Mid-year report:

Optimizing fungicide application methods for management of Sclerotinia in soybeans

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Objectives of the research:

1. Quantify the impact of fungicide spray droplet size on white mold control across multiple soybean varieties differing in canopy characteristics.
2. Quantify the consistency of the response to fungicide spray droplet size across two nozzle manufacturers (TeeJet and Wilger).
3. Quantify the return to applying fungicides through drop nozzles (versus boom-mounted nozzles) across multiple fungicides commonly used for white mold.

Completed work:

Planting was conducted May 12-18: Studies evaluating the impact of fungicide droplet size were planted May 11 (TeeJet and Wilger nozzle studies, Oakes), May 15 (TeeJet nozzle study, Carrington), and May 18 (Wilger nozzle study, Carrington), and the study evaluating the impact of fungicide application method and application frequency on the comparative efficacy of fungicides was planted May 15. Testing was conducted on four soybean varieties in Carrington and two varieties in Oakes; row spacing was 21 inches, and seeding rate was 165,000 pure live seeds/ac. Treatment plots consisted of three rows, 20 feet (Carrington droplet size studies), 25 feet (Oakes droplet size studies) or 30 feet long (Carrington fungicide application methods study) at seeding.

Fungicides were applied in the droplet size studies at the early to full R2 growth stage (75 to 100% of plants at R2) on July 7 (TeeJet and Wilger nozzles, Oakes), July 10 (TeeJet nozzles, Carrington), and July 14 (Wilger nozzles, Carrington). In the application methods study, fungicides were applied with boom-mounted nozzles on July 8 when 59% of plants were at the R2 growth stage and canopy closure averaged 81% and July 21 at the late R2/early R3 growth stage when canopy closure averaged 91%. On July 8, applications were made with XR11006 flat-fan nozzles at 35 psi (medium droplets); on July 21, applications were made with XR11010 flat-fan nozzles at 30 psi (coarse droplets). Applications with drop nozzles were made on July 12 when 88% of plants were at the R2 growth stage and canopy closure averaged 82% and on July 22 at the late R2/early R3 growth stage when canopy closure averaged 91%. Applications were made with 360 Undercover drop nozzles (360 Yield Center; Morton, IL) equipped with TJ60-11002 nozzles on the side ports and operated at 40 psi (very fine droplets). All applications across all studies were made with a 15 gal/ac spray volume.

Studies were harvested October 8 (TeeJet droplet size, Oakes), October 9 (Wilger droplet size), October 19 (TeeJet droplet size, Carrington), November 2 (Wilger droplet size, Carrington), and November 2-3 (application methods).

Preliminary results:

Results from the studies conducted with TeeJet nozzles were consistent with research conducted in previous years. When soybean canopy closure averaged 80-89% at the R2 growth stage when fungicides were applied, medium droplets optimized fungicide performance (**Figure 2**). Statistical separation was achieved in only one of four varieties, but results were parallel across all studies, with yields optimized when fungicides were applied with medium droplets. In

the two soybean varieties for which canopy closure averaged less than 75% at the R2 growth stage when fungicides were applied, results were inconclusive due to poor treatment separation (**Figure 1**). The findings from 2020 are consistent with results from field trials conducted in 2017, 2018 and 2019, in which fine to medium droplets optimized fungicide performance against white mold when the soybean canopy was open, and coarse droplets optimized fungicide performance against white mold 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). Spray volume was 15 gal/ac, and pulse width was modified to maintain a constant driving seed and constant spray volume across nozzles differing in output. Fungicide application rate, application 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 & Oakes**	**2019 Carrington & 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

Work to be completed:

Grain still needs to be cleaned, and yield data still need to be collected from the droplet size study conducted with Wilger nozzles in Oakes and the fungicide application methods study conducted in Carrington. Data still needs to be analyzed for droplet size studies conducted with Wilger nozzles and the fungicide application methods study. Anticipated completion: December 2020.

Results need to be placed into a user-friendly format and disseminated to growers. Anticipated completion: December 2020.

The droplet size spectrum produced by the various nozzles and pressures utilized across the study years needs to be quantified. Anticipated completion: May 2021.

This was the final year of our multi-year research effort optimizing fungicide application methods for improved management of white mold in soybeans, and results need to be summarized and published in peer-reviewed scientific journals. Two academic papers will be prepared, one on the use of drop nozzles to deliver fungicides targeting white mold in soybeans (anticipated completion, March 2021) and one on the impact of fungicide droplet size on white mold management in soybeans (anticipated completion, June 2021).

Figures 1 and 2:
Impact of fungicide droplet size on white mold management in soybeans when the soybean canopy closure averaged less than 75% (**figure 1, right**) and when soybean canopy closure averaged 80-89% (**figure 2, below**) when fungicides were applied at the R2 growth stage. Within-column means followed by different letters are significantly different ($P < 0.05$).