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Enhancing Low Volume Fungicide Applications on Corn with Additives

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Abstract. *Aerial fungicide applications were made at a total volume of 18.9 L/Ha (2 GPA) to corn at tassel emergence. Seven to nine different adjuvant mixes were evaluated to examine their ability to enhance deposition in nine locations scattered over four states: Arkansas, Kansas, and Illinois. There were no statistically significant differences among yields in any of these locations.*

Kromecote® cards were placed at three different levels within the corn canopy during the application to evaluate deposition quantity. Cards were scanned using DropletScan™ to determine, VMD, Vd.1, Vd.9, and RS (Relative Span). Significant deposition differences were noted within test locations. Treatment effects were not consistent across all locations.

Keywords. Application technology, corn, image analysis, aerial, low volume, fungicide, adjuvant, Dropletscan

Introduction

Aircraft are an excellent tool to apply fungicides to crops in mature or semi-mature stages. This is especially true with corn. Many corn fungicide applications are timed at tasseling. Applications by ground equipment may be difficult at this growth stage. Timing is very critical. Aircraft are well suited to cover large acreages quickly without damaging the crop. Applying at low volumes, such as 18.7 L/ha (2 GPA), coverage and application uniformity are extremely important for efficacy.

The demand for energy has increased the number of acres of corn being grown. Many of these acres reach the treatment stage at about the same time. Application volumes have been reduced to increase application efficiency. Low volumes require that applicators understand and manage droplet spectrums closely. Droplet spectrums with a VMD of ~285µ with a Relative Span of 1 or less have been targeted for low volume fungicide applications.

Many of these applications may be made when ambient temperatures are 28ºC (82ºF) or higher. Evaporation is always a consideration with these temperatures.

Adjuvants have been utilized for years to increase coverage, efficacy, and application efficiency. There are a lot of questions among the application community on which adjuvant, or combination of adjuvants, will result in the most efficacious application.

Objectives

1. Evaluate aerial applications with multiple adjuvant combinations with Headline fungicide.
2. Compare droplet deposition based on adjuvant types in low volume aerial application.
3. Compare yields and disease control (if present) among the adjuvant treatments in corn when sprayed with low volume aerial applications of Headline.

Methodology

This study was initiated in four locations: Arkansas, Kansas, and two locations in Illinois (Western IL – Bushnell and Eastern IL - Kankakee). There were seven varieties at the Bushnell, IL location and each variety is treated as a separate location for this report analysis. There were a total of nine locations for yield comparisons and four locations for droplet analysis.

All applications were made at 18.9 L/ha (2 GPA). The application timing was at tassel emergence, ± 1 week. These were actual production fields with applications being done as swaths across the full length of the field. In the Bushnell field all applications were made across the rows encompassing all seven varieties for each treatment. For all locations a completely randomized design was utilized. Each treatment received 3 to 5 replications, Table 1. Kromecote® cards were placed in the center 10 rows of each treatment replication at 3 different plant heights: top corn leaf, ear leaf, and leaf 3 collars below ear leaf – with all being 12 inches from the main stalk. Yields were taken from the center rows of each treatment. No yield data was taken from the Kansas location, which was lost to flood by a high rainfall event shortly after the treatment date.

All of the aircraft utilized were configured as similar as possible to develop a droplet spectrum with a VMD of 285µ (microns). The USDA ARS aerial applicators spray nozzle models indicate all aircraft used in the study should all have been very close with the Kansas location being an exception – with a larger droplet spectrum - 364µ, Table 2.

All depositions were evaluated using the WRK DropletScan™ system. This technique uses a high resolution color scanner to digitize the images on the Kromecote® papers. The software then analyzes the images statistically to determine median size (VMD), amount at the 10 and 90% volume levels, and does a histogram for all the cards combined and for each individual card. An estimate of volume is determined for each card – based on the image sizes and the spread factor for water on this collection media.

Coverage is calculated for each card based on the number of scanned pixels that are darkened by the dye deposition. Garrco Vision Pink dye was mixed with each treatment at a dilution rate of 0.5%. The red pigment in this dye provides the positive contrast needed by the scanner to determine which pixels have deposition.

Weather data was collected during each application. Recorded variables included: RH, Temperature, Wind direction and speed, and Barometric pressure.

Treatments

Table 1. Treatment data.

Treatment #	Treatment[1]	Application Rate	Location[2]	Source
1	Check		All	
2-5, 7-10	Headline	6 ounces/acre	All	BASF
2	Crop Oil Concentrate (COC)	1 pint/acre	All	Agriliance
3	Non-ionic Surfactant (NIS)	0.25% v/v	All	Agriliance
4	Methylated Seed Oil (MSO) & NIS	4 ounces/acre	All	Helena
	Controlled Release Fertilizer (25-0-0 B)	1 gallon/acre	All	Helena
5	Non-ionic Surfactant (NIS)	0.25% v/v	All	Agriliance
	Interlock	2 ounces/acre	All	Agriliance
6	Quilt	14 ounces/acre	All	
	Non-ionic Surfactant (NIS)	0.25% v/v	All	Agriliance
7	MSO + Organosilicone Surfactant Blend	4 ounces/acre	All	Helena
	Controlled Release Fertilizer (25-0-0 B)	1 gallon/acre	All	Helena
8	High Surfactant Oil Concentrate	0.5 pint/acre	All	Agriliance
	Interlock	2 ounces/acre	All	Agriliance
9	Control	4 ounces	Arkansas	Garrco
	Crop Oil Concentrate (COC)	1 pint/acre	Arkansas	Agriliance
9	NIS + deposition aid	1% v/v	WS IL	Agriliance
10	NIS + deposition aid	1% v/v	WS IL	Agriliance

[1]All treatments were applied at 18.9 L/Ha (2 GPA) using tap water and Garrco Vision Pink dye at 0.5%.

[2] Locations include Arkansas, Kansas, Eastern IL, and Western IL.

Aircraft Setup Data

Table 2. Aircraft setup data

Location	Aircraft	Airspeed	Nozzle	Orifice	Deflection
Arkansas	Thrush S2R-T34 510	140	CP09	0.062	30
Kansas	AT 301	128	CP11	12	8
Western IL (Bushnell)	AT 502	145	CP03	0.078	30
Eastern IL (Kankakee)	Thrush S2R-660	132	ASC-A10	D-12 (0.187)	0

	Pressure	VMD	Span	# of nozzles	SW	app height
Arkansas	37	272	0.98	59	66	12
Kansas	27	364	1.08	36	65	12
Western IL (Bushnell)	35	232	1.21	40	70	12
Eastern IL (Kankakee)	25	277	0.84	9	75	10

	Company	Owner	Location	Pilot	Cooperator
Arkansas	Wil-Co	Barry Wilson	Dewitt, AR	Barry Wilson	Terry Whiting
Kansas	Warner Ag Air	Bill Warner	Independence, KS	Bill Warner	Dave McMillan
Western IL (Bushnell)	Lindell Aerial Ag	Garrett Lindell	Aledo, IL	Michael Miller	Ken & Dan Wolf
Eastern IL (Kankakee)	Benoit Aerial Spraying, Inc.	Steve Benoit	Kankakee, IL	David Kurtz	Bill Olthoff

Yield

Figure 1. Arkansas Yield data

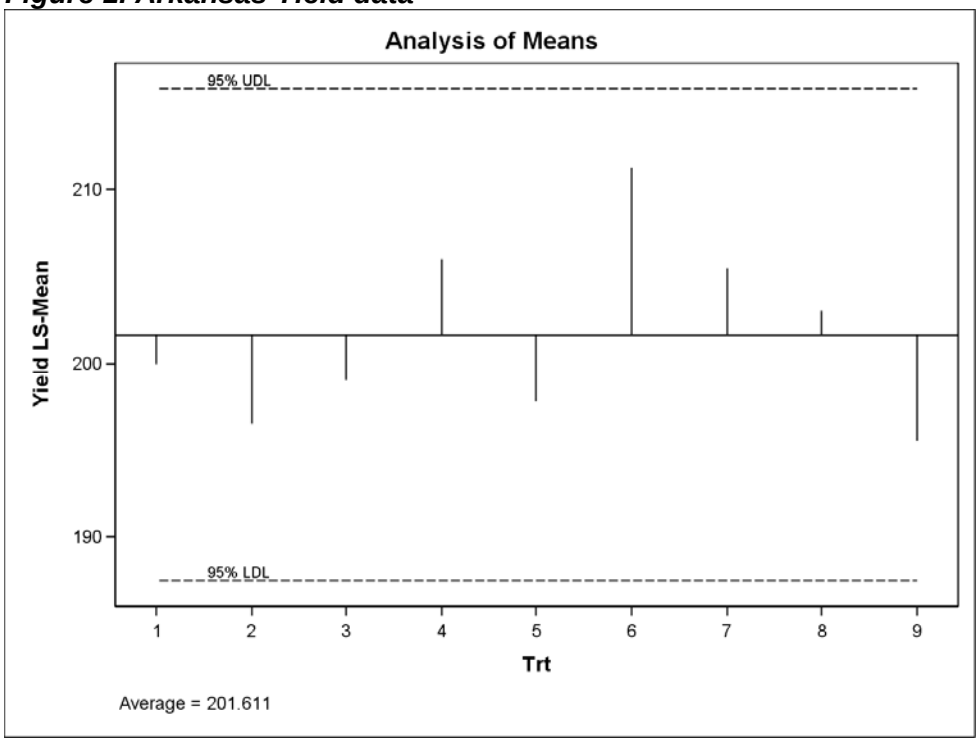


Figure 2. Kankakee, IL (Eastern IL) Yield data

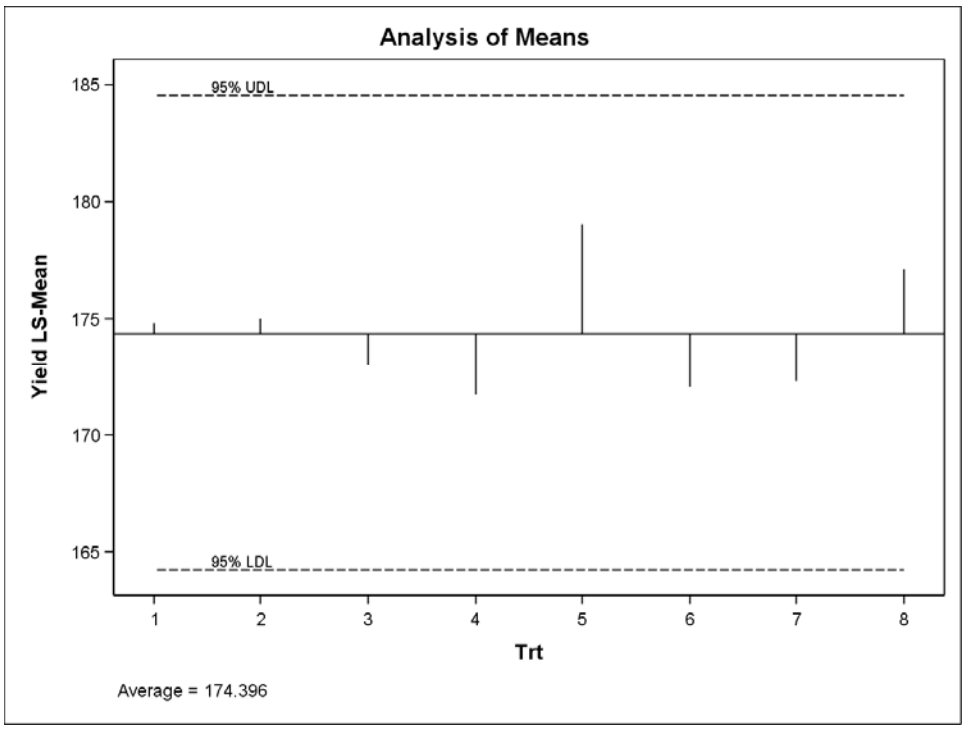
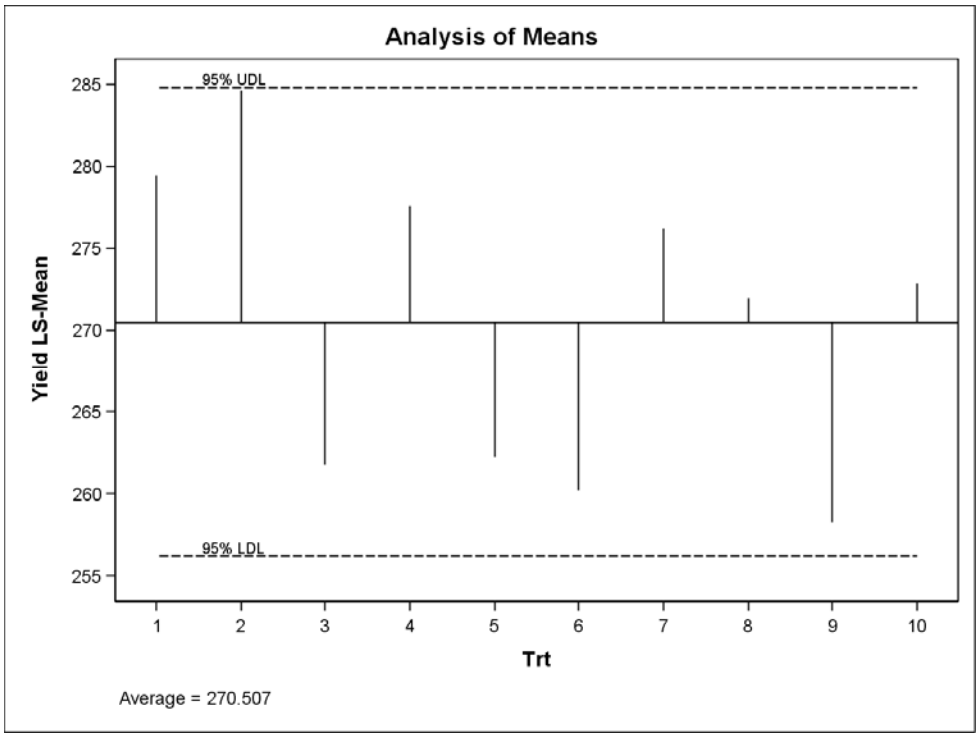


Figure 3. Bushnell, IL (Western IL) Yield data for droplet data plot (variety #3)



Figures 1 through 3 show the analysis of yield means for each treatment at each test location. For the Arkansas location, treatment number six had the highest measured yield. Treatment 5

had the highest yield at the Eastern IL location and treatment two had the highest yield in the Western IL tests. The yield data for Western IL represents yield data taken in the variety #3 plot where the droplet data was taken. Yields are represented by the vertical lines. Treatment one in each location was the check (no applications). The horizontal solid line in the center of the chart represents the average with the 95% upper and lower confidence limits indicated by the horizontal checked lines. Some treatments are higher or lower than average, but none of the mean yield plots cross these 95% lines, thus in all comparisons there are no treatments significantly different for yield.

Coverage Analyses

Figure 4. Arkansas Coverage

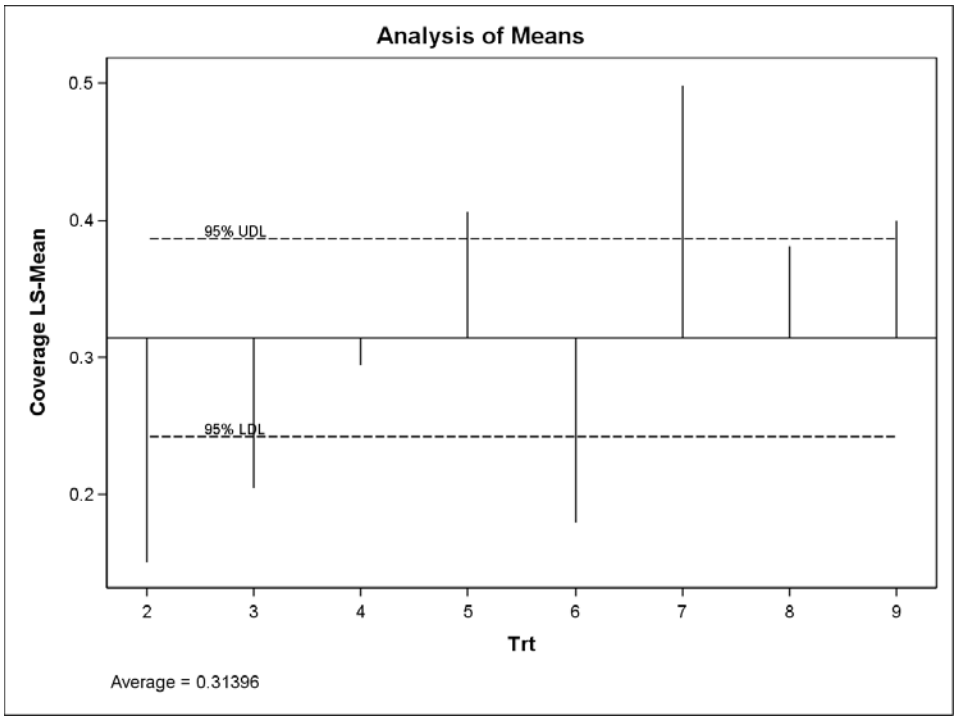


Figure 5.Kankakee, IL (Eastern IL) Coverage

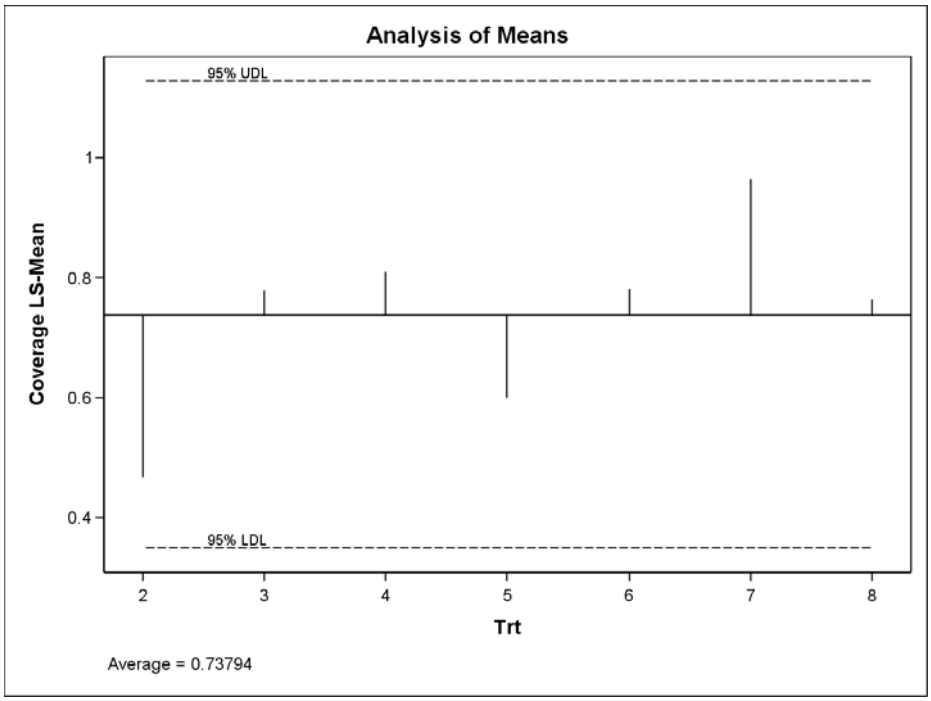


Figure 6. Bushnell, IL (Western IL) Coverage

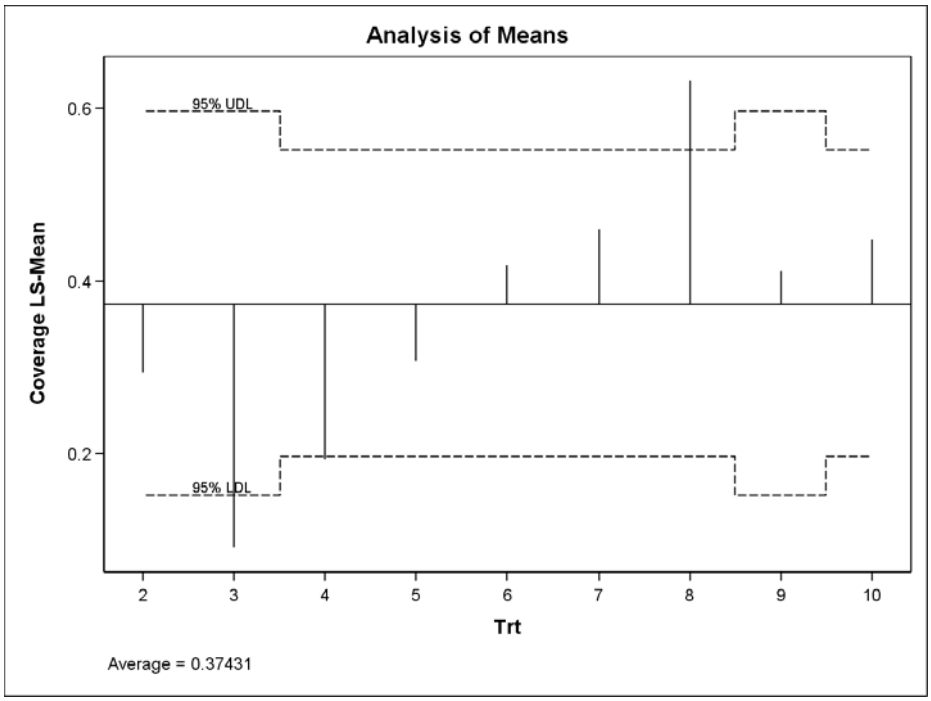
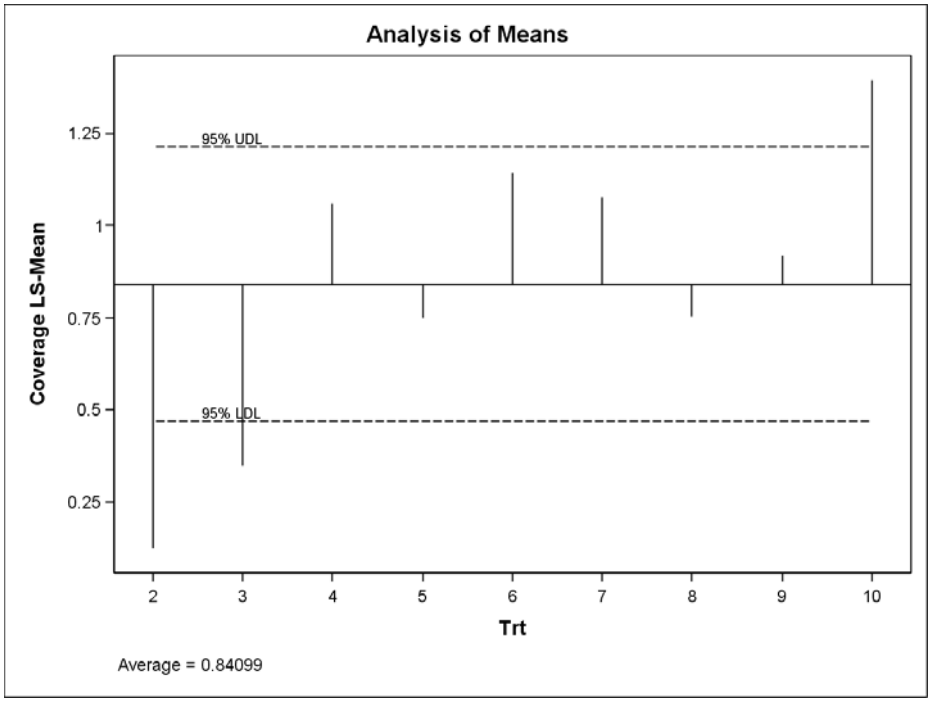


Figure 7. Kansas Coverage



Figures 4 through 7 show the analysis of means for coverage. There are significant differences between treatments at individual locations. The treatments that are either below or above the average for each location are not consistent across the state locations.

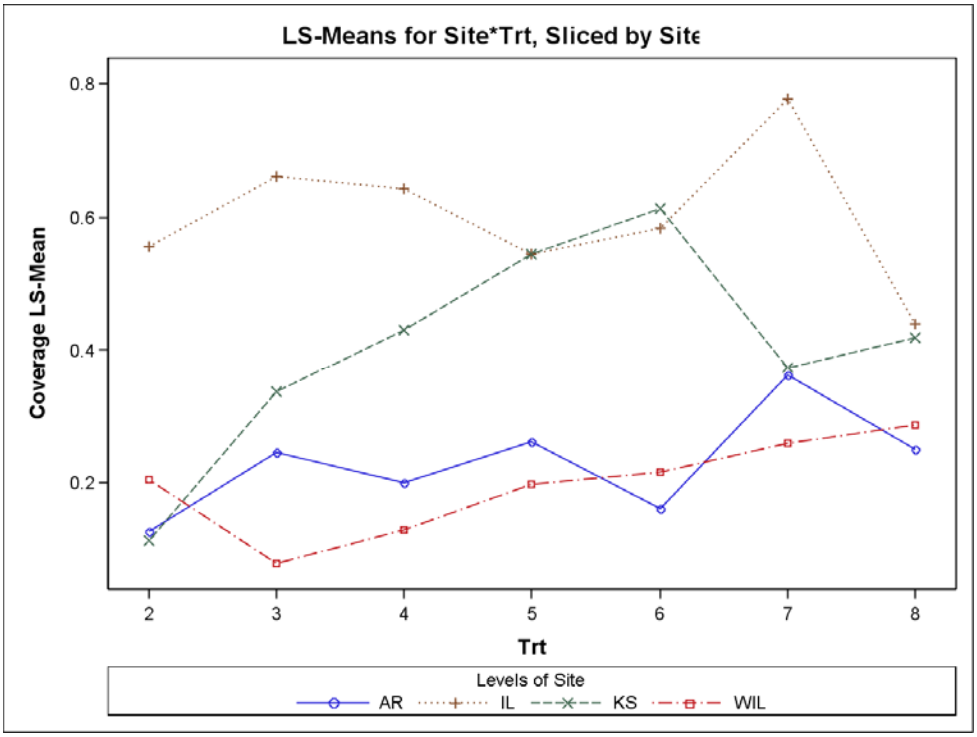
Figure 8. VMD comparisons for each location

Arkansas				**Kansas**			
T Grouping for Treatment Least Squares Means				T Grouping for Treatment Least Squares Means			
LS-means with the same letter are not significantly different.				LS-means with the same letter are not significantly different.			
Treatment code	VMD			Treatment code	VMD		
9	320.04		A	3	324.66		A
			A				A
6	270.01	B	A	5	318.72	B	A
		B				B	A
3	243.58	B	C	8	310.19	B	A
		B	C			B	A
7	241.73	B	C	6	309.18	B	A
		B	C			B	A
4	234.11	B	C	7	307.53	B	A
		B	C			B	A
5	233.79	B	C	4	301.02	B	A
			C			B	A
8	216.53		C	9	297.02	B	A
			C			B	A
2	210.16		C	10	290.52	B	A
						B	
				2	284.59	B	
Eastern Illinois				**Western Illinois**			
3	240.87	A		3	293.18		A
		A					A
6	239.78	A		5	282.96		A
		A					A
7	231.7	A		6	274.93		A
		A					A
5	228.61	A		9	273.81		A
		A					A
4	218.21	A		10	268.8		A
		A					A
8	217.4	A		7	263.49		A
		A					A
2	211.77	A		4	262.08		A
							A
				2	258.6		A
							A
				8	252.29		A

The droplet spectrum VMD values varied some but were only significant in the Kansas and Arkansas locations. Figure 8 has the actual values. There are treatments that were either on the high end or low end of the droplet spectrum in all locations. As an example treatment 3 was near the top at each location and treatment 2 was consistently near the smallest.

The average deposition for the different locations varied dramatically. This is affected by many factors including: temperature, relative humidity, wind speed and direction relative to the crop row, differences in plant structure among varieties, and droplet spectrum. Treatments 2 through 8 were the same at every location. All locations are shown together for coverage analysis in Figure 9. It is easy to see differences within location, but the trends for a particular treatment are harder to discern.

Figure 9. Coverage – All locations by treatment



Conclusions

1. There were no significant yield differences among these treatments. This effect could be due to low disease pressure.
2. There are significant differences in deposition between the treatments. Some of the treatments did not follow the same trend in every location.
3. There were significant differences in the aircraft setups: flat fans, rotary atomizers, and CP09 – resulting in some significant differences in droplet spectrums.
4. The highest deposition values in the lower canopy were at the Kansas location – which had the largest droplet spectrum.
5. There were some differences noted in canopy structure that are hard to address. Some varieties are more upright with open canopies.

Acknowledgements

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