Tan Section: Application Technology Page

WetCit NIS. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate the efficacy of Wetcit non-ionic surfactant. 'York' flax, and 'Plainsman' amaranth were planted on June 14, 2011. POST treatments were applied on August 5 at 9:40 am with 75 F air, 84 F soil surface, 84% relative humidity, 5% cloud cover, 4 to 6 mph E wind, dry soil surface, wet subsoil, poor crop vigor and no dew present. Excessive moisture during the season had stunted all crops and weeds in this study. Weeds and species stages at the time of POST were: 6 to 14 inch, 15% bloom (1 to 15/ft^2) flax; 10 to 20 inch (5 to 15/yd^2) amaranth; 10 to 30 inch (1 to 10/yd^2) redroot pigweed; and 8 to 14 inch (1 to 2/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 8.5 gpa at 40 psi through 11001 Turbo TeeJet nozzles. The experiment had a randomized complete block design with three replicates per treatment.

This study clearly shows that not all NIS are the same. R-11 was chosen as a comparison to WetCit because of high herbicide enhancement observed in a multitude of field and greenhouse trials. LI-700 was chosen as a comparison to WetCit because activity and weed control is usually low. Weed control increased as WetCit rate increased from 0.25% to 0.4% v/v but weed control decreased from 0.4% v/v to 0.8% v/v possibly because micelle concentration was saturated. Glyphosate control of flax, amaranth, and redroot pigweed applied with WetCit was similar to other treatments. However, R-11 was the only surfactant to sufficiently retain spray droplets on the leaf surface, deposit the herbicide active ingredient within the cuticular matrix, and facilitate absorption of the herbicide into the plant. Lambsquarters is the quintessential example of an extremely hard-to-wet plant. Droplets of water or spray droplets with an inferior surfactant will bounce off the leaf surface as this data shows. This also questions the ubiquitous NIS use rate of 0.25% v/v. If the weed spectrum is composed largely of lambsquarters and other hard-to-wet weeds then a higher rate of NIS may be justified as it does not significantly increase the cost of the treatment per acre. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. WetCit NIS (Zollinger, Ries, Kazmierczak).

		14 DAT			
Treatment[1]	Rate	Flax	Amar	Rrpw	Colq
	(product/A)	-------- % control --------			
Touchdown HiTech+	7.2fl oz+	27	60	53	20
R-11	0.25% v/v	57	85	78	90
LI-700	0.25% v/v	27	62	55	32
WetCit	0.25% v/v	37	75	70	35
WetCit	0.4% v/v	40	82	78	42
WetCit	0.8% v/v	38	78	75	52
AMS	8.5lb/100gal	53	92	88	27
R-11+AMS	0.25% v/v+8.5lb/100gal	91	98	95	94
WetCit+AMS	0.25% v/v+8.5lb/100gal	75	83	80	67
WetCit+AMS	0.4% v/v+8.5lb/100gal	67	85	82	78
LSD (0.05)		10	6	6	8

[1]WetCit = a product from ORO AGRI.

Oil adjuvants and AMS with herbicides. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Prosper, ND, to evaluate the efficacy of oil adjuvants and AMS with herbicides. POST treatments were applied to a non-crop weed area on August 17, 2011 at 8:30 am with 66 F air, 66F soil surface, 77% relative humidity, 0% cloud cover, 3 to 5 mph SW wind, dry soil surface, moist subsoil and no dew present. Weeds present at the time of POST applications were: 10 to 24 inch, headed (10 to 30/yd^2) redroot pigweed; 14 to 24 inch (3 to 10/yd^2) common lambsquarters; 10 to 20 inch (1 to 5/yd^2) common ragweed; 12 to 24 inch (5 to 30/yd^2) grasses consisting of 90% yellow foxtail, 5% green foxtail and 5% barnyard grass. 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 for POST treatments. The experiment had a randomized complete block design with three replicates per treatment.

No changes in ratings at 14 DAT (data not shown). (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Oil adjuvants and AMS with herbicides (Zollinger, Ries, Kazmierczak).

		7 DAT			
Treatment[1]	Rate	Grass	Rrpw	Colq	Corw
	(product/A)	----- % control -----			
Sharpen+	0.5fl oz+				
AMS+WE1069	0.5fl oz+2% v/v	47	83	78	89
WE1220	2% v/v	30	40	40	57
WE1283	40fl oz	50	93	87	88
Buccaneer+Sharpen+	12fl oz+0.5fl oz+				
AMS+WE1069	8.5lb/100gal+1% v/v	47	68	70	70
AMS+WE1220	8.5lb/100gal+2% v/v	57	95	93	87
WE1283	40fl oz	50	83	77	78
AMS+WE1283	8.5lb/100gal+40fl oz	57	93	91	90
Bucanneer Plus+Sharpen+					
WE1069	1% v/v	45	67	65	65
AMS+WE1069	8.5lb/100gal+1% v/v	55	93	90	90
WE1220	2% v/v	50	80	72	73
AMS+WE1220	8.5lb/100gal+2% v/v	45	66	67	67
WE1283	40fl oz	48	73	70	70
AMS+WE1283	8.5lb/100gal+40fl oz	52	85	85	70
LSD (0.05)		7	6	5	7

[1]WE = proprietary compounds from Wilbur Ellis.

Sharpen plus oil adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate the efficacy of Sharpen plus oil adjuvants. 'York' flax, 'Plainsman' amaranth, Quinoa (*Chenopodium*), and 'Mancan' tame buckwheat was planted on June 14, 2011. POST treatments were applied on August 5 at 10:00 am with 76 F air, 84 F soil surface, 75% relative humidity, 5% cloud cover, 2 to 4 mph E wind, dry soil surface, wet subsoil, poor crop vigor and no dew present. This study had excessive water damage to the first rep. Weed and species stages at the time of POST treatments were: 6 to 18 inch, pre to full bloom (15 to 25/ft^2) flax; 6 to 30 inch (5 to 25/yd^2) amaranth; 5 to 12 inch (1 to 5/yd^2) common lambsquarters; and 4 to 10 inch (1 to 3/yd^2) biennial wormwood. 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.

Weed control from Sharpen was greatest when oil adjuvant was applied on an area basis (1 pt/A) as compared to any % volume (% v/v) adjuvant rate even at 1% v/v. (Department of Plant Sciences, North Dakota State, Fargo).

Table. Sharpen plus oil adjuvants (Zollinger, Ries, Kazmierczak).

		Application	14 DAT			
Treatment[1]	Rate	Gallons/A	Flax	Amar	Colq	Biww
	(product/A)	17 or 8.5	------ % control -------			
Sharpen+Soy-Stik	1fl oz+1% v/v	17	43	85	47	40
		8.5	43	87	52	47
Sharpen+Destiny HC	1floz+0.5% v/v	17	38	69	33	30
		8.5	37	65	38	30
Sharpen+Destiny HC	1floz+1pt	17	53	96	70	73
		8.5	53	93	75	70
Sharpen+Destiny HC	1floz+0.75% v/v	17	47	86	42	42
		8.5	47	90	40	50
Sharpen+AG 110H2	1fl oz+1pt	17	54	96	67	75
		8.5	45	95	40	50
LSD (0.05)			6	4	6	7

[1]AG = proprietary products from Winfield Solutions.

Ignite with AMS replacement adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate the efficacy of Ignite with AMS replacement adjuvants. 'York' flax, 'Plainsman' amaranth, Quinoa (*Chenopodium*), and 'Mancan' tame buckwheat were planted on June 14, 2011. POST treatments were applied on August 4 at 3:15 pm with 92 F air, 94 F soil surface, 39% relative humidity, 20% cloud cover, 3 to 5 mph SW wind, moist soil surface, wet subsoil, poor to good crop vigor, and no dew present. This study had excessive water damage. Weed and species stages at the time of treatment applications were: 10 to 18 inch, 50% bloom (20 to 30/yd^2) flax; 10 to 24 inch (3 to 7/yd^2) amaranth; 10 to 18 inch, 50 to 75% bloom (1 to 3/yd^2) tame buckwheat; and 12 to 24 inch (3 to 10/yd^2) redroot pigweed. 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.

Liquid AMS (N-Pac AMS) was comparable to Class Act NG which contains AMS + NIS). Adding Interlock drift retardant lowered weed control with Class Act but not AG 8034. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Ignite with AMS replacement adjuvants (Zollinger, Ries, Kazmierczak).

		14 DAT			
Treatment[1]	Rate	Flax	Amar	Rrpw	Tabw
	(product/A)	-------- % control --------			
Ignite+	11fl oz+	72	33	37	37
N-Pac AMS	56.3fl oz	80	50	62	62
N-Pac AMS	113fl oz	90	60	63	67
Class Act NG	2.5% v/v	91	60	68	68
Class Act NG+Interlock	2.5% v/v+4fl oz	80	48	68	68
AG 8034	2% v/v	91	60	76	76
AG 8034+Interlock	2% v/v+4fl oz	91	60	73	73
LSD (0.05)		2	4	8	8

[1]AG = proprietary products from Winfield Solutions.

Blue Diamond NIS. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy from Blue Diamond NIS. 'York' flax and 'Plainsman' amaranth were planted on June 14, 2011. POST treatments were applied on August 8 at 10:15 am with 83 F air, 87 F soil surface, 59% relative humidity, 10% cloud cover, 5 to 10 mph NW wind, dry soil surface, wet subsoil, poor top good crop vigor (excessive moisture) and no dew present. Weeds and species stages at the time of treatment applications were: 10 to 18 inch, 75% bloom (9 to 25/ yd^2) flax; 12 to 26 inch (3 to 15/yd^2) amaranth; 10 to 24 inch (3 to 5/yd^2) common lambsquarters; and 5 to 14 inch (1 to 2/yd^2) biennial wormwood. 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 applied with distilled water and at 1000 ppm water hardness (see table below).
1 gallon of Blue Diamond adjuvant weighs 10 lbs and contains:
AMS = 3.5 lbs
NIS = 40%
Anti foam = 0.5%
Drift retardant = 0.5%
(Department of Plant Sciences, North Dakota State University, Fargo).

Table. Blue Diamond NIS (Zollinger, Ries, Kazmierczak).

		14 DAT			
Treatment[1]	Rate	Flax	Amar	Colq	Biww
	(product/A)	-------- % control --------			
Distilled Water					
Touchdown HiTech+	7.2fl oz+	32	62	20	20
R-11	0.25% v/v	87	83	69	63
Blue Diamond	0.25% v/v	78	83	57	65
Blue Diamond	0.5% v/v	72	85	57	72
AMS	8.5lb/100gal	48	79	23	72
R-11+AMS	0.25% v/v+8.5lb/100 gal	96	96	89	96
Blue Diamond+AMS	0.25% v/v+0.5lb/A	88	90	57	87
1000 ppm					
Touchdown HiTech+	7.2fl oz+	23	47	7	7
R-11	0.25% v/v	48	53	47	43
Blue Diamond	0.25% v/v	48	72	40	47
Blue Diamond	0.5% v/v	63	85	63	70
AMS	8.5lb/100gal	75	90	35	82
R-11+AMS	0.25% v/v+8.5lb/100 gal	94	96	87	92
Blue Diamond+AMS	0.25% v/v+0.5lb/A	75	90	50	73
LSD (0.05)		11	6	8	8

[1]Blue Diamond = NWC Inc, Emerado, ND.

AS500 adjuvant comparison. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Prosper, ND, to evaluate AS500 adjuvant. No crop was planted to evaluate this study. POST treatments were applied on July 6, 2011 at 9:30 am with 78 F air, 82 F soil surface, 46% relative humidity, 10% cloud cover, 3 to 5 mph SE wind, dry soil surface, wet subsoil and no dew present. Weeds present at the time of POST were: 3 to 8 inch (5 to 25/yd^2) common lambsquarters; 3 to 8 inch (10 to 30/yd^2) redroot pigweed; 4 to 10 inch, 5% flowering (3 to 10/ft^2) hairy nightshade; 6 to 12 inch (3 to 5/yd^2) common cocklebur; 6 to 18 inch, bud to flowering (1 to 5/yd^2) wild mustard; and 3 to 12 inch (1 to 5/yd^2) common ragweed. 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 for POST treatments. The experiment had a randomized complete block design with three replicates per treatment.

Treatments were applied at 1000 ppm water hardness to observe the water conditioning effect of AS500 compared to AMS + NIS. AS500 is a product developed in Poland and part of "Better Glyphosate Technology". BGT comprises brand names for this product and novel liquid glyphosate formulations which contains AMS combined with a multifunction adjuvant combination with possible mixtures with 2,4 D, MCPA and dicamba. Communication is managed by SN BIOTECH TECHNOLOGIES. See http://as500.pl/en/index.html for more information. 1 to 2 L/ha is the recommended rate. 1 liter is slightly less than 1 qt - 3.785 L = 4 qts or one gallon.

(Department of Plant Sciences, North Dakota State University, Fargo).

Table. AS500 adjuvant comparison (Zollinger, Ries, Kazmierczak).

		14 DAT						28 DAT					
Treatment[1]	Rate	Wimu	Rrpw	Colq	Hans	Corw	Cocb	Wimu	Rrpw	Colq	Hans	Corw	Cocb
	(product/A)	% control						% control					
Touchdown Hi-Tech+	7.2fl oz+	53	20	20	22	20	23	57	23	23	25	23	27
R-11	0.5% v/v	93	67	68	38	48	72	93	65	70	45	48	65
AMS	8.5lb/100gal	96	77	63	52	57	85	96	70	50	53	53	72
R-11+AMS	0.5%v/v+8.5lb/100 gal	99	93	85	46	63	90	99	92	85	83	73	88
Class Act NG	2.5% v/v	96	90	88	73	62	87	96	88	85	83	72	82
Brimstone	3pt	99	92	85	60	53	77	99	83	83	73	62	78
Brimstone	4pt	99	93	88	72	63	83	99	88	90	82	72	87
AS500	0.855pt = 1 L/ha	99	77	68	42	47	77	99	68	67	55	47	70
AS500	1.28pt = 1.5 L/ha	99	88	80	58	53	87	99	75	77	60	58	77
AS500	1.71pt = 2 L/ha	99	85	82	57	63	92	99	83	80	78	68	88
LSD (0.05)		17	13	15	19	14	16	19	14	11	14	10	14

[1]AS500 = a proprietary product from Better Glyphosate Technology, Poland.

Acidic water conditioning agents. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Prosper ND, to evaluate weed efficacy of acidic water conditioner adjuvants. No crop was planted to evaluate this study. POST treatments were applied on August 17, 2011 at 8:45 am with 67 F air, 67 F soil surface, 75% relative humidity, 0% cloud cover, 3 to 5 mph SW wind, dry soil surface, moist subsoil and no dew present. Weed species present at the time of treatment applications were: 12 to 30 inch, (15 to 30/yd^2) headed redroot pigweed; 6 to 18 inch (3 to 5/yd^2) common lambsquarters; 8 to 14 inch (3 to 5/yd^2) flowering common ragweed; and 12 to 24 inch (10 to 50/yd^2) headed/tillered grasses consisting of 95% yellow foxtail and 5% green foxtail. 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 ratings at 7 and 21 DAT were the same. Brimstone, Hel-Fire, Import, and GunSmoke are Acidic AMS Replacement adjuvants (AAR) (see Adjuvant Compendium in the ND Weed Control Guide) and contain AMADS or monocarbamide dihydrogen sulfate which lower the spray solution pH to near 2.0. Previous research has shown that AMADS and a few commercial AAR adjuvants will condition hard water and enhance glyphosate similar to AMS + NIS only when applied at 1% v/v. Commercial AAR adjuvants are recommended at lower rates of 0.38 to 0.5% v/v and weed control will usually be reduced. Treatments of Brimstone at low use rates (2 to 3 pt/A) + AMS shows that the level of weed control can be increased to AMS + NIS if additional AMS is added to AAR adjuvants. (Dept of Plant Sciences, North Dakota State University, Fargo).

Table. Acidic water conditioning agents (Zollinger, Ries, Kazmierczak).

Treatment	Rate	7 and 21 DAT			
		Grass	Rrpw	Colq	Corw
	(product/A)	-------- % control --------			
Touchdown HiTech+R-11+	7.2fl oz+0.5% v/v+				
AMS	2.125lb/100gal	62	83	70	57
AMS	4.25lb/100gal	84	89	84	78
AMS	8.5lb/100gal	89	94	93	87
Brimstone	2pt/100gal	63	80	70	48
Brimstone	3pt/100gal	70	82	70	60
Hel-Fire	2pt/100gal	77	86	75	75
Hel-Fire	3pt/100gal	78	83	73	60
Import	2pt/100gal	67	70	70	57
Import	3pt/100gal	85	82	78	55
GunSmoke	2pt/100gal	72	72	72	50
GunSmoke	3pt/100gal	85	87	83	69
Brimstone+AMS	2pt/100gal+2.125lb/100gal	78	83	75	65
Brimstone+AMS	2pt/100gal+4.25lb/100gal	82	80	82	78
Brimstone+AMS	2pt/100gal+8.5lb/100gal	90	88	87	78
Brimstone+AMS	3pt/100gal+2.125lb/100gal	82	82	82	70
Brimstone+AMS	3pt/100gal+4.25lb/100gal	85	88	88	75
Brimstone+AMS	3pt/100gal+8.5lb/100gal	94	93	91	80
LSD (0.05)		5	5	5	6

Micronutrients with glyphosate. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate the efficacy of micronutrients with glyphosate. 'York' flax, 'Plainsman' amaranth, Quinoa (*Chenopodium*), and 'Mancan' tame buckwheat were planted on June 14, 2011. POST treatments were applied on August 4 at 11:15 am with 79 F air, 85 F soil surface, 66% relative humidity, 40% cloud cover, 3 to 5 mph SW wind, moist soil surface, wet subsoil, poor to good crop vigor and no dew present. This study had excessive water damage. Weed and species stages at the time of treatment applications were: 10 to 16 inch, 50% bloom (20 to 30/yd^2) flax; 10 to 24 inch (3 to 10/yd^2) amaranth; 8 to 18 inch, 100% bloom (1/yd^2) tame buckwheat; and 8 to 16 inch (1 to 5/yd^2) quinoa. 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.

Weed control was greatest with activating adjuvants and without micronutrient solutions. Most micronutrient solutions antagonized glyphosate and resulted in poor weed control. AMS was bale to overcome some antagonism. Some micronutrient solutions were less antagonistic than others. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Micronutrients with glyphosate (Zollinger, Ries, Kazmierczak).

Treatments[1]	Rate	14 DAT Flax	Amar	Quin	Tabw
	(product/A)	------- % control -------			
Buccaneer Plus+	24fl oz+	70	77	72	70
Prefer 90+AMS	0.25% v/v+8.5lb/100gal	95	95	95	93
N-Tense	0.75% v/v	88	87	87	87
WC095	0.75% v/v	90	92	93	93
EB Mix	1qt	33	50	30	33
Prefer 90+AMS+EB Mix	0.25% v/v+8.5lb/100gal+1qt	78	82	78	78
N-Tense+EB Mix	0.375% v/v+1qt	48	70	68	65
N-Tense+EB Mix	0.75% v/v+1qt	60	78	68	68
42 PHI	1qt	68	73	67	70
Prefer 90+AMS+42 PHI	0.25% v/v+8.5lb/100gal+1qt	85	94	90	90
N-Tense+42 PHI	0.75% v/v+1qt	89	89	92	92
ManGro	3lb	50	53	50	53
Prefer90+AMS+ManGro	0.25% v/v+8.5lb/100gal+3lb	65	70	70	70
N-Tense+ManGro	0.75% v/v+3lb	85	72	72	72
WC095+ManGro	0.75% v/v+3lb	53	67	67	67
Soygreen	1.5lb	32	40	37	37
Prefer 90+AMS+Soygreen	0.25% v/v+8.5lb/100gal+1.5lb	62	62	60	60
N-Tense+Soygreen	0.75% v/v+1.5lb	50	37	37	37
Equation	1qt	78	70	70	70
Prefer 90+AMS+Equation	0.25% v/v+8.5lb/100gal+1qt	92	89	85	85
N-Tense+Equation	0.75% v/v+1qt	95	88	88	88
Prefer 90+AMS+EB Mix	0.5% v/v+8.5lb/100gal+2qt	60	62	57	57
Prefer 90+AMS+42 PHI	0.5% v/v+8.5lb/100gal+2qt	78	73	73	73
Prefer 90+AMS+Equation	0.5% v/v+8.5lb/100gal+2qt	94	87	85	85
LSD (0.05)		7	5	7	7

[1]WC095 = proprietary product from West Central.

AMADS components on weed efficacy. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate the components of AMADS to weed efficacy. 'York' flax and 'Plainsman' amaranth were planted on June 14, 2011. POST treatments were applied on August 8 at 11:45 am with 80 F air, 83 F soil surface, 40% relative humidity, 5 to 10 mph NW wind, poor to good crop vigor (excess water) and no dew present. Weed and species stages at the time of POST applications were: 8 to 20 inch (25% bloom to 25% boll formation, 5 to 30/yd^2) flax; 10 to 24 inch (3 to 15/yd^2) amaranth; 8 to 14 inch (1 to 2/yd^2) biennial wormwood; and 12 to 30 inch (3 to 5/yd^2) redroot pigweed. 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.

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 to water and CO_2. Sulfuric acid instantly converts to sulfate in water. The purpose of this study was to determine the amount of water conditioning of some sulfate containing compounds and herbicide enhancement from some ammonium containing compounds when applied at the same relative rate of sulfate and ammonium in AMS at 4.25 and 8.5 lbs/100 gallons of water. Treatments were applied at 1000 ppm water hardness. AMADS and sulfuric acid provided the same level of water conditioning as AMS at the respective rates. Potassium is a weak antagonist of weak acid herbicides and potassium sulfate (K_2SO_4) provided poor conditioning. Ammonium chloride and urea treatments did not have sulfate to condition water and weed control was reduced. Conversion of urea to ammonium is considered slow which may also delay the effect enhancing effects of ammonium. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. AMADS components on weed efficacy (Zollinger, Ries, Kazmierczak).

		14 DAT			
Treatment	Rate	Flax	Amar	Rrpw	Biww
	(product/A)	------------ % control ------------			
Touchdown HiTech+R-11+	7.2fl oz+0.5% v/v+				
1. AMS	4.25lb/100gal	83	90	90	87
2. AMS	8.5lb/100gal	92	93	95	92
AMADS	Equiv sulfate as Trt 1	65	73	80	83
AMADS	Equiv sulfate as Trt 2	90	94	93	88
H_2SO_4	Equiv sulfate as Trt 1	70	83	80	67
H_2SO_4	Equiv sulfate as Trt 2	73	85	85	75
K_2SO_4	Equiv sulfate as Trt 1	40	55	65	40
K_2SO_4	Equiv sulfate as Trt 2	55	57	67	50
HCl	Equiv sulfate as Trt 2	17	20	30	7
NH_4Cl	Equiv ammonium as Trt 1	33	42	52	30
NH_4Cl	Equiv ammonium as Trt 2	37	50	60	27
NH_4Cl+HCl	Equiv ammonium as Trt 1	42	48	58	28
NH_4Cl+HCl	Equiv ammonium as Trt 2	42	57	57	30
Urea+HCl	Equiv ammonium as Trt 1	38	57	60	40
Urea+HCl	Equiv ammonium as Trt 2	60	65	65	40
Urea	Equiv ammonium as Trt 1	57	55	55	42
Urea	Equiv ammonium as Trt 2	55	68	68	57
LSD (0.05)		7	8	7	8

AMADS component effect on glyphosate efficacy. Howatt, Roach, and Harrington. Amaranth, tame buckwheat, quinoa, and 'York' flax were seeded at Casselton, ND, on June 9. Treatments mixed using hard water (1000 ppm equivalency, including Ca and Mg) as the carrier were applied to 6- to 12-inch amaranth and Venice mallow, 12- to 16-inch flax, 18- to 24-inch tame buckwheat, 12 inch common purslane, and 6 to 20 inch redroot pigweed on July 29 with 85°F, 43% relative humidity, clear sky, 0 mph wind, and dry soil at 80°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 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.

		Aug 12	Aug 26					
Treatment[a]	Rate	Avg	Vema	Copu	Amar	Flax	Tabw	Avg
	oz ai/A	%	%	%	%	%	%	%
Glyt-K+AMS	4.5+4.85	57	45	43	78	94	78	67
Glyt-K+AMS	4.5+9.7	70	65	60	91	97	90	81
Glyt-K+AMADS	4.5+4.85	56	43	38	91	96	92	72
Glyt-K+AMADS	4.5+9.7	66	70	66	94	96	94	84
Glyt-K+H2SO4	4.5+4.85	61	53	33	94	93	95	73
Glyt-K+H2SO4	4.5+9.7	66	70	65	95	94	94	84
Glyt-K+K2SO4	4.5+4.85	32	13	18	50	28	38	29
Glyt-K+K2SO4	4.5+9.7	25	5	8	25	23	48	22
Glyt-K+HCL	4.5+0.085	14	0	10	5	10	25	10
Glyt-K+NH4CL	4.5+0.93	10	5	8	5	13	20	10
Glyt-K+NH4CL	4.5+1.86	14	0	5	5	8	20	8
Glyt-K+NH4CL+HCL	4.5+0.93+0.043G	12	13	18	20	23	30	21
Glyt-K+NH4CL+HCL	4.5+1.86+0.085G	8	3	10	13	13	25	13
Glyt-K+Urea+HCL	4.5+0.93+0.043G	9	5	10	13	20	23	14
Glyt-K+Urea+HCL	4.5+1.86+0.085G	15	5	15	25	33	33	22
Glyt-K+Urea	4.5+0.93	9	0	13	18	10	18	12
Glyt-K+Urea	4.5+1.86	12	8	28	18	10	13	15
CV		12	30	30	14	17	17	12
LSD 5%		5	10	11	9	11	12	6

[a] All treatments included NIS at 0.25% v/v as R-11 from Wilbur-Ellis Company, P.O. Box 1286, Fresno, CA 93715.

The treatment list was constructed for equivalency to the amount of nitrogen or sulfate provided in 4.25 or 8.5 pounds of AMS (Treatments 1 and 2, respectively) per 100 gallons of spray mixture. The amount of HCL included is equivalent to the acidity provided by the high rate of H2SO4.

The primary benefit of AMS was again demonstrated to be sulfate ion, which reacts with hard water cations such as Ca and Mg to prevent antagonism of glyphosate activity. However, sulfate provided through K2SO4 did not have the same effect as other SO4 sources. If the treatment was properly mixed, this could indicate that the acidity of AMADS or NH4 provided by AMS, plays an important role. Sources of NH4 only were inferior products to alleviate antagonism of glyphosate by hard water. It is important that AMS replacements have sufficient SO4 content and activity.

Spray quality effect on auxinic herbicide efficacy. Howatt, Ciernia and Harrington. 'York' flax, amaranth, tame buckwheat, and quinoa were seeded near Fargo on June 9. Treatments were applied to 8- to 12-inch flax, 6- to 10-inch pigweed (amaranth), 12- to 24-inch tame buckwheat, and 6- to 8-inch Venice mallow (quinoa did not emerge) on July 29 with 85°F, 40% relative humidity, 0% cloud cover, 0 to 5 mph wind at 180°, and dry soil surface at 72°F. The treatments were applied with a sprayer mounted on a 4-wheeler delivering 10 gpa at various psi through various nozzles, attaining the 5 different spray qualities (droplet size range), to the center 7 ft of plots the length of 10 by 40 feet. The experiment was a randomized complete block design with four replicates, with the exception of tame buckwheat with three replicates. Evaluation was performed on August 12.

Treatment	Rate	Quality	Vema	Amar	Flax	Tabw	Avg
	oz/A		%	%	%	%	%
E-99	8	Fine	65	63	8	57	46
E-99+AG02013	8+0.03G	Fine	70	68	15	70	53
AGH09008	7	Fine	58	60	8	64	44
AGH09008+AG02013	7+0.03G	Fine	63	63	3	67	47
AGH09035	8.6	Fine	28	25	84	50	44
AGH09035+AG02013	8.6+0.03G	Fine	35	38	80	34	45
E-99	8	Medium	61	55	0	54	40
E-99+AG02013	8+0.03G	Medium	68	65	8	65	47
AGH09008	7	Medium	60	60	8	37	38
AGH09008+AG02013	7+0.03G	Medium	63	64	10	69	52
AGH09035	8.6	Medium	28	30	85	38	45
AGH09035+AG02013	8.6+0.03G	Medium	25	20	83	24	36
E-99	8	Coarse	58	40	0	40	32
E-99+AG02013	8+0.03G	Coarse	58	48	0	47	37
AGH09008	7	Coarse	50	43	0	30	29
AGH09008+AG02013	7+0.03G	Coarse	35	35	0	49	25
AGH09035	8.6	Coarse	23	20	76	30	35
AGH09035+AG02013	8.6+0.03G	Coarse	28	20	76	44	39
E-99	8	V coarse	33	40	0	44	27
E-99+AG02013	8+0.03G	V coarse	30	26	5	27	19
AGH09008	7	V coarse	25	28	0	24	17
AGH09008+AG02013	7+0.03G	V coarse	50	33	3	34	28
AGH09035	8.6	V coarse	10	13	80	24	29
AGH09035+AG02013	8.6+0.03G	V coarse	10	18	80	27	31
E-99	8	EX coarse	53	35	0	17	24
E-99+AG02013	8+0.03G	EX coarse	40	33	3	24	23
AGH09008	7	EX coarse	18	23	3	17	13
AGH09008+AG02013	7+0.03G	EX coarse	43	36	3	17	22
AGH09035	8.6	EX coarse	10	10	76	10	24
AGH09035+AG02013	8.6+0.03G	EX coarse	13	15	79	24	30
CV			15	16	18	23	14
LSD 5%			8	9	7	12	7

Plants were under severe stress from excess soil moisture through most of the study duration. This was believed to be the reason for poor control in general. Average values for control across species declined from 45 to 50% with fine and medium spray quality to 20 to 25% control with extremely coarse spray quality. The deposition aid AG02013 did not consistently affect weed control with herbicides.

Crop growth hormone supplements as foxtail herbicide adjuvants. Howatt, Roach, and Harrington. 'Faller' hard red spring wheat was seeded near Fargo on June 7. Treatments were applied to two-leaf wheat and yellow foxtail on July 8 with 74°F, 49% relative humidity, clear sky, 2 mph wind at 135°, and dry soil at 70°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 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	7/22 Yeft
	oz/A	%
Flcz&flox+NIS	2.2+0.25%	40
Flcz&flox+HM1045+NIS	2.2+0.04+0.25%	53
Flcz&flox+Ascend+NIS	2.2+0.03G+0.25%	63
Flcz&flox+Rachet+NIS	2.2+0.04G+0.25%	37
Flcz&flox+Radiate+NIS	2.2+0.02G+0.25%	33
Flcz&flox+GA3+NIS	2.2+0.4+0.25%	47
Pxdn+flas&MCPA+NIS	0.86+5+0.25%	68
Pxdn+flas&MCPA+HM1045+NIS	0.86+5+0.04G+0.25%	80
Pxdn+flas&MCPA+Ascend+NIS	0.86+5+0.03G+0.25%	85
Pxdn+flas&MCPA+Rachet+NIS	0.86+5+0.04G+0.25%	73
Pxdn+flas&MCPA+Radiate+NIS	0.86+5+0.02G+0.25%	77
Pxdn+flas&MCPA+GA3+NIS	0.86+5+0.4+0.25%	75
CV		13
LSD 5%		13

If weeds need to be growing to produce symptoms of herbicide activity, then perhaps a growth stimulant may encourage more rapid symptom progression and stabilize herbicide activity under environmental stress. Even with rather large LSD, control of yellow foxtail with flucarbazone was enhanced with HM1045 or Ascend from 40% alone to 53 and 63%, respectively. With pinoxaden, only Ascend had beneficial influence on herbicidal activity, although all hormone products tended to improve foxtail control. While this is early in the investigation of this potential use, at least the products did not make the yellow foxtail more resilient to herbicidal activity. More work is planned for next season.