Evaluating Drift when Spraying an Active Ingredient Tank Mix Solution with and without Additional Adjuvants

NAAA/ASABE

Technical Session

Dec. 5, 2011
Las Vegas, NV

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OBJECTIVES:

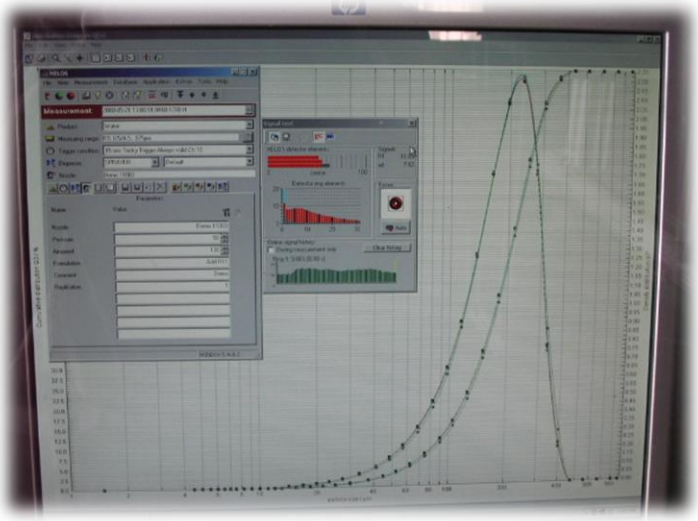
- Evaluate spray drift from active ingredient tank mixes
- With and without additional spray adjuvants.
- Testing in a high speed wind tunnel.
- Testing drift with a field study component.
- Modeling spray drift with AGDISP.

COMPANIES AND PRODUCTS:

Wilbur-Ellis	Winfield Solutions	Rosen's	GarrCo	Precison Labs
SSMSO	Superb HC	Vector	Control	PX 159-11
InPlace	Interlock	Event		PX 259-11
High Load	Interlock + Superb HC	Array		
		DVA 9773		

MATERIALS AND METHODS WIND TUNNEL:

- USDA ARS High Speed Wind Tunnel
  - 137 mph wind speed
- Flow calibrated for 2 GPA
- Nozzles tested:
  - CP-11TT 4012 Flat-fan nozzles w/23°deflection, 38 PSI
  - ASC Rotary Atomizer D-12 orifice and blade setting #2, 23 PSI
  - XR11003 (nozzle standard), 43 PSI, 0°deflection
- HELOS laser diffraction droplet sizing system



DROPLET SIZE DATA - CP11T-4012

Adjuvant	DV10 (um)	DV50 (um)	DV90 (um)	RS	%<100 um	%<200 um
R11 (43 ml)(XR 11003)	65	168	297	1.38	22	63
R11 (43 ml)	99	239	403	1.27	10	37
n/a	100	256	434	1.31	10	33
R11 (43 ml)	103	255	416	1.23	[illegible]	32
ROC (511 ml)	105	244	393	[illegible]	[illegible]	4
SSMSO (511 ml)	89	223	[illegible]	[illegible]	[illegible]	42
Superb HC (85 ml)	108	257	[illegible]	[illegible]	9	31
Interlock (170 ml)	98	[illegible]	[illegible]	1.16	10	40
Interlock (85 ml) + Superb HC (85 ml)	[illegible]	[illegible]	375	1.17	10	37
In-Place ([illegible]	[illegible]	228	365	1.17	10	39
Vector ([illegible]	91	294	548	1.56	12	31
Event (1[illegible]	84	282	557	1.67	13	34
Rosen DVA[illegible]773 (170 ml)	76	249	470	1.58	16	39
Array	92	298	582	1.65	12	32
Control (3 ml)	78	265	661	2.20	15	39
Precision PX 159-11 (43 ml)	111	274	454	1.25	8	29
Precision PX 259-11 (43 ml)	106	262	427	1.23	9	31
High Load (85 ml)	109	268	439	1.23	8	30

APPENDIX A IN PAPER

DROPLET SIZE DATA – ROTARY ATOMIZER

Adjuvant*	DV10	DV50	DV90	RS	%<100	%<200
R11 NIS (43 ml)	74	190	354	1.47	17	54
n/a	71	189	332	1.38	18	54
R11 NIS (43 ml)	72	193	348	1.43	17	53
ROC (511 ml)	65	171	285	1.29	[illegible]	63
SSMSO (511 ml)	58	155	265	[illegible]	[illegible]	1
Superb HC (85 ml)	72	190	[illegible]	[illegible]	[illegible]	54
Interlock (170 ml)	57	149	[illegible]	[illegible]	26	75
Interlock (85 ml) + Superb HC (85 ml)	61	[illegible]	[illegible]	1.29	23	69
In Place (83 ml)	[illegible]	[illegible]	260	1.29	24	71
Vector (40 gr[illegible]	[illegible]	227	416	1.52	17	42
Event ([illegible]	70	242	475	1.67	17	40
Rosen DV[illegible]	56	191	356	1.56	23	53
Array	65	227	441	1.66	19	43
Control (3 ml)	66	239	549	2.01	19	43
Precision Products PX 159-11 (43 ml)	73	191	331	1.35	17	54
Precision Products PX 259-11 (43 ml)	71	190	333	1.38	18	54
High Load (85 ml)	74	196	345	1.38	17	52

APPENDIX A IN PAPER

COMPANIES AND PRODUCTS - FIELD TRIAL:

Wilber-Ellis	Winfield Solutions	Rosen's	GarrCo	Precison Labs
SSMSO	Superb HC TRT 4	Vector TRT 5	Control TRT 6	PX 159-11 TRT 7
InPlace	Interlock	Event		PX 259-11
High Load	Interlock + Superb HC	Array		
		DVA 9773		
TRT 1- XR + NIS	TRT 2 – Headline Amp + NIS	TRT – 3 ROC		

FIELD TRIAL TREATMENTS:

trt	Nozzle type	Degree deflection	PSI	Solution
T1	11003 FF	0°	43	Water + non-ionic surfactant - 0.25% (v/v)
T2	4012 FF	23°	38	Headline Amp - 10 oz/ac
T3	4012 FF	23°	38	Headline Amp at 10 oz/ac + ROC - 3% v/v
T4	4012 FF	23°	38	Headline Amp at 10 oz/ac + Superb HC - 0.5% v/v
T5	4012 FF	23°	38	Headline Amp at 10 oz/ac + Vector – 2 lb/100gal
T6	4012 FF	23°	38	Headline Amp at 10 oz/ac + Control – 2 fl oz/100 gal
T7	4012 FF	23°	38	Headline Amp 10 oz/ac + Precision PX 159 - 0.25% v/v

ATOMIZATION RESULTS FROM THE HIGH SPEED WIND TUNNEL TEST OF THE TREATMENTS SELECTED FOR FIELD STUDIES - CP11T-4012

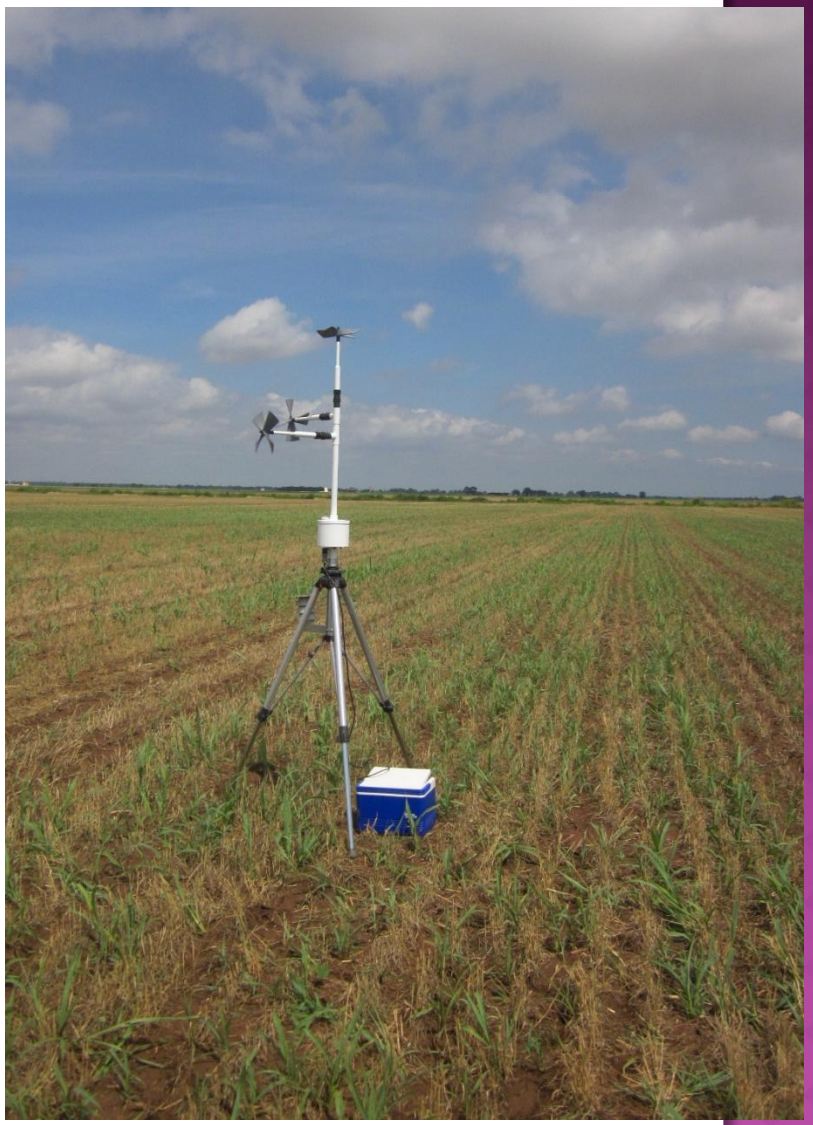
Trt	DV10 (um)	DV50 (um)	DV90 (um)	RS	%<100 um	%<200 um
T1	65.5	167.9	297.4	1.4	21.7	63.1
T2	100.2	255.7	434.3	1.3	10.0	33.3
T3	105.3	244.3	393.1	1.2	9.0	34.3
T4	108.2	257.4	415.2	1.2	8.6	31.5
T5	90.7	293.9	547.9	1.6	11.7	31.3
T6	78.1	265.3	661.0	2.2	15.5	38.7
T7	111.3	274.2	453.7	1.3	8.1	28.7

MATERIALS AND METHODS FIELD TRIAL (2011):

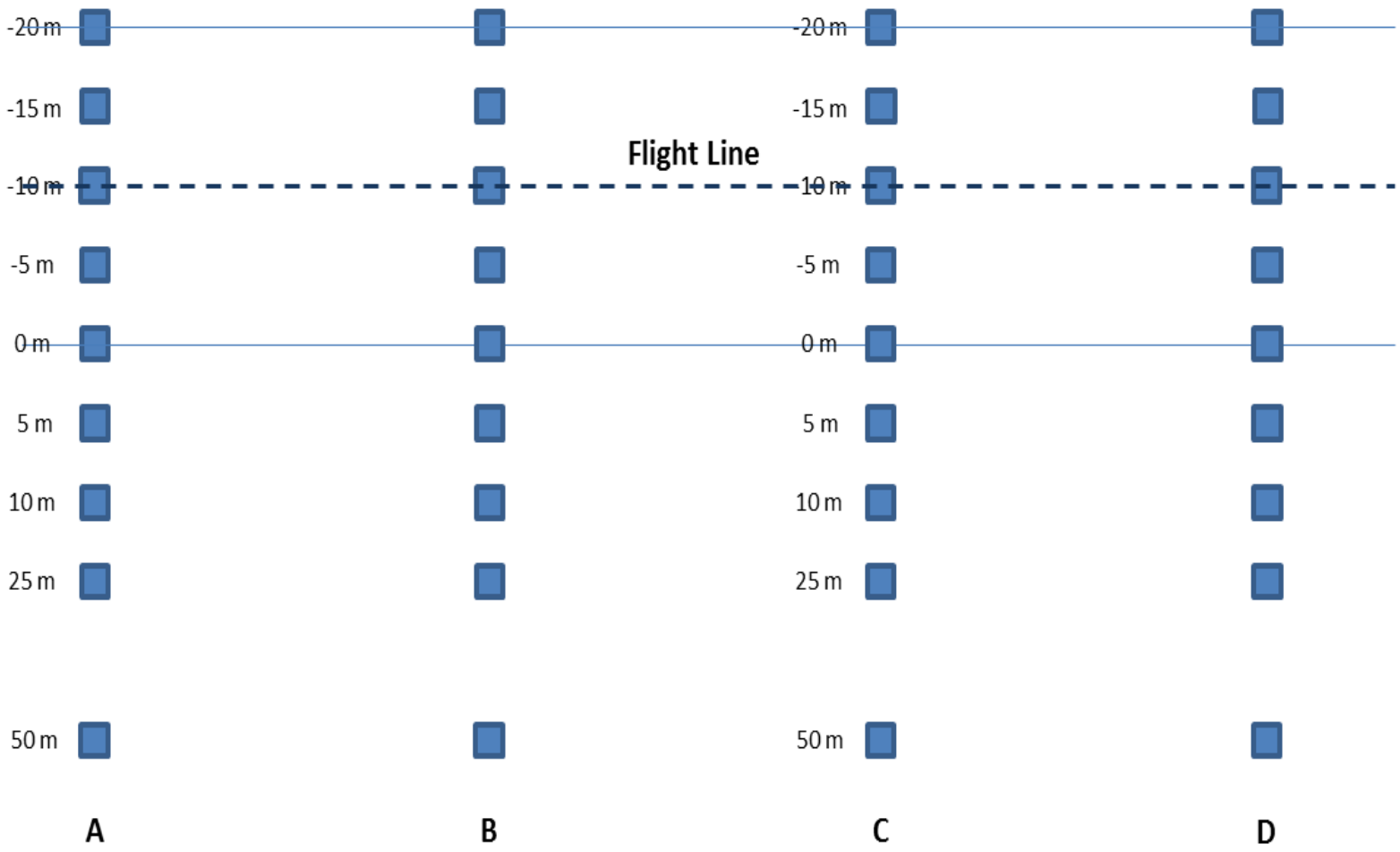
- AT-402B
  - CP-11TT 4012 Flat-fan nozzles w/23° deflection
  - 67 foot swath, 10 foot release height
  - 38 PSI
  - 137 mph ground speed by GPS
- Aircraft calibrated for 2 GPA

WEATHER DATA:

- July 10, 2011
  - 8:00 am – 12:00 noon
- Wind speed range:
  - 3.1 – 4.7 MPH
- Average wind speed:
  - 3.6 MPH
- Wind direction:
  - 143° - 201°
- Temperature:
  - 83.8°F
- Humidity:
  - 83 %



FIELD DRIFT STUDY LAYOUT:



PREPARING MYLAR FOR ANALYSIS:

FIELD TRIAL RESULTS:

	In-Swath Deposition (% of Total Applied)					Downwind Deposition (% of Total Applied)			
	Avg	signif	±	St.Dev.		Avg	signif	±	St.Dev.
1	5.8	a	±	1.6		7.3	b	±	4.7
2	22.6	b	±	5.9		4.9	ab	±	2.4
3	37.0	c	±	13.2		7.4	b	±	4.2
4	22.1	b	±	7.9		6.6	ab	±	2.4
5	33.4	bc	±	13.0		5.1	ab	±	4.0
6	29.4	bc	±	9.6		2.8	a	±	0.9
7	24.3	b	±	10.8		3.0	a	±	1.5

SUMMARY - FIELD STUDY

- Data acquisition complicated due to light and variable winds – speed and direction
- Evidenced in the large deviations in both swath deposition and downwind deposits.
- Result – very few significant if meaningful differences
- In general – when compared to no adjuvants added, the addition of adjuvants can improve in-swath deposition and reduce downwind deposits.

CONCLUSIONS:

- Even with using the wind tunnel to narrow down the scope of the field study, it is concluded that field testing potential DRTs under aerial application conditions is still highly cost prohibitive.
- Due to the varying environmental conditions over the duration of field tests of this type, the data gathered will likely produce highly variable results…possibly learning nothing.

CONCLUSIONS CONTINUED:

- Though not reported fully in this paper, wind tunnel testing in combination with a model such as AGDISP has more potential to generate useful data…at much less cost.
- What was learned is that more studies to learn about the influence of adjuvants in active tank mix solutions on droplet spectra during high speed aerial applications are needed.

ACKNOWLEDGEMENTS:

- The crew at the USDA ARS facility in College Station, TX
- USDA ARS for the available equipment
- The participating companies:
  - GarrCo
  - Precision Labs
  - Rosen's
  - Wilbur-Ellis
  - Winfield Solutions