

AMS replacements with glyphosate. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy with glyphosate and various AMS replacements. Treatments were mixed with distilled and 1004 ppm hard water test. 'York' flax, 'Mancan' tame buckwheat, quinoa (*Chenopodium quinoa*), and Pioneer '39B22' conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 14, at 9:10 am with 68 F air, 71 F soil surface, 97% relative humidity, 100% cloud cover, 6 to 12 mph SE wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 9 to 15 inch (20 to 30/ft²) flax; 12 to 20 inch (15 to 20/ft², 80% flowering) tame buckwheat; 4 to 20 inch (3 to 10/ft², 80% budding) quinoa; and 24 to 28 inch (V5, 3 to 5/ft²) conventional corn. 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.

Using Class Act NG at 2.5% v/v (NIS + AMS at 8.5 lb/100 gal) as the standard to compare other adjuvants, no AG adjuvant gave the same level of control. N Go (acidic AMS replacement water conditioner adjuvant) was the only other adjuvant that gave similar control. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. AMS replacements with glyphosate (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	14 DAT			
		Flax	Quin	Tabw	Corn
		----- % control -----			
<u>Hard Water (1004 ppm)</u>					
Touchdown HiTech+	7.2fl oz+				
Preference	0.25% v/v	42	45	33	23
N-Pac AMS	2.5% v/v	17	22	40	50
N-Pac AMS	5% v/v	22	25	47	55
Class Act NG	1.25% v/v	72	65	53	53
Class Act NG	2.5% v/v	78	80	62	65
AG 07046	1.25% v/v	67	43	40	48
AG 08014	1% v/v	72	53	35	48
AG 08014	2% v/v	83	87	37	58
AG 08015	1% v/v	60	53	35	35
AG 08015	2% v/v	72	57	40	47
AG 08031	1% v/v	53	40	30	43
AG 08031	2% v/v	58	40	37	42
AG 08034	1% v/v	60	38	33	47
AG 08034	2% v/v	64	52	42	47
AG 07090	1.25% v/v	35	42	25	15
AG 03019	0.5% v/v	47	37	30	30
AG 07043	1% v/v	43	53	32	28
ET 4000	1% v/v	23	20	27	33
ET 4000+R-11	1% v/v+0.25% v/v	55	42	32	37
ET 4000+AMS	1% v/v+8.5lb/100gal	18	17	38	45
M2100	1.1% v/v	13	15	37	45
N Go	1% v/v	86	82	53	58
<u>LSD (0.05)</u>		6	8	8	7

¹AG = proprietary compounds from Winfield Solutions; M2100 = a proprietary product from MK Ag Service.

Glyphosate formulations. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy from glyphosate formulations at 1112 ppm hard water test. 'York' flax, 'Mancan' tame buckwheat, quinoa (*Chenopodium quinoa*), and Pioneer '39B22' conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 14, at 10:10 am with 67 F air, 70 F soil surface, 67% relative humidity, 100% cloud cover, 8 to 10 mph SE wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 6 to 14 inch (20 to 30/ft²) flax; 14 to 20 inch (15 to 20/ft², 90% budding) tame buckwheat; 4 to 14 inch (15 to 20/ft², 80% budding) quinoa; and 20 to 24 inch (V5, 3 to 5/ft²) conventional corn. 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 801 ppm calcium + 312 ppm magnesium = 1112 ppm hard water test. Glyphosate was applied at the same acid equivalent (0.28 ae/A) in all treatments. Gly N Go showed the greatest herbicide enhancement. Gly is 97% glyphosate acid in its crystalline form. N Go is a water conditioner (acid AMS replacement type) that was developed for glyphosate. Gly, with its water conditioner adjuvant (N-Go), usually performs equal to or greater than liquid glyphosate formulations. ET-4000 and M2100 are acidic AMS replacement adjuvants. Touchdown Hi-Tech is an unloaded glyphosate formulation with no surfactant in the formulation. NIS (R-11) partially restores activity with Touchdown Hi-Tech plus M2100 as compared to other treatments. (Department of Plant Sciences, North Dakota State University, Fargo).

Table: Glyphosate formulations (Zollinger, Ries, and Kazmierczak).

Treatments ¹	Rate (product/A)	14 DAT			
		Flax	Quin	Tabw	Corn
		----- % control -----			
<u>Hard water - 1112 ppm</u>					
Touchdown Total	8.6fl oz	50	40	40	60
Roundup PowerMax	8fl oz	68	68	45	72
Cornerstone Plus	12fl oz	30	30	30	60
AGH 09001	12fl oz	27	32	32	62
AGH 09002	9fl oz	33	30	35	58
AGH 09003	9fl oz	33	30	37	57
AGH 09005	12fl oz	37	37	33	53
AGH 09005	9fl oz	27	33	28	57
AGH 09006	12fl oz	28	30	30	57
AC 09015	12fl oz	33	35	28	55
Gly+N Go	0.3lb+1% v/v	80	83	52	45
Gly+ET 4000	0.3lb+1% v/v	17	28	35	40
Gly+M2100	0.3lb+1.1% v/v	10	27	30	40
Touchdown HiTech+ET 4000	7.2fl oz+1% v/v	10	20	37	35
Touchdown HiTech+M2100	7.2fl oz+1.1% v/v	7	18	43	47
Touchdown HiTech+R-11+M2100	7.2fl oz+0.25% v/v+1.1% v/v	70	62	43	45
LSD (0.05)		7	5	7	5

¹AGH and AC products = proprietary compounds from Winfield Solutions; M2100 = proprietary product from MK Ag Service.

Gly N Go. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate broadleaf efficacy with Roundup PowerMax and Gly N Go tank-mixes at 0 (distilled) and 1004 ppm water hardness test. 'York' flax, 'Quinoa' (*Chenopodium quinoa*), 'Mancan' tame buckwheat, and Pioneer '39B22' conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 17, at 7:15 am with 53 F air, 50 F soil surface, 60% relative humidity, 40% cloud cover, 2 to 6 mph W wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 10 to 16 inch (20 to 30/ft, 15% bloom) flax; 6 to 16 inch (5 to 12/ft², 100% budding) quinoa; 14 to 22 inch (20 to 25/ft², 100% bloom) tame buckwheat; and 24 to 30 inch (V7, 3 to 5/ft²) corn. 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.

Distilled water was used for treatment solutions and hard water components were added to the distilled water to reach the desired hard water. Gly is 97% glyphosate acid in its crystalline form. N Go is a water conditioner (acid AMS replacement type) that was developed for glyphosate. RU Power Max at 22 fl oz/A contains the same amount of glyphosate acid equivalent (ae) as Gly at 0.8 lbs/A. Treatments are paired based on glyphosate ae rates. Gly with its water conditioner adjuvant (N Go) usually performs equal to a liquid glyphosate formulation. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Gly N Go (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	Water source DW ² or HW ³	14 DAT				28 DAT			
			Flax	Quin	Tabw	Corn	Flax	Quin	Tabw	Corn
			----- % control -----				----- % control -----			
RUPM+AMS	22fl oz	DW	95	84	65	89	95	91	82	93
		HW	92	85	67	86	92	85	75	92
Gly+N Go	0.8lb+1% v/v	DW	95	86	75	56	96	93	83	94
		HW	93	71	75	82	97	83	80	87
RUPM+R-11+AMS	14.5fl oz+0.25% v/v	DW	90	80	60	82	93	80	70	93
		HW	88	84	67	82	93	84	73	93
Gly+N Go	0.53lb+1% v/v	DW	86	78	73	72	95	78	72	92
		HW	86	75	50	70	93	75	70	90
RUPM+R-11+AMS	8fl oz+0.25% v/v	DW	77	58	57	78	83	65	58	83
		HW	55	67	58	65	58	67	62	63
Bucc Plus+R-11+AMS	12fl oz+0.25% v/v	DW	75	67	45	68	85	37	62	78
		HW	55	35	57	68	58	35	57	68
Gly+N Go	0.3lb+0.5% v/v	DW	60	53	52	47	70	53	52	47
		HW	60	53	45	48	67	58	48	52
Gly+N Go	0.3lb+1% v/v	DW	68	62	45	55	77	63	45	53
		HW	68	75	65	60	83	79	65	67
LSD (0.05)			8	9	8	5	5	6	5	4

¹RUPM = Roundup PowerMax; Bucc Plus = Buccaneer Plus. Gly and N Go = products from MEY; AMS = 8.5 lb/100 gal water.

²DW = Distilled water

³HW = Hard water = 1004 ppm hardness (Ca + Mg)

Glyphosate with acidic AMS replacement adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. Two identical treatment experiments were conducted near Mapleton, ND, to evaluate weed efficacy with glyphosate and various acidic AMS replacement rates. Study one treatments were mixed with distilled water, and study two treatments were mixed with 1004 ppm hard water test. Hard water test had a pH of 5.9. 'York' flax, 'Mancan' tame buckwheat, quinoa (*Chenopodium quinoa*), and Pioneer '39B22" conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 20, at 9:25 am with 67 F air, 77 F soil surface, 85% relative humidity, 15% cloud cover, 6 to 12 mph S wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 9 to 15 inch (20 to 30/ft²) flax; 24 to 30 inch (10 to 20/ft²) tame buckwheat; 8 to 18 inch (3 to 10/ft²) quinoa; and 26 to 32 inch (V5 to V6, 5 to 15/ft²) conventional corn. 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.

There is wide range in adjuvant enhancement for each weed species. Some adjuvants enhanced glyphosate activity for some species and less for others while other adjuvants showed different results. This again confirms differential plant response for each herbicide / adjuvant / species interaction. Most adjuvants did not enhance glyphosate to the level of NIS + AMS. However some adjuvants gave equal or greater enhancement with some species. AMS (and + NIS) overcame hard water antagonism. Most adjuvants did not overcome hard water antagonism. It appears that acidic AMS replacement adjuvants are not created equal and there is wide variability in their affect on glyphosate and capacity to overcome hard water antagonism.
(Department of Plant Sciences, North Dakota State University, Fargo).

Table 1. Glyphosate with acidic AMS replacement adjuvants, distilled water (Zollinger, Ries, and Kazmierczak).

Treatment	Rate (product/A)	Water source		Treatment Solution -- pH --	28 DAT			
		Distilled (DW)	Hard (HW)		Flax	Quin	Tabw	C Crn
					----- % control -----			
TD HiTech+	7.2fl oz+	DW		5.4	10	10	13	12
		HW		5.0	2	2	5	7
R-11	0.25% v/v	DW		6.3	72	40	30	30
		HW		4.8	40	38	15	15
AMS	8.5lb/100gal	DW		5.7	28	30	64	70
		HW		5.1	27	25	62	68
R-11+AMS	0.25% v/v+8.5lb/100gal	DW		5.5	93	53	52	73
		HW		5.1	89	58	53	67
CutRate	2lb/100gal	DW		3.4	12	10	13	17
		HW		3.3	8	17	12	13
	4lb/100gal	DW		2.9	17	15	22	27
		HW		3.1	20	20	22	25
Hel-Fire	0.5% v/v	DW		2.3	70	57	37	37
		HW		2.6	52	37	33	27
	1% v/v	DW		1.9	90	88	43	50
		HW		2.0	68	68	43	43
Import	0.5% v/v	DW		1.9	28	27	33	52
		HW		1.7	32	30	28	25
	1% v/v	DW		1.4	48	42	47	70
		HW		1.4	42	37	38	63
CT-301	4fl oz/100gal	DW		2.8	22	22	20	17
		HW		2.0	18	25	17	13
	8fl oz/100gal	DW		3.4	10	20	30	27
		HW		2.0	10	18	25	25
ET 4000	0.5% v/v	DW		2.5	17	20	25	30
		HW		2.0	17	15	18	22
	1% v/v	DW		2.1	20	27	47	72
		HW		1.9	27	22	27	47
N-Tense	0.5% v/v	DW		2.6	52	42	32	30
		HW		2.1	42	42	32	25
	1% v/v	DW		2.4	62	52	43	55
		HW		2.0	52	50	40	38
LSD (0.05)					DW/HW	DW/HW	DW/HW	DW/HW
					7/5	6/5	6/5	6/5

¹CT-301 = a proprietary product from Cheltec.
Hard water = 1004 ppm Ca + Mg hardness.

Glyphosate with different spray volumes. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy from glyphosate treatments and spray volume. 'York' flax, 'Mancan' tame buckwheat, Quinoa (*Chenopodium quinoa*), and Pioneer '39B22' conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 17, at 8:30 am with 67 F air, 78 F soil surface, 44% relative humidity, 15% cloud cover, 6 to 12 mph NW wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 10 to 16 inch (20 to 30/ft²) flax; 20 to 26 inch (20 to 30/ft²) tame buckwheat; 12 to 24 inch (3 to 7/ft²) quinoa; and 20 to 30 inch (V5, 5 to 7/ft²) corn. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with an ATV-type plot sprayer. Nozzles, pressure, and speed were adjusted to obtain correct spray applications. The experiment had a randomized complete block design with three replicates per treatment.

Nozzle Information:

Fine Droplet = XR 11003, 30 psi, and 8 mph.
 Medium course droplet = XR 11004, 30 psi, and 10 mph.
 Course droplet = AIXR 110015, 30 psi, and 4 mph.
 Extra Course droplet = AIXR 11003, 30 psi, and 8mph.

When mixing treatments, certain mixing orders of herbicide and adjuvants were followed. 10 gpa was the targeted application spray volume rate. In the absence of WE adjuvants, glyphosate activity increased as droplet size increased from fine to course droplet size but activity decreased from course to extra course droplet size. The increase in efficacy from larger droplets confirm current theory that glyphosate activity increases as spray droplet herbicide concentration increases which improves spray droplet retention and herbicide absorption. The decrease in activity of extra course droplets may be due to a reduction in retention from very large droplets. When comparing adjuvants WE-1118-1 in medium droplets and WE1160-1 in very course droplets expressed the greatest enhancement from adjuvant activity. WE 1160-1 may improve retention and increase glyphosate activity along with a more concentrated droplet in a very course droplet size. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate with different spray volumes (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	14 DAT			
		Flax	Quin	Tabw	Corn
		----- % control -----			
<u>Fine Droplet</u>					
Buccaneer Plus+Bronc Max+R-11	12fl oz+2qt/100 gal+0.25% v/v	55	60	32	63
<u>Medium Droplet</u>					
Buccaneer Plus+Bronc Max+R-11+	12fl oz+2qt/100 gal+0.25% v/v	47	60	35	53
WE 1118-1	3fl oz pre-slurry with Bucc Plus	65	77	57	78
WE 1150-1	4fl oz	47	60	38	55
WE 1160-1	2qt/100 gal	55	72	40	63
<u>Course Droplet</u>					
Buccaneer Plus+Bronc Max+R-11+	12fl oz+2qt/100 gal+0.25% v/v	65	75	50	75
WE 1118-1	3fl oz pre-slurry with Bucc Plus	42	55	28	43
WE 1150-1	4fl oz	35	48	30	62
WE 1160-1	2qt/100 gal	40	57	37	54
<u>Extra Course Droplet</u>					
Buccaneer Plus+Bronc Max+R-11+	12fl oz+2qt/100 gal+0.25% v/v	40	60	37	52
WE 1118-1	3fl oz pre-slurry with Bucc Plus	48	58	37	67
WE 1150-1	4fl oz	48	62	42	68
WE 1160-1	2qt/100 gal	63	82	52	78
LSD (0.05)		27	22	19	30

¹WE = proprietary compounds from Wilbur-Ellis.

Ignite with droplet size. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy from Ignite treatments and spray droplet size. 'York' flax, 'Mancan' tame buckwheat, Quinoa (*Chenopodium quinoa*), and Pioneer '39B22' conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 17, at 9:00 am with 67 F air, 78 F soil surface, 44% relative humidity, 15% cloud cover, 6 to 12 mph NW wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 10 to 16 inch (20 to 30/ft², 15% flowering) flax; 20 to 24 inch (20 to 30/ft², 90% budding) tame buckwheat; 10 to 20 inch (5 to 7/ft², 90% budding) quinoa; and 24 to 30 inch (V5, 5 to 7/ft²) corn. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with an ATV-type plot sprayer. Nozzles, pressure, and speed were adjusted to obtain correct spray applications.

Nozzle Information:

1. Nozzle 1 = Fine droplets with XR 11003, 10 gpa, 30 psi, and 8 mph.
2. Nozzle 2 = Fine droplets with XR 11003, 15 gpa, 30 psi, and 5 mph.
3. Nozzle 3 = Med droplets with XR 11004, 10 gpa, 30 psi, and 10 mph.
4. Nozzle 4 = Med droplets with XR 11004, 15 gpa, 30 psi, and 7 mph.
5. Nozzle 5 = Coarse droplets with AIXR 110015, 10 gpa, 30 psi, and 4 mph.
6. Nozzle 6 = Coarse droplets with AIXR 110015, 15 gpa, 30 psi, and 2.6 mph.
7. Nozzle 7 = XCoarse droplets with AIXR 11003, 10 gpa, 30 psi, and 8 mph.
8. Nozzle 8 = XCoarse droplets with AIXR 11003, 15 gpa, 30 psi, and 5 mph.

AMS generally provided the greatest enhancement of glyphosate with data from each nozzle/droplet size. Nozzle, spray volume (gpa), pressure, and travel speed configuration for nozzle 2 and 4 generally provided the greatest control. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Ingite with droplet size (Zollinger, Ries, and Kazmierczak).

Treatment	Rate (product/A)	14 DAT			
		Flax	Quin	Tabw	Corn
		----- % control -----			
<u>Nozzle 1</u>					
Ignite+	12fl oz+	60	70	80	40
AMS	3lb	70	75	85	50
Class Act NG	2.5% v/v	55	75	82	40
Class Act NG+Interlock	2.5% v/v+4fl oz	70	70	77	45
Clethodim+Class Act NG+Interlock	2fl oz+2.5% v/v+4fl oz	60	55	75	50
<u>Nozzle 2</u>					
Ignite+	12fl oz+	75	85	85	55
AMS	3lb	80	90	90	60
Class Act NG	2.5% v/v	80	87	90	65
Class Act NG+Interlock	2.5% v/v+4fl oz	75	87	97	68
Clethodim+Class Act NG+Interlock	2fl oz+2.5% v/v+4fl oz	80	92	93	60
<u>Nozzle 3</u>					
Ignite+	12fl oz+	55	75	75	50
AMS	3lb	65	80	85	55
Class Act NG	2.5% v/v	60	75	82	50
Class Act NG+Interlock	2.5% v/v+4fl oz	50	72	70	55
Clethodim+Class Act NG+Interlock	2fl oz+2.5% v/v+4fl oz	70	70	65	50
<u>Nozzle 4</u>					
Ignite+	12fl oz+	80	75	85	40
AMS	3lb	80	87	85	45
Class Act NG	2.5% v/v	80	87	90	40
Class Act NG+Interlock	2.5% v/v+4fl oz	80	87	80	50
Clethodim+Class Act NG+Interlock	2fl oz+2.5% v/v+4fl oz	80	90	85	65
<u>Nozzle 5</u>					
Ignite+	12fl oz+	15	20	50	20
AMS	3lb	65	70	77	35
Class Act NG	2.5% v/v	65	65	70	30
Class Act NG+Interlock	2.5% v/v+4fl oz	51	60	65	35
Clethodim+Class Act NG+Interlock	2fl oz+2.5% v/v+4fl oz	65	65	75	40
<u>Nozzle 6</u>					
Ignite+	12fl oz+	75	85	70	40
AMS	3lb	75	87	95	45
Class Act NG	2.5% v/v	70	85	88	40
Class Act NG+Interlock	2.5% v/v+4fl oz	80	70	85	40
Clethodim+Class Act NG+Interlock	2fl oz+2.5% v/v+4fl oz	80	75	75	40
<u>Nozzle 7</u>					
Ignite+	12fl oz+	45	55	40	30
AMS	3lb	50	55	65	45
Class Act NG	2.5% v/v	55	55	60	45
Class Act NG+Interlock	2.5% v/v+4fl oz	65	45	55	40
Clethodim+Class Act NG+Interlock	2fl oz+2.5% v/v+4fl oz	55	40	60	55
<u>Nozzle 8</u>					
Ignite+	12fl oz+	60	75	70	40
AMS	3lb	80	85	65	75
Class Act NG	2.5% v/v	70	75	75	55
Class Act NG+Interlock	2.5% v/v+4fl oz	70	85	88	55
Clethodim+Class Act NG+Interlock	2fl oz+2.5% v/v+4fl oz	65	75	75	50
<u>LSD (0.05)</u>		6	8	7	5

Spray quality effect on 2,4-D activity, evaluation on small plants. Howatt, Roach, and Harrington. Bioassay strips of amaranth, 'IS3057RR' canola, 'York' flax, 'Mincar' buckwheat, 'Admiral' field pea, and '8N386CL' sunflower were seeded in Prosper, ND, on May 29. Treatments were applied to 2 inch tall crops on June 25 with 79°F, 46% RH, 0% cloud cover, 9 mph wind at 45°, and moist soil at 69°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 (fine spray), 35 (medium spray), 18 (coarse spray), and 30 (very coarse spray) psi through 11001 TT (fine or medium spray) or 110015 TT (coarse or very coarse spray) nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with three replicates.

Treatment	Rate oz/A	Spray quality	6/30	7/6	7/6	7/6	7/6	7/6	7/6
			All	Amaranth sp.	Canola	Flax	Buckwheat	Field pea	Sunflower
10	4	fine	30	93	88	43	53	20	75
11	4	fine	30	90	78	43	53	20	75
10	4	medium	30	85	82	40	50	20	75
11	4	medium	30	85	77	40	50	20	75
10	4	coarse	30	83	73	40	43	20	75
11	4	coarse	30	80	67	40	50	20	75
10	4	very coarse	30	80	75	40	40	20	75
11	4	very coarse	30	77	63	40	43	20	75
Untreated	0		30	0	0	0	0	0	0
C.V.			0	7	6	8	15	0	0
LSD 5%			0	8	7	5	11	0	0

Flax, field pea, and sunflower response to 2,4-D was stable across spray qualities. Control of amaranth, canola and buckwheat decreased as droplet size increased. It was thought that larger droplets may not impinge on enough area to adequately cover small plant surfaces. Plants could be missed by a spray pattern characterized by few, but large, droplets. In addition, the kinetic energy of large droplets might reduce retention on leaves and vertical surfaces. While control decreased with increasing droplet size for some of the species, coverage and retention did not seem to be a factor. It is possible that plants did not receive foliar exposure to herbicide, but soil availability of 2,4-D may have masked any effect of poor coverage. Additional studies with more specific methods would be necessary to elucidate this relationship.

Spray quality effect on weed control with 2,4-D. Howatt, Roach, and Harrington. Bioassay strips of '8N386CL' sunflower, 'Mincar' buckwheat, 'IS3057RR' canola, 'Admiral' field pea, amaranth, and 'York' flax were seeded near Fargo on May 29. Treatments were applied July 10 with 66°F, 74% RH, 80% cloud cover, 4 to 7 mph wind at 270°F, and moist soil at 67°F. At application, sunflower and buckwheat was 4 to 8 inches, canola had bolted, field pea and flax was 5 inches, and amaranth was 3 inches. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 (fine spray), 35 (medium spray), 18 (coarse spray), and 30 (very coarse spray) psi through 11001 (fine or medium spray) and 110015 (coarse or very coarse spray) nozzles to an area 7 feet wide the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Spray	7/20	7/20	7/20	7/20	7/20	7/20	8/06	8/06	8/06	8/06
			Sunflower	Field pea	Buckwheat	Flax	Canola	Amaranth	Sunflower	Buckwheat	Canola	Amaranth
	oz/A	quality	%	%	%	%	%	%	%	%	%	%
10	8	fine	50	42	60	45	55	67	89	71	92	92
11	8	fine	57	45	57	47	57	69	90	77	86	87
1052	8	fine	50	50	55	50	57	67	87	71	92	90
1156	8	fine	50	42	57	50	52	67	85	66	87	87
10+ Encapsulator	8+4	fine	57	52	62	50	62	76	91	75	93	94
11+ Encapsulator	8+3	fine	60	57	66	55	60	72	91	80	93	94
10+ Polymer	8+0.5%	fine	52	57	55	45	57	67	89	69	93	90
11+ Polymer	8+0.5%	fine	55	50	61	55	57	75	91	79	91	92
10	8	medium	52	45	55	42	55	67	87	69	90	90
11	8	medium	55	42	57	40	47	62	89	69	87	87
1052	8	medium	52	42	50	42	57	65	86	67	88	87
1156	8	medium	50	45	60	50	55	71	87	70	89	91
10+ Encapsulator	8+4	medium	52	50	65	40	47	69	85	71	89	91
11+ Encapsulator	8+3	medium	57	45	55	42	47	70	87	69	87	91
10+ Polymer	8+0.5%	medium	50	42	55	45	50	62	86	71	86	89
11+ Polymer	8+0.5%	medium	52	45	55	37	45	65	84	72	87	85
10	8	coarse	50	37	50	37	42	60	82	57	84	84
11	8	coarse	50	40	52	37	37	62	84	60	84	80
1052	8	coarse	47	40	50	37	40	70	82	60	84	84
1156	8	coarse	50	32	40	37	37	62	82	50	82	82
10+ Encapsulator	8+4	coarse	52	42	47	35	40	60	82	52	84	84
11+ Encapsulator	8+3	coarse	47	35	47	32	40	62	82	56	81	80
10+ Polymer	8+0.5%	coarse	42	32	47	30	37	50	75	42	84	80
11+ Polymer	8+0.5%	coarse	47	35	42	32	35	57	80	47	80	75
10	8	very coarse	50	30	47	37	40	60	84	50	81	77
11	8	very coarse	47	32	50	27	27	52	81	55	79	71
1052	8	very coarse	47	37	42	35	42	60	81	47	82	77
1156	8	very coarse	47	30	45	30	35	55	82	52	84	77
10+ Encapsulator	8+4	very coarse	50	35	45	32	32	55	81	45	81	77
11+ Encapsulator	8+3	very coarse	45	30	40	22	30	50	80	50	76	71
10+ Polymer	8+0.5%	very coarse	35	22	30	30	30	45	75	32	77	67
11+ Polymer	8+0.5%	very coarse	42	27	35	25	30	40	80	32	68	62
C.V.			9	16	15	18	18	9	4	14	4	6
LSD 5%			6	9	11	10	11	7	5	12	5	7

2,4-D formulation did not affect weed control. Generally, weed control decreased with increasing droplet size. There was a substantial visible difference between control with fine and medium qualities and coarse and very coarse. Diminished control was not corrected with encapsulation or polymer adjuvant systems.

Spray quality effect on 2,4-D, Prosper. Howatt, Roach, and Harrington. Bioassay strips of '8N386CL' sunflower, 'Mincar' buckwheat, 'IS3057RR' canola, 'Admiral' Field pea, amaranth, and 'York' flax were seeded near Prosper on May 6. Treatments were applied July 6 with 68°F, 72% RH, 30% cloud cover, 3 to 3.5 mph wind at 45°, and moist soil at 69°F. Species generally were 4 to 5 inches tall at application. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 (fine), 35 (medium), 18 (coarse), and 30 (very coarse) psi through 11001 TT (fine and medium) and 110015 TT (coarse and very coarse) nozzles to an area 7 feet wide the length of 10 by 30 ft plots. The experiment was a randomized complete block design with three replicates.

Treatment	Rate	Spray	7/17	7/17	7/17	7/17	7/17	7/17	8/03	8/03	8/03	8/03
			Amaranth	Canola	Flax	Buckwheat	Field pea	Sunflower	Amaranth	Canola	Buckwheat	Sunflower
2,4-D	8 oz/A	quality	78	75	47	57	47	53	87	92	67	91
2,4-D +encapsulator	8+4	fine	77	73	50	53	53	57	90	96	78	92
2,4-D +polymer	8+0.5%	fine	73	77	53	57	57	57	90	96	73	92
2,4-D	8	medium	75	70	43	47	47	53	90	93	70	92
2,4-D +encapsulator	8+4	medium	70	70	40	47	47	50	90	94	63	93
2,4-D +polymer	8+0.5%	medium	67	70	40	43	47	53	83	88	60	91
2,4-D	8	coarse	70	63	43	47	43	50	80	83	53	90
2,4-D +encapsulator	8+4	coarse	67	63	33	43	47	50	82	77	43	88
2,4-D +polymer	8+0.5%	coarse	60	60	32	33	43	47	78	80	40	83
2,4-D	8	very coarse	72	57	33	40	43	50	80	75	40	85
2,4-D +encapsulator	8+4	very coarse	67	60	28	40	40	47	82	77	47	83
2,4-D +polymer	8+0.5%	very coarse	57	53	23	33	33	40	70	70	23	80
Untreated	0		0	0	0	0	0	0	0	0	0	0
C.V.			8	7	23	14	17	12	5	5	21	5
LSD 5%			8	8	14	10	12	9	6	6	18	7

2,4-D efficacy decreased as droplet size increased. For example, control of canola with 2,4-D on August 3 was 92 to 96% with fine spray droplet size compared with 70 to 77% control when spray quality was very coarse. Likewise, buckwheat control was 67 to 78% when equipment was set to deliver fine droplet sizes but only 23 to 47% with very coarse droplets. Category rankings generally placed fine with slightly better control than medium, but less difference that between medium and coarse or between coarse and very coarse. Adjuvants based on encapsulation or polymer technologies were not able to consistently affect control or compensate for the effect of spray quality.

Glyphosate with deposition aids. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy from glyphosate with deposition aid tank-mixes. 'York' flax, 'Mancan' tame buckwheat, quinoa (*Chenopodium quinoa*), and Pioneer '39B22' conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 14, at 8:50 am with 69 F air, 71 F soil surface, 65% relative humidity, 100% cloud cover, 8 to 12 mph S wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 8 to 14 inch (25 to 30/ft²) flax; 12 to 20 inch (15 to 20/ft², 80% flowering) tame buckwheat; 4 to 14 inch (5 to 10/ft², 80% flowering) quinoa; and 20 to 24 inch (V5, 3 to 5/ft²) conventional corn. 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.

When mixing treatments, certain mixing orders of herbicide and adjuvants were followed. Some deposition aids decreased glyphosate activity while others did not lower control. Bronc Plus EDT Dry increased glyphosate more than the AMS + NIS standard.

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

Table. Glyphosate with deposition aids (Zollinger, Ries, and Kazmierczak).

Treatment	Rate (product/A)	14 DAT				28 DAT			
		Flax	Quin	Tabw	Corn	Flax	Quin	Tabw	Corn
		----- % control -----				----- % control -----			
Buccaneer Plus+AMS+R-11+	12fl oz+8.5lb/100gal+0.25% v/v+	63	72	43	63	80	92	50	63
In-Place	3fl oz	80	85	43	62	82	93	43	62
Coverage G-20	4fl oz	84	91	48	65	78	91	48	68
Coverage G-20	8fl oz	75	88	42	53	82	93	42	53
Bronc Max EDT	0.5% v/v	70	73	33	57	67	75	33	55
Bronc Max EDT	0.75% v/v	73	74	35	52	68	78	38	50
Bronc Plus EDT Dry	10lb/100gal	90	86	63	65	88	89	90	65
EDT Concentrate	0.5% v/v	73	72	47	52	73	72	47	48
EDT Concentrate	0.75% v/v	73	74	43	55	73	78	48	55
LSD (0.05)		8	6	11	6	6	5	9	7

Glyphosate with HSOC Adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. Two experiments were conducted near Mapleton, ND, to evaluate weed efficacy from glyphosate and high surfactant oil concentrates (HSOC). 'York' flax, 'Mancan' tame buckwheat, quinoa (*Chenopodium quinoa*), and Pioneer '39B22' conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments for both studies were applied on July 17, at 6:10 am with 51 F air, 52 F soil surface, 97% relative humidity, 50% cloud cover, 3 to 6 mph NW wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 6 to 17 inch (20 to 50/ft², 10% flowering) flax; 18 to 30 inch (15 to 25/ft², 90% flowering) tame buckwheat; 6 to 24 inch (5 to 10/ft², 90% budding) quinoa; and 20 to 30 inch (V4 to V5, 3 to 7/ft²) conventional corn. 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.

NIS + AMS provided the greatest level of enhancement. PO or MSO oil adjuvants antagonize glyphosate. The function of high surfactant oil adjuvants (HSOC) are to enhance the oil soluble herbicide (clethodim) while not antagonizing the water soluble herbicide (glyphosate). Corn control addresses HSOC adjuvants enhancing the oil soluble herbicide while control of the three broadleaf herbicide addresses the function of HSOC adjuvants not antagonizing glyphosate since clethodim does not have activity on broadleaf species. With the exception of the MSO type HSOC adjuvant most HSOC adjuvants did not fit this definition. The addition of AMS increased weed control with all adjuvants, especially with NIS, Trophy Gold, and Destiny HC. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Study 1 - Glyphosate with HSCO Adjuvants (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	AMS	28 DAT				
			Flax	Quin	Tabw	Corn	
			----- % control -----				
TD HiTech+Select+ R-11	7.2fl oz+6fl oz+		23	13	18	33	
	0.25% v/v	- AMS	35	64	37	68	
Prime Oil (PO)	1qt	+AMS	94	87	73	92	
		- AMS	27	27	33	50	
Between (PO - HSOC)	1pt	+AMS	33	35	40	55	
		- AMS	22	13	28	53	
Diplomat (PO - HSOC)	1pt	+AMS	50	57	37	75	
		- AMS	30	20	26	55	
Exchange (PO - HSOC)	1pt	+AMS	40	50	44	75	
		- AMS	20	25	32	53	
High Load (PO - HSOC)	1pt	+AMS	55	58	48	80	
		- AMS	23	18	28	57	
Superb HC (PO - HSOC)	1pt	+AMS	45	45	48	78	
		- AMS	45	45	48	63	
Trophy Gold (oil based NIS)	0.5pt	+AMS	60	63	50	75	
		- AMS	28	30	32	53	
Soy-Stik (MSO)	1.5pt	+AMS	92	86	85	75	
		- AMS	33	30	33	65	
Destiny HC (MSO - HSOC)	1pt	+AMS	60	57	57	77	
		- AMS	70	70	80	80	
PX40802	1pt	+AMS	77	82	80	89	
		- AMS	60	61	52	74	
			+AMS	45	55	37	62
			-/+ AMS	-/+ AMS	-/+ AMS	-/+ AMS	
LSD (0.05)			6/6	8/6	9/9	5/6	

TD HiTech = Touchdown HiTech; PX40802 = proprietary product from Precision Labs.

AMS = 8.5 lb/100 gal of water.

Glyphosate with oil adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy from glyphosate with oil adjuvant aid tank-mixes. 'York' flax, 'Mancan' tame buckwheat, quinoa (*Chenopodium quinoa*), and Pioneer '39B22' conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 14, at 8:40 am with 69 F air, 72 F soil surface, 96% relative humidity, 100% cloud cover, 8 to 10 mph S wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 8 to 14 inch (25 to 30/ft²) flax; 12 to 20 inch (15 to 20/ft², 80% flowering) tame buckwheat; 4 to 14 inch (5 to 20/ft², 80% flowering) quinoa; and 20 to 24 inch (V5, 3 to 5/ft²) conventional corn. 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.

When mixing treatments, certain mixing orders of herbicide and adjuvants were followed. Oil adjuvants antagonize glyphosate activity but AMS may partially overcome some of the antagonism. Using the AMS + NIS as the standard to compare other adjuvants, WE 1084-1 gives greater enhancement. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate with oil adjuvants (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	14 DAT				28 DAT			
		Flax	Quin	Tabw	Corn	Flax	Quin	Tabw	Corn
		----- % control -----				----- % control -----			
Buccaneer Plus+AMS+	12fl oz+8.5lb/100gal+	27	27	37	60	27	27	37	60
Competitor	1pt	50	62	43	62	50	53	43	62
R-11	0.25% v/v	72	78	57	73	72	79	72	77
SuperSpread MSO	1pt	63	83	40	65	63	87	40	65
High Load	0.5pt	55	65	47	67	55	65	47	67
Syl-Tac	4fl oz	75	73	32	62	75	87	32	62
ROC	1pt	57	62	40	62	57	62	40	62
WE 1084-1	0.5pt	76	78	42	57	82	93	63	70
LSD (0.05)		8	7	8	6	8	5	8	6

¹WE 1084-1 = proprietary product from Wilbur-Ellis.

Glyphosate + Impact + Adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate grass and broadleaf efficacy with various Impact tank-mixes with glyphosate and adjuvants. 'Siberian' foxtail millet, 'Stockford' forage barley, 'Mancan' tame buckwheat, and Pioneer '63M80' conventional sunflower were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 13, at 2:20 pm with 70 F air, 79 F soil surface, 40% relative humidity, 100% cloud cover, 3 to 5 mph E wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 8 to 14 inch (20 to 30/ft², T3 to T4) foxtail millet; 7 to 13 inch (20 to 30/ft², T2 to T3) forage barley; 14 to 20 inch (10 to 20/ft², 70 to 80% bloom) tame buckwheat; and 22 to 28 inch (V10 to V12, 5 to 15/ft²) sunflower. 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.

Oil adjuvants enhance Impact but antagonized glyphosate. Some surfactant based adjuvants enhance some glyphosate treatments. AMS enhances all treatments and partially overcomes some antagonism from oil adjuvants. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate + Impact + Adjuvants (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	14 DAT				28 DAT			
		Tabw	Fomi	Foba	Snfl	Tabw	Fomi	Foba	Snfl
		----- % control -----				----- % control -----			
Impact+	0.25fl oz+								
Soy-Stik+AMS	1% v/v+8.5lb/100 gal	45	99	82	57	72	99	92	60
Bucc Plus+Soy-Stik+AMS	0.75pt+1% v/v+8.5lb/100gal	33	95	75	43	82	96	80	70
Bucc Plus+Soy-Stik+N-Tense	0.75pt+1% v/v+0.5% v/v	35	99	65	40	63	99	52	47
Bucc Plus+Trophy Gold+N-Tense	0.75pt+0.25% v/v+0.5% v/v	20	96	65	35	53	99	73	38
Bucc Plus+Trophy Gold+AMS	0.75pt+0.25% v/v+8.5lb/100gal	48	99	77	53	93	99	87	83
Bucc Plus+WC074+N-Tense	0.75pt+0.25% v/v+0.5% v/v	23	96	60	28	38	99	82	48
Bucc Plus+N-Tense	0.75pt+0.75% v/v	18	99	67	25	42	99	78	33
Bucc Plus+Veracity	0.75pt+1% v/v	27	99	57	40	47	99	42	50
LSD (0.05)		7	3	6	7	5	2	5	4

¹Bucc Plus = Buccaneer Plus; WC074 = proprietary product from West Central.

Sharpen with adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy with Sharpen, glyphosate, and various adjuvant combinations. 'York' flax, 'Mancan' tame buckwheat, quinoa (*Chenopodium quinoa*), and 'Plainsman' amaranth were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 13, at 11:20 am with 70 F air, 77 F soil surface, 48% relative humidity, 95% cloud cover, 2 to 6 mph E wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 10 to 15 inch (30 to 50/ft²) flax; 14 to 20 inch (10 to 20/ft²) tame buckwheat; 10 to 20 inch (5 to 10/ft²) quinoa; 5 to 12 inch (10 to 25/ft²) amaranth; and 1 to 4 inch (1 to 5/ft²) kochia. 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 greatest enhancement of Sharpen was from MSO and high surfactant oil concentrate (HSOC) type adjuvants. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Sharpen with adjuvants (Zollinger, Ries, and Kazmierczak).

Treatment ¹		7 DAT					21 DAT				
		Flax	Quin	Tabw	Amar	Kochia	Flax	Quin	Tabw	Amar	Kochia
		----- % control -----					----- % control -----				
		-----					-----				
RU Original+AMS	0.75pt+8.5lb/100gal	33	23	28	67	27	47	27	47	95	27
Sharpen+AMS	0.5fl oz+8.5lb/100gal	10	10	17	27	17	10	10	15	30	17
Sharpen+RU Original+AMS	0.5floz +0.75pt+8.5lb/100gal	47	42	30	78	42	47	32	55	95	42
PX40802+AMS	0.5% v/v+8.5lb/100gal	65	62	58	90	62	73	73	77	95	62
Persist Ultra+AMS	1% v/v+8.5lb/100gal	75	73	72	85	72	72	68	72	95	72
Superb HC+AMS	0.5% v/v+8.5lb/100gal	73	60	45	85	60	73	60	45	95	60
Destiny HC+AMS	0.5% v/v+8.5lb/100gal	60	73	48	85	70	62	72	57	95	70
Premium COC (Cornbelt)+AMS	1% v/v+8.5lb/100gal	40	55	45	85	50	42	52	47	95	50
Soy-Stik+AMS	1% v/v+8.5lb/100gal	65	72	65	91	63	65	73	70	95	63
Liberate+AMS	0.25% v/v+8.5lb/100gal	22	53	32	73	53	30	53	32	95	53
Liberate+AMS	0.5% v/v+8.5lb/100gal	23	63	40	80	60	42	63	60	95	60
MSO Leci-Tech+AMS	1% v/v+8.5lb/100gal	52	55	58	85	53	65	62	63	95	53
Premium COC (Un. Sup.)+AMS	1% v/v+8.5lb/100gal	23	40	42	85	40	14	40	43	95	40
Succeed+AMS	1% v/v+8.5lb/100gal	68	70	75	89	63	77	73	83	95	63
Diplomat+AMS	0.5% v/v+8.5lb/100gal	32	43	43	89	42	37	42	43	95	42
Sundance II+AMS	1% v/v+8.5lb/100gal	63	60	70	83	53	77	72	77	95	53
DLZ+HM 0825	1% v/v+8.5lb/100gal	48	57	50	77	53	78	62	62	95	53
HM 8802A+HM 0825	0.5% v/v+8.5lb/100gal	67	68	52	70	62	80	70	72	95	62
Rigo COC+AMS	1% v/v+8.5lb/100gal	32	48	45	80	50	33	50	47	95	50
Super Spread MSO+AMS	1% v/v+8.5lb/100gal	72	75	67	70	70	77	75	73	95	70
LSD (0.05)		5	5	5	3	6	6	5	4	NS	6

¹RU Original = Roundup Original; HM 0825 and DLZ= proprietary compounds from Helena; PX40802 = proprietary compound from Precision Labs.

Ignite + Flexstar + Adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy with Ignite and Flexstar with adjuvant tank-mixes. 'York' flax, 'Mancan' tame buckwheat, quinoa (*Chenopodium quinoa*), and Pioneer '39B22' conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 7, at 8:30 am with 68 F air, 78 F soil surface, 63% relative humidity, 25% cloud cover, 1 to 3 mph E wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 4 to 8 inch (25 to 50/ft²) flax; 10 to 14 inch (20 to 30/ft²) tame buckwheat; 5 to 10 inch (5 to 10/ft²) quinoa; and 12 to 17 inch (V4 to V5, 3 to 5/ft²) conventional corn. 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.

Oil adjuvants demonstrated a wide range of enhancing activity of Ignite and Flexstar. Current theory suggests little Ignite enhancement from oil adjuvants and the greatest enhancement from AMS. Flexstar is enhanced most from oil adjuvants, especially MSO type oil adjuvants. As all assay species are susceptible to both herbicides it may difficult to determine what level of control is coming from either herbicide and which herbicide is affected most by added adjuvants. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Ignite + Flexstar + Adjuvants (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	14 DAT			
		Flax	Quin	Tabw	Corn
		----- % control -----			
Ignite+Flexstar+	8fl oz+0.25pt+	72	57	40	12
N-Pac AMS	2.5% v/v	70	67	60	32
Class Act NG	2.5% v/v	75	70	57	28
Prime Oil+N-Pac AMS	1% v/v+2.5% v/v	75	48	68	32
Superb HC+N-Pac AMS	0.5% v/v+2.5% v/v	75	67	80	32
Superb HC+Class Act NG+Interlock	0.5% v/v+2.5% v/v+4fl oz	77	55	83	33
Destiny HC+Class Act NG+Interlock	0.5% v/v+2.5% v/v+4fl oz	80	80	80	35
AG 08047+N-Pac AMS	0.5% v/v+2.5% v/v	75	80	84	35
LSD (0.05)		3	8	9	6

¹AG 08047 = proprietary product from Winfield Solutions.

Glyphosate + Sharpen + Adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate grass and broadleaf efficacy with various Sharpen tank-mixes with glyphosate and adjuvants. 'York' flax, 'Quinoa' (*Chenopodium quinoa*), 'Mancan' tame buckwheat, and Pioneer '63M80' conventional sunflower were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 17, at 7:00 am with 61 F air, 50 F soil surface, 61% relative humidity, 40% cloud cover, 2 to 6 mph W wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 12 to 17 inch (20 to 40/ft²) flax; 10 to 24 inch (5 to 10/ft²) quinoa, 14 to 12 inch (15 to 25/ft², 90% bloom) tame buckwheat; and 20 to 28 inch (V12 to V14, 2 to 5/ft²) sunflower. 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.

Conclusions may be difficult to identify as Sharpen has little grass activity, glyphosate has activity on both grass and broadleaf species, oil adjuvants enhance Sharpen and antagonize glyphosate, and AMS partially overcomes antagonism. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate + Sharpen + Adjuvants (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	14 DAT				28 DAT			
		Tabw	Fomi	Foba	Snfl	Tabw	Fomi	Foba	Snfl
		----- % control -----				----- % control -----			
Sharpen+	0.25fl oz+								
Soy-Stik+AMS	1% v/v+8.5lb/100 gal	25	33	30	30	25	33	30	50
Bucc Plus+Soy-Stik+AMS	0.75pt+1% v/v+8.5lb/100gal	40	60	53	57	40	62	72	70
Bucc Plus+Soy-Stik+N-Tense	0.75pt+1% v/v+0.5% v/v	53	65	70	67	80	83	80	78
Bucc Plus+Trophy Gold+N-Tense	0.75pt+0.25% v/v+0.5% v/v	42	60	55	73	42	60	57	72
Bucc Plus+Trophy Gold+AMS	0.75pt+0.25% v/v+8.5lb/100gal	83	73	63	77	70	72	87	83
Bucc Plus+WC074+N-Tense	0.75pt+0.25% v/v+0.5% v/v	40	62	60	60	48	60	63	60
Bucc Plus+N-Tense	0.75pt+0.75% v/v	72	77	68	67	67	67	67	58
Bucc Plus+Veracity	0.75pt+1% v/v	43	58	55	62	53	57	60	62
LSD (0.05)		7	7	10	7	4	5	8	6

¹Bucc Plus = Buccaneer Plus; WC074 = proprietary product from West Central.

Ignite with AMS and hard water. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate weed efficacy with Ignite and various hard water concentrations. 'York' flax, 'Mancan' tame buckwheat, quinoa (*Chenopodium quinoa*), and Pioneer '39B22" conventional corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 7, at 8:15 am with 67 F air, 78 F soil surface, 63% relative humidity, 25% cloud cover, 2 to 3 mph E wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 4 to 8 inch (25 to 50/ft²) flax; 10 to 14 inch (20 to 30/ft²) tame buckwheat; 5 to 10 inch (5 to 10/ft²) quinoa; and 12 to 17 inch (V4 to V5, 3 to 5/ft²) conventional corn. 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.

Distilled water was used for 0 hard water treatments. Hard water consisted of 435 ppm Ca + 157 ppm Mg = 592 ppm hard water test, and 801 ppm Ca + 312 ppm Mg = 1112 ppm hard water test.

Glufosinate efficacy increased in response to ammonium. In distilled water, the greatest increase in enhancement of glufosinate from AMS was seen at 4.25 lb/100 gal water. This data support label directions for adding ammonium to spray applications; however, the 3 lb/A rate specified on the label may be excessive with good water quality. In this study, AMS was applied at 4.25, 8.5, and 17 lb/100 gal of water which applied in a water volume of 15 gpa is equivalent to 0.64, 1.3, and 2.25 lb/A, respectively. This data shows AMS at rates less than label recommendations may provide optimal nitrogen enhancement and necessary water conditioning requirements. Glufosinate efficacy was antagonized by hard water. AMS overcame antagonism of herbicide efficacy by hard water. AMS at 4.25, 8.5, and 17 lb/100 gal of water completely overcame antagonism at 500 ppm hardness when compared to glufosinate applied in distilled water but the highest rate of AMS at 17 lb/100 gal was needed to completely overcome antagonism at 1000 ppm hardness. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Ignite with AMS and hard water (Zollinger, Ries, and Kazmierczak).

Treatment	Rate (product/A)	14 DAT			
		Flax	Quin	Tabw	Corn
		----- % control -----			
<u>Distilled water (0 ppm)</u>					
Ignite	8fl oz	43	43	30	25
Ignite+AMS	8fl oz+4.25lb/100gal	62	55	56	35
Ignite+AMS	8fl oz+8.5lb/100gal	65	57	48	38
Ignite+AMS	8fl oz+17lb/100gal	68	48	62	47
<u>Hard water (592 ppm)</u>					
Ignite	8fl oz	32	30	30	15
Ignite+AMS	8fl oz+4.25lb/100gal	63	37	45	32
Ignite+AMS	8fl oz+8.5lb/100gal	63	50	63	40
Ignite+AMS	8fl oz+17lb/100gal	58	43	55	35
<u>Hard water (1112 ppm)</u>					
Ignite	8fl oz	35	22	27	13
Ignite+AMS	8fl oz+4.25lb/100gal	47	27	27	22
Ignite+AMS	8fl oz+8.5lb/100gal	53	50	35	32
Ignite+AMS	8fl oz+17lb/100gal	62	62	55	42
<u>LSD (0.05)</u>		6	7	10	5

Milestone with AMS and hard water. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate broadleaf efficacy from Milestone treatments with distilled a varying amounts of hard water. 'Quinoa' (*Chenopodium quinoa*), 'Finch' safflower, Pioneer '91M10' conventional soybean, and Pioneer '63M80' conventional sunflower were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 13, at 11:00 am with 70 F air, 77 F soil surface, 48% relative humidity, 95% cloud cover, 2 to 6 mph E wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 10 to 25 inch (10 to 20/ft², 90 to 95 % budding) quinoa; 6 to 10 inch (5 to /ft², V3 to V4) soybean; 12 to 18 inch (15 to 25/ft²) safflower; and 22 to 28 inch (V10 to V12, 5 to 15/ft²) sunflower. 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.

Aminopyralid efficacy was increased by adding ammonium. The data from aminopyralid applied in distilled water show increasing activity as AMS concentration increases. Since primary use of this herbicide is in non-crop environments, adding ammonium could enhance herbicide efficacy without risk of increased crop injury. Aminopyralid efficacy was antagonized by hard water. Assay species control decreased from 30% with no hard water to 21% with 250 ppm hard water and to 15% with 500 ppm hard water. AMS overcame antagonism of herbicide efficacy by hard water. Using the value of 30% control from aminopyralid applied without hard water and without AMS; adding AMS at 4.25, 8.5, and 17 lb/100 gal to 250 and 500 ppm hard water resulted in control equal to or greater than 30%. AMS at 4.25, 8.5, and 17 lb/100 gal of water completely overcame antagonism at 250 ppm hardness when compared to aminopyralid applied in distilled water; however the highest rate of AMS at 17 lb/100 gal of water did not completely overcome antagonism at 500 ppm hardness. Aminopyralid, with a pKa of 2.6, can bind with antagonistic cations in water with normal spray solution pH of 5 to 7. This data shows that antagonistic cations that bind with and antagonize glyphosate can also bind with and antagonize aminopyralid. This data also shows that AMS can overcome all or most of the antagonism from hard water. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Milestone with AMS and hard water (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	10 DAT		14 DAT				28 DAT			
		Snfl height - inches -	Snfl - % injury-	Quin	Soyb	Saff	Snfl	Quin	Soyb	Saff	Snfl
				---- % control ----				---- % control ----			
<u>Untreated Sunflower</u>		54	0								
<u>Distilled water (0 ppm Ca)</u>											
Milestone	2fl oz	44	10	23	23	18	20	30	30	30	30
Milestone+AMS	2fl oz+4.25lb/100gal	34	23	32	42	40	37	33	42	40	40
Milestone+AMS	2fl oz+8.5lb/100gal	30	28	38	45	32	37	42	52	52	50
Milestone+AMS	2fl oz+17lb/100gal	25	38	42	58	55	53	48	62	62	60
<u>Hard water (250 ppm Ca)</u>											
Milestone	2fl oz	41	13	23	25	20	18	23	27	22	18
Milestone+AMS	2fl oz+4.25lb/100gal	28	37	23	47	32	35	23	52	32	32
Milestone+AMS	2fl oz+8.5lb/100gal	26	40	27	47	32	30	27	20	33	37
Milestone+AMS	2fl oz+17lb/100gal	23	43	30	57	52	48	27	70	55	33
<u>Hard water (500 ppm Ca)</u>											
Milestone	2fl oz	31	28	15	22	18	22	15	22	18	18
Milestone+AMS	2fl oz+4.25lb/100gal	29	30	20	45	40	37	32	45	40	37
Milestone+AMS	2fl oz+8.5lb/100gal	23	47	25	50	48	37	43	50	48	37
Milestone+AMS	2fl oz+17lb/100gal	30	37	42	55	57	50	50	58	60	50
LSD (0.05)		3	6	7	8	11	11	5	5	5	5

Assure II plus glyphosate on volunteer Roundup Ready corn. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate volunteer Roundup Ready corn control with various Assure II and adjuvant tank-mixes. Dekalb 'DKC38-89' Roundup Ready corn was planted perpendicular to each plot length on June 4, 2009. Lumax at 4pt/A was applied PRE to the entire plot area. POST treatments were applied on July 23 at 7:50 am with 68 F air, 72 F soil surface, 58% relative humidity, 10% cloud cover, 2 to 4 mph S wind, dry soil surface, moist subsoil, excellent crop vigor, and no dew present to V5 to V7 (18 to 20 inch) corn. 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.

Control of volunteer RR corn from Assure II is affected by tank-mix additives and adjuvants. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Assure II plus glyphosate on volunteer Roundup Ready corn (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	14 DAT
		RR corn --- % control ---
Assure II+Bucc Plus+Prem COC+AMS	2fl oz+1pt+1% v/v+8.5lb/100gal	90
Assure II+Bucc Plus+Prem COC+N-Tense	2fl oz+1pt+1% v/v+0.5% v/v	92
Assure II+Bucc Plus+Trophy Gold+N-Tense	2fl oz+1pt+0.25% v/v+0.5% v/v	50
Assure II+Bucc Plus+Trophy Gold+AMS	2fl oz+1pt+0.25% v/v+8.5lb/100gal	40
Assure II+Bucc Plus+WC074+N-Tense	2fl oz+1pt+0.25% v/v+0.5% v/v	50
Assure II+Bucc Plus+N-Tense	2fl oz+1pt+0.75% v/v	85
Assure II+Bucc Plus+Veracity	2fl oz+1pt+1% v/v	55
LSD (0.05)		6

¹Bucc Plus = Buccaneer Plus; Prem COC = Premium COC, WC074 = a proprietary product from West Central.

Volunteer Roundup Ready corn control with adjuvants. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate volunteer Roundup Ready corn control with various grass herbicides and adjuvant tank-mixes. Dekalb 'DKC38-89' Roundup Ready corn was planted on June 4, 2009. Lumax at 4pt/A was applied PRE to the entire plot area. POST treatments were applied on July 23 at 7:40 am with 68 F air, 72 F soil surface, 58% relative humidity, 10% cloud cover, 2 to 4 mph S wind, dry soil surface, moist subsoil, excellent crop vigor, and no dew present to V5 to V7 (18 to 20 inch) corn. 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.

Control of volunteer RR corn from clethodim is affected by formulation, tank-mix additives and adjuvants. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Volunteer Roundup Ready corn control with adjuvants (Zollinger, Ries, and Kazmierczak).

Treatment	Rate (product/A)	14 DAT
		RR corn --- % control ---
Roundup PowerMax+	11fl oz+	
Section	2fl oz	30
Select Max	4fl oz	70
Section+N-Pac AMS	2fl oz+2.5% v/v	50
Section+N-Pac AMS	4fl oz+2.5% v/v	70
Section+ClassAct Next Generation (NG)	2fl oz+2.5% v/v	50
Section+ClassAct NG	4fl oz+2.5% v/v	70
Section+ClassAct NG+Interlock	2fl oz+2.5% v/v+5fl oz	60
Section+ClassAct NG+Interlock	4fl oz+2.5% v/v+5fl oz	72
Section+ClassAct NG+Superb HC+Interlock	2fl oz+2.5% v/v+0.5% v/v+4fl oz	82
Section+ClassAct NG+Superb HC+Interlock	4fl oz+2.5% v/v+0.5% v/v+4fl oz	72
Section+ClassAct NG+Destiny HC+Interlock	2fl oz+2.5% v/v+0.5% v/v+4fl oz	85
Section+ClassAct NG+Destiny HC+Interlock	4fl oz+2.5% v/v+0.5% v/v+4fl oz	73
LSD (0.05)		3

Volunteer Roundup Ready corn control - micronutrients. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate volunteer Roundup Ready corn control with various tank-mixes and micronutrients. Dekalb 'DKC38-89' Roundup Ready corn was planted perpendicular to each plot length followed by the planting of four row of Asgrow 'AG0801' soybean to each plot length on June 4, 2009. Outlook was applied PRE at 18fl oz/A to the entire plot area. POST treatments were applied on July 23 at 8:15 am with 68 F air, 72 F soil surface, 58% relative humidity, 10% cloud cover, 2 to 4 mph S wind, dry soil surface, moist subsoil, excellent crop vigor, and no dew present to V5 to V7 (18 to 20 inch) corn. 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.

No soybean injury was observed (data not shown). This trial investigates reported antagonism of volunteer corn control when Targa was applied with liquid fertilizer with and without chelated Mn. (Department of Plant Sciences, North Dakota State University, Fargo).

Table: Volunteer Roundup Ready corn control - micronutrients (Zollinger, Ries, and Kazmierczak).

Treatment	Rate (product/A)	14 DAT
		RR corn --- % control ---
Targa+Bucc.Plus+9-18-9 Fertilizer	8fl oz+1qt+2gal	70
Targa+Bucc.Plus+9-18-9 Fertilizer+Chelated Mn	8fl oz+1qt+2gal+1pt	70
Targa+9-18-9 Fertilizer+Chelated Mn+R-11	8fl oz+2gal+1pt+0.25% v/v	70
Untreated		0
LSD (0.05)		NS

¹Bucc Plus = Buccaneer Plus.

Volunteer Roundup Ready corn control with clethodim formulations. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate volunteer Roundup Ready corn control with various clethodim formulations. Dekalb 'DKC38-89' Roundup Ready corn was planted perpendicular to the plot length on June 4, 2009. Lumax was applied PRE at 2 qt/A to the entire plot area. POST treatments were applied on July 23 at 8:15 am with 68 F air, 72 F soil surface, 58% relative humidity, 10% cloud cover, 2 to 4 mph S wind, dry soil surface, moist subsoil, excellent crop vigor, and no dew present to V5 to V7 (18 to 20 inch) corn. 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.

Control of volunteer RR corn from clethodim or quizalofop are affected by formulation, tank-mix additives and adjuvants. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Volunteer Roundup Ready corn control with clethodim formulations (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	14 DAT
		RR corn --- % control ---
Select Max+AMS	6fl oz+0.75lb	57
Select Max+RUPM+AMS	6fl oz+16fl oz+0.75lb	63
Select Max+Bucc Plus+AMS	6fl oz+24fl oz+0.75lb	70
Targa+Herbimax+AMS	2.5fl oz+1qt+0.75lb	80
Targa+RUPM+AMS	2.5fl oz+16fl oz+0.75lb	80
Targa+Bucc Plus+AMS	2.5fl oz+24fl oz+0.75lb	45
ARY-0411-07+AMS	6fl oz+0.75lb	83
ARY-0411-07+RUPM+AMS	6fl oz+16fl oz+0.75lb	91
ARY-0411-07+Bucc Plus+AMS	6fl oz+24fl oz+0.75lb	72
ARY-0411-04+Herbimax+AMS	2fl oz+1% v/v+0.75lb	70
ARY-0411-04+RUPM+AMS	2fl oz+16fl oz+0.75lb	48
ARY-0411-04+Bucc Plus+AMS	2fl oz+24fl oz+0.75lb	52
ARY-0411-05+Herbimax+AMS	3fl oz+1% v/v+0.75lb	72
ARY-0411-05+RUPM+AMS	3fl oz+16fl oz+0.75lb	42
ARY-0411-05+Bucc Plus+AMS	3fl oz+24fl oz+0.75lb	52
ARY-0411-05+Bucc Plus+R-11+AMS	3fl oz+24fl oz+0.25% v/v+0.75lb	58
ARY-0411-05+Bucc Plus+Herbimax+AMS	3fl oz+24fl oz+1% v/v+0.75lb	75
LSD (0.05)		6

¹RUPM = Roundup PowerMax; Bucc Plus = Buccaneer Plus; ARY compounds are proprietary clethodim formulations from Arysta.

Volunteer Roundup Ready corn control with clethodim rates. Zollinger, Richard K., Jerry L. Ries, and Angela J. Kazmierczak. An experiment was conducted near Mapleton, ND, to evaluate grass efficacy with various clethodim formulations and rates. 'Souris' oat, 'Siberian' foxtail millet, 'Stockford' forage barley, and Dekalb 'DKC 38-89' Roundup Ready corn were planted perpendicular to each plot length on June 4, 2009. POST treatments were applied on July 13, at 10:10 am with 70 F air, 77 F soil surface, 48% relative humidity, 100% cloud cover, 2 to 6 mph E wind, dry soil surface, moist subsoil, good crop vigor, and no dew present. Species stages at time of application were: 8 to 14 inch (20 to 30/ft², T2 to T3) oat; 8 to 14 inch (10 to 20/ft², T2 to T3) foxtail millet; 7 to 13 inch (20 to 30/ft², T2 to T3) forage barley; and 8 to 12 inch (V3 to V4, 3 to 5/ft²) corn. 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.

Control of grass species from clethodim and quizalofop are affected by formulation and adjuvants. (Department of Plant Sciences, North Dakota State University, Fargo).

Table. Volunteer Roundup Ready corn control with clethodim rates (Zollinger, Ries, and Kazmierczak).

Treatment ¹	Rate (product/A)	7 DAT				28 DAT			
		Fomi	Foba	Oat	Corn	Fomi	Foba	Oat	Corn
		----- % control -----				----- % control -----			
Select Max+AMS	4froz+0.75lb	32	32	32	52	30	30	30	53
ARY-0411-06+AMS	4fl oz+0.75lb	37	43	47	67	57	60	57	75
ARY-0411-04+Herbimax+AMS	1.33fl oz+1% v/v+0.75lb	43	37	43	62	40	42	42	70
ARY-0411-05+Herbimax+AMS	2fl oz+1% v/v+0.75lb	30	42	43	65	60	60	57	77
Select Max+AMS	6froz+0.75lb	35	38	40	67	52	48	48	75
ARY-0411-07+AMS	6fl oz+0.75lb	30	38	50	82	70	72	72	99
ARY-0411-04+Herbimax+AMS	2fl oz+1% v/v+0.75lb	30	33	45	67	60	60	57	82
ARY-0411-05+Herbimax+AMS	3fl oz+1% v/v+0.75lb	32	42	33	62	60	70	72	93
Select Max+AMS	8froz+0.75lb	38	32	37	69	72	70	70	99
ARY-0411-07	8fl oz	43	30	35	85	70	60	72	95
ARY-0411-07+AMS	8fl oz+0.75lb	35	40	43	83	73	70	73	95
ARY-0411-04+Herbimax	2.66fl oz+1% v/v	28	27	33	67	38	28	37	60
ARY-0411-04+Herbimax+AMS	2.66fl oz+1% v/v+0.75lb	25	35	40	72	57	73	60	99
ARY-0411-05+Herbimax	4fl oz+1% v/v	30	32	33	60	35	32	35	67
ARY-0411-05+Herbimax+AMS	4fl oz+1% v/v+0.75lb	25	38	48	72	63	73	68	93
Targa+Herbimax+AMS	3fl oz+1qt+0.75lb	25	45	32	99	73	72	58	96
Targa+Herbimax+AMS	4fl oz+1qt+0.75lb	43	47	32	98	80	75	75	99
Targa+Herbimax+AMS	5fl oz+1qt+0.75lb	37	38	30	99	78	75	70	99
LSD (0.05)		6	5	7	5	5	3	5	4

¹ARY = proprietary clethodim formulations from Arysta.