Tan Section: Adjuvant and Application Technology Page

Clethodim formulations with adjuvants. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate the effect adjuvants have on different formulations of clethodim. Foxtail Millet, Forage Barley, and Corn were planted on June 8, 2016. POST treatments were applied on July 15, 2016 at 10:00 AM with 72 F air, 64 F soil at a four inch depth, 64% RH, 0% cloud cover, 3-5 mph WNW wind, and adequate soil moisture. Weeds present at the time of POST applications were: fomi 14-16" at 50/ft2, foba 12-14" at 40/ft2, and corn 14-16" at 2/yd2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 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 through 11001 TT nozzles at 40 psi. The experiment was a randomized complete block design with three replicates per treatment.

Shadow is a 3 lb ai/gal formulation of clethodim and Vaquero is a 2 lb ai/gal formulation of clethodim. They both contain different formulation packages. Grass control increased: clethodim alone>PO>MSO. Shadow and Vaquero at similar active ingredient rates (3 fl oz = 4.5 fl oz) applied alone, with PO, and with MSO gave similar grass control for each similar comparison.

Table. Clethodim formulations with adjuvants (Zollinger, Wirth, Adams).

		14 DAA			28 DAA		
Treatment	Rate	Fomi	Foba	Corn	Fomi	Foba	Corn
	(Product/A)	-----% control-----			-----% control-----		
Shadow 3	3floz	30	30	12	37	30	12
Shadow 3+PO	3floz+1%v/v	52	52	58	62	69	72
Shadow 3+MSO	3floz+1%v/v	50	60	70	45	73	78
Vaquero	4.5floz	30	30	30	33	30	30
Vaquero+PO	4.5floz+1%v/v	52	62	62	52	68	74
Vaquero+MSO	4.5floz+1%v/v	52	62	62	60	76	72
LSD (0.05)		3	3	6	6	3	6

Fomi = foxtail millet, Foba = foxtail barley

Glyphosate formulation comparisons. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate the difference between multiple glyphosate formulations. Quinoa, tame buckwheat, and conventional soybean were planted on June 8, 2016. POST treatments were applied on July 9, 2016 at 7:30 AM with 75 F air, 66 F soil at a four inch depth, 79% RH, 0% cloud cover, 1-5 mph SE wind, and adequate soil moisture. Weeds present at the time of POST applications were: quinoa 14-16" 10-15/ft2, tame buckwheat 12-14" at 5-10/ft2, and conventional soybean 6-8" at 5-10/ft2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 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 through 11001 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Table. Glyphosate formulation comparisons (Zollinger, Wirth, Adams).

		14 DAA			28 DAA		
Treatment[1]	Rate	Quin[2]	Tabw	Soy	Quin	Tabw	Soy
	(Product/A)	-----% control-----			-----% control-----		
Roundup Weathermax	21.3floz	73	71	78	72	75	83
Roundup Powermax	21.3floz	86	70	90	84	70	90
Buccaneer Plus	32floz	62	69	61	62	69	61
Gly Star K+Activator 90	21.3floz+0.25%v/v	83	76	83	86	78	87
Barbarian Max	21.3floz	69	68	65	75	78	65
Credit Xtreme	21.3floz	75	72	70	68	70	70
Touchdown Total	23floz	84	73	84	84	82	86
Roundup Pro	32floz	48	68	70	47	77	82
Imitator Plus	32floz	82	72	94	82	82	94
Abundit Xtra	32floz	63	60	70	63	68	75
Imitator DA	32floz	73	57	62	73	60	62
Durango DMA	24floz	73	70	87	75	80	87
TD HiTech+Rainier EA	19.2floz+0.5%v/v	70	53	64	77	65	73
LSD (0.05)		5	5	9	5	5	6

[1] Glyphosate rates based on active ingredient load in the formulation

[2] Quin = Quinoa, Tabw = Tame Buckwheat, Soy = Soybean

Surfactant and water conditioner comparison with unloaded glyphosate. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate the effect surfactants and water conditioners have on glyphosate efficacy. Flax, amaranth, sunflower, conventional corn were planted on June 8, 2016. POST treatments were applied on July 9, 2016 at 7:30 AM with 75 F air, 66 F soil at a four inch depth, 79% RH, 0% cloud cover, 1-5 mph SE wind, and adequate soil moisture. Weeds present at the time of POST application were: flax 6" at 20-30/ft2, amaranth 14-16" at 10-20/ft2, sunflower 12-14" at 1-2/yd2, and conventional color 12-14" at 1-2/yd2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 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 through 11001 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Touchdown HiTech plus Class Act NG (a surfactant with AMS) provided the most species control. There was little change in species control as rates of LoadUp or AQ2100 increased.

Table. Surfactant and water conditioner comparison with unloaded glyphosate (Zollinger, Wirth, Adams).

		14 DAA				28 DAA			
Treatment[1]	Rate	Amar[2]	Flax	Snfl	Corn	Amar	Flax	Snfl	Corn
	(Product/A)	--------% control--------				--------% control--------			
TDHT[3]	9.6floz	20	23	65	47	20	23	80	57
TDHT+AMS	9.6floz+8.5lb/100gal	48	20	80	60	48	20	95	75
TDHT+Activator 90 +AMS	9.6floz+0.5%v/v +8.5lb/100gal	53	62	82	60	62	85	92	83
TDHT+Class Act NG	9.6floz+2.5%v/v	80	91	86	62	83	95	95	87
TDHT+LoadUp	9.6floz+0.375%v/v	35	68	70	47	35	72	82	55
TDHT+LoadUp	9.6floz+0.5%v/v	42	72	68	48	42	75	85	60
TDHT+LoadUp +AQ2092	9.6floz+0.5%v/v +0.25%v/v	43	66	70	50	43	68	85	53
TDHT+LoadUp +Drift Fiant	9.6floz+0.375%v/v 0.15%v/v	42	69	65	48	42	72	53	52
TDHT+AQ2100	9.6floz+0.25%v/v	45	68	70	50	52	82	80	62
TDHT+AQ2100	9.6floz+0.375%v/v	50	62	63	53	50	65	67	57
TDHT+AQ2100	9.6floz+0.5%v/v	50	68	71	53	58	73	78	58
LSD (0.05)		6	7	7	5	6	5	5	6

[1] All treatments were mixed in hard water at 1,000 ppm

[2] Amar = Amaranth and Snfl = Sunflower

[3] TDHT = Touchdown HiTech (unloaded glyphosate formulation)

Glyphosate with water conditioners in hard water. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate the effect water conditioners have with glyphosate in hard water. Flax, amaranth, sunflower, and conventional corn were planted on June 8, 2016. POST treatments were applied on July 6, 2016 at 10:00 AM with 87 F air, 71 F soil at a four inch depth, 39% RH, 50% cloud cover, 4-6 mph NE wind, and adequate soil moisture. Weeds present at the time of POST applications were: flax 0.5-6" at 20-30/ft2, amaranth 10-12" at 10-20/ft2, sunflower 10-12" at 1-2/yd2, and conventional corn 12-14" at 1-2/yd2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 pH. 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 through 11002 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

The first 4 treatments were applied as standards to compare all other treatments. Treatment 3 was applied with undistilled water to evaluation herbicide efficacy with no antagonism from minerals in the spray solution. All other treatments contained 1,000 ppm calcium and magnesium (hard water) to test the level of water conditioning from Brimstone, an acidic AMADS based water conditioner and from Regulator 2.0. Revolution 3.0 was applied with Regulator 2.0 to provide the surfactant requirements. Wet-Sol surfactant was also added to determine of additional surfactant or if a different surfactant other than Revolution 3.0 would influence herbicide efficacy.

Table. Glyphosate with water conditioners in hard water (Zollinger, Wirth, Adams).

			14 DAA				28 DAA			
Treatment	Rate	Water	Amar[1]	Flax	Snfl	Corn	Amar	Flax	Snfl	Corn
	(Product/A)		---------% control---------				---------% control---------			
TDHT[2]+Rainier EA	14.3floz+0.5%v/v	1,000 ppm	62	53	63	47	62	53	63	47
TDHT+AMS	14.3floz+8.5lb/100gal	1,000 ppm	73	10	95	70	73	10	95	70
TDHT+Rainier EA+AMS	14.3floz+0.5%v/v+8.5lb/100gal	Distilled	93	93	95	84	91	95	99	95
TDHT+Rainier EA+AMS	14.3floz+0.5%v/v+8.5lb/100gal	1,000 ppm	94	91	97	78	92	99	99	88
TDHT+Brimstone	14.3floz+0.5%v/v	1,000 ppm	63	52	67	60	58	52	67	68
TDHT+Brimstone	14.3floz+1%v/v	1,000 ppm	72	73	78	69	70	72	80	75
TDHT+Revolution 3.0 +Regulator 2.0	14.3floz+4floz +2qt/100gal	1,000 ppm	45	32	69	38	42	30	66	38
TDHT+Revolution 3.0 +Regulator 2.0	14.3floz+4floz +4qt/100gal	1,000 ppm	53	37	73	32	50	33	73	32
TDHT+Revolution 3.0 +Regulator 2.0	14.3floz+6floz +2qt/100gal	1,000 ppm	52	32	62	38	52	32	62	38
TDHT+Revolution 3.0 +Regulator 2.0	14.3floz+6floz +4qt/100gal	1,000 ppm	57	37	62	32	60	37	62	32
TDHT+Revolution 3.0 +Regulator 2.0+Wet-Sol 99	14.3floz+4floz +2qt/100gal+4floz	1,000 ppm	53	32	55	42	57	32	55	42
TDHT+Revolution 3.0 +Regulator 2.0+Wet-Sol 99	14.3floz++4floz +4qt/100gal+4floz	1,000 ppm	55	35	63	38	57	32	63	42
LSD (0.05)			7	5	5	4	8	5	5	4

[1] Amar = Amaranth, Snfl = Sunflower, Corn = Conventional Corn

[2] TDHT = Touchdown HiTech (unloaded glyphosate formulation)

Comparison of N Pak AMS and ATS as water conditioners. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate the ability of N Pak AMS and ATS to condition water. Flax, amaranth, quinoa, and tame buckwheat were planted on June 8, 2016. POST treatments were applied on July 1, 2016 at 8:30 AM with 66 F air, 64 F soil at a four inch depth, 24% RH, 10% cloud cover, 7-9 mph SSE wind, and adequate soil moisture. Weeds present at the time of POST applications were: flax 4-4" at 20-30/ft2, amaranth 4-6" at 10-20/ft2, quinoa 6-8" at 10-15/ft2, and tame buckwheat 4-6" at 5-10/ft2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 pH. 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 through 11002 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Assay species of flax, amaranth (similar to redroot pigweed), quinoa (similar to lambsquarters), and tame buckwheat were used in this water conditioner comparison experiment because they have shown good treatment separation in previous historical studies. Commercial liquid AMS contains approximately 3.4 lbs of active ingredient (ammonium and sulfate) per gallon while ATS (1.34-0-0-2.89) contains aproximately 4.23 lbs of active ingredient per gallon. Liberty recommends AMS at a rate of 3 lbs/a while ATS recommends a rate of 4.23 lbs/A. Four rates were selected based on the two rates listed above: 2.38 lbs/A, 3 lbs/A, 3.625 lbs/A, and 4.25 lbs/A. Brimstone is a urea + sulfuric acid mixture which is know as AMADS - see page 127 in the ND Weed Control Guide. Commercial rates of products containing AMADS are usually 0.5% v/v but NDSU has shown these rates are low and do not enhance herbicide activity. NDSU recommends at least 4 pt/A. The sulfuric acid in AMADS forms sulfate in water. The conversion of urea to ammonium is slow. Brimstone rates used in this study were calculated to contain similar sulfate rates as AMS rates used but are so cost prohibitive that they would not be used. ET-4000 is a sulfuric acid based water conditioner and was also added as a comparison to AMS and ATS.

Table. Comparison of N Pak AMS and ATS as water conditioners (Zollinger, Wirth, Adams).

		14 DAA				28 DAA			
Treatment[1]	Rate	Flax	Amar[2]	Quin	Tabw	Flax	Amar	Quin	Tabw
	(Product/A)	---------% control---------				---------% control---------			
Liberty	16floz	70	65	63	73	67	45	53	73
Products and rates comparable to 2.38 lbs/A - see paragraph above									
Liberty+N Pak AMS	16floz+2.8qt	70	58	70	82	68	52	68	90
Liberty+ATS	16floz+2.25qt	69	62	52	68	63	48	35	73
Products and rates comparable to 3 lbs/A - see paragraph above									
Liberty+N Pak AMS	16floz+3.53qt	82	78	82	90	82	68	83	96
Liberty+ATS	16floz+2.84qt	68	69	58	67	67	58	37	83
Products and rates comparable to 3.625 lbs/A - see paragraph above									
Liberty+N Pak AMS	16floz+4.26qt	80	78	80	88	80	73	73	93
Liberty+ATS	16floz+3.43qt	69	70	61	71	69	63	43	82
Products and rates comparable to 4.25 lbs/A - see paragraph above									
Liberty+N Pak AMS	16floz+5qt	84	83	86	87	84	83	83	95
Liberty+ATS	16floz+4qt	65	68	60	72	63	50	32	78
Brimstone rates contain similar sulfate rates as AMS shown above.									
Liberty+Brimstone	16floz+2.31qt	77	83	77	80	78	90	72	95
Liberty+Brimstone	16floz+2.8qt	93	94	93	97	93	90	90	98
Liberty+Brimstone	16floz+3.27	91	87	86	88	90	85	73	99
ET-4000 - a sulfuric acid based water conditioner applied at recommended rate									
Liberty+ET-4000	16floz+1%v/v	83	82	85	85	83	69	73	88
LSD (0.05)		6	7	6	7	7	4	5	6

[1] All treatments were applied in 1,000 ppm hard water

[2] Amar = Amaranth, Quin = Quinoa, Tabw = Tame Buckwheat

Roundup Powermax with Hook, Hook Zero, and Micropac Plus. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate Roundup Powermax enhancement with Hook, Hook Zero, and Micropac Plus. Amaranth, quinoa, and RR soybean were planted on June 8, 2016. POST treatments were applied on July 6, 2016 at 10:00 AM with 87 F air, 71 F soil at a four inch depth, 39% RH, 50% cloud cover, 4-6 mph NE wind, and adequate soil moisture. Weeds present at the time of POST applications were: amaranth 10-12" at 10-20/ft2, quinoa 10-14" at 10-15/ft2, and RR soybean 5-7" at 5-10/yd2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 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 through 11001 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

The tank-mix of Hook and Micropac Plus lowered species control while individually they increased species control.

Table. Roundup Powermax with Hook, Hook Zero, and Micropac Plus (Zollinger, Wirth, Adams).

		14 DAA			28 DAA		
Treatment[1]	Rate	Amar[2]	Quin	Soy	Amar	Quin	Soy
	(Product/A)	-----% control-----			-----% control-----		
RUPM	22floz	72	63	0	72	73	0
RUPM+Hook	22floz+0.25%v/v	83	75	0	80	82	0
RUPM+Hook+Micropac Plus	22floz+0.25%v/v+0.25%v/v	82	72	0	82	82	0
RUPM+Hook+Micropac Plus	22floz+0.25%v/v+2.5%v/v	68	53	0	67	53	0
RUPM+Hook Zero	22floz+0.25%v/v	95	75	0	85	85	0
RUPM+Micropac Plus	22floz+0.25%v/v	83	72	0	83	95	0
RUPM+Micropac Plus	22floz+2.5%v/v	80	70	0	80	80	0
LSD (0.05)		8	11	0	8	5	0

[1] RUPM = Roundup Powermax

[2] Amar = Amaranth, Quin = Quinoa, Soy = Soybean

Surfactant comparison with unloaded glyphosate. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate the ability of different surfactants to enhance glyphosate efficacy. Flax, amaranth, tame buckwheat, and conventional soybean were planted on June 8, 2016. POST treatments were applied on July 6, 2016 at 10:00 AM with 87 F air, 71 F soil at a four inch depth, 39% RH, 50% cloud cover, 4-6 mph NE wind, and adequate soil moisture. Weeds present at the time of POST applications were: flax 0.5-6" at 20-30/ft2, amaranth 10-12" at 10-20/ft2, tame buckwheat 8-12" at 5-10/ft2, and conventional soybean 5-7" at 5-10/yd2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 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 through 11001 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Assay species of flax, quinoa (similar to lambsquarters), tame buckwheat, and soybean were used in this surfactant comparison experiment because they have shown good surfactant treatment separation in previous historical studies. R-11, Rainier EA, Activator 90, and LI-700 surfactants were used as standards because previous studies showed a range of herbicide enhancement in in previous historical studies. Standard surfactants were applied at 0.5% v/v because Touchdown Hi-Tech glyphosate was used and is an unloaded glyphosate formulation. Touchdown Hi-Tech glyphosate formulation was used to not confound the activity of the added surfactants.

Table. Surfactant comparison with unloaded glyphosate (Zollinger, Wirth, Adams).

		14 DAA				28 DAA			
Treatment[1]	Rate	Flax	Quin	Tabw	Soyb	Flax	Quin	Tabw	Soyb
	(Product/A)	---------% control---------				---------% control---------			
TDHT[2]	9.6floz	43	10	32	23	43	10	32	23
TDHT+R-11	9.6floz+0.5%v/v	70	72	72	78	70	72	72	78
TDHT+Ranier EA	9.6floz+0.5%v/v	78	80	72	95	80	82	73	95
TDHT+Activator 90	9.6floz+0.5%v/v	53	33	45	50	50	30	42	47
TDHT+LI-700	9.6floz+0.5%v/v	52	42	58	60	48	40	57	58
TDHT+X-Celerate	9.6floz+0.25%v/v	53	43	43	28	50	42	43	27
TDHT+X-Celerate	9.6floz+0.5%v/v	60	58	45	60	60	57	45	57
TDHT+X-Celerate	9.6floz+0.75%v/v	50	38	43	37	50	33	43	33
TDHT+Revolution 3.0	9.6floz+4floz	52	35	37	32	52	32	37	32
TDHT+Revolution 3.0	9.6floz+6floz	52	45	42	25	52	42	42	25
TDHT+Wet-Sol 99	9.6floz+4floz	63	70	57	68	63	63	57	70
TDHT+Wet-Sol 99	9.6floz+6floz	63	70	63	79	63	65	60	72
TDHT+Wet-Sol 99	9.6floz+6.4floz	65	70	57	86	65	63	57	81
LSD (0.05)		6	7	7	7	4	4	6	5

[1] Quin = Quinoa, Tabw = Tame Buckwheat, Soyb = Soybean

[2] TDHT = Touchdown HiTech (unloaded glyphosate formulation)

High Surfactant Methylated Seed Oil Concentrate comparison with glyphosate. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate the effect HSMOC adjuvants have on glyphosate efficacy. Amaranth, quinoa, and RR soybean were planted on June 8, 2016. POST treatments were applied on July 6, 2016 at 10:00 AM with 87 F air, 71 F soil at a four inch depth, 39% RH, 50% cloud cover, 4-6 mph NE wind, and adequate soil moisture. Weeds present at the time of POST applications were: amaranth 10-12" at 10-20/ft2, quinoa 10-14" at 10-15/ft2, and RR soybean 5-7" at 5-10/yd2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 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 through 11001 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Table. High Surfactant Methylated Seed Oil Concentrate comparison with glyphosate (Zollinger, Wirth, Adams).

		14 DAA			28 DAA		
Treatment[1]	Rate	Amar[2]	Quin	Soyb	Amar	Quin	Soyb
	(Product/A)	-----% control-----			-----% control-----		
TDHT+Laudis+MES 100	9.6floz+1.5floz+1%v/v	40	40	35	38	40	33
TDHT+Laudis+Hot MES	9.6floz+1.5floz+1%v/v	52	40	43	52	40	42
TDHT+Laudis+HL MSO	9.6floz+1.5floz+1%v/v	63	67	48	62	70	48
TDHT+Laudis+Hybrid	9.6floz+1.5floz+1%v/v	77	72	57	77	72	68
TDHT+Laudis+MES 100	9.6floz+1.5floz+1pt	45	43	35	43	43	33
TDHT+Laudis+Hot MES	9.6floz+1.5floz+1pt	67	52	43	60	50	42
TDHT+Laudis+HL MSO	9.6floz+1.5floz+1pt	72	80	50	70	78	50
TDHT+Laudis+Hybrid	9.6floz+1.5floz+1pt	89	80	62	89	82	82
TDHT+Laudis+MES 100	9.6floz+1.5floz+1.5pt	48	42	35	47	40	33
TDHT+Laudis+Hot MES	9.6floz+1.5floz+1.5pt	67	62	55	63	72	55
TDHT+Laudis+HL MSO	9.6floz+1.5floz+1.5pt	72	73	62	70	70	72
TDHT+Laudis+Hybrid	9.6floz+1.5floz+1.5pt	93	86	63	93	86	65
LSD (0.05)		7	5	6	5	3	4

[1] TDHT = Touchdown HiTech (unloaded glyphosate formulation), HL MSO = High Load MSO

[2] Amar = Amaranth, Quin = Quinoa, Soyb = Soybean

Glyphosate and tembotrione enhancement using HSMOC and surfactant . Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate the enhancement of glyphosate and tembotrione using varying rates of an HSMOC and surfactant. Flax, amaranth, quinoa, and RR soybean were planted on June 8, 2016. POST treatments were applied on July 6, 2016 at 10:00 AM with 87 F air, 71 F soil at a four inch depth, 39% RH, 50% cloud cover, 4-6 mph NE wind, and adequate soil moisture. Weeds present at the time of POST applications were: flax 0.5-6" at 20-30/ft2, amaranth 10-12" at 10-20/ft2, quinoa 10-14" at 10-15/ft2, and RR soybean 5-7" at 5-10/yd2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 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 through 11001 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Table. Glyphosate and tembotrione enhancement using HSMOC and surfactant (Zollinger, Wirth, Adams).

		14 DAA			28 DAA		
Treatment[1]	Rate	Amar[2]	Quin	Soyb	Amar	Quin	Soyb
	(Product/A)	-----% control-----			-----% control-----		
TDHT+Laudis	9.6floz+1.5floz						
+MES 100+Surf-AC 910	0.89pt+53ml	45	47	47	42	45	45
TDHT+Laudis	9.6floz+1.5floz						
+Hot MES+Surf-AC 910	0.78pt+105ml	42	45	45	42	45	45
TDHT+Laudis	9.6floz+1.5floz						
+Hot MES+Surf-AC 910	0.67pt+158ml	73	33	33	72	33	33
TDHT+Laudis	9.6floz+1.5floz						
+Hot MES+Surf-AC 910	0.56pt+210ml	58	32	32	58	32	32
TDHT+Laudis	9.6floz+1.5floz						
+MES 100+Surf-AC 910	1.33pt+79ml	47	40	40	47	40	40
TDHT+Laudis	9.6floz+1.5floz						
+Hot MES+Surf-AC 910	1.67pt+158ml	57	32	32	57	32	32
TDHT+Laudis	9.6floz+1.5floz						
+Hot MES+Surf-AC 910	1pt+237ml	53	55	52	60	65	72
TDHT+Laudis	9.6floz+1.5floz						
+Hot MES+Surf-AC 910	0.83pt+316ml	65	50	43	63	52	43
LSD (0.05)		6	7	9	6	6	9

[1]TDHT = Touchdown HiTech (unloaded glyphosate formulation)

[2]Amar = Amaranth, Quin = Quinoa, Soyb = Soybean

Glypohsate and tembotrione enhancement using HSMOC and varying surfactants. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate the enhancement of . Flax, amaranth, quinoa, and RR soybean were planted on June 8, 2016. POST treatments were applied on July 6, 2016 at 10:00 AM with 87 F air, 71 F soil at a four inch depth, 39% RH, 50% cloud cover, 4-6 mph NE wind, and adequate soil moisture. Weeds present at the time of POST applications were: flax 0.5-6" at 20-30/ft2, amaranth 10-12" at 10-20/ft2, quinoa 10-14" at 10-15/ft2, and RR soybean 5-7" at 5-10/yd2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 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 through 11001 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Table. Glyphosate and tembotrione enhancement using HSMOC and varying surfactants (Zollinger, Wirth, Adams).

		14 DAA			28 DAA		
Treatment[1]	Rate	Amar[2]	Quin	Soyb	Amar	Quin	Soyb
	(Product/A)	-----% control-----			-----% control-----		
TDHT+Laudis +Hot MES+Rainier EA	9.6floz+1.5floz +0.67pt+158mls	84	86	63	84	90	65
TDHT+Laudis +Hot MES+Wet Cit	9.6floz+1.5floz +0.67pt+158mls	67	56	37	68	58	38
TDHT+Laudis +Hot MES+Translate	9.6floz+1.5floz +0.67pt+158mls	53	30	23	52	30	23
TDHT+Laudis +Hot MES+Wet-Sol 99	9.6floz+1.5floz +0.67pt+158mls	72	65	45	73	67	47
TDHT+Laudis +Hot MES+Activator 90	9.6floz+1.5floz +0.67pt+158mls	50	32	22	48	30	22
TDHT+Laudis +Hot MES+Liberate	9.6floz+1.5floz +0.67pt+158mls	53	62	45	60	62	43
TDHT+Laudis +Hot MES+Preference	9.6floz+1.5floz +0.67pt+158mls	53	45	30	58	47	30
TDHT+Laudis +Hot MES+Induce	9.6floz+1.5floz +0.67pt+158mls	61	38	28	64	40	28
TDHT+Laudis +Hot MES+Prefer 90	9.6floz+1.5floz +0.67pt+158mls	65	57	43	67	67	47
TDHT+Laudis +Hot MES+Tween 20	9.6floz+1.5floz +0.67pt+158mls	90	80	62	89	83	63
LSD (0.05)		9	7	9	6	5	6

[1] TDHT = Touchdown HiTech (unloaded glyphosate formulation)

[2] Amar = Amaranth, Quin = Quinoa, Soyb = Soybean

Glyphosate and 2,4-D with adjuvants. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate glyphosate and 2,4-D enhancement using adjuvants. Amaranth, quinoa, and RR corn were planted on June 8, 2016. POST treatments were applied on July 9, 2016 at 7:30 AM with 75 F air, 67 F soil at a four inch depth, 79% RH, 0% cloud cover, 1-5 mph SE wind, and adequate soil moisture. Weeds present at the time of POST applications were: amaranth 14-16" at 10-20/ft2, quinoa at 10-15/ft2, and RR corn 12-14" at 1-2/yd2. Soil characteristics were: 15.3% sand, 53.9% silt, 30.8% clay, silty clay loam, 6.2% OM, and 7.5 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 through 11001 TT nozzles at 40 psi. The experiment had a randomized complete block design with three replicates per treatment.

Control of species in treatment including Touchdown HiTech were lower compared to treatments including Durango DMA because Touchdown HiTech is an unloaded glyphosate. In some treatments, the addition of ET-4000 decreased the control of quinoa while increasing the control of amaranth.

Table. Glyphosate and 2,4-D with adjuvants (Zollinger, Wirth, Adams).

		14 DAA			28 DAA		
Treatment[1]	Rate	Amar[2]	Quin	Corn	Amar	Quin	Corn
	(Product/A)	-----% control-----			-----% control-----		
Durango+2,4-D+NIS	12floz+0.5pt+0.25%v/v	60	85	0	57	85	0
Durango+2,4-D+ET-4000 +NIS	12floz+0.5pt+1%v/v +0.25%v/v	67	78	0	63	85	0
TDHT+2,4-D+NIS	9.6floz+0.5pt+0.5%v/v	57	73	0	57	77	0
TDHT+2,4-D+ET-4000 +NIS	9.6floz+0.5pt+1%v/v +0.5%v/v	50	60	0	50	60	0
Durango+Stinger+NIS	12floz+4floz+0.25%v/v	55	77	0	55	75	0
Durango+Stinger+ET-4000 +NIS	12floz+4floz+1%v/v +0.25%v/v	52	77	0	52	75	0
TDHT+Stinger+NIS	9.6floz+4floz+0.5%v/v	40	60	0	40	50	0
TDHT+Stinger+ET-4000 +NIS	9.6floz+4floz+1%v/v +0.5%v/v	52	55	0	52	52	0
Durango+Status+NIS	12floz+4oz+0.25%v/v	58	73	0	52	75	0
Durango+Status+ET-4000 +NIS	12floz+4oz+1%v/v +0.25%v/v	67	75	0	60	85	0
TDHT+Status+NIS	9.6floz+4oz+0.5%v/v	55	60	0	43	57	0
TDHT+Status+ET-4000 +NIS	9.6floz+4oz+1%v/v +0.5%v/v	58	60	0	52	60	0
Durango+Laudis+NIS	12floz+2floz+0.25%v/v	43	87	0	40	83	0
Durango+Laudis+ET-4000 +NIS	12floz+2floz+1%v/v +0.25%v/v	57	80	0	55	82	0
TDHT+Laudis+NIS	9.6floz+2floz+0.5%v/v	40	30	0	30	30	0
TDHT+Laudis+ET-4000 +NIS	9.6floz+2floz+1%v/v +0.5%v/v	48	37	0	42	37	0
LSD (0.05)		5	5	0	5	5	0

[1] TDHT = Touchdown HiTech (unloaded glyphosate formulation), 2,4-D = 2,4-D Amine

[2] Amar = Amaranth, Quin = Quinoa

Pulse Width Modulator sprayer- carrier volume comparison. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate the effect carrier volume has on pulse width modulator sprayers. POST treatments were applied on June 29, 2016 at 12:30 PM with 80 F air, 83 F soil at a four inch depth, 44% RH, 0% cloud cover, 6-8 mph NW wind, and adequate soil moisture. Weeds present at the time of POST applications were: colq 8-12" at 20/ft2, cocb 8-12" at 10/ft2, yeft 4-6" at 40/ft2, and corw 8-12" at 10/ft2. Soil characteristics were: 23.1% sand, 52% silt, 24.9% clay, Silt Loam, 4.5% OM, and 7.7 pH. Treatments were applied to the center 10 feet of the 15 by 40 foot plots with a pulse width modulator sprayer mounted on the back of a Polaris Ranger. Nozzles and pressure were changed to achieve different spray qualities. Trial was a randomized complete block design.

Table. Pulse Width Modulator sprayer- carrier volume comparison (Zollinger, Wirth, Adams).

Treatment	Rate	Water Volume	Dropplet Size	14 DAA Weeds[1]	28 DAA Weeds
	(Product/A)	(GPA)	(Microns)	--------% control--------	
Untreated				0	0
Liberty	22floz	5	150	33	60
Liberty	22floz	5	300	30	67
Liberty	22floz	5	450	43	55
Liberty	22floz	5	600	60	60
Liberty	22floz	5	750	77	60
Liberty	22floz	5	900	43	60
Liberty	22floz	20	150	62	70
Liberty	22floz	20	300	72	55
Liberty	22floz	20	450	70	65
Liberty	22floz	20	600	78	60
Liberty	22floz	20	750	68	50
Liberty	22floz	20	900	65	57
Clarity	8floz	5	150	27	40
Clarity	8floz	5	300	27	50
Clarity	8floz	5	450	47	55
Clarity	8floz	5	600	52	67
Clarity	8floz	5	750	40	70
Clarity	8floz	5	900	50	55
Clarity	8floz	20	150	7	13
Clarity	8floz	20	300	47	60
Clarity	8floz	20	450	40	60
Clarity	8floz	20	600	50	72
Clarity	8floz	20	750	43	65
Clarity	8floz	20	900	60	65
LSD (0.05)				8	7

[1] Average control of all weeds

Pulse Width Modulator sprayer- Enlist Duo spray quality. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate the spray quality of Enlist Duo using a pulse width modulator sprayer. POST treatments were applied on June 29, 2016 at 12:30 PM with 80 F air, 83 F soil at a four inch depth, 44% RH, 0% cloud cover, 6-8 mph NW wind, and adequate soil moisture. Weeds present at the time of POST applications were: colq 8-12" at 20/ft2, cocb 8-12" at 10/ft2, yeft 4-6" at 40/ft2, and corw 8-12" at 10/ft2. Soil characteristics were: 23.1% sand, 52% silt, 24.9% clay, Silt Loam, 4.5% OM, and 7.7 pH. Treatments were applied to the center 10 feet of the 15 by 40 foot plots with a pulse width modulator sprayer mounted on the back of a Polaris Ranger. Nozzles and pressure were changed to achieve different spray qualities. Trial was a randomized complete block design.

Table. Pulse Width Modulator sprayer- Enlist Duo spray quality (Zollinger, Wirth, Adams).

Treatment	Rate	Water Volume	Dropplet Size	14 DAA Weeds[1]	28 DAA Weeds
	(Product/A)	(GPA)	(Microns)	--------% control--------	
Untreated				0	0
Enlist Duo	3.5pt	10	150	82	85
Enlist Duo	3.5pt	10	300	58	80
Enlist Duo	3.5pt	10	450	53	80
Enlist Duo	3.5pt	10	600	70	85
Enlist Duo	3.5pt	10	750	82	87
Enlist Duo	3.5pt	10	900	67	82
LSD (0.05)				7	8

[1] Average control of all weeds

Pulse Width Modulator sprayer- glyphosate and dicamba spray quality. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate the spray quality of glyphosate and dicamba using a pulse width modulator sprayer. POST treatments were applied on June 29, 2016 at 12:30 PM with 80 F air, 83 F soil at a four inch depth, 44% RH, 0% cloud cover, 6-8 mph NW wind, and adequate soil moisture. Weeds present at the time of POST applications were: colq 8-12" at 20/ft2, cocb 8-12" at 10/ft2, yeft 4-6" at 40/ft2, and corw 8-12" at 10/ft2. Soil characteristics were: 23.1% sand, 52% silt, 24.9% clay, Silt Loam, 4.5% OM, and 7.7 pH. Treatments were applied to the center 10 feet of the 15 by 40 foot plots with a pulse width modulator sprayer mounted on the back of a Polaris Ranger. Nozzles and pressure were changed to achieve different spray qualities. Trial was a randomized complete block design.

Table. Pulse Width Modulator sprayer-glyphosate and dicamba spray quality (Zollinger, Wirth, Adams).

Treatment	Rate	Water Volume	Dropplet Size	14 DAA Weeds[1]	28 DAA Weeds
	(Product/A)	(GPA)	(Microns)	--------% control--------	
Untreated				0	0
RUWM+Clarity	22floz+8floz	10	150	50	70
RUWM+Clarity	22floz+8floz	10	300	73	88
RUWM+Clarity	22floz+8floz	10	450	60	85
RUWM+Clarity	22floz+8floz	10	600	73	87
RUWM+Clarity	22floz+8floz	10	750	68	85
RUWM+Clarity	22floz+8floz	10	900	60	85
LSD (0.05)				5	3

[1] Average control of all weeds

Clopyralid&fluroxypyr&MCPA+Pinoxaden efficacy with pulse sprayer. Howatt, Roach, and Harrington. 'Asgrow 0835' soybean was planted near Fargo on May 20. Treatments were applied to 3 to 4 trifoliolate soybean, 12 to 15 inch redroot pigweed, flowering Venice mallow and wild mustard, and 10 to 12 inch common lambsquarters on July 1 with 72°F, 32% relative humidity, 40% cloud cover, 5.5 to 6 mph wind velocity at 135°, and dry topsoil at 65°F. All treatments received the herbicides listed in the first treatment line. First treatment was applied with a backpack sprayer delivering 8.5 gpa at 40 psi to a 7 foot wide area the length of 15 by 30 foot plots. All other treatments were applied with a pulse-width modulation sprayer mounted on a utility vehicle delivering 8.5 gpa at 40 psi with droplet size, duty cycle, nozzle tip, and travel speed described in the table to a 12-foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with three replicates.

				Broadleaf control	
Treatment	Rate	Nozzle tip	Travel	July 15	July 29
	oz/A		mph	%	%
Pinoxaden+Clpy&Flox&MCPA	0.86+5.75	TT11001	3.5	70	82
300µm&100% duty cycle		SR04	12	68	77
300µm&70% duty cycle		ER06	12	67	77
300µm&30% duty cycle		ER06	4.5	72	83
750µm&100% duty cycle		UR04	12	58	72
750µm&70% duty cycle		UR06	12	57	72
750µm&30% duty cycle		UR06	5.5	68	83
Untreated Check				0	0
CV				5	4
LSD P=0.05				5	4

Compared with the handboom which produced droplets near 300µm for 82% control, the pulse-sprayer provided similar control at either droplet size at speeds less than 6 mph. Traveling 12 mph resulted in less than 80% control. At this higher speed, a greater separation between droplet sizes was evident with 77% control using 300µm droplets at either 70 or 100% duty cycle and 72% control using larger droplets near 750µm.

Carfentrazone&2,4-D+Flucarbazone efficacy with pulse sprayer. Howatt, Roach, and Harrington. 'Asgro 0835' soybean was seeded near Fargo on May 20. Treatments were applied to 3 to 4 trifoliolate soybean and 12 to 15 inch redroot pigweed on July 1 with 72°F, 32% relative humidity, 40% cloud cover, 5 to 6 mph wind velocity at 135°, and dry topsoil at 65°F. All treatments received the herbicides listed in the first treatment line. First treatment was applied with a backpack sprayer delivering 8.5 gpa at 40 psi to a 7 foot wide area the length of 15 by 30 foot plots. All other treatments were applied with a pulse-width modulation sprayer mounted on a utility vehicle delivering 8.5 gpa at 40 psi with droplet size, duty cycle, nozzle tip, and travel speed described in the table to a 12-foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

				Broadleaf control	
Treatment	Rate	Nozzle tip	Travel	July 15	July 29
	oz/A		mph	%	%
Flcz+Carf+2,4-D+BB	0.32+0.128+6+1%	TT11001	3.5	93	92
300µm&100% duty cycle		SR04	12	65	84
300µm&70% duty cycle		ER06	12	74	84
300µm&30% duty cycle		ER06	4.5	90	95
750µm&100% duty cycle		UR04	12	50	76
750µm&70% duty cycle		UR06	12	56	74
750µm&30% duty cycle		UR06	5.5	86	90
Untreated				0	0
CV				11	4
LSD P=0.05				11	4

Compared with the handboom which produced droplets near 300µm for 92% control, the pulse-sprayer provided similar control at either droplet size at speeds less than 6 mph. Traveling 12 mph resulted in less than 85% control. At this higher speed, a greater separation between droplet sizes was evident with 84% control using 300µm droplets at either 70 or 100% duty cycle and 75% control using larger droplets near 750µm.

Pyroxsulam&Florasulam&Fluroxypyr efficacy with pulse sprayer. Howatt, Roach, and Harrington. 'Asgrow 0835' soybean was seeded near Fargo on May 20. Treatments were applied to 3 to 4 trifoliolate soybean and 12 to 15 inch redroot pigweed, flowering wild mustard and Venice mallow, and 5 to 7 inch sage on July 1 with 72°F, 32% relative humidity, 40% cloud cover, 5 to 6 mph wind at 135°, and dry soil at 65°F. All treatments received the herbicides listed in the first treatment line. First treatment was applied with a backpack sprayer delivering 8.5 gpa at 40 psi to a 7 foot wide area the length of 15 by 30 foot plots. All other treatments were applied with a pulse-width modulation sprayer mounted on a utility vehicle delivering 8.5 gpa at 40 psi with droplet size, duty cycle, nozzle tip, and travel speed described in the table to a 12-foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

				Broadleaf control	
Treatment	Rate	Nozzle tip	Travel	July 15	July 29
	oz/A		mph	%	%
Pxlm&Flas&Flox+BB	1.68+1%	TT11001	3.5	73	91
300µm&100% duty cycle		SR04	12	9	86
300µm&70% duty cycle		ER06	12	68	86
300µm&30% duty cycle		ER06	4.5	76	90
750µm&100% duty cycle		UR04	12	68	86
750µm&70% duty cycle		UR06	12	64	81
750µm&30% duty cycle		UR06	5.5	79	87
Untreated				0	0
CV				6	4
LSD P=0.05				6	4

Compared with the handboom which produced droplets near 300µm for 91% control, the pulse-sprayer provided near similar control at either droplet size at speeds less than 6 mph. The pulse sprayer at 750µm gave 87% control which was at the LSD for separation. Traveling 12 mph resulted in 86% control or less. The lowest control value of 81% was obtained from this higher speed and using larger droplets near 750µm.

Brox&MCPA+Fenoxaprop efficacy with pulse sprayer. Howatt, Roach, and Harrington. 'Asgrow 0835' soybean was seeded near Fargo on May 20. Treatments were applied to 3 to 4 trifoliolate soybean, 12 to 15 inch redroot pigweed, flowering wild mustard and flowering Venice mallow on July 1 with 72°F, 32% relative humidity, 40% cloud cover, 5.6 mph average wind velocity at 135°, dry topsoil at 65°F. All treatments received the herbicides listed in the first treatment line. First treatment was applied with a backpack sprayer delivering 8.5 gpa at 40 psi to a 7 foot wide area the length of 15 by 30 foot plots. All other treatments were applied with a pulse-width modulation sprayer mounted on a utility vehicle delivering 8.5 gpa at 40 psi with droplet size, duty cycle, nozzle tip, and travel speed described in the table to a 12-foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

				Broadleaf control	
Treatment	Rate	Nozzle tip	Travel	July 15	July 29
	oz/A		mph	%	%
Fenx+Brox&MCPA	1+8	TT11001	3.5	69	86
300µm&100% duty cycle		SR04	12	69	90
300µm&70% duty cycle		ER06	12	68	88
300µm&30% duty cycle		ER06	4.5	68	88
750µm&100% duty cycle		UR04	12	65	88
750µm&70% duty cycle		UR06	12	40	60
750µm&30% duty cycle		UR06	5.5	54	79
Untreated				0	0
CV				12	10
LSD P=0.05				10	10

Compared with the handboom which produced droplets near 300µm for 86% control, the pulse-sprayer provided similar control at either droplet size at speeds less than 6 mph although control was only 79% with 750µm droplet size. Traveling 12 mph did not reduce control across all treatments as was measured in other studies. However, the fast travel speed of 12 mph with larger droplets near 750µm resulted in the least control with these herbicides, 60%.

Thifensulfuron+Tribenuron+2,4-D+Clodinafop efficacy with pulse sprayer. Howatt, Roach, and Harrington. 'Asgrow 0835' soybean was seeded near Fargo on May 20. Treatments were applied to 3 to 4 trifoliolate soybean, 12 to 15 inch redroot pigweed, and flowering wild mustard and Venice mallow on July 1 with 72°F 32% relative humidity, 40% cloud cover, 5 to 6 mph wind at 135°and dry top soil at 65°F. All treatments received the herbicides listed in the first treatment line. First treatment was applied with a backpack sprayer delivering 8.5 gpa at 40 psi to a 7 foot wide area the length of 15 by 30 foot plots. All other treatments were applied with a pulse-width modulation sprayer mounted on a utility vehicle delivering 8.5 gpa at 40 psi with droplet size, duty cycle, nozzle tip, and travel speed described in the table to a 12-foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with three replicates.

				Broadleaf control	
Treatment	Rate	Nozzle tip	mph	July 15	July 29
	oz/A		mph	%	%
Clfp+Thifsg+Tribsg+2,4-D	0.8+0.24+0.06+4	TT11001	3.5	83	94
300µm&100% duty cycle		SR04	12	68	88
300µm&70% duty cycle		ER06	12	70	83
300µm&30% duty cycle		ER06	4.5	73	88
750µm&100% duty cycle		UR04	12	*	*
750µm&70% duty cycle		UR06	12	57	75
750µm&30% duty cycle		UR06	5.5	75	92
Untreated Check				0	0
CV				8	3
LSD=0.05				9	3

* Computer was set for 06 tips instead of 04 tips so values are not reported.

Compared with the handboom which produced droplets near 300µm for 94% control, the pulse-sprayer provided similar control at 750µm droplet size at speed less than 6 mph but control at 300µm droplets was lower at 88%. Traveling 12 mph resulted in less control than the standard research method. At this higher speed, a greater separation between droplet sizes was evident with 85% control using 300µm droplets at either 70 or 100% duty cycle and 75% control using larger droplets near 750µm at 70% duty cycle. The lowest control value of 75% was obtained from the higher speed and using larger droplets near 750µm.

Bromoxynil&Pyrasulfotole&Thiencarbazone efficacy with pulse sprayer. Howatt, Roach, and Harrington. 'Asgrow 0835' soybean were seeded near Fargo on May 20. Treatments were applied to 3 to 4 trifoliolate soybean and 12 to 14 inch redroot pigweed on July 1 with 72°F, 32% relative humidity, 40% cloud cover, 5 to 6 mph wind velocity at 135°, and dry topsoil at 65°F. All treatments received the herbicides listed in the first treatment line. First treatment was applied with a backpack sprayer delivering 8.5 gpa at 40 psi to a 7 foot wide area the length of 15 by 30 foot plots. All other treatments were applied with a pulse-width modulation sprayer mounted on a utility vehicle delivering 8.5 gpa at 40 psi with droplet size, duty cycle, nozzle tip, and travel speed described in the table to a 12-foot wide area the length of 15 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

				Broadleaf control	
Treatment	Rate	Nozzle	Travel	July 15	July 29
	oz/A		mph	%	%
Brox&Pyst&Thcz+UAN	3+16	TT11001	3.5	74	91
300µm&100% duty cycle		SR04	12	4	3
300µm&70% duty cycle		ER06	12	40	50
300µm&30% duty cycle		ER06	4.5	74	91
750µm&100% duty cycle		UR04	12	54	66
750µm&70% duty cycle		UR06	12	61	78
750µm&30% duty cycle		UR06	5.5	71	87
Untreated Check				0	0
CV				13	20
LSD P=.05				10	17

The results of this study were highly irregular with such low rating for one treatment. While 300µm droplet with 100% duty cycle pulse was barely discernible from the untreated, difference in travel speed was consistent with other products tested. At speeds less than 6 mph, control was similar across sprayer type and droplet sizes. Traveling 12 mph resulted in less than 80% control.