Optimizing Fungicide Droplet Size for Improved Management of White Mold in Soybeans

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Results from a 4-year research project conducted in Carrington and Oakes indicate that fungicide droplet size is a critical determinant of fungicide performance for the management of white mold in soybeans and that the optimal droplet size is dependent on canopy characteristics.

In research conducted with TeeJet extended-range (XR) flat-fan nozzles (Spraying Systems Company, Glendale Heights, IL), nozzles emitting fine to medium droplets optimized fungicide performance against white mold when the soybean canopy was open and nozzles emitting coarse droplets optimized fungicide performance against white mold when the soybean canopy was at or near closure. When the soybean canopy averaged less than 80% closure at fungicide application, nozzles emitting fine to medium droplets optimized white mold management (Figure 1). When the soybean averaged 80-89% closure when fungicides were applied, nozzles emitting medium droplets optimized white mold management (Figure 2). When the soybean canopy averaged 92 to 100% closure when fungicides were applied, nozzles emitting coarse droplets optimized white mold management (Figures 3 and 4).

Parallel research was also conducted with Wilger Combo-Jet flat-fan nozzles (Wilger Corp.; Lexington, TN). As this report went to press, yield data from the 2020 studies conducted with Wilger nozzles were still being assessed and data were still being analyzed. Preliminary results with Wilger nozzles from the 2019 season suggest that a similar relationship between optimal droplet size and canopy closure exists, except that the droplet spectrum may differ with Wilger nozzles. In 2019, very coarse droplets optimized fungicide performance with Wilger nozzles when the soybean canopy was at or near closure.

Testing was conducted with a tractor-mounted sprayer equipped with a pulse-width modulation system (Capstan AG; Topeka, KS). A single application of the fungicide Endura (5.5 or 8.0 oz/ac) was made at the R2 growth stage. Spray volume was 15 gal/ac, and pulse width was modified to maintain a constant driving speed and constant spray volume across nozzles differing in output. Driving speed and the nozzles and application pressures utilized to achieve the target droplet size spectrum differed across studies (Table 1).

Table 1. Driving speed, fungicide application rate, nozzles, and application pressures utilized in the studies evaluating the impact of fungicide droplet size on management of white mold in soybeans.

	2017 Carrington	2018 Carrington and Oakes	2019 Carrington and Oakes	2020 Carrington	2020 Oakes
			Fungicide applied:		
	Endura at 5.5 oz/ac	Endura at 5.5 oz/ac	Endura at 5.5 oz/ac	Endura at 8.0 oz/ac	Endura at 5.5 oz/ac
			Driving speed:		
	4.0 mph	6.7 mph	8.9 mph	10.5 mph	6.0 mph
	Nozzles and application pressures utilized to achieve the target droplet size spectrum				
Fine droplets	XR8004, 60 psi	XR8003, 50 psi	XR11004, 50 psi	XR11005, 60 psi	XR11004, 60 psi
Medium-fine	XR8004, 40 psi	XR8004, 40 psi	XR11005, 40 psi	XR11006, 50 psi	XR11005, 40 psi
Medium droplets	XR8006, 60 psi	XR8006, 40 psi	XR11006, 35 psi	XR11006, 35 psi	XR11006, 35 psi
Medium-coarse	not tested	XR8008, 35 psi	XR11008, 40 psi	XR11008, 40 psi	XR11008, 40 psi
Coarse droplets	XR8010, 40 psi	XR8010, 30 psi	XR11010, 30 psi	XR11010, 30 psi	XR11010, 30 psi

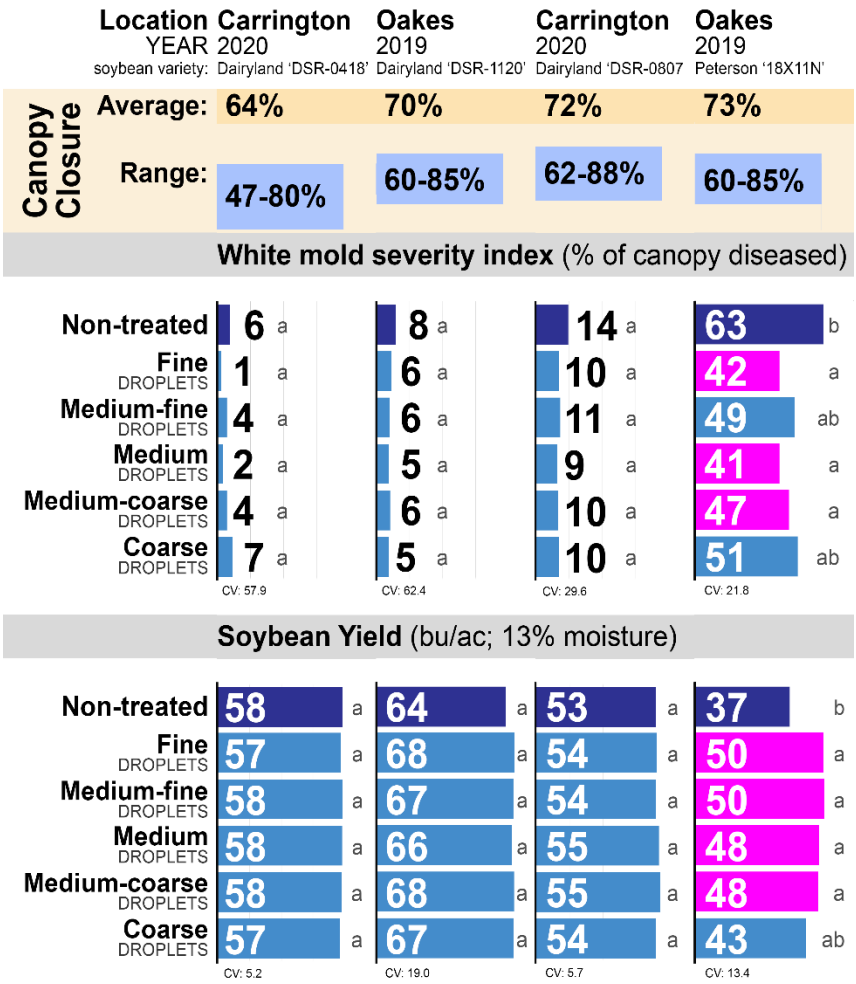

Figure 1: When the soybean canopy closure averaged less than 75% at fungicide application at the R2 growth stage, fine to medium-fine droplets optimized fungicide performance in the only study in which statistical separation of treatments was observed. Within-column means followed by different letters are significantly different ($P < 0.05$).

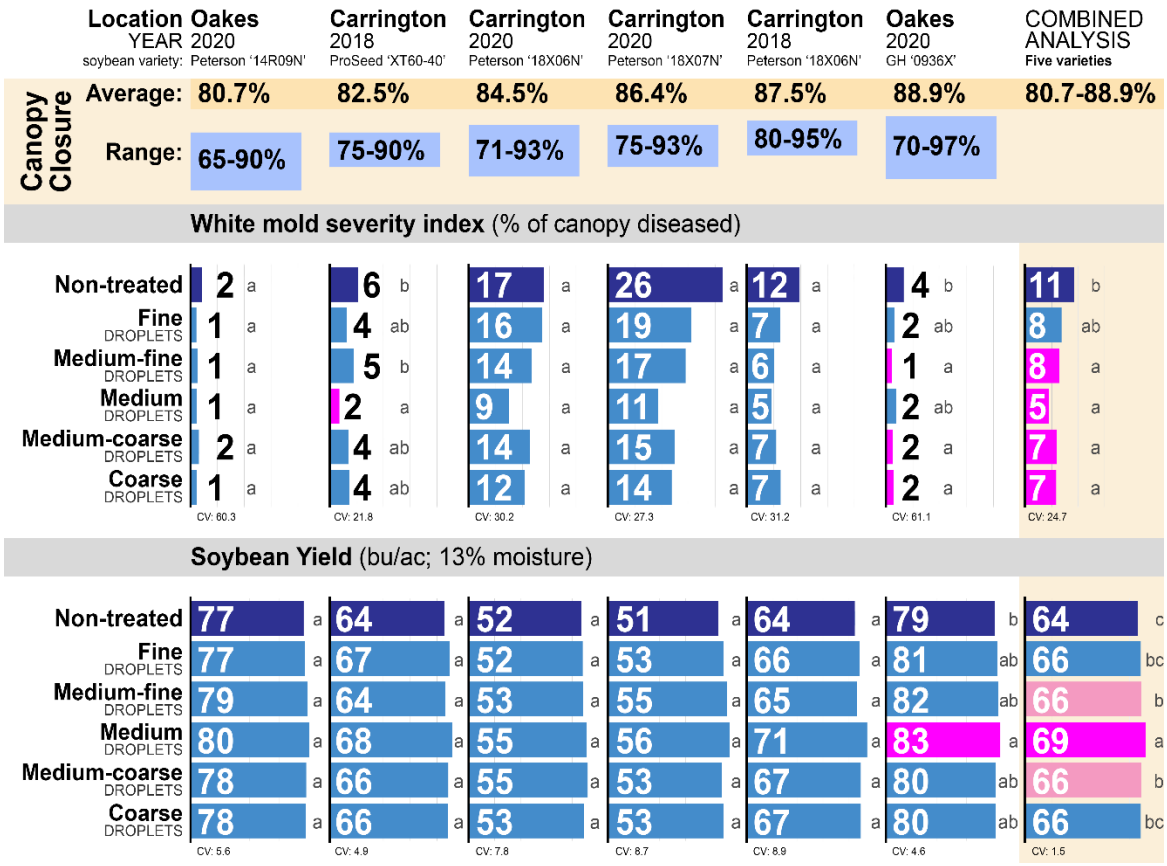

Figure 2: When the soybean canopy closure averaged 80-89% at fungicide application at the R2 growth stage, medium droplets optimized fungicide performance against white mold in soybeans. Within-column means followed by different letters are significantly different ($P < 0.05$).

Making applications with the tractor-mounted sprayer to the droplet size studies in Carrington in 2019. Flags mark the start and end of the treatment plots. To prevent edge effects, alleys were not cut between plots until harvest.

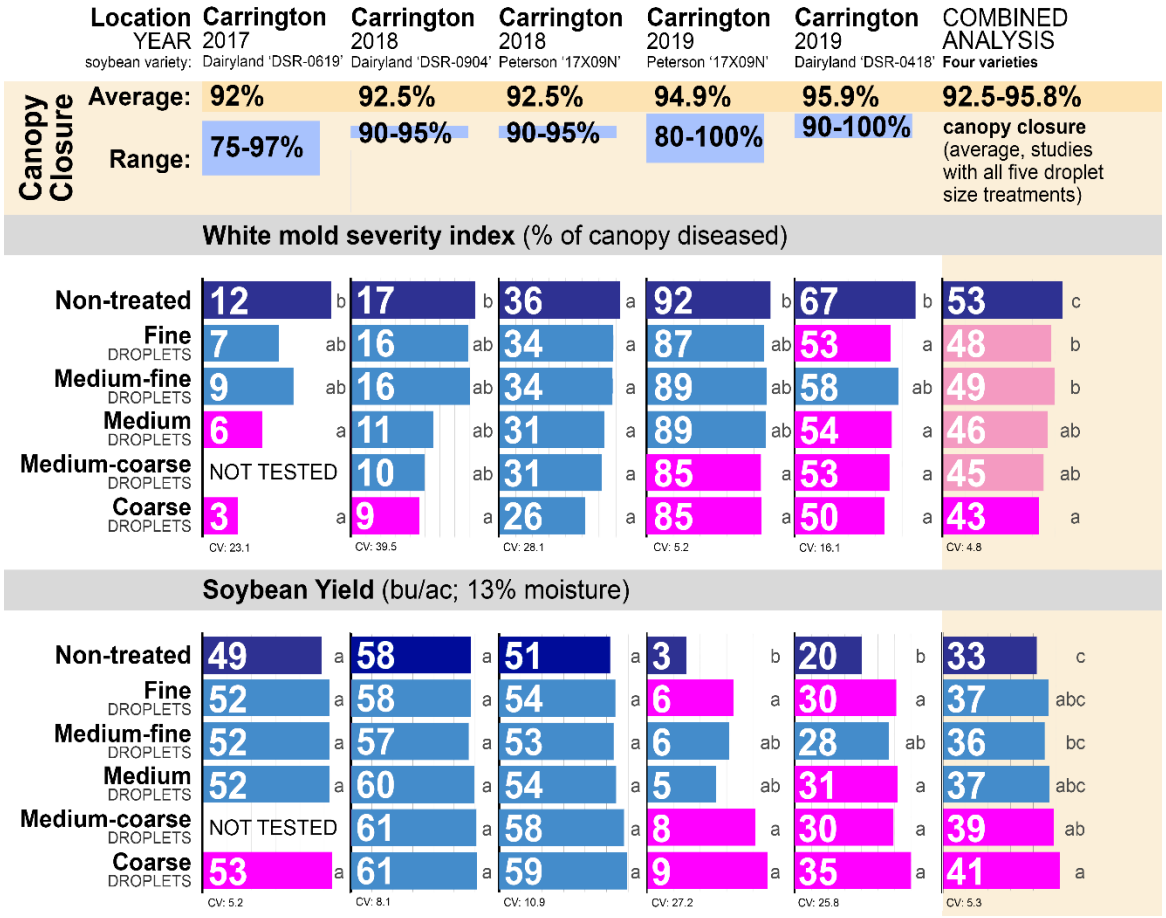

Figure 3: When the soybean canopy closure averaged 92-96% at fungicide application at the R2 growth stage, coarse droplets optimized fungicide performance against white mold in soybeans. Within-column means followed by different letters are significantly different ($P < 0.05$).

To ensure a constant spray volume of precisely 15 gal/ac across droplet size treatments, sprayer output was measured, and pulse width was manually calibrated immediately before fungicides were applied.

	Location	Oakes	Carrington	Carrington	Carrington	Carrington	COMBINED ANALYSIS
	YEAR	2018	2019	2019	2019	2019	
	soybean variety:	Pioneer 'P11A95X'	Peterson '14R09N'	Peterson '18X07N'	Dairyland 'DSR-0807'	Peterson '18X06N'	**Five varieties**
Canopy Closure	**Average:**	**98.5%**	**98.7%**	**98.9%**	**99.6%**	**99.6%**	**98.5-99.6%**
	Range:	**97-100%**	**98-100%**	**97-100%**	**98-100%**	**99-100%**	**canopy closure** (average)

White mold severity index (% of canopy diseased)

	Oakes	Carrington 2019	Carrington 2019	Carrington 2019	Carrington 2019	COMBINED ANALYSIS
Non-treated	39 b	84 b	79 b	73 b	72 b	69 c
Fine DROPLETS	32 ab	75 a	68 a	63 ab	61 a	60 ab
Medium-fine DROPLETS	28 ab	81 ab	72 ab	68 ab	65 ab	63 b
Medium DROPLETS	30 ab	79 ab	72 ab	67 ab	63 a	62 b
Medium-coarse DROPLETS	29 ab	77 ab	73 ab	60 a	60 a	60 ab
Coarse DROPLETS	25 a	74 a	66 a	61 a	58 a	57 a
	CV: 21.6	CV: 8.8	CV: 10.0	CV: 13.5	CV: 12.2	CV: 3.2

Soybean Yield (bu/ac; 13% moisture)

	Oakes	Carrington 2019	Carrington 2019	Carrington 2019	Carrington 2019	COMBINED ANALYSIS
Non-treated	53 b	9 b	14 b	18 b	15 b	22 c
Fine DROPLETS	59 ab	17 a	20 ab	27 ab	23 a	29 b
Medium-fine DROPLETS	63 ab	13 ab	18 ab	24 ab	20 ab	27 b
Medium DROPLETS	62 ab	15 a	19 ab	25 ab	20 a	28 b
Medium-coarse DROPLETS	61 ab	15 a	18 ab	27 a	24 a	29 b
Coarse DROPLETS	66 a	18 a	22 a	30 a	24 a	32 a
	CV: 10.5	CV: 16.02	CV: 28.8	CV: 29.3	CV: 25.1	CV: 5.0

Figure 4: When the soybean canopy closure averaged 98-100% at fungicide application at the R2 growth stage, coarse droplets optimized fungicide performance against white mold in soybeans. Within-column means followed by different letters are significantly different ($P < 0.05$).

Soybean *Sclerotinia* infection.

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