MISSISSIPPI SOYBEAN PROMOTION BOARD
PROJECT NO. 15-2017 (CONT)
2017 ANNUAL REPORT

Title: Soybean disease monitoring for Mississippi soybean producers

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BACKGROUND

On an annual basis, soybean diseases continue to reduce yield in the MS soybean production system. Since the first reports of soybean rust from the continental United States in late 2004, soybean rust has remained one of the most closely monitored plant diseases in the U.S. Between 2004 and 2017, sentinel plots were considered to be a valuable tool to aid soybean farmers in making informed management decisions based on the particular economically important disease(s) present at each sentinel plot location.

Mississippi has cooperated at the regional and national level by monitoring for soybean rust by planting sentinel plots, typically planted several weeks prior to the commercial soybean crop, to monitor for the presence of soybean rust. The information gained from sentinel plots has helped soybean farmers avoid yield losses as a result of soybean rust and other economically important diseases, or losing money by making an ill-timed fungicide application when disease is not threatening. In addition, information obtained from monitoring soybean diseases from throughout MS has led to important graduate student projects (Jeff Standish, Nicole Brochard, Hope Renfroe) because we had a vehicle to support monitoring soybean diseases from throughout the state on an annual basis that helped obtain infected plant material for graduate student projects as well as projects with collaborators outside of MS.

Beginning in 2011/2012, MSU faculty and staff emeritus used sentinel plots and commercial soybean fields throughout the state to monitor for all economically important soybean diseases, particularly those diseases that could be managed with a timely fungicide application. In addition to monitoring for the presence of economically important foliar diseases (e.g, aerial web blight, Cercospora blight, frogeye leaf spot, soybean rust), we also started to use sentinel plots to monitor for the presence of fungicide resistance within the frogeye leaf spot fungal population in 2013.

As a result of monitoring for economically important diseases, beginning in 2012 two counties were reported to contain strobilurin-resistant frogeye leaf spot, one each in Carroll and Coahoma counties. At that time leaf samples were submitted to the University of Illinois for resistance screening. However, beginning in the 2013 season leaf samples were screened in Starkville, MS due to some issues encountered while shipping samples. As a result of that monitoring effort a graduate student was added to focus on the distribution of fungicide resistant frogeye leaf spot throughout MS.

The strobilurin class of fungicides (or QoI fungicides) have been widely used in soybean production systems throughout MS and have provided farmers with a broad-spectrum fungicide that has additional benefits when it comes to enhancing yield in continuous soybean situations. However, the members of this particular class of fungicides have a high risk for developing resistance within fungal populations.

The main objective of the soybean disease monitoring project is to determine where important yield-limiting diseases may be occurring (inclusive of soybean rust) and disseminate pertinent information in the form of management alternatives when necessary using several different media sources so that farmers are aware of a potential threat.

REPORT OF PROGRESS/ACTIVITY

OBJECTIVE(S)

Objective 1. Monitor for foliar soybean diseases throughout MS to provide soybean farmers the necessary information to make informed, timely decisions regarding fungicide application(s), as well as making product choices (either strobilurin or triazole) depending on the specific disease(s) present in commercial fields.

Soybean sentinel plots, planted earlier than the commercial soybean crop throughout the state, were used to monitor soybean diseases throughout MS during the 2017 season. However, a more limited number of sentinel plots were planted during 2017 and were only planted south of I-20 except for two locations in Thornton and Mayersville, MS. As opposed to years in the past, MSU Official Variety Trial locations were relied on to round out the number of sentinel plots in the northern part of MS. Sentinel plots consisted of a single Maturity Group IV and V entry, and were planted in 11 counties (Adams, Amite, Claiborne, Hancock, Harrison, Hinds, Issaquena, Jackson, Jefferson, Newton, and Pearl River).

In addition to scouting sentinel plots on a weekly basis between April and September (or when they reached R8, physiological maturity), many unique commercial field locations were observed for the presence of soybean diseases throughout the 2017 season. However, GPS coordinates were not collected for much of the 2017 season unless plant samples were collected from the location for other research purposes (e.g., taproot decline). In addition to scouting for diseases of economic concern, commercial soybean fields were observed for the presence of important diseases as well as nematode issues (a list of the major disease and nematode observations made during the 2017 season is included below). If a management practice was necessary to reduce the impact of a particular disease, the information was reported to the farmer so that the situation could be addressed.

As a final report for the 2017 soybean season, several economically important diseases were observed in either sentinel plots or commercial soybean fields:

Foliar fungal diseases:
aerial web blight
bacterial blight
brown spot (Septoria leaf blight)
Cercospora blight
downy mildew
frogeye leaf spot
powdery mildew
soybean rust
target spot

Soilbore diseases:
charcoal root rot
southern blight
stem canker
sudden death syndrome
taproot decline

Viruses:	**Nematodes:**
Bean pod mottle virus	reniform nematode
Soybean mosaic virus	root-knot nematode
Soybean vein necrosis virus	soybean cyst nematode

One important note regarding the diseases outlined above. Similar to the disease situation over the past several seasons, soybean viruses were widespread in the MS soybean production system. Virus diseases were observed at approximately the same time (growth stage and month) as they have been in the past. But, with that in mind, determining the potential yield losses as a result of viruses is difficult at best because in some cases multiple viruses may be present in a single plant or some viruses may be compounded due to other diseases or vice versa. On an annual basis, virus diseases account for some yield losses; however, an actual number that could be attributed to yield reduction as a result of viruses would be difficult to assess.

Objective 2. If the ability arises, determine the most effective fungicide management schemes by conducting efficacy trials specifically for soybean rust (SBR) timing. In addition, if strobilurin-resistant aerial web blight, Cercospora blight, or frogeye leaf spot are identified, fungicide trial plots could provide valuable information to the soybean industry (if identified early enough to benefit the situation).

During 2017, soybean rust observations were not made until later in the cropping season, typically August and September, when the majority of the soybean grown in the state had reached a growth stage where foliar diseases will not result in a yield reduction. As a result, efficacy trials could not be conducted to determine the efficacy of commercially available fungicides on soybean rust in our production system. However, frogeye leaf spot and target spot were two of the more prominent diseases observed at specific locations where fungicide efficacy trials were conducted (Starkville and Stoneville).

Several different types of fungicide trials were conducted to determine the role of "early" fungicide application strategies to manage Cercospora leaf blight as well as frogeye leaf spot in Starkville and Stoneville. Fungicide trials were conducted on the experiment station in Stoneville to determine efficient timing strategies to manage soybean diseases as well as overall yield losses. Reports from those trials will be published in the Plant Disease Management reports journal through the American Phytopathological Society, and information will also be published on the Mississippi Crop Situation Blog to aid soybean farmers in making decisions when managing potentially yield-limiting diseases.

Application strategies during 2017 included strobilurin, pre-mix fungicides, several triazole products, and a few numbered compounds. The information obtained from these trials will be used for several blog articles (www.mississippi-crops.com) as well as drafting several Plant Disease Management Reports to be published through APS:

-R3 alone and some sequentials
-R3 alone (multiple trials in Stoneville)
-R5 alone (trials conducted in Starkville were all applied at R5)

Generally speaking, regardless of timing strategy, fungicides did not reduce the observable symptoms from Cercospora blight; however, a tremendous data set was created from the trials conducted to manage frogeye leaf spot (in Starkville), especially in the trials conducted since the fungus was

determined to be resistant to the strobilurin fungicides at all locations during 2017. Moreover, an extensive data set was obtained from trials conducted where target spot was the main disease of interest as a result of prolonged periods of conducive weather.

Objective 3. Continue to monitor the environmental conditions at 3 locations (Eden, Hurley, Pond) where weather stations are present to determine if a specific correlation exists between environmental variables and infection of the local plant material (either kudzu or soybean) by the SBR fungus.

Weather stations continue to be monitored at three key locations (Eden, Hurley, Pond, MS) where soybean rust has been a regular occurrence. The weather stations were upgraded during the 2015/2016 winter, and data from each of the weather stations are now available on the internet with the remainder of the monitoring stations. The cellular uplinks have greatly increased our environmental data gathering capabilities throughout the state. At present, a few additional kinks continue to be worked out of the system to maintain the weather stations and provide those data on a regularly basis.

Objective 4. Continue to make weekly radio updates during the soybean growing season for the Mississippi Radio Network (via Mr. Lynn Sheldon and/or Mr. John Winfield) on important topics occurring in soybean pathology or other pathology-related issues (e.g. foliar diseases, nematodes, fungicide application suggestions, presence of particular diseases and their proximity to the major production areas).

During the 2017 season, radio updates regarding pertinent disease information were made to the MS Ag Network. The information that was contained in those reports was also pertinent to disease monitoring as well as structured around providing information that would benefit farmers' management practices regarding important yield-limiting diseases. A list of the specific titles and topics is included in the appendix below.

IMPACTS AND BENEFITS TO MISSISSIPPI SOYBEAN PRODUCERS

Ideally, monitoring for yield limiting diseases throughout MS impacted all of the farmers that managed the approximately 2.3 million acres of soybean in the state. During 2017 the soybean disease monitoring team that included Billy Moore, myself, and Jack Bridgers with Jimmy Sanders, Inc. observed more soybean acres in MS than any other single entity. Our weekly visits to soybean farms, sentinel plots, and kudzu patches throughout the MS soybean production system provided constant benefit to soybean farmers by showing we are aware of their needs as well as monitoring their crop acres should an issue arise.

In locations where soybean rust was confirmed in field situations where a fungicide may have produced a positive benefit, we were able to protect yield; however, even though soybean rust made an earlier entrance than normal into MS, we were still able to protect yield and reduce the costs associated with unnecessary fungicide applications by monitoring for the disease extensively. As has been the case over the past several years, we were also able to provide important information for the subsequent soybean season regarding such diseases as red crown rot, stem canker, frogeye leaf spot, root-knot, reniform, and soybean cyst nematode.

END PRODUCTS–COMPLETED OR FORTHCOMING

Throughout the 2017 season, updates were provided to the farming community through the Mississippi Crop Situation Blog (www.mississippi-crops.com) as well as radio interviews that provided updates on pertinent disease management issues by way of the Mississippi Radio Network. However, radio pieces were only conducted through July due to limited frequency of disease and untimely scheduling of radio pieces. Funds provided by the MSPB allowed us to spend considerable time throughout the state to determine what diseases were present, where they were located, and provide this information to farmers through several different outlets.

The specific Extension-related outputs are included in the appendix below.

APPENDIX 1

Publications associated with soybean disease monitoring (n=1)

Sharma, S., Zaccaron, A. Z., Ridenour, J. B., **Allen**, **T. W.**, Conner, K., Doyle, V. P., Price, T., Sikora, E., Singh, R., Spurlock, T., Tomaso-Peterson, M., Wilkerson, T., and Bluhm, B. H. 2018. Draft genome sequence of *Xylaria* sp., the causal agent of taproot decline of soybean in the southern United States. Data in Brief 17:129-133.

Mississippi Crop Situation Blog updates (n=10)

Allen, T. W., Catchot, A., Irby, T., Cook, D., and Gore, J. 2017. Protecting seed quality. Mississippi Crop Situation, August 19, 2017.

Allen, T. W., and Irby, T. 2017. Foliar soybean disease update: August 19, 2017. Mississippi Crop Situation, August 19, 2017.

Allen, T. W., and Irby, T. 2017.Soybean rust update: August 5, 2017. Mississippi Crop Situation, August 5, 2017.

Allen, T. W. 2017. Soybean target spot: Information regarding susceptible varieties observed during 2016. Mississippi Crop Situation, July 24, 2017.

Allen, T. W. 2017. Soybean disease update: July 22, 2017. Mississippi Crop Situation, July 22, 2017.

Allen, T. W. 2017. Soybean disease update: July 1, 2017. Mississippi Crop Situation, July 1, 2017.

Allen, T. W. 2017. Soybean disease update: June 18, 2017. Mississippi Crop Situation, June 18, 2017.

Allen, T. W., and Irby, T. 2017. Considering the R3/R4 automatic fungicide application in soybean: time to apply two modes of action instead of one. Mississippi Crop Situation, June 3, 2017.

Allen, T. W. 2017. Managing target spot of soybean: 2016 fungicide trial efficacy results. Mississippi Crop Situation, April 1, 2017.

Allen, T. W. 2017. Target spot management: thoughts from 2016 observations. Mississippi Crop Situation, March 21, 2017.

Soybean educational radio interviews for Mississippi Ag Network and AgPhD radio (n=9): Soybean seed quality and other issues encountered during the 2017 season. AgPhD radio national broadcast, October 18, 2017.

Managing soybean seedling diseases: An early-season perspective. Mississippi Radio Network, April 4 2017.

Soybean sentinel plot monitoring efforts and how they impact MS soybean farmers. Mississippi Radio Network, May 8, 2017.

Importance of Septoria brown spot as an early-season soybean disease. Mississippi Radio Network, May 22, 2017.

Early-season soybean disease considerations with regards to early foliar diseases observed in the MS crop production system. Mississippi Radio Network, June 2, 2017.

General soybean disease update and overall fungicide management considerations. Mississippi Radio Network, June 19, 2017.

General soybean sentinel plot update and disease outlook. Mississippi Radio Network, July 3, 2017.

Fungicide application considerations and the R3/R4 application timing. Mississippi Radio Network, July 10, 2017.

General soybean disease situation update for Mississippi soybean production systems. Mississippi Radio Network, July 17, 2017.

Proceedings (n=11)

Petrovic, K., Castlebury, L., Dobridina, M., **Allen, T.**, Bergstrom, G., Block, C., Bonkowski, J., Bradley, C., Buck, J., Byamukama, E., Chilvers, M., Dorrance, A., Dufault, N., Giesler, L., Kelly, H., Kleczewski, N., Price, III, P. P., Malvick, D., Markell, S., Mueller, D., Sikora, E., Smith, D., Spurlock, T., Wise, K., and Mathew, F. 2018. Diagnosis of diseases caused by *Diaporthe* (*Phomopsis*) species on soybean in the United States. Phytopathology ??:???.

Esker, P. D., **Allen, T. W.**, and Bradley, C. A. 2018. Soybean losses due to diseases and nematodes in the USA since 1996: General trends and observations. Phytopathology ??:???.

Renfroe, H., Wilkerson, T., **Allen, T. W.**, and Tomaso-Peterson, M. 2018. The distribution of taproot decline of Mississippi soybean. Phytopathology ??:???.

Garcia-Aroca, T., Price, P., Tomaso-Peterson, M., Spurlock, T., Faske, T., Bluhm, B., Conner, K., Sikora, E., Guyer, R., Kelly, H., **Allen, T.**, and Doyle, V.P. 2018. A novel lineage of *Xylaria* is

responsible for taproot decline of soybean in the southern United States. Proceedings of the 11th International Mycological Congress, San Juan, Puerto Rico, July 16-21, 2018.

Garcia-Aroca, T., Price, P., Tomaso-Peterson, M., Spurlock, T., Faske, T., Bluhm, B., Conner, K., Sikora, E., Guyer, R., Kelly, H., **Allen, T.**, and Doyle, V.P. 2018. A novel lineage of *Xylaria* is responsible for taproot decline of soybean in the southern United States. Proceedings of the 11th International Mycological Congress, San Juan, Puerto Rico, July 16-21, 2018.

Allen, T. W., Esker, P. D., and Bradley, C. A. 2018. Retrospective analyses regarding the impact of soybean diseases in the USA. Page 7. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 7-8, 2017.

Mathew, F., Petrovic, K., Castlebury, L., **Allen, T.** Bergstrom, G., Bonkowski, J., Bradley, C., Buck, J., Byamukama, E., Chilvers, M., Dorrance, A., Dufault, N., Giesler, L., Gregory, N., Kelly, H., Kleczewski, N., Price, T. Malvick, D., Markell, S., Mueller, D., Smith, D., Spurlock, T., Wise, K., and Johnson, M. 2018. *Diaporthe* (*Phomopsis*) species on soybean: Current status in the United States. Page 8. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 7-8, 2017.

Garcia-Aroca, T., Price, P., Tomaso-Peterson, M., Spurlock, T., Faske, T. R., Bluhm, B., Conner, K., Sikora, E. J., Guyer, R., Kelly, H., **Allen, T. W.**, and Doyle, V. P. 2018. Taproot decline of soybean is caused by an undescribed species in the genus Xylaria. Page 16. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 7-8, 2017.

Renfroe, H., Wilkerson, T., **Allen, T.**, and Tomaso-Peterson, M. 2018. Assessing pathogenicity and virulence of *Xylaria* sp. isolates from Mississippi soybean. Page 17. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 7-8, 2017.

Allen, T. W., and Wilkerson, T. H. 2018. Results from the 2017 Mississippi State University target spot fungicide efficacy program. Page 26. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 7-8, 2017.

Allen, T. W., Bissonnette, K., Bradley, C. A., Damicone, J. P., Dufault, N. S., Faske, T. R., Hollier, C. A., Isakeit, T., Kemerait, R. C., Kleczewski, N. M., Mehl, H. L., Mueller, J.D., Overstreet, C., Price, P. P., Sikora, E. J., Spurlock, T. N., Thiessen, L., and Young, H. 2018. Southern United States soybean disease loss estimates for 2017. Pages 31-37. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 7-8, 2017.

Future plans for output(s) (n=1 refereed publication):

The 2012 season was the last year for the soybean rust hotline. I am in the process of drafting a manuscript regarding the connectedness of the telephone calls made to the hotline and how soybean rust information was disseminated. The overall delay in this particular paper to this point has had to do with the type of statistical analysis desired. MSU does not have the statistical support that we require to do many in-depth analyses required for this type of project. Much of this information can be used in presentations as well as included on the MSPB website once it has all been completed. However, it may be several months (likely 10-12) before this will be completed.

APPENDIX 2: Graphics/Tables

Figure 1. Map of scouted locations throughout MS that were relied on to gather important disease monitoring information. Red counties indicate a location where soybean rust was detected. During 2017, soybean rust was detected in all 82 counties (n = 15 kudzu and n= 67 soybean).