North Central Soybean Research Program

Developing an integrated management and communication plan for soybean SDS

Daren Mueller (Project Leader - dsmueler@iastate.edu), Leonor Leandro, Yuba Kandel and Greg Tylka (Iowa State University), Damon Smith (University of Wisconsin), Kiersten Wise and Carl Bradley (University of Kentucky), Martin Chilvers and Dechun Wang (Michigan State University), Febina Mathew (South Dakota State University), Albert Tenuta (Ontario Ministry of Agriculture)

Progress Report October 2018

The foundational management strategy for sudden death syndrome (SDS) is using resistant cultivars. However, in years when environmental conditions are favorable for disease development, resistance alone does not provide adequate control or reduce farmer risk sufficiently. Also, SDS continues to move into new areas. The main goal of this project is to investigate management options that will help ensure resistant cultivars will be as effective as possible even in unusually conducive SDS conditions.

Project Objectives

1. Evaluate if soybean root health can be improved to reduce SDS or be used as an indicator of SDS risk;
2. Determine how shifts in soybean production practices affect the risk of SDS development; and
3. Communicate research results with farmers, agribusinesses and other soybean stakeholders.

Results

A manuscript entitled "*Benefits and Profitability of Fluopyram-Amended Seed Treatments for Suppressing Sudden Death Syndrome and Protecting Soybean Yield: A Meta-Analysis*" has been published in the journal Plant Disease (Plant Disease 102:1093-1100).

In this manuscript, we complied data from multiple locations evaluating ILeVO seed treatment for SDS management and yield response to the seed treatment using a meta-analysis approach. In summary, a 35% reduction in foliar disease and 4.4 bushels/acre (7.6%) increase in yield were estimated for fluopyram-amended seed treatment relative to commercial base seed treatments without fluopyram. A graduate student, Daniel Sjarpe, working on this project for his master's degree with Dr. Daren Mueller and Leonor Leandro at Iowa State University, recently graduated. A manuscript evaluating different rates of fluopyram-amended seed treatments and cultivars on root infection by *Fusarium virguliforme*, foliar symptom development, and yield of soybean is being written and will be submitted to a journal for publication in a couple months.

In 2018, we conducted field experiments in Illinois, Iowa, Michigan, South Dakota, Wisconsin and Ontario, Canada to test the efficacy of fungicide/nematicides for SDS management. We evaluated 12 treatments including fungicides and nematicides applied on seed and in-furrow on SDS susceptible and resistant cultivars at each location. Each location collected data on plant population, root rot, root dry weight, foliar SDS incidence and severity, using standard protocols.

We also collected soil samples for SCN counts and HG tying at planting at each location. SCN counting from those spring samples has just finished. Soil samples from all locations have been sent to SCN diagnostics at University of Missouri, Columbia for HG typing. In 2017, ILeVO and ILeVO with ethephone were found to be the most effective at reducing SDS when combined from all locations. We are gathering and analyzing data from 2018 field experiments. We are finishing up a manuscript from our 2015 and 2016 evaluations and will be submitted soon in Plant Disease.

We collected soil samples from ILeVO-treated and untreated plots at planting and will be collected in fall after harvest to determine how ILeVO treatment effects on F. virguliforme population and soil health. Spring samples were split in half and one half was used to extract *F. virguliforme* DNA using qPCR protocol identified in our previous study. The remaining samples was used to assess indicators of soil function and health, including soil physicochemical properties, enzyme activities, mycorrhizal colonization potential, and total nematode community assessment. Samples for soil health test are being processed in Dr. Nathan Kleczewski at University of Illinois.

We conducted field experiments in Iowa, Indiana, Michigan, Wisconsin and Ontario to investigate the effect of corn residue on SDS development in 2016 and 2017. In 2018, we continued this experiment in Iowa and Ontario, Canada for the third year. We compared two levels of residue removals and two tillage systems in corn and soybean rotation system. We recorded data on plant population, root rot, foliar SDS, and yield. We are collecting and analyzing data, and writing a manuscript.

In Iowa, we sprayed corn plots of the same field with Trivapro at R1 and collected leaf samples from sprayed and non-sprayed corn plots to examine if fungicide application in corn influences microbial population including *F. virguliforme* on corn leaf. Samples were sent to Dr. Nathan Kleczewski, University of Illinois for processing.

Fields with long-term fertility experiments established by Dr. Antonio Malarino, Professor Nutrient Management Research and Extension, ISU, in North east research farm, Nashua and South east research farm, Crawfordsville Iowa were selected to determine how soil potassium levels affect SDS in 2017. We collected SDS and yield data and analyzed in 2017. In 2017, plots with no potassium had less disease than the potassium applied plots. In 2018, the experiments were continued and we monitored those plots in Nashua for SDS at soybean GS R5.6 but no foliar symptoms were observed.

In 2018, we tagged nearly 700 individual plants with different visual ratings of SDS from low to high in three farmers field located in the Boone, Hamilton and Webster counties and micro-plot experiment at ISU research farm at hinds. The microplot experiment was artificially inoculated using different rates of *F. virguliforme* inoculum to generate a wide range of SDS foliar symptoms. Disease was rated multiple times in those plants. About 200 plants were collected to quantify F. virguliforme in roots at R6. We are extracting DNA and running qPCR, which is next step to quantify the pathogen in root tissue and determine the correlation with visual ratings. At the end of the season, the remaining labelled plants will be harvested individually to correlate yield with the SDS severity. To determine the soil sampling protocol for determining SDS pathogen level in soil, we identified fields with low and high risk of SDS based on previous years SDS severity and collected samples in different time and from different soil zones in 2017. DNA extraction has been completed and DNA samples are being processed for qPCR in 2018.

We completed field experiments on determining how increasing SCN resistance to SCN-resistant cultivars will affect SDS resistance performance. A manuscript has been published in Plant Disease (Plant Disease 101: 2137-2143).

We published a manuscript in Crop Protection (Crop protection 106:103-109) from a study determining the interaction between the fluopyram seed treatment and pre-emergence herbicide in Iowa and Indiana. In summary, seed treated with fluopyram resulted in higher phytotoxicity at VC-V1 than seed without fluopyram, regardless of preemergence herbicide treatment. The combination of preemergence herbicide and fluopyram did not increase the severity of soybean injury in any year or location compared to either applied alone. These results indicate that while injury can occur with both preemergence herbicides and fluopyram-treated seed, phytotoxicity is not more severe when both pesticides are used together, and yield is not reduced by their use. We presented our research reports at professional meetings (SSDW and APS), on Plant Management Network, many state or province level talks, seminars, media interviews, talk in field days and conferences for farmers and also published in state newsletter articles, several media releases etc. We updated SRII with information from this proposal.

The result from this study will have directly benefited soybean farmers in the North Central region and also establish foundation to address future research and management questions.