3-2023

Proceedings of the 50th Annual Meeting, Southern Soybean Disease Workers (March 1-2, 2023, Pensacola Beach, Florida)

Kiersten A. Wise
University of Kentucky, kiersten.wise@uky.edu

Ian Small
University of Florida, ismall@ufl.edu

Tessie Wilkerson
Mississippi State University, twilkerson@drec.msstate.edu

Danise Beadle
Oakland, Florida, United States, danise.beadle@gmail.com

Trey Price
Louisiana State University, pprice@agcenter.lsu.edu

See next page for additional authors

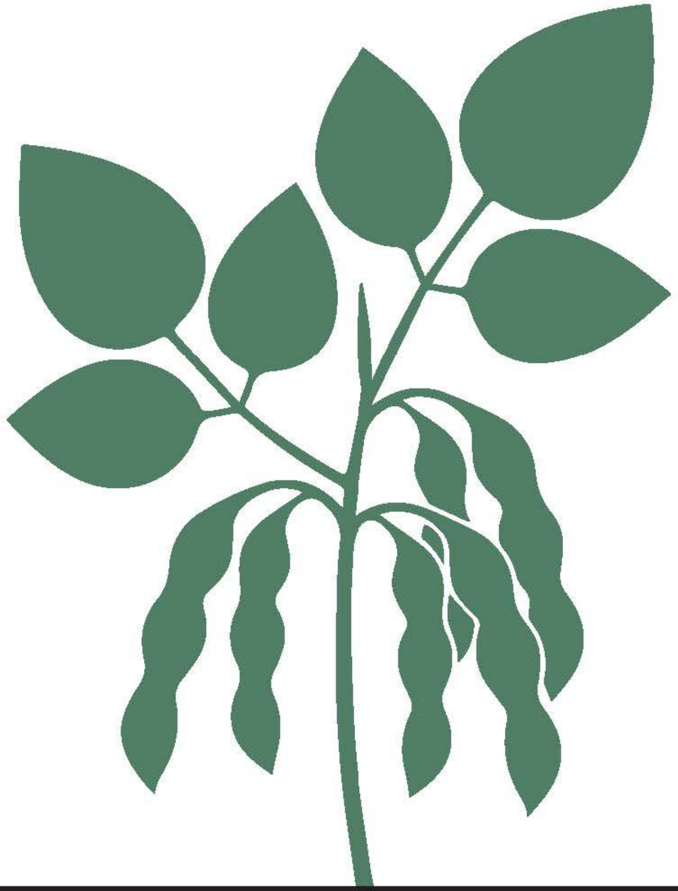
Wise, Kiersten A.; Small, Ian; Wilkerson, Tessie; Beadle, Danise; Price, Trey; and Allen, Tom W., "Proceedings of the 50th Annual Meeting, Southern Soybean Disease Workers (March 1-2, 2023, Pensacola Beach, Florida)" (2023). *Southern Soybean Disease Workers Proceedings*. 33.
https://digitalcommons.unl.edu/ssdwproc/33

Authors

Kiersten A. Wise, Ian Small, Tessie Wilkerson, Danise Beadle, Trey Price, and Tom W. Allen

PROCEEDINGS OF THE

SOUTHERN SOYBEAN



DISEASE WORKERS

50TH ANNUAL MEETING

MARCH 1 & 2, 2023   PENSACOLA BEACH, FL

50TH Annual Meeting of the Southern Soybean Disease Workers – was supported by generous contributions by the following:

BASF
We create chemistry

MSB
MARYLAND SOYBEAN BOARD

BAYER

syngenta

CORTEVA™
agriscience

UNITED SOYBEAN BOARD™

FMC

VALENT®

PROCEEDINGS OF THE SOUTHERN SOYBEAN DISEASE WORKERS

50TH ANNUAL MEETING

March 1st and 2nd, 2023
Pensacola, Florida

Proceedings of the Southern Soybean Disease Workers are published annually by the Southern Soybean Disease Workers.

2023 Southern Soybean Disease Workers Agenda

Wednesday March 1, 2023

12:50 – 1:00 **2023 Welcome**

Reflecting and looking forward: perspectives from "legends" and "fresh faces" of the SSDW (moderators: Kiersten Wise and Ian Small)

1:00 – 1:25 **The implementation of a national response to a new soybean pathogen, *Phakopsora pachyrhizi*, in North America.** Jim Marois

1:25 – 1:50 **Fungicide resistance in *Cercospora sojina*: How did we get here and what's next?** Carl Bradley

1:50 – 2:15 **Exploring mechanisms of effector-triggered susceptibility in the soybean-*Sclerotinia* pathosystem.** Mitch Roth and Tiffanna J. Ross

2:15 – 2:45 **Panel: Lessons learned and advice to early career scientists**

2:45 – 3:15 **Break and poster viewing**

Student Papers (moderator: Kiersten Wise)

3:15 – 3:30 **Investigating a potential relationship between *Xylaria necrophora* and plant parasitic nematodes of soybean.** Pate, Shelly N., H.M. Kelly, E. Bernard, and L.A. Schumacher

3:30 – 3:45 **Soybean on-farm foliar fungicide trial summary 2020-2022.** R. Zaia, T. Spurlock, R. Hoyle, and A. Rojas

3:45 – 4:00 **Identifying the factors influencing soybean disease management decisions in Nebraska.** Asha G. Mane, Sydney E. Everhart, Tamra A. Jackson-Ziems

4:00 – 4:15 **Effect of fungicides and resistant varieties in the crop profitability.** Elias Zuchelli, Jhonatan Barro, Heather Kelly

4:15 – 4:30 **Effects of fungicide application in drought stress environments on Soybean.** Jackson Adcock, Heather Kelly, Avat Shekoofa

2023 Southern Soybean Disease Workers Agenda

Wednesday March 1, 2023

Student Papers [continued] (moderator: Kiersten Wise)

4:30 – 4:45 **Fungicides sensitivity of *Athelia rolfsii* from Mississippi fields.** Subina Tripathi, Tom Allen, Alejandra Jimenez Madrid, Tessie Wilkerson

4:45 – 5:00 **Quantification of *Athelia rolfsii* by qPCR to assess cultivar susceptibility and fungicide efficacy for control of southern blight of soybean.** Adam Connor, Tom Allen, Alejandra Jimenez Madrid , Nina Aboughanem-Sabanadzovic Trent Irby, Tessie Wilkerson

5:00 – 5:15 **Insecticide treatments and their influence on sudden death syndrome (SDS) in Tennessee Soybean.** Alexandra Crowder, Sebe Brown, Heather Kelly

5:15 – 5:30 **Evaluating fungicide sensitivity within the *Septoria glycines* population from Mississippi soybean.** Corser, J., Madrid, A. J., Wilkerson, T. H., and Allen, T. W.

6:00 – 7:30 **Reception and Special Student Competition –** Balcony near Aquamarine

7:30 – 9:00 **SSDW Banquet –** Emerald Coast

Thursday March 2, 2023

Contributed Papers (moderator: Tom Allen)

8:30 – 8:45 **Advancing soybean nematode, sudden death syndrome, frogeye leaf spot and target spot management employing the latest seed-applied technology.** Dale S. Ireland, J. Simmons, A. Simon

8:45 – 9:00 **Charcoal rot severity and soybean yield responses to planting date, irrigation, and genotypes.** Alemu Mengistu, Heather M. Kelly, Quentin D. Read, Jeff D. Ray, Nacer Bellaloui, Lesley A. Schumacher

9:00 – 9:15 **Fitness parameters within the *Corynespora cassiicola* population from Mississippi soybean.** Tom W. Allen, Wang, X., Tomaso-Peterson, M., and Wilkerson, T.H.

2023 Southern Soybean Disease Workers Agenda

Thursday March 2, 2023

Contributed Papers [Continued]

9:15 – 9:30 **Soybean disease management programs in Louisiana.** G. Boyd Padgett, P.P. ‘Trey’ Price, David Moseley, Fred Collins, Dustin Ezell, Dana Landry, Laura Lee, Tashia M. Monaghan, Myra Purvis, Chris Roider, Brandi Woolam

9:30 – 10:00 **Industry Updates**

10:00 – 10:30 **Break**

10:30 – 12:00 **Student Paper Awards/SSDW Business Meeting**

- **Old Business**
- **New Business**
  - **Committee Reports**
  - **Vice President election**
  - **Treasury Report**
- **Graduate student competition awards**
- **Adjourn SSDW Business Meeting**

12:00 – 1:00 **Lunch (on your own) if staying for Committee Meetings**

1:00 – 4:00 **Committee Meetings and Planning for SSDW 2024**

2022-2023 Southern Soybean Disease Workers Officers

President, Kiersten Wise
Department of Plant Pathology
University of Kentucky – Research and Education Center
348 University Drive
Princeton, KY 42445

Vice President, Ian Small
North Florida Research & Education Center,
University of Florida
Quincy, FL 32351
ismall@ufl.edu

Past President, Tessie Wilkerson
Department of Biochemistry, Entomology, Molecular Biology, and Plant Pathology
Mississippi State University
Delta Research and Extension Center
Stoneville, MS 38776
twilkerson@drec.msstate.edu

Secretary, Danise Beadle Retired
Oakland, FL 34787
danise.beadle@gmail.com

Treasurer/Sponsorship Chair, Trey Price
Macon Ridge Research Station
Louisiana State University
Agricultural Center
212A Macon Ridge Rd. Winnsboro, LA 71295
pprice@agcenter.lsu.edu

Chair of Disease Loss Committee, Tom Allen
Department of Biochemistry, Molecular Biology, Entomology & Plant Pathology
Mississippi State University
Stoneville, MS 38776
tallen@drec.msstate.edu

Table of Contents

Abstracts of Presented Papers

Abstracts of Student Posters

Southern United States Soybean Disease Loss Estimates for 2022

Tom W. Allen[1], Bissonnette, K.[2], Bradley, C.A.[3], Faske, T.R.[4], Grabau, Z. [5], Isakeit, T.[6], Kemerait, R.C.[7], Koehler, A.[8], Langston, D.[9], Lofton, J. [10], Mueller, J.D.[11], Padgett, G.B.[12], Price, P.P.[13], Sikora, E.J.[14], Small, I.M.[15], Vann, R. [16], and Young, H.[17]

[1]Mississippi State University, Stoneville, MS; [2]University of Missouri, Columbia, MO; [3]University of Kentucky, Princeton, KY; [4]University of Arkansas, Lonoke, AR; [5]University of Florida, Gainesville, FL; [6]Texas A&M University, College Station, TX; [7]University of Georgia, Tifton, GA; [8]University of Delaware, Newark, DE; [9]Virginia Tech, Suffolk, VA; [10]Oklahoma State University, Stillwater, OK; [11]Clemson University, Blackville, SC; [12]Louisiana State University, Baton Rouge, LA; [13]Louisiana State University, Winnsboro, LA; [14]Auburn University, Auburn, AL; [15]University of Florida, Quincy, FL; [16]North Carolina State University, Raleigh, NC; [17]University of Tennessee, Jackson, TN

The Southern Soybean Disease Workers (SSDW) have published soybean disease loss estimates for the southern United States since 1974. Summaries of the results from between 1977 and 2019 have been published in numerous refereed scientific journals (6; 9-10; 15; 17-26; 28-29). The annual losses from between 2015 and 2021 have been presented annually in the SSDW proceedings (2-5; 7-8) and most recently in a publication that included the estimates from 2015 to 2019 in Plant Health Progress that includes the loss estimates from the entire soybean production region including the southern and northern states for a total of 29 states and Ontario, Canada (10). A website through the University of Illinois Extension Service summarizes the estimated yield losses from both the northern and southern U.S. and includes data from 1996 through 2014. The website can be accessed at:

http://extension.cropsci.illinois.edu/fieldcrops/diseases/yield_reductions.php

The additional supporting presentation of loss estimates were included in the annual proceedings of the SSDW as well as some university-related sources (11-14; 16; 27). One last new output source has been at the Crop Protection Network where a soybean disease loss calculator uses data from 1996 through 2021 to provide information related to the percent losses, total bushels lost to disease and specific diseases, loss in dollars, and the potential losses on a per acre basis. The disease loss calculator can be access at:

https://loss.cropprotectionnetwork.org/crops/soybean-diseases

The disease loss estimates for the 2022 season contained in the current proceedings document were obtained from representatives across the southern U.S. through various methods. Plant pathologists with soybean pathology responsibilities were queried to provide the estimates of loss from their respective states in November 2020. Most individuals relied on multiple methods to derive estimates. Methods to derive losses included: Field surveys, plant disease diagnostic clinic samples, variety trials, questionnaires to Cooperative Extension staff, research plots, grower demonstrations, private crop consultant reports, foliar fungicide trials, sentinel plot data, variety trial ratings, and "pure guess". To complete the loss estimates for each state, USDA/NASS production figures were downloaded in January 2021 and production losses were calculated based on estimates of yield in the absence of disease. One additional topic that has recently been included to the presentation of the loss estimates (2018 through 2022) has been a general environmental comparison from each state. However, one major change was made for the 2022 season in that all of the weather station locations were changed to a location collecting weather data from each state's greatest soybean producing county/parish. In situations where the greatest county/parish did not contain a weather station that recorded data the next greatest county/parish was used. Soybean county data were gathered from the USDA Farm Service Agency (FSA) website (https://www.fsa.usda.gov/news-room/efoia/electronic-reading-room/frequently-requested-information/crop-acreage-data/index). The data set from 2022 was parsed to determine the greatest counties in each state and irrigated and non-irrigated acres were added up to arrive at those totals. Environmental data from each county were then collected from the National Centers for Environmental Information (https://www.ncdc.noaa.gov/cdo-web/) by conducting searches within each state and downloading the entire data set for temperature and precipitation from each corresponding location. State, county/parish, total number of acres within each county/parish, and designated weather station name are presented in Table 1. Environmental data representing the most current 30-year normal (1981-2010) were downloaded for each corresponding location from the National Centers for Environmental Information data tools which includes climate normal (https://www.ncdc.noaa.gov/cdo-web/datatools/normals).

Production losses associated with disease severity estimates were based on the formula used to derive production losses:

Potential production without disease loss = actual production ÷ (1-percent loss) (decimal fraction)

Rounding errors may occur in the tables provided below due to the presence of low levels of disease estimated by the state pathologist. Total losses in the form of percent disease loss by state and total losses in millions of bushels were determined by averaging the loss by state with the inclusion of the trace estimates.

The 2022 total acres harvested, average yield (bushels/Acre), and total production (yield in bushels) from each state are presented in Table 2. Soybean acreage in the 16 southern states increased in 2022 when compared to the 2021 acreage reported by 5% (1). In general, 14 of the southern states reported an increase in the harvested acres, while two states reported decreases. The 2022 average per acre soybean yield was 41.9 bu/A, which was a 10.0% decrease compared to the average yield from 2021. As opposed to 2021 when several states reported a statewide record yield, none of the states reported a statewide yield in 2022. In addition, 14 of the states reported reductions in yield between 2022 and 2021. Only one state, Mississippi reported a yield that remained the same between the two years and Arkansas recorded a slight, 1 bu/A increase while Florida reported a 7 bu/A increase compared to 2021. In 2022, more than 962 million bushels were harvested from approximately 20.6 million acres from the 16 southern states accounting for a 0.2% increase in the total harvest compared to 2021.

Percentage loss estimates from each state are specific as to causal organism or the common name of the disease (Table 3). The total estimated average percent disease loss for 2022 was slightly lower than the estimated loss observed during 2021 by 1.1%. As a whole, three states reported an increase in percent disease losses compared to 2021 (LA, SC, and TN). The remainder of the 16 states, 13, reported a reduction in percent loss estimates ranging from 0.05% (in TX) to 3.21% (in GA). In terms of the top five diseases encountered during 2021, root-knot nematode, soybean cyst nematode (SCN), Cercospora leaf blight, Phomopsis seed decay, and "other" nematodes were the top five diseases in order or importance. Four of the top five diseases were similar between 2021 and 2022, with Phomopsis seed decay being a greater issue in 2022 than in 2021 likely as a result of the environment encountered during the season. Breaking the diseases evaluated into categories based on specific plant parts impacted by the diseases within the survey resulted in four categories: Nematode diseases (50.5%), stem and root diseases (16.8%), foliar diseases (21.3%), seedling diseases (4.2%), and seed diseases (11.4%). Breaking the diseases down into categories of plant parts impacted helps highlight the importance of specific groups of diseases and which disease areas are causing the greatest estimated losses in a given year/season. Diseases included in the category "other diseases" could not be separated into separate categories and therefore were not included in any single category.

In terms of the disease losses in millions of bushels, the 2022 disease losses accounted for and estimated 58.90, a 23% decrease compared to the estimated losses incurred during 2021 (Table 4).

Environmental conditions during 2022 were extremely dry and somewhat cooler than normal across the southern region (Table 5). In general, a greater number of states recorded reductions in total rainfall over the course of 2022 when compared to the 30-year norm. In all, 12 states recorded negative rainfall totals for 2022. In general, less rainfall was received across the southern region during 2022 with rainfall totals being over 100 inches below normal across the region. The decrease accounted for an 12.1% decrease in total rainfall across the region when compared with the 30-year norm. Total rainfall varied greatly by state with 12 states (AL, DE, GA, KY, MD, MO, MS, NC, OK, SC, TX, and VA) recording overall reductions during 2022 when compared with the 30-year normal by between -0.8 inches (GA) and -20.5 inches (MD). The remainder of the states, AR, FL, LA, and TN recorded increases in rainfall compared to the 30-year norm that ranged from 0.2 (FL) to 2.6 (TN). In addition, temperature for 2022 was also compared to the 30-year normal (1981-2010) at each of the locations. In general, looking across the entire year, based on temperature averages for the whole year, four months, January, August, October, and November were below the 30-year normal temperatures across the region. Conversely, the remainder of the months had temperatures above normal with the greatest temperature increases in March (2.8°F) and May (1.4°F). Looking at temperature data by month, seven months had average temperature increases.

Acknowledgments

Funding was provided from the United Soybean Board to collate the disease loss estimates from the southern region as part of a larger effort to collect losses as they relate to plant diseases from the entire soybean producing area in the U.S. The members of the SSDW Disease Loss Estimate Committee see value in continuing to collect the estimates on an annual basis and will continue to seek funding to support the effort in the future.

Literature Cited

1. Allen, T. W., Bissonnette, K., Bradley, C. A., Damicone, J. P., Dufault, N. S., Faske, T. R., Isakeit, T., Kemerait, R. C., Koehler, A., Langston, D., Lofton, J., Mueller, J. D., Padgett, G. B., Price, P. P., Sikora, E. J., Small, I. M., Vann, R., and Young, H. 2022. Southern United States soybean disease loss estimates for 2021. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 4-5, 2022.
2. Allen, T. W., Bissonnette, K., Bradley, C. A., Damicone, J. P., Dufault, N. S., Faske, T. R., Isakeit, T., Kemerait, R. C., Koehler, A., Mehl, H. L., Mueller, J. D., Padgett, G. B., Price, P. P., Sikora, E. J., Small, I. M., Thiessen, L., and Young, H. 2021. Southern United States soybean disease loss estimates for 2020. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 4-5, 2021.
3. Allen, T. W., Bissonnette, K., Bradley, C. A., Damicone, J. P., Dufault, N. S., Faske, T. R., Isakeit, T., Kemerait, R. C., Koehler, A., Mehl, H. L., Mueller, J. D., Padgett, G. B., Price, P. P., Sikora, E. J., Small, I. M., Thiessen, L., and Young, H. 2020. Southern United States soybean disease loss estimates for 2019. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 4-5, 2020.
4. 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. 2019. Southern United States soybean disease loss estimates for 2018. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 7-8, 2019.
5. 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. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 7-8, 2018.
6. Allen, T. W., Bradley, C. A., Sisson, A. J., Byamukama, E., Chilvers, M. I., Coker, C. M., Collins, A. A., Damicone, J. P., Dorrance, A. E., Dufault, N. S., Esker, P. D., Faske, T. R., Giesler, L. J., Grybauskas, A. P., Hershman, D. E., Hollier, C. A., Isakeit, T., Jardine, D. J., Kemerait, R. C., Kleczewski, N. M., Koenning, S. R., Kurle, J. E., Malvick, D. K., Markell, S. G., Mehl, H. L., Mueller, D. S., Mueller, J. D., Mulrooney, R. P., Nelson, B. D., Newman, M. A., Osborne, L., Overstreet, C., Padgett, G. B., Phipps, P. M., Price, P. P., Sikora, E. J., Smith, D. L., Spurlock, T. N., Tande, C. A., Tenuta, A. U., Wise, K. A., Wrather, J. A., and Young-Kelly, H. 2017. Soybean yield loss estimates due to diseases in the United States and Ontario, Canada from 2010 to 2014. Plant Health Progress. doi: 10.1094/PHP-RS-16-0066.
7. Allen, T. W., Bradley, C. A., Damicone, J. P., Dufault, N. S., Faske, T. R., Hollier, C. A., Isakeit, T., Kemerait, R. C., Kleczewski, N. M., Kratochvil, R. J., Mehl, H. L., Mueller, J. D., Overstreet, C., Price, P. P., Sikora, E. J., Spurlock, T. N., Thiessen, L., Wiebold, W. J., and Young, H. 2017. Southern United States soybean disease loss estimates for 2016. Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 8-9, 2017.
8. Allen, T.W., Damicone, J. P., Dufault, N. S., Faske, T. R., Hershman, D. E., Hollier, C. A., Isakeit, T., Kemerait, R. C., Kleczewski, N. M., Koenning, S. R., Mehl, H. L., Mueller, J. D., Overstreet, C., Price, P. P., Sikora, E. J., and Young, H. 2016. Southern United States

soybean disease loss estimate for 2015. Pages 11-15 in: Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 9-10, 2016.

9. Allen, T.W., Damicone, J. P., Dufault, N. S., Faske, T. R., Hershman, D. E., Hollier, C. A., Isakeit, T., Kemerait, R. C., Kleczewski, N. M., Koenning, S. R., Mehl, H. L., Mueller, J. D., Overstreet, C., Price, P. P., Sikora, E. J., and Young, H. 2015. Southern United States soybean disease loss estimate for 2014. Pages 10-15 in: Proceedings of the Southern Soybean Disease Workers, Pensacola Beach, FL, March 11-12, 2015.
10. Bradley, C. A., Allen, T. W., Sisson, A. J., Bergstrom, G. C., Bissonnette, K. M., Bond, J., Byamukama, E., Chilvers, M. I., Collins, A. A., Damicone, J. P., Dorrance, A. E., Dufault, N. S., Esker, P. D., Faske, T. R., Fiorellino, N. M., Giesler, L. J., Hartman, G. L., Hollier, C. A., Isakeit, T., Jackson-Ziems, T. A., Jardine, D. J., Kelly, H. M., Kemerait, R. C., Kleczewski, N. M., Koehler, A. M., Kratochvil, R. J., Kurle, J. E., Malvick, D. K., Markell, S. G., Mathew, F. M., Mehl, H. L., Hehl, K. M., Mueller, D. S., Mueller, J. D., Nelson, B. D., Overstreet, C., Padgett, G. B., Price, P. P., Sikora, E. J., Small, I., Smith, D. L., Spurlock, T. N., Tande, C. A., Telenko, D. E. P., Tenuta, A. U., Thiessen, L. D., Warner, F., Wiebold, W. J., and Wise, K. A. 2021. Soybean yield loss estimates due to diseases in the United States and Ontario, Canada, from 2015 to 2019. Plant Health Prog. 22:483-495.
11. Koenning, S. R. 2014. Southern United States soybean disease loss estimate for 2013. Pages 1-5 in: Proceedings of the Southern Soybean Disease Workers, Forty-First Annual Meeting, Pensacola, FL.
12. Koenning, S. R. 2013. Southern United States soybean disease loss estimate for 2012. Pages 1-5 in: Proceedings of the Southern Soybean Disease Workers, Fortieth Annual Meeting, Pensacola, FL.
13. Koenning, S. R. 2012. Southern United States soybean disease loss estimate for 2011. Pages 1-5 in: Proceedings of the Southern Soybean Disease Workers, Thirty-Ninth Annual Meeting, Pensacola, FL.
14. Koenning, S. R. 2011. Southern United States soybean disease loss estimate for 2010. Pages 1-5 in: Proceedings of the Southern Soybean Disease Workers, Thirty-Eighth Annual Meeting, Pensacola, FL.
15. Koenning, S. R., and Wrather, J. A. 2010. Suppression of soybean yield potential in the Continental United States by plant diseases from 2006 to 2009. Plant Health Progress doi:10.1094-2010-1122-01-RS.
16. Koenning, S. R. 2010. Southern United States soybean disease loss estimate for 2009. Pages 1-5 in: Proceedings of the Southern Soybean Disease Workers, Thirty-Seventh Annual Meeting, Pensacola, FL.
17. Mulrooney, R. P. 1988. Soybean disease loss estimate for Southern United States in 1985 and 1986. Plant Disease 72:364-365.
18. Mulrooney, R. P. 1988. Soybean disease loss estimate for Southern United States in 1987. Plant Disease 72:915.
19. Pratt, P. W., and Wrather, J. A. 1998. Soybean disease loss estimates for the Southern United States during 1994-1996. Plant Disease 82:114-116.
20. Sciumbato, G. L. 1993. Soybean disease loss estimate for the Southern United States during 1988-1991. Plant Disease 77:954-956.
21. Whitney, G. 1978. Southern states soybean disease loss estimates 1977. Plant Disease Reporter 62:1078-1079.

22. Wrather, J. A., Chambers, A. Y., Fox, J. A., Moore, W. F., and Sciumbato, G. L. 1995. Soybean disease loss estimates for the southern United States, 1974 to 1994. Plant Disease 79:1076-1079.
23. Wrather, J. A., and Sciumbato, G. L. 1995. Soybean disease loss estimates for the Southern United States during 1992-1993. Plant Disease 79:84-85.
24. Wrather, J. A., Anderson, T. R., Arsyad, D. M., Gai, J., Ploper, L. D., Porta-Puglia, A., Ram, H. H., and Yorinori, J. T. 1997. Soybean disease loss estimates for the top 10 soybean producing countries in 1994. Plant Disease 81:107-110.
25. Wrather, J. A., Stienstra, W. C., and Koenning, S. R. 2001. Soybean disease loss estimates for the United States from 1996-1998. Canadian Journal of Plant Pathology 23:122-131.
26. Wrather, J. A., Koenning, S. R., and Anderson, T. 2003. Effect of diseases on soybean yields in the United States and Ontario 1999-2002. Online. Plant Health Progress doi: 10.1094/PHP-2003-0325-01-RV.
27. Wrather, J. A., and Koenning, S. R. 2005. Soybean disease loss estimates for the United States 1996-2004. http://aes.missouri.edu/delta/research/soyloss.stm
28. Wrather, J. A., and Koenning, S. R. 2006. Estimates of disease effects on soybean yields in the United States 2003-2005. Journal of Nematology 38:173-180.
29. Wrather, J. A., and Koenning, S. R. 2009. Effects of diseases on soybean yields in the United States 1996 to 2007. Plant Health Progress doi10:1094/PHP-2009-0401-01-RS.

Table 1. Locations where environmental data were downloaded based on the county/parish in each state with the greatest soybean production and a town within that county that contained environmental data for the 2022.

State	**County/Parish** [a]	**Location**	**Acres of soybean production** [b]	**Specific weather station** [c]
Alabama	Limestone	Athens	55,431	Athens
Arkansas	Mississippi	Keiser	278,900	Keiser
Delaware	Sussex	Georgetown	76,895	Georgetown Delaware Coastal Airport
Florida	Jackson	Marianna	3,455	Marianna Municipal Airport
Georgia	Laurens	Dublin	7,904	Dublin 2
Kentucky	Christian	Hopkinsville	88,915	Hopkinsville (Christian County)
Louisiana	Madison	Tallulah	114,934	Tallulah Vicksburg Regional Airport
Maryland	Worcester	Snow Hill	35,083	Gaithersburg Montgomery Co Air Park
Mississippi	Bolivar	Cleveland	289,736	Cleveland
Missouri	Saline	Marshall	145,446	Marshall
North Carolina	Robeson	Lumberton	83,630	Lumberton
Oklahoma	Kay	Blackwell	104,835	Blackwell 4 SSE Mesonet
South Carolina	Florence	Florence	43,320	Florence Regional Airport
Tennessee	Gibson	Milan	115,285	Milan Experimental Station
Texas	Lamar	Paris	18,607	Paris
Virginia	Accomack	Painter	32,951	Painter 2 W

[a] County or parish soybean production data from each of the greatest soybean producing counties/parishes were determined based on data provided from the crop acreage data set from the USDA Farm Service Agency (www.fsa.usda.gov). Note that a weather station could not be located in the greatest soybean producing county/parish in Louisiana, Maryland, or Missouri. The third largest soybean producing parish in Louisiana, fifth largest soybean producing county in Maryland and third largest in Missouri were therefore relied on for environmental data.

[b] The total soybean acres produced in each county were determined based on FSA data and were added in instances where soybean production was separated based on irrigation practice, seed production, or the production of edamame.

[c] Specific weather station names are included for the purposes of presenting a historical record of these data as downloaded from the National Centers for Environmental Information website (www.ncdc.noaa.gov). In addition, weather stations were chosen that included a 30-year normal data set so comparisons could be made between 2022 and the normal environmental data. The specific weather station was based on the name assigned by NASS and can be located on their website.

[d] The data for the location in Kentucky was downloaded from http://kymesonet.org/monthly_summaries.html. The Kentucky Mesonet site was the only one that included temperature as well as precipitation data.

Table 2. Soybean production from the 16 southern states during 2022 [a].

State	Acres (1,000s) [b]	Bu/Acre [b,c]	Yield in bu/A (1,000s) [b]
Alabama	355 (+)	41 (-5)	14,555 (+)
Arkansas	3,150 (+)	52 (+1)	163,800 (+)
Delaware	158 (+)	43 (-8)	6,794 (-)
Florida	22 (+)	52 (+7)	1,144 (+)
Georgia	160 (+)	41 (-5)	6,560 (+)
Kentucky	1,940 (+)	51 (-5)	98,940 (-)
Louisiana	1,210 (+)	47 (-4)	56,870 (+)
Maryland	510 (+)	43 (-10)	21,930 (-)
Mississippi	2,290 (+)	54 (.)	123,660 (+)
Missouri	6,060 (+)	45.5 (-3.5)	275,730 (-)
North Carolina	1,690 (+)	38.5 (-1.5)	65,065 (-)
Oklahoma	385 (-)	17 (-6)	6,545 (-)
South Carolina	390 (+)	37 (-1)	14,430 (-)
Tennessee	1,620 (+)	48 (-2)	77,760 (+)
Texas	85 (-)	20 (-18)	1,700 (-)
Virginia	610 (+)	41 (-5)	27,140 (-)
TOTAL	**20,635 (+)**		**962,623 (+)**
		Avg. 41.9 (-4.2)	

[a] Data were compiled from the USDA National Agricultural Statistics Service Crop Production 2022 Summary as distributed in January 2022. The report, in its entirety, can be downloaded from: https://downloads.usda.library.cornell.edu/usda-esmis/files/k3569432s/sn00c1252/g158cj98r/cropan22.pdf.

[b] Difference from 2021 indicated in parentheses as either a decrease (-) or increase (+).

Table 3. Estimated percentage loss of soybean yield due to diseases from 16 southern states during 2022.

	% yield suppression by state																
Disease	**AL[a]**	**AR**	**DE**	**FL**	**GA**	**KY**	**LA**	**MD**	**MO**	**MS**	**NC**	**OK**	**SC**	**TN**	**TX**	**VA**	**AVG**
Anthracnose	0.01	0.01	0.00	0.05	0.50	0.00	0.02	0.00	0.00	0.18	0.01	0.10	0.03	0.30	0.00	0.01	**0.08**
Bacterial diseases	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.01	0.00	0.00	0.00	**0.01**
Brown stem rot	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Cercospora leaf blight	1.10	1.00	0.01	1.50	1.00	0.10	1.75	0.01	0.10	2.00	0.50	0.50	1.10	0.01	0.00	0.25	**0.68**
Charcoal rot	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.01	1.80	0.30	0.50	0.00	0.01	**0.17**
Downy mildew	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	**0.00**
Frogeye leaf spot	0.02	0.03	0.00	0.00	0.00	0.90	0.01	0.01	0.00	0.00	0.15	0.00	0.01	1.10	0.00	0.13	**0.15**
Fusarium wilt and root rot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.30	0.00	0.00	0.00	0.01	**0.02**
Other diseases (please list in comments column)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Phomopsis seed decay	0.03	0.00	0.10	0.50	0.50	0.00	5.00	0.05	0.00	0.01	0.00	0.80	0.70	0.50	0.00	0.10	**0.52**
Phytophthora root and stem rot	0.00	0.01	0.00	0.00	0.00	0.30	0.00	0.00	0.50	0.00	0.00	0.30	0.00	0.01	0.00	0.00	**0.07**
Pod and stem blight	0.01	0.01	0.20	0.10	1.00	0.05	0.05	0.05	0.10	0.00	0.01	0.20	0.20	0.01	0.00	0.01	**0.13**
Purple seed stain	0.02	0.05	0.10	0.05	0.10	0.03	0.01	0.10	0.00	0.02	0.01	0.60	0.05	0.50	0.00	0.01	**0.10**
Reniform nematode	0.30	0.30	0.00	0.50	0.10	0.00	1.89	0.00	0.00	0.06	0.00	0.00	0.90	0.01	0.00	0.00	**0.25**
Root-knot nematode	1.20	4.20	1.50	1.00	1.50	0.00	2.23	0.50	0.02	1.75	1.00	0.30	3.00	0.01	0.00	1.00	**1.20**
Soybean cyst nematode	0.20	0.30	2.50	0.00	0.00	2.80	0.00	1.00	2.50	0.05	2.00	1.30	0.50	1.60	0.00	2.00	**1.05**
Other nematodes (please list in comments column)	0.00	0.03	0.50	0.00	0.10	0.00	0.00	0.01	0.00	0.00	0.25	0.00	3.00	0.00	0.00	0.25	**0.26**
Red crown rot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	**0.01**
Rhizoctonia aerial blight	0.02	0.05	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	**0.04**
Sclerotinia stem rot (white mold - *Sclerotinia sclerotiorum*)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Seedling diseases due to *Fusarium, Pythium, Phomopsis, Rhizoctonia*	0.01	0.05	0.05	0.01	0.00	0.70	0.02	0.50	0.05	0.40	0.25	0.40	0.03	1.00	0.00	0.25	**0.23**
Septoria brown spot	0.00	0.02	0.02	0.05	0.00	0.30	0.05	0.20	0.01	0.10	0.05	0.60	0.04	0.80	0.00	0.05	**0.14**
Southern blight	0.10	0.10	0.00	0.00	0.01	0.00	0.06	0.00	0.00	0.20	0.00	0.00	0.05	0.00	0.00	0.00	**0.03**
Soybean rust	0.05	0.00	0.00	0.50	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	**0.10**
Stem Canker	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	**0.03**
Sudden death syndrome	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.25	0.00	0.01	0.10	0.01	0.00	0.00	0.01	**0.07**
Taproot decline	0.05	0.05	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	**0.08**
Target spot	0.00	0.01	0.00	0.00	0.00	0.30	0.00	0.00	0.01	0.00	0.01	0.00	0.10	0.05	0.00	0.01	**0.03**
Virus Diseases (please list in comments column)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	**0.00**
Total disease %	**3.12**	**6.22**	**4.98**	**4.27**	**5.82**	**6.70**	**12.61**	**2.44**	**3.55**	**5.12**	**4.29**	**7.40**	**10.28**	**6.39**	**0.00**	**4.12**	**5.46**

[a] Rounding errors may exist since some numbers presented carry decimal places beyond the hundredths place.

[b] Other diseases listed included: Phymatotrichopsis root rot (TX).

[c] Other nematodes listed included: Columbia lance nematode (SC), lance nematode (AR, DE, MD), lesion nematode (DE, MD), sting nematode (GA), stubby root nematode (SC).

[d] Virus diseases listed included: *Bean pod mottle virus* (KY), *Soybean vein necrosis virus* (DE, KY, MD, MS), *Tobacco ringspot virus* (KY).

Table 4. Estimated suppression of soybean yield (Millions of Bushels) as a result of disease during 2022.

	yield suppression by state (millions of bushels)[a]																
Disease	**AL**	**AR**	**DE**	**FL**	**GA**	**KY**	**LA**	**MD**	**MO**	**MS**	**NC**	**OK**	**SC**	**TN**	**TX**	**VA**	**TOTAL**
Anthracnose	0.00	0.02	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.23	0.01	0.01	0.00	0.25	0.00	0.00	**0.57**
Bacterial diseases	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	**0.01**
Brown stem rot	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**
Cercospora leaf blight	0.17	1.75	0.00	0.02	0.07	0.11	1.14	0.00	0.29	2.61	0.34	0.04	0.18	0.00	0.00	0.07	**6.76**
Charcoal rot	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.01	0.13	0.05	0.42	0.00	0.00	**0.63**
Downy mildew	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.01**
Frogeye leaf spot	0.00	0.05	0.00	0.00	0.00	0.95	0.01	0.00	0.00	0.00	0.10	0.00	0.00	0.91	0.00	0.03	**2.07**
Fusarium wilt and root rot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	**0.04**
Other diseases (please list in comments column)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Phomopsis seed decay	0.00	0.00	0.01	0.01	0.03	0.00	3.25	0.01	0.00	0.01	0.00	0.06	0.11	0.42	0.00	0.03	**3.95**
Phytophthora root and stem rot	0.00	0.02	0.00	0.00	0.00	0.32	0.00	0.00	1.43	0.00	0.00	0.02	0.00	0.01	0.00	0.00	**1.80**
Pod and stem blight	0.00	0.02	0.01	0.00	0.07	0.05	0.03	0.01	0.29	0.00	0.01	0.01	0.03	0.01	0.00	0.00	**0.55**
Purple seed stain	0.00	0.09	0.01	0.00	0.01	0.03	0.01	0.02	0.00	0.03	0.01	0.04	0.01	0.42	0.00	0.00	**0.67**
Reniform nematode	0.05	0.52	0.00	0.01	0.01	0.00	1.23	0.00	0.00	0.07	0.00	0.00	0.14	0.01	0.00	0.00	**2.04**
Root-knot nematode	0.18	7.34	0.11	0.01	0.10	0.00	1.45	0.11	0.06	2.28	0.68	0.02	0.48	0.01	0.00	0.26	**13.09**
Soybean cyst nematode	0.03	0.52	0.18	0.00	0.00	2.97	0.00	0.22	7.15	0.07	1.36	0.09	0.08	1.33	0.00	0.52	**14.52**
Other nematodes (please list in comments column)	0.00	0.05	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.48	0.00	0.00	0.07	**0.81**
Red crown rot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	**0.03**
Rhizoctonia aerial blight	0.00	0.09	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	**0.55**
Sclerotinia stem rot (white mold - *Sclerotinia sclerotiorum*)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Seedling diseases due to *Fusarium, Pythium, Phomopsis, Rhizoctonia*	0.00	0.09	0.00	0.00	0.00	0.74	0.01	0.11	0.14	0.52	0.17	0.03	0.00	0.83	0.00	0.07	**2.72**
Septoria brown spot	0.00	0.03	0.00	0.00	0.00	0.32	0.03	0.04	0.03	0.13	0.03	0.04	0.01	0.66	0.00	0.01	**1.35**
Southern blight	0.02	0.17	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.26	0.00	0.00	0.01	0.00	0.00	0.00	**0.50**
Soybean rust	0.01	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.08**
Stem Canker	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.44**
Sudden death syndrome	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.71	0.00	0.01	0.01	0.00	0.00	0.00	0.00	**1.58**
Taproot decline	0.01	0.09	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	**1.07**
Target spot	0.00	0.01	0.00	0.00	0.00	0.32	0.00	0.00	0.03	0.00	0.01	0.00	0.02	0.04	0.00	0.00	**0.43**
Virus Diseases (please list in comments column)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	**0.01**
Total disease %	**0.47**	**10.86**	**0.36**	**0.05**	**0.41**	**7.11**	**8.20**	**0.55**	**10.15**	**6.67**	**2.92**	**0.52**	**1.65**	**5.31**	**0.00**	**1.08**	**56.29**

[a] Rounding errors may exist since some numbers presented carry decimal places beyond the hundredths place.

[c] Other nematodes listed included: Columbia lance nematode (SC), lance nematode (DE), lesion nematode (AL, AR, DE, KY, SC), spiral (KY, LA), sting nematode (GA, SC), stubby root nematode (SC).

[c] Virus diseases listed included: *Soybean vein necrosis virus* (DE, KY, MD, MS, NC).

Table 5. Deviation of the 2022 temperature from the 30-year normal and the total precipitation for 2022 and the 30-year normal from each of the 16 southern soybean producing states based on data downloaded from the centroid for each respective state.

	Deviation from the 30-year temperature norm (°F) [a]												**Total precip (in) [b]**		
State	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**2022**	**30-year**	**Deviation**
Alabama	-2.7	-2.7	-2.8	-1.3	-1.2	-0.2	-0.2	0.1	0.2	-0.5	-2.5	-2.0	56.3 (6)	59.1	**-2.8**
Arkansas	-2.3	-2.4	1.5	-3.8	0.7	0.1	0.1	-4.1	-0.3	-0.4	-1.5	1.7	54.7 (8)	52.2	**2.5**
Delaware	-3.0	4.1	4.4	-0.7	0.6	1.7	1.7	3.6	1.4	-2.1	4.2	-0.1	40.6 (4)	43.8	**-3.2**
Florida	-2.2	1.4	2.2	-0.8	-1.2	-1.5	-1.5	-1.4	-0.3	-0.1	0.7	0.6	58.3 (5)	51.1	**0.2**
Georgia	0.1	5.0	4.9	2.9	2.3	-0.7	-0.7	-1.5	-1.1	-2.6	0.8	-1.2	47.3 (5)	49.3	**-0.8**
Kentucky	-1.9	0.8	3.8	-2.7	0.9	1.2	1.2	-1.8	-0.4	-0.1	0.7	-0.1	50.7 (3)	51.8	**-1.1**
Louisiana	2.4	0.8	3.0	2.9	4.6	1.7	1.7	-2.1	0.7	1.7	1.0	2.6	53.9 (5)	53.3	**0.6**
Maryland	-1.7	12.0	7.7	1.9	1.2	0.0	0.0	1.3	-0.3	-4.2	6.2	3.4	26.9 (1)	47.4	**-20.5**
Missouri	0.7	-0.4	2.1	-2.0	1.4	1.3	1.3	0.6	3.7	2.0	1.6	-2.4	30.7 (2)	41.8	**-11.1**
Mississippi	0.3	-0.6	0.8	-2.8	2.4	0.3	0.3	-4.6	-9.5	-13.2	-8.8	6.1	52.6 (7)	59.3	**-6.7**
North Carolina	-1.7	4.0	5.1	1.8	4.4	0.1	0.1	0.5	2.0	-2.4	0.0	-1.7	24.1 (1)	50.8	**-26.7**
Oklahoma	2.5	-1.3	1.2	3.8	-0.1	6.7	6.7	3.3	7.2	4.5	-3.0	-0.8	22.2 (2)	38.8	**-16.6**
South Carolina	-1.3	5.3	4.1	0.8	3.2	-0.8	-0.8	-1.4	0.0	-2.5	1.8	-2.4	39.2 (5)	45.3	**-6.1**
Tennessee	-2.3	0.8	1.1	-1.4	0.7	3.4	3.4	-1.5	-2.6	0.8	-2.2	11.1	58.8 (6)	56.2	**2.6**
Texas	1.9	-3.1	2.6	1.3	3.1	6.3	6.3	-0.4	4.6	0.9	-4.1	-1.5	41.2 (4)	48.9	**-7.7**
Virginia	-0.2	4.1	3.8	0.1	-0.2	-0.2	-0.2	1.6	2.0	-3.3	2.7	-0.3	42.6 (4)	47.2	**-4.6**
Avg.	-0.7	1.7	2.8	0.0	1.4	1.2	1.2	-0.5	0.5	-1.3	-0.1	0.8	--	--	**-102.0**

[a] Deviations of temperature were calculated based on subtracting the average temperature for each month from the 30-year normal. Negative numbers are deviations below the normal and positive numbers are deviations above the normal temperature for the 30-year period from 1981-2010.

[b] Numbers in parentheses equal the number of months where the total rainfall was greater than the 30-year normal for each month at the given location. Only values greater than 0.0 were considered "above the normal".

The Implementation of a National Response to a New Soybean Pathogen, *Phakopsora pachyrhizi*, in North America

James J. Marois

University of Florida

The pathogen causing soybean rust, *Phakopsora pachyrhizi*, was first described in Japan in 1902. In 2004, Ray Schneider discovered *P. pachyrhizi* in Louisiana. It is likely the pathogen arrived with hurricane Ivan. Based on yield losses from other countries, it was clear that this pathogen could have a major economic impact on the yield of 30 million ha of soybean in the United States. Because of its potential impact on soybean production the fungus had been added to the list of Federal Select Agent Program directed by USDA APHIS and the CDC to identify organisms and toxins that pose a severe threat to public, animal, or plant health. The organized response by the SSDW and national cooperators was unprecedented. This presentation will cover some of the major aspects of that effort.

Fungicide Resistance in *Cercospora sojina*: How Did We Get Here and What's Next?

Carl A. Bradley

Department of Plant Pathology, University of Kentucky, Princeton, KY

Frogeye leaf spot, caused by *Cercospora sojina*, can be one of the most damaging foliar diseases of soybean in the U.S. Management of frogeye leaf spot can be achieved by integrating different practices, such as planting resistant soybean cultivars, rotating with non-host crops, and applying foliar fungicides. Over the past two decades, application of fungicides on soybean for management of foliar diseases, like frogeye leaf spot, and for other reasons, has increased. The fungicide "boom" on soybean started in the early to mid-2000s with the first registration of quinone outside inhibitor (QoI) fungicides, such as azoxystrobin and pyraclostrobin. At the beginning, these QoI fungicides were highly effective at managing frogeye leaf spot, and helped protect soybean yields. The popularity of the QoI fungicides grew over the next few years, which coincided with the first detection of soybean rust (caused by *Phakopsora pachyrhizi*) in the continental U.S. in 2004. Initially, the QoI fungicides often were applied alone, but shortly after were applied as products pre-mixed primarily with demethylation inhibitor (DMI) fungicides.

Beginning in 2010, QoI-resistant strains of *C. sojina* were identified in southern Illinois, western Kentucky, and western Tennessee. The resistance was complete at field use rates of QoI fungicides, with QoI-resistant isolates often being over 1,000-fold less sensitive than QoI-sensitive isolates. The mechanism of resistance was later attributed to a mutation in the cytochrome b gene that resulted in an amino acid substitution of glycine to alanine at position 143, known as the G143A mutation. Molecular and discriminatory dose assays were developed that allowed for more efficient and higher volume screening for QoI resistance in *C. sojina* populations. To date, QoI-resistant *C. sojina* isolates that have the G143A mutation have been observed in over 20 states. This has resulted in poor efficacy of the QoI fungicides for frogeye leaf spot management across a wide area in the U.S., and has led to a greater reliance on DMI, methyl benzimidazole carbamate (MBC), and succinate dehydrogenase inhibitor (SDHI) fungicides for frogeye leaf spot management. This has also led to greater selection pressure on these fungicide classes, which may result in reduced sensitivity of *C. sojina* to these fungicides over time. A recent meta-analysis of frogeye leaf spot fungicide trials conducted from 2015 to 2020 showed a trend of reduced efficacy of these fungicides over that six-year period.

With the current trend, *C. sojina* isolates with resistance to multiple fungicide chemistry classes is likely in the future. Breeding soybean cultivars with improved and durable resistance to frogeye leaf spot, developing tools that help farmers better predict frogeye leaf spot risk in their fields, developing effective biological and alternative management products, and placing a greater emphasis on only applying fungicides when they are needed, based on scouting observations and disease risk, will help slow down the current trend and result into more sustainable ways to manage this important disease into the future.

Exploring Mechanisms of Effector-Triggered Susceptibility in the Soybean-*Sclerotinia* Pathosystem

Mitchell G. Roth and Tiffanna J. Ross

The Ohio State University, Department of Plant Pathology, Wooster, OH 44691

To date, strong genetic resistance to white mold is lacking in commercial soybean lines, partially due to the lack of R-genes effective against *S. sclerotiorum*. Utilizing a unique set of criteria, an analysis of a time-course RNA-seq data set in a pair of recombinant inbred lines (RILs) has revealed strong evidence that *S. sclerotiorum* might be manipulating R-gene mediated defense mechanisms, triggering uncontrolled programmed cell death (PCD), and increasing disease susceptibility. In the partially resistant RIL, this R-gene mediated susceptibility is lacking although the R-gene appears to be present and expressed. Candidate effectors used by *S. sclerotiorum* to trigger the R-gene mediated susceptibility have already been identified through homology searches to known elicitors in other fungi. We have begun whole-genome sequencing of the two RILs with long read (Nanopore) technologies and will be performing de novo assemblies to examine structural variation between the RILs, particularly in the region containing the R-gene. We have identified and cloned two candidate *S. sclerotiorum* effectors and the corresponding soybean R-gene into *Agrobacterium* expression vectors and yeast 2-hybrid bait and prey vectors to examine the effects of transient expression of the *Sclerotinia* effectors *in planta* and for screening of direct interactions respectively. Lastly, two unique silencing constructs were generated using the cowpea severe mosaic virus system to perform virus induced gene silencing (VIGS) experiments. These VIGS constructs will be used to silence this R gene in soybean and perform inoculations with *Sclerotinia* and examine if silencing the R-gene confers enhanced resistance, as expected. Overall, this work aims to identify and validate that less is more; removing an R-gene could lead to enhanced resistance to SSR in soybean.

Investigating a Potential Relationship Between *Xylaria necrophora* and Plant Parasitic Nematodes of Soybean

Shelly N. Pate[1], H.M. Kelly[1], E. Bernard[1], and L.A. Schumacher[2]

[1]Entomology and Plant Pathology Department, University of Tennessee, 370 Plant Biotechnology, Knoxville, TN 37996-4560 and 605 Airways Blvd, Jackson, TN 38301, USA
[2]USDA, Agricultural Research Service, Crop Genetics Research Unit, 605 Airways Blvd, Jackson, TN 38301, USA

Growers and extension agents across the Southeast have become increasingly concerned about a previously unknown root disease of soybean. This disease is now known as taproot decline and is caused by the fungus *Xylaria necrophora*. Preliminary reports from other states indicate significant yield loss. Some research efforts have been made to address concerns related to this mysterious emerging pathogen. However, no studies have been conducted to assess the relationship of *X. necrophora* with other soil-borne pathogens. Knowing that plant-parasitic nematodes (PPNs) have the potential to have synergistic interactions with fungal pathogens, ongoing greenhouse and microplot studies at the University of Tennessee are aimed at determining the relationship between *X. necrophora* and economically important PPNs of Tennessee soybean: synergistic, antagonistic, or non-existent.

Soybean On-farm Foliar Fungicide Trial Summary 2020-2022

Rafael Zaia, T. Spurlock, R. Hoyle, and A. Rojas

Thirty-two on-farm large block fungicide trials were established in Arkansas in 2020, 2021, and 2022. Trials were arranged in randomized complete block designs and either planted on 30-inch or 38-inch rows with each fungicide treatment, typically two, replicated three times, and a non-treated control included in each replication. Trial sizes varied but were typically around 30 acres each. The standard fungicide treatment was Miravis Top applied at 13.7 fl oz/A at all locations. Other fungicide applications included Revytek applied at 8 fl oz/A, Lucento applied at 5.5 fl oz/A, Trivapro applied at 13.7 fl oz/A, Approach Prima applied at 6.8 fl oz/A or Priaxor applied at 4 fl oz/A + Tilt at 4 fl oz/A. Each trial was furrow irrigated except for one location in Arkansas County which was irrigated with a center pivot. Fungicides were applied at R3 with a 30ft boom mounted on a ground-driven sprayer in a total water volume of 10 gal/A at 40 psi using TeeJet XR11002VS tips at 5.0 mph. Five points were georeferenced approximately equidistant throughout each block for disease assessments. Disease severity data were collected at a 5-foot radius around each point on a percentage scale in 2020, 0-100% where a higher percentage indicated more severe disease, or a 0-9 scale in 2021 and 2022 where a rating of 9 represented the most severe disease. Diseases were assessed prior to treatment and again at R6. Aerial imagery was collected using a 5-band multispectral sensor mounted on a drone at the time of fungicide application and when disease levels were determined. The grain was harvested with a commercial combine and yield data collected using either a yield monitor or weigh wagon. Yields were adjusted to 13% moisture content for comparison. Prior to analysis, field disease ratings were treated as ordinal data and rank transformed using the rank function in R or Python. Georeferenced yield data were buffered and ‘cleaned’ by treatment block. All resulting data were averaged within each fungicide block and analyzed by nested ANOVA followed by means separation of fixed effects using Tukey’s honest significant difference test (HSD) at P=0.05. Weather data at each location was collected by subscription service to DTN. Across all years, yield data was collected from 27 trials and a significant yield response to fungicide application occurred in 18 trials. Of the trials where a significant yield response occurred, only one was R3 prior to 1 July, and only two others R3 at or before 15 July. These data indicate that the opportunities for yield protection by a fungicide application tended to occur in later maturing soybean fields.

Identifying the Factors Influencing Soybean Disease Management Decisions in Nebraska

Asha G. Mane[1*], Sydney E. Everhart[2], and Tamra A. Jackson-Ziems[1]
*Presenting, PhD Candidate

[1]Department of Plant Pathology, University of Nebraska-Lincoln, Lincoln, Nebraska
[2]Department of Plant Science and Landscape Architecture, University of Connecticut, Storrs, Connecticut

In 2020, resistance to group 11 QoI (strobilurin) fungicides was confirmed in soybean frogeye leaf spot samples from 48 Nebraska counties. The issue of fungicide resistance is becoming more prevalent in the United States. To effectively communicate with stakeholders, extension educators need information on how the decision to apply fungicides is made. Our research examined stakeholders' priorities to better understand their needs. We developed a survey to assess perceptions of soybean diseases and reasons for foliar fungicide applications. The 10-question survey included both multiple-choice and short-answer responses. After obtaining approval from the Institutional Review Board, a year-long survey was distributed at University Extension row crop meetings. Survey responses were captured in Qualtrics. Data and statistical analyses were conducted with Qualtrics, MS Excel, and R studio.

A total of 1,054 (26% response rate) survey responses were received from 84 counties representing soybean producers (74%), agriculture business representatives (12%), crop consultants (8%), farm managers (2%), Extension employees (1%), and others (3%). The application of fungicides was the second most recommended disease management practice after crop rotation. Over 90% of crop consultants and agriculture business representatives statewide recommended a fungicide application on soybeans at least once during the last five years. In comparison, 64% of farmers/farm managers applied a foliar fungicide on soybeans at least once. Regardless of the fungicides applied or recommended, the factors considered remained the same: disease severity (34%), fungicide cost (31%), and crop market value (27%). Only 8% of respondents consider the fungicide mode of action essential to making application decisions. Recommendations from the local agricultural cooperative service providers (51%) were the most cited source of information used to make disease management decisions, followed by University Extension (21%). In the future, extension programs will be designed to target cooperative service providers to promote integrated disease management strategies and sustainable use of foliar fungicide and will emphasize the importance of the mode of action.

Use of NDVI to Assess Soybean Disease

Elias Zuchelli, Heather Kelly

The University of Tennessee

Soybean diseases such as frogeye leaf spot (FLS), target spot (TS) and Septoria brown spot (SBS), are caused by fungal pathogens that infect plants, and interfere with photosynthesis. As a response to disease infection plants show signs of stress and eventual lesion development on foliage. NDVI is an index estimate based on the plant reflectance of the red and the near infrared part of the light spectra, therefore the use of NDVI has a potential to estimate stressed, diseased plants. The goal for this project was to evaluate the use of NDVI as a method to quantify disease in soybean. A trial was conducted in a commercial field in Jackson TN, using a randomized factorial design. The following factors and treatments were evaluated: Factor 1- fungicide treatment applied at R3 (beginning pod development) non-treated check, azoxystrobin + propiconazole, azoxystrobin + tebuconazole and pydiflumetofen + difenoconazole; Factor 2 – variety: 45XF0 (FLS resistant) and 47XF0 (FLS susceptible). Plots were 4 rows wide on 30-inch centers and 30 feet long with four replications. To assess NDVI, a DJI Inspire equipped with a MicaSense Altumn was flown at a speed of 2 m/s, 20 m in altitude, and 90% overlap. NDVI was calculated using Pix4D-created maps and ArcGIS. Yield was also recorded. Results were submitted to analysis of variance and means were separated using Tukey's HSD (α=5%) in JMP. FLS severity was greater in the non-treated check, although there were no differences between fungicide treatments (p=0.0017). There were no differences for NDVI and yield when comparing fungicide treatments. The variety Asgrow 47XF0 had higher NDVI than the 45XF0 (p=0.0002), however there was no difference for yield and disease severity. Further advances in camera development and/or different areas of spectra need to be utilized to be able to identify small changes in the leaf spectra such as the ones caused by disease; whereas changes such as variety are identified by NDVI.

Effects of Fungicide Application in Drought Stress Environments on Soybean

Jackson Adcock, Dr. Heather Kelly, and Dr. Avat Shekoofa

University of Tennessee

Tennessee soybean growers regularly use fungicides to help manage disease pressure within their fields. The value of a traditional fungicide application can be called into question when drought conditions are present in a growing season. This study investigates both the physiological and yield effects of a fungicide application to soybeans under drought stressed environments. Between three locations in West Tennessee, soybean response to an application of Miravis Top (a pre-mix of Pydiflumetofen and Difenoconazole) was monitored in irrigated fields, rain fed fields, and plots under rain-out shelters. Multiple soybean varieties were chosen with varying levels of drought tolerance and disease susceptibility. Data was collected for impacts in leaf area size, relative water content, disease pressure, and yield. In this presentation, the results of the trial will be discussed.

Fungicides Sensitivity of *Athelia rolfsii* from Mississippi Fields

Subina Tripathi, Tom Allen, Alejandra Jimenez Madrid, Tessie Wilkerson

Delta Research and Extension Center, Mississippi State University, Stoneville, Mississippi 38776

Southern blight, caused by the fungus *Athelia rolfsii* (*AR*) is one of the most devastating plant diseases worldwide causing huge yield and economic losses. It is a soilborne disease that affects a wide range of hosts, including vegetables, fruits, ornamentals, and field crops. The disease is prevalent in the southern United States (US) due to the wet, humid weather creating perfect conditions for fungal growth and disease outbreaks. Southern blight causes up to 70% or greater yield losses in the US. Southern blight is frequently observed in regions that receive significant rainfall or have high levels of irrigation. The symptoms of southern blight vary depending on the crop species, but in general, affected plants exhibit a rapid wilting and collapse of the stem, often accompanied by white fungal growth at the soil line. The fungus can infect plant roots, stems, and fruit, and can cause significant crop damage. Currently, the management options include a combination of control practices and fungicide applications. When resistant varieties are not available, the most common and simplest way to control the disease is by using fungicides. Although, fungicides are used to manage the disease, the efficacy of these fungicides can vary depending on the fungal population and environmental factors. Therefore, it is important to conduct *in vitro* sensitivity assays to evaluate the effectiveness of different fungicides against *AR* populations. In this study, *AR* isolates were collected from various locations in Mississippi and were tested against five fungicides (prothioconazole, azoxystrobin, fluxapyroxad, fluazinam, and pyraclostrobin). During 2022 *AR* sclerotia stored from the previous year were isolated on potato dextrose agar and incubated at 25°C under dark conditions. After a 7-day incubation period, silky-white, fluffy mycelia, was observed, which was further examined under the microscope to confirm the presence of the clamp connection. After 20 days, formation of sclerotia, which had a small tan to dark brown or black coloration, was observed. Genomic DNA was extracted from six isolates using the Norgen kit with some modification using liquid nitrogen. The internal transcribed spacer region (ITS) was amplified using universal primers (ITS1and ITS4) and with species-specific primers (SRITS1 and SRITS4) to confirm *AR*. The isolates were confirmed based on morphological characteristics and the polymerase chain reaction-based method. For the i*n vitro* sensitivity assay, a 5 mm actively growing fungal plug was placed in the center of fungicide amended plates at rates of 10,1,0.1,0.01,0.001 µg/ml and colony diameter was measured after 4 days. This experiment was arranged as a completely randomized design with three replicate plates per isolate and the experiment was repeated three times. Azoxystrobin was found to be less sensitive with an EC_{50} value of 3.35 to 8.41 µg/ml when compared to other fungicides. Whereas fluazinam (EC_{50}= 0.05µg/ml) was highly sensitive followed by fluxapyroxad and prothioconazole (EC50= 0.08 µg/ml). Based on the findings of this study, fungicide sensitivity levels of *AR* populations should be monitored for future research.

Quantification of *Athelia rolfsii* by qPCR to Assess Cultivar Susceptibility and Fungicide Efficacy for Control of Southern Blight of Soybean

Adam Connor[1], Tom Allen[1], Alejandra Jimenez Madrid[1], Nina Aboughanem-Sabanadzovic[2],
Trent Irby[3], and Tessie Wilkerson[1]

[1] Delta Research and Extension Center, Mississippi State University, Stoneville, Mississippi 38776
[2]Institute for Genomics, Biocomputing and Biotechnology, Mississippi State, MS 39762, USA
[3]Department of Plant and Soil Sciences, Mississippi State University, 32 Creelman Street, Starkville Ms, 39762, USA

Southern Blight (SB), caused by the fungus *Athelia rolfsii*, has increasingly impacted Mississippi soybean production with economic losses in recent years rising from \$181,616 in 2016 to \$9,508,412 in 2021. Currently, there are no recommended fungicides and no known commercially available cultivar resistance. The objectives of this study were to develop a real-time quantitative method to measure the aggressiveness of SB, and (ii) to evaluate the fungicidal efficacy in combination with commercially available soybean cultivars using the newly developed qPCR method. The experiment was arranged in a randomized complete block design with three cultivars and five fungicides. Assessment of plant vigor, severity, and germination rate were recorded weekly beginning 10 days after planting. Soil and stem samples were taken at harvest and DNA was extracted for downstream use. A qPCR method was developed using the SCR-F and SCR-R primers to amplify a 540-bp product. All qPCR mixtures consisted of 10 µl of SYBR Green PCR Master Mix, 1 µl of 10 µM forward and reverse primers, 1 µl BSA, 6 µl of nuclease-free water, and 1 µl of DNA template resulting in a 20µl mixture. The resulting mixtures will be subjected to real-time qPCR as follows: 2 min at 94°C, 35 cycles of 30 s at 94°C, 1 min at 54°C, 1 min at 72°C, and one final extension of 8 min at 72°C followed by a melt curve analysis. Differences in fungicidal efficacy as well as cultivar response to the presence of SB will be evaluated.

Insecticide Seed Treatments and Their Influence on Sudden Death Syndrome (SDS) in Tennessee Soybean

Alexandra Crowder, Dr. Sebe Brown, and Dr. Heather Kelly

University of Tennessee

Sudden Death Syndrome (SDS) is yield-reducing disease of soybean caused by *Fusarium* spp., most commonly associated with *F. virguliforme*. Losses from SDS can reach up to an estimated 29 million bushels or $284 million USD (based on a five-year average). Symptoms of this disease includes necrotic roots, malformed leaves, chlorotic to necrotic spots on foliage, green venation, and abscised leaflets from petioles leading to plant death. Foliar symptoms are due to toxin introduced to the vascular tissues from the fungus colonizing the root system. Conducive conditions for SDS are cool and wet temperatures and fertile soils. Increased risk factors for SDS include planting a susceptible variety, early planting, rotation after corn, irrigation, and high yield potential. While evaluating the regional insecticide seed treatment (IST) trial in Jackson, TN in 2022, significant SDS symptoms were rated (SDS Index = SDS incidence (0-100%) x SDS severity (1-9 scale)/9), with SDS incidence ranging from 8 to 48%, SDS severity from 3 to 6 and SDS index from 4 to 30. This trial was planted April 29, 2022 using Asgrow 45XF0, under irrigation where the previous crop was corn. The trial was a randomized complete block design with 4 replicates, using 4 row plots on 30-inch centers and 30 ft long with 10 ft alleys between replicates. All data was taken from the center 2 rows. Treatments included a non-treated check, fungicide only (Evergol Energy SB 1 oz/cwt, AIs: metataxyl, penflufen, prothioconazole, Bayer Crop Science), and 8 fungicide-insecticide commercial seed treatments (Bayer Crop Science, Syngenta, and Valent). Seed treatments significantly affected emergence, SDS index, and yield. ISTs (Neonicotinoids - Cruiser, Gaucho, Poncho) have been widely used on soybean in the Mid-South and have increased seed yields in ≈80% of previous field trials. Yield increases have ranged from 1-17 bu/acre. This is supported by a regional project demonstrating seed yield increases of 2-15 bu/acre in about 85% of trials during the past five years in the Mid-South. However, the IST's in 2022 field season yielded about 10 bu/a less than treatments without IST. All the treatments with IST's, except CruiserMaxx Vibrance, had statistically greater SDS index than the non-treated check based on ANOVA using LSD means separation at $P \leq 0.05$. Additionally, yield was significantly negatively correlated (P = 0.0001, r^2=-0.73) with SDS index ratings. While this research will be repeated in 2023 to gain a deeper understanding of the possible implications of the 2022 results, the existing data indicates that under high risk factors for SDS, ISTs may cause an increase in disease and a reduction in yields.

Evaluating Fungicide Sensitivity Within the *Septoria glycines* Population from Mississippi Soybean

Corser, J., Madrid, A. J.*, Wilkerson, T. H., and Allen, T. W.

Mississippi State University, Delta Research and Extension Center, Stoneville, MS
*Current address: University of Georgia, Tifton, GA

Septoria brown spot, caused by the fungus *Septoria glycines*, is one of the most common foliar diseases of soybean in the lower-to-middle canopy throughout the United States. In Mississippi, Septoria brown spot can be observed from early vegetative stages (V2/V3) through reproductive growth stages that immediately precede harvest (R6/R7). A general lack of resistance to Septoria brown spot within commercially available cultivars means that in situations where the disease threatens yield, fungicides may be beneficial to prevent yield losses. In addition, over the past decade reports of increased yield losses resulting from Septoria brown spot from the southern U.S. as well as throughout the U.S. soybean production system have been made. Fungicides are commonly used as a management tool; however, repeated applications of a single fungicide class can lead to pathogen resistance especially in situations where fungicides are applied to improve yield in the absence of yield-limiting diseases. While additional important soybean pathogens are known to be resistant to the quinone outside inhibitor (QoI) fungicides, *S. glycines* isolates with a resistant genotype from Mississippi have not previously been observed. In 2021, soybean leaflets exhibiting Septoria brown spot symptoms were collected from 23 commercial fields in MS and 40 isolates preliminarily identified as *Septoria* spp. were collected on semi-selective medium. *Septoria glycines* was confirmed by colony and conidia morphology as well as genetically by ITS sequencing. For the purposes of conducting a preliminary fungicide sensitivity assay, two isolates (TW37-21; TW59-21) were selected. Technical grade azoxystrobin and propiconazole were used for assays. Seven fungicide concentrations including 0, 0.0001, 0.001, 0.01, 0.1, 1, and 10 µg a.i. ml^{-1} were evaluated. A 5 mm agar plug was placed on fungicide-amended media. Plates were incubated at 25°C for 10 days and colony diameter was measured. Complete growth inhibition was observed with isolates plated on propiconazole-amended media at 10 µg ml^{-1}. However, azoxystrobin did not reduce colony growth of isolate TW37-21 at the greatest dose while isolate TW59-21 grew on the lowest dose. Mean EC_{50} values of the isolates plated on propiconazole-amended media ranged from 0.0729 to 0.0377 µg ml^{-1}. Additional evaluations will be conducted to calculate EC_{50} values for the remaining isolates.

Advancing Soybean Nematode, Sudden Death Syndrome, Frogeye Leaf Spot and Target Spot Management Employing the Latest Seed-Applied Technology

Dale S. Ireland, J. Simmons, A. Simon

Syngenta Crop Protection, Seedcare

Soybean Cyst Nematode (SCN) is estimated as the number one pathogen in US soybean. Agricultural economists estimate most years the US soybean grower loses more to SCN than the next five soybean pathogens added together (Koenning & Wrather, 2010). One of the most recent additions to a comprehensive SCN management program is using a seed-applied nematicide (SAN). In combination with all other management tools, a SAN offers additional protection and potentially reduces the heavy reliance on single genetic SCN resistance sources. Since healthy root development is vital to establishing the most stable yield potential, SANs have been one of the most anticipated and rapidly adopted new seed-applied technologies offered in recent years. Under moderate to heavy SCN pressure TYMIRIUM™ technology (0.075 mga/seed) seed treatment in soybean outperformed FLPM (0.075 mga) by an average of +2.3 bu/A driven by a 71 percent win record (n=45; 2020-2022). Under the same conditions TYMIRIUM technology (0.075 mga) outperformed ABA (0.15 mga) by an average of +2.0 bu/A with a 75 percent win record (n=101; 2015-2022). Under moderate to heavy Sudden Death Syndrome infection TYMIRIUM technology (0.075 mga) outperformed FLPM (0.15 mga) by an average of +4.3 bu/A leading to a 86 percent win record (n=29; 2018-2022). TYMIRIUM technology also statistically reduces early season Septoria Brown Spot, Frogeye Leaf Spot and Target Spot when compared to Check treatment. When registered, TYMIRIUM technology will deliver a new level of soybean protection performance across multiple pathogens.

Charcoal Rot Severity and Soybean Yield Responses to Planting Date, Irrigation, and Genotypes

Alemu Mengistu[1], Heather M. Kelly[3], Quentin D. Read[4], Jeff D. Ray[2], Nacer Bellaloui[2], and Lesley A. Schumacher[1]

[1]United States Department of Agriculture, Agricultural Research Service (USDA-ARS), Crop Genetics Research Unit, 605 Airways Boulevard, Jackson, TN 38301.
[2]United States Department of Agriculture, Agricultural Research Service (USDA-ARS), Crop Genetics Research Unit, 141 Experiment Station Road, Stoneville, MS 38776-0350, USA.
[3]University of Tennessee, Entomology and Plant Pathology, 605 Airways Blvd., Jackson, TN 38301.
[4]United States Department of Agriculture, Agricultural Research Service (USDA-ARS), Southeast Area Statistician, North Carolina State University, Ligon Street, 3127, USA.

Soybean production is influenced by planting date but its impact on yield in fields infested with *Macrophomina phaseolina*, the cause of charcoal rot of soybean, under varying environments is unknown. A three-year field experiment was conducted at the West Tennessee Research and Education Center in Jackson, TN. The experiment was a three-way factorial design consisting of three planting day × 8 genotypes × two irrigation treatments. The three planting dates were early April, early May, and early June; eight genotypes consisted of four moderately resistant and four susceptible; and the two irrigation levels were irrigated and, non-irrigated.

Our research detected that disease severity in May planting date was significantly lower compared to that of April and June in field infested with *Macrophomina phaseolina*. Correspondingly, yield in April planting date was significantly lower than that of May and June in both irrigated and non-irrigated environments. Soybean lines interacted with planting date differently, where selected moderately resistant lines showed the greatest yields in early May to early June with increased yields. Interestingly, yields of susceptible lines also increased significantly with each subsequent planting date remained lower than yields of the moderately resistant lines across the three planting dates. Planting date by irrigation interaction revealed that irrigation in May had an effect in significantly lowering disease severity than April and June planting dates, while yields in May and June remained significantly higher than April under both irrigated and non-irrigated environments.

There was a general trend for selected moderately resistant genotypes to have greater yield than susceptible genotypes across planting dates and irrigation environments. Two moderately resistant genotypes had significantly greater yield than most of the susceptible genotypes across all planting dates, while two others with moderate resistance had significantly greater yield than most of the susceptible genotypes in the April planting date treatment only. Our results could fill the knowledge gap in the current planting date choices where fields are severely infested with *Macrophomina phaseolina*.

Fitness Parameters Within the *Corynespora cassiicola* Population from Mississippi Soybean

Tom W. Allen[1], Wang, X.[1], Tomaso-Peterson, M.[2], and Wilkerson, T. H.[1]

[1] Mississippi State University, Delta Research and Extension Center, Stoneville, MS
[2] Mississippi State University, Department of Biochemistry, Molecular Biology, Entomology and Plant Pathology, Starkville, MS

Following a survey of the Mississippi soybean production system, isolates of *Corynespora cassiicola* (n=819), the causal organism of target spot, were recovered from 73 counties. A PCR-RFLP procedure was used to determine whether isolates contained the G143A substitution that confers resistance to quinone outside inhibitor (QoI) fungicide class or remained wild-type. Overall, approximately 86% of the isolates recovered from 228 field locations throughout Mississippi determined that the G143A substitution was genotypically dominant in the *C. cassiicola* population. In general, the members of the QoI class of fungicides have been widely used since first released for broad spectrum disease control as well as providing a "yield benefit" in the absence of disease. As a result of repeated applications of the QoIs to the same fields over a period of multiple years, resistance to QoI fungicides has recently been reported within the *C. cassiicola* population from Alabama, Arkansas, Mississippi, and Tennessee. The resistance in this specific instance is inferred based on the genotypic amino acid substitution at position 143 (the G143A substitution) and not always on the *in vitro* inhibition of fungal growth in fungicide challenge experiments.

In addition to determining the proportion of the *C. cassiicola* population to either contain the G143A or remain wild-type, several specific fitness parameters were investigated. Since target spot continues to be an important plant disease in the southern soybean production system a research project was conducted to determine whether the G143A genotype could benefit the fungus. Therefore, the relative fitness and stability of isolates containing the G143A substitution compared to isolates that remained wild-type were investigated by analyzing several fitness parameters *in vitro*. In addition, *in vivo* virulence assays were conducted in the greenhouse on a previously identified target spot-susceptible cultivar (Local Seed LS4889XS). Fitness evaluations considered the difference between isolates from the wild-type (n=10) and G143A-containing genotypes (n=10) by evaluating colony growth parameters following the first and the tenth subcultures on potato dextrose agar. When considered as an average of the isolates that contained the G143A substitution, the isolates were observed to produced 6.2% greater colony diameter growth but 2.3% less conidia following the tenth subculture. Conversely, over the same period, wild-type isolates produced 6.7% less colony growth but 10.9% more conidia. In addition, *in vivo* virulence evaluations determined that the isolates characterized by the G143A substitution were 32.6% more virulent than the wild-type genotype regardless of the number of subsequent isolations (either first or tenth). Based on our results, the *C. cassiicola* isolates that were determined to contain the G143A substitution appear to be stable in the population since successive subculturing did not significantly affect the measured fitness parameters whether *in vitro* or *in vivo*. The general fitness benefit accompanying the genotypic shift to the G143A amino acid substitution indicates that these isolates may have fitness advantages and could remain stable in the population as well as displace wild-type isolates with repeated fungicide applications of products that contain active ingredients in the QoI class.

Soybean Disease Management Programs in Louisiana

G. Boyd Padgett, P.P. ‘Trey’ Price, David Moseley, Fred Collins, Dustin Ezell, Dana Landry,
Laura Lee, Tashia M. Monaghan, Myra Purvis, Chris Roider, Brandi Woolam

LSU AgCenter

In Louisiana, diseases can reduce yield and quality of soybean every year if not properly managed. While *Cercospora* leaf blight (CLB) continues to be a significant disease, frogeye leaf spot (FLS) and target spot (TS) are also becoming more prevalent as well. In Central and South Louisiana, aerial blight (AB) can also be a significant threat. An effective disease management program begins with selecting disease resistant high yielding varieties. Varieties entered in LSU AgCenter Official Variety Trials (OVT) are evaluated every year for agronomic performance and disease resistance on seven research stations and on-farm demonstrations. At two locations (Dean Lee near Alexandria and Doyle Chambers near Baton Rouge), two OVTs are planted side by side. One trial is treated with a fungicide and the adjacent trial is not treated. Other research has been conducted to determine the impact of planting date and the benefit of fungicide on disease development and yield. Fungicide efficacy and application timing trials are conducted to determine if these products will benefit our stakeholders. Disease severity and yield differed among varieties in the OVTs and planting date trials. Fungicides were beneficial and preserved yield in trials where disease was severe. This information provides stakeholders with information to make better informed decisions on variety selection, planting date, and fungicides.

Transcriptome Analysis Identifies Candidate Genes and Pathways Associated with Target Spot Resistance in Soybean (*Glycine max* (L.) Merrill)

Sejal Patel, Jinesh Patel, Kira Bowen and Jenny Koebernick

Auburn University

Target spot caused by *Corynespora cassiicola* is an overwhelming disease in the soybean in Mid-south and the southeastern United States. However, molecular mechanisms governing resistance to *C. cassiicola* infection in soybean are unknown. Our previous screening study revealed that soybean genotype Council and Bedford are resistant to *C. cassiicola* isolates. This study performed comparative transcriptomic profiling using two resistant genotypes (Council and Bedford) and two susceptible genotypes (Henderson and Pembina) under infected and control conditions to understand the regulatory network operating between soybean and *C. cassiicola*. RNA-Seq analysis identified a total of 2,571 differentially expressed genes (DEGs) which were shared by all four genotypes. These DEGs are related to secondary metabolites, immune response, defense response, phenylpropanoid, and flavonoid/isoflavonoid pathways in all four genotypes after *C. cassiicola* infection. Additional upregulated DEGs after infection of *C. cassiicola* were identified in resistance lines affiliated with the defense network, flavonoids, jasmonic, salicylic, and brassinosteroids acid. Further analysis led to the identification of differentially expressed transcription factors (TFs), immune receptor and defense genes with a leucine-rich repeat (LRR) domain, dirigent proteins (DIRs), and Cysteine (C)-rich receptor-like kinases (CRKs) to be involved in resistance mechanism to *C. cassiicola*. Our results will provide insight into molecular mechanisms of soybean resistance to *C. cassiicola* infection and valuable resources to pyramid quantitative resistance loci (QRLs) to improve soybean germplasm.