North Central Soybean Research Program

Improving our understanding of stem canker and how to manage it in soybean across the Midwest

Damon Smith (Project Leader, University of Wisconsin), Daren Mueller (Iowa State University), Kiersten Wise (University of Kentucky), Febina Mathew (South Dakota State University)

Progress report April 2018

The overall goal of this research is to unravel the fungal species complex that cause stem canker and related diseases and identify soybean stressors that can influence stem canker in order to develop more effective and economical management strategies.

Project Objectives

1. Increase understanding and importance of diseases caused by *Diaporthe* species.

2. Determine the prevalence of *Diaporthe* species causing stem canker among the soybean producing states.

3. Determine which *Diaporthe* species cause the most damage on soybean.

4. Comparison of inoculation methods to study the aggressiveness of *Diaporthe* isolates by species.

5. Soybean seed treatments and in-furrow treatments for control of *Diaporthe* spp

6. Communicate research results with farmers, agribusinesses and other soybean stakeholders.

Research Accomplishments

In 2018 we will continue to identify species of *Diaporthe* that cause disease on soybean in the upper Midwest. Analysis of samples collected in previous years has been completed. Other *Diaporthe* samples from around the country were obtained from colleagues and added to this dataset.

Between 2014 and 2017, 219 soybean plants exhibiting symptoms such as reddish-brown discoloration on the stem, leaf petioles or pods and shriveled seeds were sent to the Oilseeds Pathology Lab at South Dakota State University by plant pathologists across 11 soybean producing U.S. states (DE, IL, IN, IA, KY, LA, MI, MS, ND, SD, and TN).

In addition to whole soybean plant samples, 66 Diaporthe cultures recovered from soybean plants exhibiting Diaporthe-associated disease symptoms were sent by plant pathologists from nine soybean producing U.S. states (AR, GA, FL, OH, MN, MO, NE, NY, and WI).

In total, 256 Diaporthe isolates were characterized using morphological features on potato dextrose agar (e.g., color and colony appearance, size and shape of stromata, arrangement of pycnidia and perithecia, and conidia size), using the latest species concepts for this genus. The identity of the Diaporthe isolates was confirmed to species level by phylogenetic analyses of the internal transcribed spacer (ITS) gene.

From the 256 isolates, seven species of Diaporthe were detected, which included D. caulivora, D. longicolla, D. aspalathi, D. eres, D. kongii, D. ueckerae and an unidentified Diaporthe sp.

Of the seven species of Diaporthe, D. caulivora and D. longicolla were isolated from stem, petioles, pods and seed of symptomatic plants frequently. Diaporthe caulivora accounted for 16% of the isolates identified, while D. longicolla was the most frequently occurring species accounting for 53% of the total isolates.

Diaporthe aspalathi was recovered from diseased stems, petioles and seeds and accounted for 29% of the total isolates. The 2% of the remaining isolates included D. kongii, D. ueckerae and an unidentified Diaporthe sp. that were all isolated from seeds, while D. eres was isolated from the stem of a symptomatic soybean plant.

In addition to the established pathogens on soybean - D. caulivora, D. longicolla, and D. aspalathi - the results from our study add new records of four species of Diaporthe causing disease on soybean in the United States. These include D. eres causing stem disease of soybean, and D. kongii, D. ueckerae and an unidentified Diaporthe sp. causing Phomopsis seed decay of soybean.

Based on recent studies, D. eres, D. kongii, and D. ueckerae are not specific to soybean. It appears that species composition of the Diaporthe population in the Midwest and south is very complicated, made up of more than just several species that were previously known. This information will be used to help direct future management trials.

In 2017, a field trial was set up in Felt Farm, Brookings, South Dakota to test the efficacy of seed treatments and in-furrow treatment against stem canker pathogens. The trial was performed as a randomized complete block design with a total of nine treatments (including seed treatments, in-furrow and combination of seed treatments and in-furrow) under inoculated conditions. Disease pressure was established by spread of sunflower plants pre-inoculated with an isolate of Diaporthe caulivora. At R6 growth stage, the plants were examined for disease. The rating was based on 1 to 4 scale ; 1= healthy plant; 2= plants with lesion restricted to one node (minor lesion); 3= plants with lesion in more than one node (major lesion) and 4= dead plants. The rating scale into disease severity index, which was calculated using the formula DSI

$(\%) = ? \{[(P \times Q) / (M \times N)] \times 100\}$ where P = disease severity rating, Q = number of infected plants having the same disease severity rating, M = total number of plants, N = maximum number on the disease severity rating scale. Although no significant differences in yield was observed for most of the fungicide seed treatments, significantly higher yield was achieved (56.6 bu/A) compared to the control for only Acceleron Plus Clariva. Seed treatments may have just limited efficacy on Diaporthe related diseases.

In another set of studies where seed treatments were applied, data were mined for response to Pod and Stem Blight. A total of 12 field trials were conducted at four locations in three states (Iowa, Wisconsin, and South Dakota) to investigate the effect of the insecticide “Neonic” and a fungicide seed treatment on soybean. Soybeans were planted at two planting dates with multiple planting populations. Stem samples were collected at R8 from five planting populations (80, 100, 120, 140, and 160k) from plots that were planted with untreated seed of the late planting.

Entire stems were rated for anthracnose and pod and stem blight (% area of pathogen). Visual ratings were performed on each stem. An image was taken of all stem samples from each plot kept in the order that their rating was recorded. Only the lower third of the stem was photographed to maintain picture quality in case stems were to be reevaluated. The six individual ratings of each plot were averaged together for a single rating per plot.

Due to missing entire populations, samples from SD were removed from the analysis. Planting population was not significant for pod and stem blight ($P=0.64$) incidence. Location was not significant in the incidence of pod and stem blight ($P=0.11$). Planting date and population likely have little influence on pod and stem blight incidence in the upper midwest.