

Multi-Pronged Strategies to Provide Efficient Sustainable and Durable Control to Sclerotinia Stem Rot – End of Project Final Reports

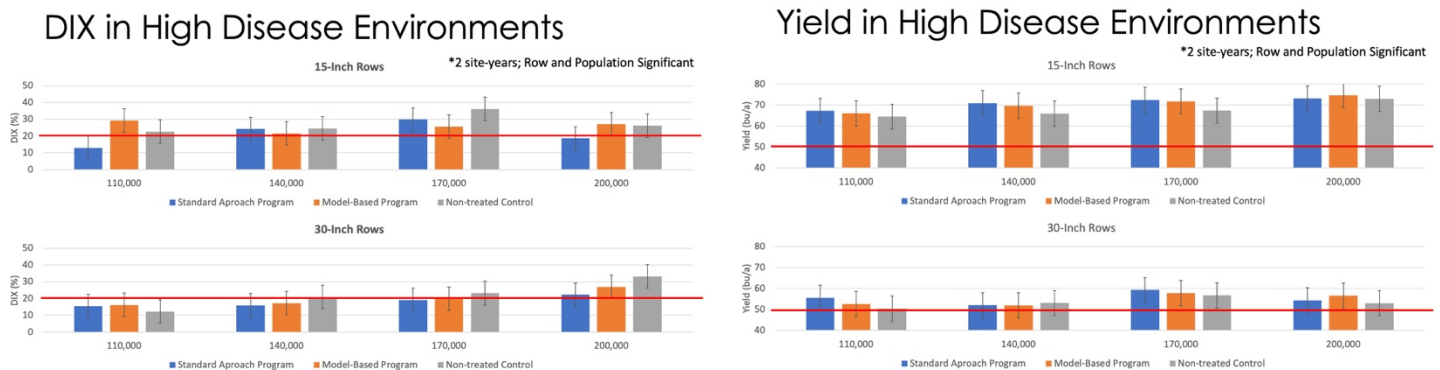
PI: Damon Smith – UW-Madison; CoPIs: Mehdi Kabbage – UW-Madison; Daren Mueller – Iowa State University; Martin Chilvers – Michigan State University

Objective 1) To evaluate current, standard soybean management practices, including irrigation, row spacing, population density, and fungicide treatment applied using an advisory tool, for use in integrated Sclerotinia stem rot management.

Goal: To develop modern, integrated management recommendations for white mold that have been vetted across multiple sites and years. Recommendations should include row spacing, population density, and fungicide treatment in the approach.

Planting at 140,000 seeds per acre, balances seeding rate and yield potential in both 15 and 30" row spacing. Yield is typically high in 15" row-spacing, however, white mold can be as much as 50% greater in a 15" row spacing compared to 30" row spacing (See Figure 1).

Figure 1. Disease index (DIX) and yield in integrated management trials for two site-years where white mold index was high enough to limit yield (WI, 2017 and MI, 2018).



In an effort to collect more data, multiple sites were added for testing in Wisconsin, Michigan, and Iowa in 2019. Currently, disease data are being collected at these sites with yield data to be collected in the coming month. All data will be analyzed over the winter of 2020. A research publication will be developed. Upon acceptance of this publication, an outreach CPN publication will be developed.

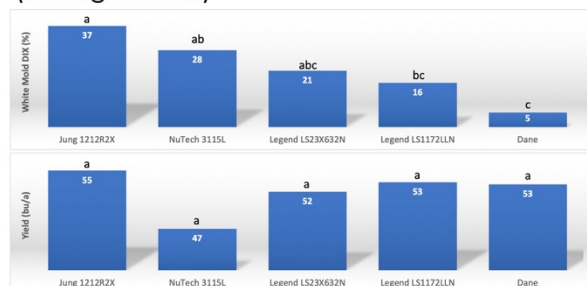
Objective 2.a) To identify new germplasm lines resistant to *Sclerotinia sclerotiorum* that can be incorporated into integrated management programs or into soybean breeding programs.

Goal: To identify soybean varieties with a high level of resistance to white mold, which are stable across locations in the North Central region.

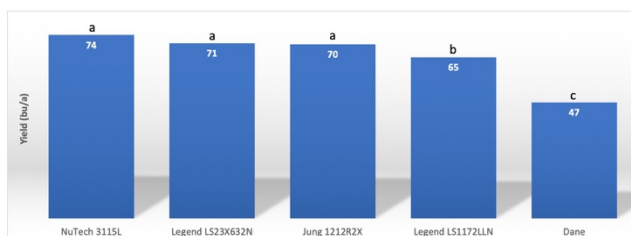
Figure 2 illustrates results of field screening of resistant lines compared to a susceptible check (Jung 1212R2X). Several commercial varieties have been identified that appear to have good physiological resistance in the greenhouse and acceptable field resistance in multiple environments.

Figure 2. Field performance of 5 soybean lines tested in: A. a high disease environment (Michigan, 2018) and B. in 6 low disease environments across the North central region.

A Field Performance – High Disease Environment (Michigan 2018)



B Field Performance – Low Disease Environments (Six Locations In Iowa, Minnesota, and Wisconsin, 2018)



These varieties were again tested in Wisconsin, Michigan, and Iowa in the 2019 field season. Disease data are currently being collected at these multiple sites, with yield data to follow in a few weeks. All data will be analyzed over the winter and plans to test other varieties with resistance will be made over the winter months.

Objective 2.b) To refine the existing soybean SSR advisory tool to incorporate model output for different forms of resistance.

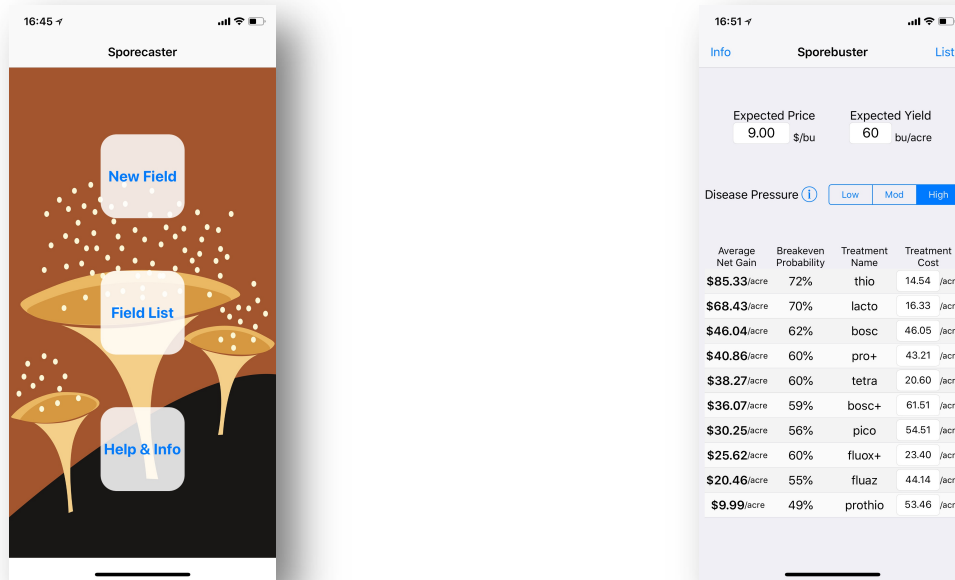
Goal: To improve the accuracy of a fungicide application decision tool for controlling white mold, by accounting for varietal resistance in soybean.

In 2018 we developed two (2) smartphone applications. Sporecaster was made available to the public as a free download on the Google Play Store and iPhone app store in May of 2018. As of this report, Sporecaster was downloaded over 1,600 times from the Apple and Android stores. Daily use rates during the major “white mold season” (July and August) averaged 250 users per day. Sporebuster has been available for just two months (since October 2018). This application has been downloaded approximately 70 times. Sporecaster is used to determine if a crop is at risk for white mold and advises if a fungicide application should be made. This app is meant to be run in-season and uses site-specific weather information to provide the risk prediction. Sporebuster is meant to complement Sporecaster. Sporebuster is a return on investment application that uses research-based economic models to determine if a particular fungicide program for white mold control, will result in a high probability of success on a case-by-case basis. Users can input their costs for programs and uses their own yield and soybean pricing scenarios to get tailored recommendations.

Sporecaster was previously validated (2016 and 2017) in commercial fields and research trials. In those validations, Sporecaster was over 80% accurate in predicting yield-limiting epidemics of white mold. Additional field validations were performed in 2018. While white mold severity was much less compared to 2016 and 2017, epidemics were present in some fields. In the 2018 validations of 16 commercial fields, Sporecaster was accurate ~80% of the time in predicting yield-limiting epidemics. This level of accuracy is good, however, we believe that incorporating varying levels of resistance into the model, such as illustrated in objective 2a, could further improve the accuracy. This could be done by modifying the action thresholds based on resistance type. A trial was implemented during the 2019 field season in Wisconsin

to test these new thresholds. Currently, disease data are being collected, with yield data to follow in a month or so. Once data are analyzed, additional adjustments to the thresholds will be made. These will then be tested in multiple locations in 2020.

Figure 3. Screenshots of the Sporecaster and Sporebuster Smartphone Applications



Objective 3) Exploitation of transgenic soybean silenced in NADPH oxidases to achieve abiotic and biotic stress tolerance.

We have successfully generated 75 transgenic events targeting 4 soybean NADPH oxidases, seed was collected from individual plants. A second round of seed increases is necessary before proceeding with the evaluation of the transgenic plants. We are currently performing this second seed increase.

Accomplishments:

- Construction of efficient silencing constructs targeting soybean NADPH oxidases.
- Successfully transformed soybean using agrobacterium mediated transformation
- Successful generation of plant and seed from transgenic events.

Objective 4.a) Develop outreach publications and tools based on results generated here and disseminate through the national Crop Protection Network (CPN) portal.

Objective 4.b) Develop an electronic book compiling information about Sclerotinia stem rot and management of the disease for a diverse audience.

A draft fact sheet pertaining to fungicide efficacy and application timing for white mold control has been developed. That publication is currently in review and expected to be posted during the Fall of 2019 on the CPN portal. Updates to the existing CPN publication on White mold are also underway and updates will be applied during spring of 2020. Finally, outlines are being developed in Fall of 2019 for the electronic book. Video clips, footage, and images were collected for this project during the 2019 field season.