AG02013	2+4	C	35	45	0	45	48	55
Dicamba	2	XC	33	40	0	30	43	58
Dicamba+AG02013	2+4	XC	33	45	0	45	45	55
Dicamba	2	UC	33	40	0	28	40	55
Dicamba+AG02013	2+4	UC	33	40	0	45	45	56
CV			13	11	0	25	13	6
LSD (P=0.05)			7	7	0	14	9	5

Control of amaranth with dicamba declined from 45% with fine or medium droplets to 33% with extremely course or ultra course sizes on July 18. This effect was also determined for wild mustard with ratings from 50 to 40% control and sunflower from 64 to 55% control. Flax response varied more than other species. Although not significant, control of flax with dicamba at medium size droplet had the highest numerical value. Dicamba at medium droplet spectra also provided better control of buckwheat than extremely course or ultra course sizes.

AG02013 improved the activity of dicamba on flax at each droplet size. However, response of other species varied and often was not different within a species and droplet size combination.

Treatment differences could not be discerned on August 7. Control of amaranth was 75%, wild mustard was 50%, Venice mallow was 70%, flax was 50%, buckwheat was 40%, and sunflower was 80%. Perhaps plants were too large at application to achieve sufficient activity for sustained control.

AGH09035 efficacy with various droplet sizes. Howatt, Roach, Ciernia, and Harrington. Buckwheat, flax, amaranth, and quinoa were seeded near Fargo. Treatments were applied to 18 inch flowering buckwheat, 6 inch flax, 6 to 8 leaf amaranth, and 4 to 6 leaf volunteer sunflower, and flowering wild mustard on July 3 with 90°F, 58% relative humidity, 40% cloud cover, 4 mph wind at 40°, and dry soil at 82°F. Treatments were applied with a sprayer mounted on a 4X4 ATV delivering 10 gpa 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.

		Droplet	July 18					
Treatment	Rate	size	Rrpw	Wimu	Amar	Flax	Tabw	Sufl
	oz ae/A		%	%	%	%	%	%
AGH09035	5.8	F	20	60	20	65	70	75
AGH09035+AG02013	5.8+4	F	20	60	20	65	70	75
AGH09035	5.8	M	20	60	20	65	70	75
AGH09035+AG02013	5.8+4	M	20	60	20	65	70	75
AGH09035	5.8	C	20	60	20	65	66	75
AGH09035+AG02013	5.8+4	C	20	60	20	65	65	75
AGH09035	5.8	XC	20	60	20	65	64	75
AGH09035+AG02013	5.8+4	XC	20	60	20	65	64	75
AGH09035	5.8	UC	20	60	20	65	66	75
AGH09035+AG02013	5.8+4	UC	20	60	20	65	63	75
CV			0	0	0	0	4	0
LSD (P=0.05)			0	0	0	0	4	0

Treatments could not be visually separated in this study except for buckwheat. Control of buckwheat with AGH09035 in fine or medium droplet sizes was slightly greater than with larger sizes. Evaluation on August 7 did not separate treatments either but control of redroot pigweed was 50%, amaranth was 85%, flax was 80%, buckwheat was 85%, and sunflower was 90%. AG02013 did not affect control of any species with AGH09035.