Project Title:

Optimizing fungicide application methods for management of Sclerotinia in soybeans

Executive Report:

Sclerotinia stem rot (white mold) caused by the fungal pathogen *Sclerotinia sclerotiorum* is an important disease of soybeans when cool, wet weather occurs during bloom. The disease is difficult to manage with crop rotation or variety selection; the causal pathogen persists in soils and has a broad host range, and, while varieties differ in susceptibility, none are resistant. Fungicides are an important tool for white mold management, but their use has been constrained by inconsistent disease control. This project seeks to improve the strength and consistency of white mold control conferred by fungicides by optimizing the deployment of fungicides.

Combined analysis of multi-year, multi-location research funded by the North Dakota Soybean Council demonstrates that the disease control and yield gain conferred by fungicides can be sharply improved by optimizing fungicide application timing relative to growth stage and canopy closure. When conditions favor white mold as soybeans enter bloom, applying fungicides at the R1 or early R2 growth stage is optimal only if the canopy is at or near closure (Figures 1 and 2). If canopy closure is less than 95% at R1 or early R2, fungicide performance is optimized by delaying applications until 100% of plants have reached the R2 growth stage (Figures 3 and 4).

Preliminary results from an ongoing project indicate that additional sharp improvements in white mold management can be achieved by optimizing fungicide spray droplet size relative to canopy characteristics. Testing is being conducted in Carrington and Oakes, ND with a tractor-mounted R&D sprayer equipped with a pulse-width modulation system. In assessments conducted with TeeJet nozzles, optimizing droplet size relative to canopy closure increased the yield gain conferred by a single application of the fungicide Endura (5.5 oz/ac) by an average of 3.5 bu/ac. Fine droplets optimized fungicide performance when average canopy closure was less than 80%; medium droplets optimized fungicide performance when average canopy closure was 80 to 90%; and coarse droplets optimized fungicide performance when average canopy closure was 90 to 100% (Figures 5 and 6). With Wilger nozzles, coarse droplets optimized fungicide performance when the canopy was open; very coarse droplets were optimal when the canopy was near closure.

The results indicate that the yield gain conferred by a single fungicide application targeting white mold can be doubled or tripled by optimizing fungicide application timing and droplet size relative to growth stage and canopy closure. Final recommendations will be developed after the 2020 growing season.

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**Figure 1**. Impact of delaying fungicide applications from the R1 to early R2 growth stage relative to soybean canopy closure at R1. Shown is the combined analysis of 21 field trials conducted across multiple years and multiple locations in North Dakota. *Within-column means followed by different letters are significantly different (P < 0.05).*

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**Figure 2**. Impact of delaying fungicide applications from the R1 to full R2 growth stage relative to soybean canopy closure at R1. Shown is the combined analysis of 15 field trials conducted across multiple years and multiple locations in North Dakota. *Within-column means followed by different letters are significantly different (P < 0.05).*



**Figure 3**. Impact of delaying fungicide applications from the early R2 to full R2 growth stage relative to soybean canopy closure at early R2. Shown is the combined analysis of 14 field trials conducted across multiple years and multiple locations in North Dakota. *Within-column means followed by different letters are significantly different (P < 0.05).*

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**Figure 4**. Impact of delaying fungicide applications from the full R2 to early R3 growth stage relative to soybean canopy closure at full R2. Shown is the combined analysis of eight field trials conducted across multiple years and multiple locations in North Dakota. *Within-column means followed by different letters are significantly different (P < 0.05).*

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**Figure 5.** Impact of spray droplet size and soybean canopy closure on efficacy of the fungicide Endura (5.5 oz/ac) applied once at the R2 growth stage. Applications were made with TeeJet extended-range flat-fan nozzles, with pulse width modified as needed to maintain a 15 gal/ac spray volume and 8.9 mph (8 studies) or 6.7 mph (5 studies) driving speed. *Within-column means followed by different letters are significantly different (P < 0.05).*

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**Figure 6.** Impact of spray droplet size and soybean canopy closure on efficacy of the fungicide Endura (5.5 oz/ac) applied once at the R2 growth stage. Applications were made with TeeJet extended-range flat-fan nozzles, with pulse width modified as needed to maintain a 15 gal/ac spray volume and 8.9 mph (8 studies), 6.7 mph (5 studies) or 4.0 mph (1 study) driving speed.