

## INFLUENCE OF ADJUVANT AND APPLICATION PARAMETERS ON MICRO-RATE EFFICACY AND PRECIPITATE FORMATION.

Trevor M. Dale, Alan G. Dexter and John L. Luecke

Graduate Research Assistant, Extension Sugarbeet Specialist, and Sugarbeet Research Specialist, North Dakota State University and the University of Minnesota, Fargo.

The objectives of these experiments were to determine precipitate formation and weed control as influenced by various adjuvants, sprayer speed and spray volume. Previous results with the micro-rate have been published in the 1995 Sugarbeet Research and Extension Reports, pp77-82; the 1996 Sugarbeet Research and Extension Reports, pp 62-66; the 1997 Sugarbeet Research and Extension Reports, pp 103-108, and the 1998 Sugarbeet Research and Extension Reports, pp 71-75. Previous results indicated a) oil adjuvant increased the risk of sugarbeet injury from the herbicides but the risk of the injury was minimal with the micro-rate plus oil adjuvant; b) the micro-rate including a methylated seed oil gave weed control similar to three times as much Betanex and Stinger, and four times as much UpBeet; c) precipitate and nozzle plugging have been a problem with commercial use of the micro-rate.

Suggestions to reduce nozzle plugging with the micro-rate:

- 1) Pre-slurry the UpBeet in hot water or in water with a pH of 8 to 9. Add the UpBeet to the tank first and make sure it is thoroughly dissolved before adding other herbicides.
- 2) Allow the spray-tank water to warm before adding herbicides.
- 3) Increase the pH of the spray tank water by adding household ammonia (2% concentration) at 1 gallon per 100 gallons of water.
- 4) As an alternative to ammonia, add a basic blend adjuvant at 1% v/v to increase the pH of the spray tank water. Trade names of basic blend adjuvants are Quad 7 from AGSCO, Linkage from Helena, Newtone from Cenex and Transactive from West Central.
- 5) Add a grass herbicide to the micro-rate.
- 6) Use the minimum amount of agitation necessary to keep the solution mixed.
- 7) Increase screen size or use slotted screens rather than mesh screens.

Laboratory experiments were conducted to determine the effects of adjuvants, Betanex, Betamix, and Progress on precipitate formation with the micro-rate. All treatments were applied at the micro-rate with one of eleven adjuvants tested. The rates of the components of the 14 treatments are given in product per acre and in active ingredient per acre ([Table 1](#)). The product rates of Betanex, Betamix, Progress and Stinger are in pt/A while the UpBeet rate is in oz/A and the adjuvants are expressed as % v/v. Treatments in the laboratory experiment were replicated five times.

Adjuvants tested were: Dash HC<sup>1</sup>, Destiny<sup>2</sup>, MethOil<sup>2</sup>, Sun-It II<sup>3</sup>, Superb<sup>4</sup>, and PX143<sup>5</sup> were methylated seed oil (MSO) based, Scoil<sup>3</sup> was a surfactant-oil blend, Quad 7<sup>3</sup> and Breakout<sup>6</sup> were a basic blend of ammoniated buffered salts plus non-ionic surfactants and First Mate<sup>2</sup> was a combination of basic blend of ammoniated buffered salts plus non-ionic surfactant and MSO. WetSol<sup>7</sup> was the only non-ionic surfactant tested.

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<sup>1</sup> Dash was from BASF.

<sup>2</sup> Destiny, MethOil, and First Mate were from Cenex.

<sup>4</sup> Superb was from Wilbur-Ellis.

<sup>5</sup> PX143 was from Precision Laboratories.

<sup>3</sup> Scoil, Quad 7, and Sun-It II were from AGSCO.

<sup>6</sup> Breakout was from Loveland.

<sup>7</sup> WetSol is a product of Schaeffer Mfg.

Table 1. Herbicide treatments replicated five times in the laboratory, 1998.

Treatment	Product rate	Active ingredient	Adjuvant	Adjuvant rate
	pt or oz/A	lb ai/A		% (v/v)
Betanex+UpBeet+Stinger	0.5+0.125+1.3	0.08+0.004+0.03	No adjuvant	
			WetSol	0.25
			Scoil	1.5
			Sun-It II	1.5
			Destiny	1.5
			Dash HC	1.5
			Superb	1.5
			Breakout	1.5
			MethOil	1.5
			Quad 7	1.5
			First Mate	2.5
			PX143	1.5
Betamix+UpBeet+Stinger	0.5+0.125+1.3	0.08+0.004+0.03	MethOil	1.5
Progress+UpBeet+Stinger	0.36+0.125+1.3	0.08+0.004+0.03	MethOil	1.5

The micro-rate with each adjuvant was mixed in 1.5 gallons of water and allowed to stand for six hours. Water temperature was maintained between 40 to 45° F. The UpBeet was pre-slurried with water from buckets and added before all other herbicides. Visual and weight comparisons were used to determine precipitate formation. Visual ratings were required because, with certain adjuvants, the precipitate was visible and was plugging the screen, but the precipitate weighed less than other precipitates that caused less nozzle plugging. Each treatment was sprayed through a single nozzle sprayer at 40 psi with an 8004 nozzle and 100 mesh screen. The following visual ratings were given: 1 = screen 1 to 5% plugged, 2 = screen 6 to 20% plugged, and 3 = screen over 20% plugged.

Table 2. The effect of adjuvants and herbicides on precipitate formation with the micro-rate.

Treatment <sup>a</sup>	Precipitate on nozzle screen	Visual rating <sup>c</sup> of screen plugging
	g/screen	
Bnex+UpB+Sting+Quad 7	0.04	2
Bnex+UpB+Sting+Quad 7 <sup>b</sup>	0.05	3
Bnex+UpB+Sting+Scoil	0.07	3
Bnex+UpB+Sting+WetSol	0.01	1
Bnex+UpB+Sting+Sun-It II	0.13	3
Bnex+UpB+Sting+Destiny	0.08	3
Bnex+UpB+Sting+Dash HC	0.09	3
Bnex+UpB+Sting+Superb	0.01	1
Bnex+UpB+Sting+Breakout	0.02	1
Bnex+UpB+Sting+First Mate	0.03	1
Bnex+UpB+Sting+Meth Oil	0.09	3
Bnex+UpB+Sting	0.01	2
Bnex+UpB+Sting+Meth Oil	0.09	3
Bmix+UpB+Sting+Meth Oil	0.01	1
Prog+UpB+Sting+Meth Oil	0.01	1
LSD (0.05)	0.03	

<sup>a</sup>WetSol was at 0.25%, First Mate was at 2.5%, and all other adjuvants were at 1.5% v/v.

<sup>b</sup>With the exception of this treatment, herbicides were added to the water prior to the adjuvants.

°1 = 1 to 5%, 2 = 6 to 20% and 3 = over 20% plugged.

Adjuvant effect on precipitate formation was significant (Table 2). WetSol, Superb, Breakout and First Mate all received a visual rating of 1 with screen plugging ranging from 1 to 5%.

The dry weights and visual evaluations of the precipitate indicated that precipitate formation with the micro-rate was less with WetSol, Superb, Breakout, First Mate or Quad 7 as compared to other adjuvants. When Quad 7 was placed in the water before the herbicides, precipitate was similar to the precipitate formed with WetSol, Superb, Breakout and First Mate. Precipitate was nearly eliminated when Betamix or Progress were used with the micro-rate rather than Betanex.

Treatments in the field experiments were applied four times at three locations (Table 3). Planting dates, treatment dates, soil temperatures, and sugarbeet size at treatment are given in Table 3. Sugarbeet was seeded 1.25 inches deep in 22 inch rows. The standard application parameters were 8.5 gpa of water, 8001 nozzles, 40 psi and 3 mph. Parameters were compared in one experiment and are listed in Table 11. 'VanDerHave 66156' sugarbeet was seeded at Breckenridge, Fargo and Crookston on April 26, May 3 and May 17, 1999, respectively.

Table 3. Dates and sugarbeet growth stages when postemergence herbicides were applied in 1999.

Loc.	Date	First POST		Second Post		Third POST		Fourth POST				
		6-in. soil temp.	Sgbt size	6-in. soil temp.	Sgbt size	6-in. Soil temp.	Sgbt size	6-in soil temp.	Sgbt size			
		F	V	F	V	F	V	F	V			
Breckenridge	5/19	57	V1.0	5/26	62	V2.5	6/2	64	V4.0	6/11	70	V6.5
Fargo	5/25	54	V1.0	6/7	62	V2.5	6/14	62	V4.5	6/24	63	V7.0
Crookston	6/7	70	V1.5	6/15	61	V3.5	6/24	72	V6.5	6/30	75	V9.0

V1.0 = cotyledonary stage, V2.0 = two unrolled leaves, V2.5 = two unrolled leaves with third leaf 50% unrolled. See 1996 Sugarbeet Research and Extension Reports, pp 152-157.

#### Adjuvant effect on sugarbeet injury and weed control with the micro-rate in 1999.

Sugarbeet injury was evaluated visually as 7% or less at Crookston and Breckenridge in 1999 (Table 4) and the micro-rate caused similar injury with all adjuvants.

Table 4. Sugarbeet injury as affected by adjuvants used in combination with the micro-rate at Breckenridge and Crookston in 1999.<sup>a</sup>

Adjuvant	Adjuvant concentration	Sugarbeet injury
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	% (v/v)	%
Quad 7	1.5	4
Scoil	1.5	5
WetSol	0.25	3
Sun-It II	1.5	4
Destiny	1.5	4
Dash HC	1.5	7
Superb	1.5	5
Breakout	1.5	4
First Mate	2.5	4
MethOil	1.5	4
PX143	1.5	4
LSD (0.05)		N.S.

<sup>a</sup> All treatments included the micro-rate: Betanex at 0.5 pt/A + UpBeet at 0.125 oz/A + Stinger at 1.3 oz/A.

Redroot pigweed control was better at Breckenridge than at Crookston probably because weed populations were greater at Crookston (Table 5). All adjuvants provided similar enhancement of redroot pigweed control. Flax is a small-leaved, waxy and hard-to-wet plant. All adjuvants provided similar enhancement of flax control (Table 6). Similarly, control of canola (Table 7) and common purslane (Table 8) was similar with all adjuvants.

Table 5. Redroot pigweed control by the micro-rate as affected by environment and adjuvants in 1999.<sup>a</sup>

Adjuvant	Adjuvant concentration	Redroot pigweed control	
		Breckenridge, MN	Crookston, MN
	% (v/v)	-----%-----	
Quad 7	1.5	99	91
Scoil	1.5	99	82
WetSol	0.25	100	81
Sun-It II	1.5	98	90
Destiny	1.5	100	90
Dash HC	1.5	99	89
Superb	1.5	100	90
Breakout	1.5	99	85
First Mate	2.5	100	90
MethOil	1.5	99	91
PX143	1.5	99	90
LSD (0.05)		NS	NS

<sup>a</sup>All treatments included the micro-rate: Betanex at 0.5 pt/A + UpBeet at 0.125 oz/A + Stinger at 1.3 fl oz/A.

Table 6. Flax control by the micro-rate as affected by environment and adjuvants in 1999<sup>a</sup>.

Adjuvant	Adjuvant concentration	Flax control
	% v/v	%
Quad 7	1.5	66

Scoil	1.5	68
WetSol	0.25	61
Sun-It II	1.5	68
Destiny	1.5	63
Dash HC	1.5	64
Superb	1.5	70
Breakout	1.5	65
First Mate	2.5	66
MethOil	1.5	67
PX 143	1.5	67
LSD (0.05)		NS

<sup>a</sup>All treatments included the micro-rate: Betanex at 0.5 pt/A + UpBeet at 0.125 oz/A + Stinger at 1.3 fl oz/A.

Table 7. Canola control by the micro-rate as affected by environment and adjuvants in 1999<sup>a</sup>.

Adjuvant	Adjuvant Concentration	Canola control
	% (v/v)	%
Quad 7	1.5	78
Scoil	1.5	79
WetSol	0.25	72
Sun-It II	1.5	77
Destiny	1.5	76
Dash HC	1.5	75
Superb	1.5	76
Breakout	1.5	79
First Mate	2.5	77
MethOil	1.5	81
PX143	1.5	76
LSD (0.05)		NS

<sup>a</sup>All treatments included the micro-rate: Betanex at 0.5 pt/A + UpBeet at 0.125 oz/A + Stinger at 1.3 fl oz/A.

Table 8. Common purslane control by the micro-rate as affected by adjuvants used at Breckenridge, MN, 1999<sup>a</sup>.

	Common purslane

Adjuvant	Adjuvant concentration	control
	% (v/v)	%
Quad 7	1.5	96
Scoil	1.5	96
WetSol	0.25	90
Sun-It II	1.5	95
Destiny	1.5	96
Dash HC	1.5	95
Superb	1.5	97
Breakout	1.5	88
First Mate	2.5	96
MethOil	1.5	95
PX143	1.5	96
LSD (0.05)		NS

<sup>a</sup>All treatments included the micro-rate: Betanex at 0.5 pt/A + UpBeet at 0.125 oz/A + Stinger at 1.3 fl oz/A.

The error mean squares for the analysis of green and yellow foxtail at Breckenridge, Crookston, and Fargo were heterogeneous. Thus, a combined analyses across locations was not done. Green and yellow foxtail control ranged from 72 to 89% at Breckenridge and 93 to 98% at Fargo (Table 9). At Crookston, Destiny, Breakout, First Mate and Superb were in the top group of adjuvants and enhanced control by the micro-rate similarly; all these herbicide-adjuvant combinations provided 94% or greater control of green and yellow foxtail. PX143 and Dash HC were in the bottom group and the micro-rate gave significantly less control with these adjuvants than with Superb, First Mate, Breakout and Destiny. The micro-rate with WetSol provided less green and yellow foxtail control than with Destiny, Breakout and First Mate.

Table 9. Green and yellow foxtail control with the micro-rate as affected by environment and adjuvants in 1999.

Adjuvant <sup>a</sup>	Adjuvant concentration	Green and yellow foxtail control		
		Breckenridge, MN	Crookston, MN	Fargo, ND
	% (v/v)	-----%-----		
Quad 7	1.5	86	91	97
Scoil	1.5	82	93	98
WetSol	0.25	77	90	95
Sun-It II	1.5	77	92	93
Destiny	1.5	78	96	98
Dash HC	1.5	82	88	97
Superb	1.5	89	94	97
Breakout	1.5	72	95	95
First Mate	2.5	89	95	95
MethOil	1.5	86	93	96
PX143	1.5	77	87	94

LSD (0.05) NS 5 NS

<sup>a</sup>All treatments included the micro-rate: Betanex at 0.5 pt/A + UpBeet at 0.125 oz/A + Stinger at 1.3 fl oz/A.

Table 10. Weed control with the micro-rate averaged over redroot pigweed, flax, canola, common purslane and foxtail spp.

Adjuvant <sup>a</sup>	Adjuvant concentration	Weed control
	% (v/v)	%
Superb	1.5	86
MethOil	1.5	86
Scoil	1.5	85
First Mate	2.5	85
Quad 7	1.5	85
Sun-It II	1.5	84
Destiny	1.5	84
PX143	1.5	84
Dash HC	1.5	83
Breakout	1.5	82
WetSol	0.25	80

<sup>a</sup>All treatments included the micro-rate: Betanex at 0.5 pt/A + UpBeet at 0.125 oz/A + Stinger at 1.3 fl oz/A.

The percent control evaluations were averaged over redroot pigweed, flax, canola, common purslane and green and yellow foxtail (Table 10). Average control ranged from 80% to 86%, a relatively small difference among adjuvants. The micro-rate plus WetSol provided the least control. The micro-rate plus Superb, MethOil, Scoil, First Mate or Quad 7 were in the top group with 85 or 86% control. Precipitate formation (Table 2) and weed control (Table 10) did not appear to be closely related.

Table 11. Influence of nozzle size and sprayer speed on weed control from Betanex + UpBeet + Stinger at 0.5 pt + 0.125 oz + 1.3 fl oz/A + methylated seed oil applied four times at a 7-day interval.

Sprayer speed	Spray nozzle	Spray volume <sup>a</sup>	Sugarbeet inj	Redroot pigweed cntl	Flax cntl	Foxtail spp. cntl	Canola cntl	Common purslane cntl
mph		gpa	%	%	%	%	%	%
3	8001	10	5	94	66	91	78	90
	8002	20	5	90	64	88	74	86
	8004	40	5	88	61	84	72	84
6	8001	5	6	92	65	88	80	88
	8002	10	5	91	66	89	77	90
	8004	20	5	91	62	90	78	88
LSD (0.05)			NS	NS	NS	NS	NS	NS

<sup>a</sup>Spray pressure = 40 psi.

Weed control was not significantly influenced by sprayer speed or nozzle size (Table 11). However, the percent control of all species tended to decline with increasing nozzle size and increasing spray volume when the sprayer traveled at 3 mph. The spray volumes were twice as large at 3 mph as at 6 mph so perhaps the relatively high volume of 40 gpa had a slight detrimental effect on control. Certainly, higher water volume had no positive effect on control.

