Nebraska Soybean Board
Year-End Summary Research Report Form for Multi-Year Projects

Please use this form to summarize the practical benefits of your research project and what has been accomplished. Your answers need to convey why the project is important and how the results will impact soybean production.

Note that this form must be submitted with the 4th Quarter Report in all multi-year projects.

Project # and Title: #707 Survey and Rapic Diagnostics for Fungicide Resistant Frogeye LeafSpot in Nebraska

Principal Investigator: Tamra Jackson-Ziems

Year of Multi Year: __2__ of __3__ (example: Year 1 of 3, Year 2 of 2)

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1. What was the focus of the research project?

The focus of the research project funded by NSB was to understand the prevalence of QoI fungicide resistance in soybean pathogen Cercospora sojina and develop a DNA-based protocol for rapid identification of QoI resistant Cercospora sojina.

A second goal is to develop and deliver educational materials and outreach programs on resistance management. Designing more effective outreach programs to address soybean disease management requires better understanding of stakeholder perceptions. To achieve that, we conducted an informational survey in Nebraska to better understand stakeholders' priorities when making decisions to apply fungicides in Nebraska.

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2. What are the major findings of the research?

In 2019, QoI fungicide resistance to the Group 11 class (QoI) of fungicides was detected in 111 Cercospora sojina isolates from 10 counties in Nebraska. To understand the prevalence of fungicide resistance in the state, we expanded this survey in 2020 and amassed a collection of 375 isolates from 48 counties throughout the soybean producing region in Nebraska. A preliminary plate-based assay suggested that QoI fungicide resistance is now widespread, but the results required confirmation with molecular genetic analysis. A major limitation of this approach is that the plate-based assay takes more than two weeks to conduct, requiring isolation of the fungus from leaves, followed by inoculation of fungicide-amended petri plates and growth-based assays in the lab.

Although platforms exist to enable rapid, in-field detection of mutations, no such diagnostic tool had been developed for detection of QoI fungicide resistance in Cercospora sojina. To fill this gap, we developed a DNA-based protocol for rapid detection of QoI fungicide resistance in Cercospora sojina that utilizes a highly sensitive isothermal DNA amplification method based on ligation-rolling circle amplification. A single reaction can detect three possible mutations (G143A, F129L, and G137R) in the cytochrome b gene that confer resistance. Mutations can be detected directly from infected leaf samples in just 2-3 hours. Rapid detection of fungicide resistance allows timely response by producers to mitigate yield loss. Fungicide resistance was confirmed in Cercospora sojina (causing soybean frogeye leaf spot) in all 48 Nebraska counties where samples were collected and tested. These counties represent most of the soybean production in the state.

To help us develop and deliver effective educational program we conducted an informational survey in Nebraska. We designed a survey to assess perceived importance of soybean diseases, determine reasons for foliar fungicide applications to soybean, and identify sources of information used to make the decision to apply fungicides. The results from 1,054 responses representing 84 Nebraska counties revealed that foliar fungicide application was the second most recommended disease management practice after crop rotation. Over 90% of crop consultants and agriculture business representatives recommended a fungicide application while 64% of farmers/farm managers applied at least one foliar fungicide on soybean in the last 5 years. The fungicides were applied/recommended for multiple diseases (69%) or a single disease (26%). Fourteen percent of applications were made for other reasons, such as yield boost and plant health. Only 10% respondents consider fungicide mode of action to be an important factor while making application decisions. Factors that influenced application decisions were disease severity (34%), fungicide cost (31%), and crop market value (27%). The most cited source of information used to make disease management decisions was recommendations from the local agricultural co-operative service providers (50%) followed by University Extension (22%).

Out of 1054 responses, 798 respondents identified as farmers/producers. Statewide, 63% of farmers/producers applied foliar fungicides at least once in the last 5 years. The fungicide application use varied by USDA NASS crop reporting district: east central (72%), northeast (69%), south central (60%), southeast (58%), central (52%), and southwest (49%). The perceived importance of diseases affected the decision to apply fungicides. Among farmers/producers that applied foliar fungicides, the soybean diseases that were perceived to be most important were sudden death syndrome (SDS), white mold and frogeye leaf spot (FLS). The farmers/producers that did not apply foliar fungicides identified SDS, white mold and soybean cyst nematode as most important. Sudden death syndrome and frogeye leaf spot were perceived to be most important in east central, southeast, and northeast Nebraska, while white mold was perceived to be most important in northeast, east central and central Nebraska.

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3. Briefly summarize, in lay terms, the impact your findings have had, or will have, on improving the productivity of soybeans in Nebraska and the U.S.

These results help farmers and applicators select and apply more effective fungicide products for better disease control and reduced impact of frogeye leaf spot on yield. The new assay will enable samples to be tested rapidly to determine if the frogeye leaf spot fungus is resistant to the common Group 11 QoI fungicides.

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4. Describe how your findings have been (or soon will be) distributed to (a) farmers and (b) public researchers. List specific publications, websites, press releases, etc.

In the past year, the research funded by Nebraska soybean Board was presented during:
• 1 Local,
• 4 National and
• 1 International meeting, listed below.

1. Mane A.G., Everhart S.E, Jackson-Ziems Tamra A. A statewide assessment fungicide resistance in Cercospora sojina, and a survey on use foliar fungicide for soybean disease management in Nebraska. Oral presentation at UNL Department of Plant Pathology-Fall 2021 Seminar Series. November 2021.
2. Mane A.G., Everhart S.E, Jackson-Ziems Tamra A. A survey on foliar fungicide use for soybean disease management in Nebraska. Poster presentation at 2021 ASA-CSSA-SSSA International Annual Meeting. Salt Lake City, UT. November 2021.
3. Mane A.G., Everhart S.E, Jackson-Ziems Tamra A. Factors impacting soybean disease management in Nebraska. Poster presentation at 10th International IPM Symposium. Denver, Colorado. March 2022.
4. Mane A.G., Everhart S.E, Jackson-Ziems Tamra A. DNA based assay for rapid detection of QoI (Strobilurin) fungicide resistance in plant fungal pathogen Cercospora sojina. Poster presentation at NIAMRRE 2nd Annual Conference, Lincoln, Nebraska. May 2022.
5. Mane A.G., Everhart S.E, Jackson-Ziems Tamra. Factors impacting foliar fungicide use for soybean disease management in Nebraska. Poster presentation at NIAMRRE 2nd Annual Conference, Lincoln, Nebraska. May 2022.
6. Mane A.G., Everhart S.E, Jackson-Ziems Tamra A. Foliar fungicide use for soybean disease management across crop reporting districts in Nebraska. North Central American Phytopathological Society Annual meeting Lincoln, Nebraska. June 2022.
7. Mane A.G., Everhart S.E, Jackson-Ziems Tamra. Understanding stakeholder perceptions of foliar fungicide use in Nebraska soybean production. American Phytopathological Society meeting, Pittsburgh, Pennsylvania. August 2022.

CropWatch article

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5. Did the NE soybean checkoff funding of your project, leverage additional State or Federal funding support? Please list sources and dollars approved.

No

Please submit this completed form to the Agriculture Research Division, jmcmahon10@unl.edu, based on the reporting schedule given to you. If you have any questions, please call Jen McMahon at the Agricultural Research Division (402) 472-7082.

Please check your information before submitting the form. [Submit by Email]