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Proceedings of the 48th Annual Meeting, Southern Soybean Disease Workers (March 3, 2021, Virtual Content)

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PROCEEDINGS OF THE

SOUTHERN SOYBEAN DISEASE WORKERS

48TH Annual Meeting of the
Southern Soybean Disease Workers

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PROCEEDINGS OF THE SOUTHERN SOYBEAN DISEASE WORKERS

48TH ANNUAL MEETING

March 3, 2021

Virtual Content

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

2021 Southern Soybean Disease Workers Agenda, Virtual

Wednesday March 3, 2021

1:00 – 1:10 2021 Introductions

Student Papers (moderator: Tessie Wilkerson)

1:10 – 1:25 **Secondary metabolites produced by *Xylaria necrophora* are responsible for the foliar symptoms associated with taproot decline of soybean.** Teddy Garcia-Aroca, Trey Price, José Solórzano, David Galo, Sophie Sheffield, Jonathan K. Richards, and Vinson P. Doyle

1:25 - 1:40 **Meta-analysis of fungicide performance for managing frogeye leaf spot on soybean in the United States.** Jhonatan P. Barro, Emerson M. Del Ponte, Tom Allen, Jason P. Bond, Travis R. Faske, Clayton A. Hollier, Yuba R. Kandel, Daren S. Mueller, Heather M. Kelly, Nathan M. Kleczewski, Paul Price, Edward J. Sikora, and Carl A. Bradley

1:40 – 1:55 **Using metagenomic tools to explore the suppression of soybean cyst nematode populations in fields double-cropped with wheat and soybean.** Leonardo F. Rocha, Jason P. Bond, Ahmad M. Fakhoury

1:55 – 2:10 **Investigating the effects of demethylation inhibitor fungicides and the insecticide malathion on *Corynespora cassiicola*.** Ty Smith, Heather Kelly, and Larry Steckel

2:10 – 2:25 **DNA-based protocol for rapid detection of QoI (Strobilurin) fungicide resistance in *Cercospora sojina* and a statewide survey of foliar fungicide use for soybean disease management in Nebraska.** Asha Mane, Tamra Jackson-Ziems, Carl Bradley, and Syndney Everhart

2:25 – 2:40 **Assessing Missouri soybean fields for fungicide-resistant *Cercospora sojina*.** Bruna Just, and Kaitlyn M. Bissonnette

Contributed Papers (Trey Price)

2:40 – 2:55 **Observations from soybean rust monitoring and fungicide field demonstrations in Alabama in 2020.** Edward J. Sikora, and Kassie Conner

2:55 – 3:10 **Field performance of two new commercially available premix fungicides for management of foliar disease of soybean in Arkansas.** Terry N. Spurlock, Robert C. Hoyle, Sydney F. Kling, and Amanda C. Tolbert

3:10 – 3:25 **The impact of different crop rotations on soilborne microbial diversity and disease emergence of soybean-corn cropping system.** Qiurong Fan, Travis Faske, Terry Spurlock, Alejandro Rojas and Trent Roberts

3:25 – 3:40 **SCN Coalition: Updates and Evolution.** Sam Markell, and Albert Tenuta

3:40 – 3:55 **Evaluating varieties in the Mississippi State University Official Variety Trial Program for the presence and severity of green stem.** Tom Allen, Walter Solomon, Brad Burgess

3:55 **Industry updates – 30 min (if needed)**

Student Paper Awards/SSDW Business Meeting

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

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Abstracts of Presented Papers

Southern United States Soybean Disease Loss Estimates for 2020

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

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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 2014 have been published in numerous refereed scientific journals (12; 14-23; 25-26). The annual losses from between 2015 and 2020 have been presented annually in the SSDW proceedings (1-3; 5-7) and most recently in a publication that included the estimates from 2010 to 2014 in Plant Health Progress that includes the loss estimates from the entire soybean production region including the southern and northern states (4). 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 (8-12; 14; 24-25).

The disease loss estimates contained in the current proceedings 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 2020) has been a general environmental comparison from each state. To keep data collection and reporting simple a centroid from each state was determined based on the designated geographic centroid for each state and obtained from Wikipedia (https://en.wikipedia.org/wiki/List_of_geographic_centers_of_the_United_States). In situations where environmental data were not available in close proximity to the centroid an alternate location was selected. In 2020, several different weather stations were used as compared to 2019 due to lapses in data from specific weather stations. However, every attempt was made to use the same weather station to maintain data integrity between seasons. State, county and designated centroid location 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 2020 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 2020 when compared to the 2019 acreage reported by 13.9% (1). In general, 10 of the southern states reported an increase in the harvested acres, while four states reported decreases. One state, Virginia, reported soybean acres that remained the same between 2019 and 2020. Almost all of the southern states save for FL and KY reported a reduction in the overall number of harvested acres between 2018 and 2019. The 2020 average per acre soybean yield was 44.4 bu/A, which was a 13.5% increase compared to the average yield from 2019. As opposed to 2019, when none of the 16 southern states reported a statewide record yield, two states (Georgia and Kentucky) reported a statewide record yield during 2020. In 2020, more than 864 million bushels were harvested from approximately 19.2 million acres from the 16 southern states accounting for a 21% decrease in the total harvest compared to 2019.

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 2020 was greater than the estimated loss during 2019 by 16%. As a whole, 11 states reported an increase in percent disease losses compared to 2019 (AL, DE, FL, GA, KY, MD, MO, MS, NC, TX, VA). One state, TN, recorded disease estimates that were the same in 2020 as they were in 2019. In terms of the top five diseases encountered during 2020, soybean cyst nematode (SCN), root-knot nematode, Cercospora leaf blight, soybean rust, and Phomopsis seed decay were the top five diseases in order or importance. Three of the top five diseases were similar between 2019 and 2020, with seed and seedling diseases and frogeye leaf spot rounding out the top five in 2019. Breaking the diseases evaluated down into categories based on specific plant parts impacted by the diseases within the survey resulted in five categories: Nematode diseases (38.8%), root diseases (13.3%), foliar diseases (33.6%), seedling diseases (5.3%), and seed diseases (8.8%). 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 2020 disease losses accounted for and estimated 59.2 million bushels in lost potential production, a 13% increase compared to the estimated losses incurred during 2019 (Table 4).

Environmental conditions during 2020 were extremely different when compared to the environment encountered during 2019 (Table 5). In general, a greater number of states recorded negative rainfall totals for 2019 (eight states) compared to 2020 (two states) when considering the annual rainfall to the 30-year norm for each state and the location considered. In general, less rainfall was received across the region during 2019 as compared to 2020. In fact, across the entire southern region, an 18% increase in rainfall for the year was observed across the 16 southern states. The increased rainfall across the southern U.S. as likely one of the main reasons for a more widespread outbreak of soybean rust than had been observed over the past few seasons. In addition, temperature for 2020 was also compared to the 30-year normal (1981-2010). In general, looking across the entire year, based on temperature averages for the whole year, three months, April, May, and August 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 (4.6°F) and November (4°F). Looking at temperature data by month, eight months had average temperature increases with three of those months being January, February, and December across the region. Total rainfall varied greatly by state with 14 states (AL, AR, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, and VA) received rainfall in excess of the 30-year normal by between 2.1 inches (OK) and 28.2 inches (VA). The remaining two states received rainfall totals that were below the 30-year normal by between 2.8 (MO) and 6.8 inches (TX).

Acknowledgments

Funding was provided from the United Soybean Board to collate the losses across the 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 sources to support the effort in the future.

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Table 1. Location of state centroids used to download environmental data for the 2020 season from each state in the southern soybean production system.

State	County/Parish	Location	Specific weather station [a]
Alabama	Chilton	Clanton	Clanton 2 NE
Arkansas	Pulaski	Little Rock	Little Rock Airport Adams Field
Delaware	Sussex	Georgetown	Georgetown Delaware Coastal Airport
Florida	Leon	Tallahassee	Tallahassee Airport
Georgia	Twiggs	Macon	Macon Middle GA Regional Airport
Kentucky [b]	Boyle	Danville	Danville
Louisiana	Rapides	Alexandria	Alexandria International Airport
Maryland	Baltimore	Baltimore	Baltimore Washington International Airport
Mississippi	Rankin	Jackson	Canton 4 N
Missouri	Miller	Jefferson City	Jefferson City Memorial Airport
North Carolina	Chatham	Sanford	Sanford 8 NE
Oklahoma	Oklahoma	Oklahoma City	Oklahoma City Will Rogers World Airport
South Carolina	Richland	Columbia	Columbia University of SC
Tennessee	Rutherford	Murfreesboro	Murfreesboro 5 N
Texas	McCulloch	Brady	Brady
Virginia	Buckingham	Lynchburg	Lynchburg Regional Airport

[a] 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).

[b] The location in Kentucky was moved due to a lack of rainfall data for the entire 2020 year. The weather data from the University of Kentucky weather repository was used and can be accessed at http://weather.uky.edu/ky/data.php.

Table 2. Soybean production in 16 southern states in 2020.

State	Acres (1,000s) [a]	Bu/Acre [b,c]	Yield in bu/A (1,000s) [d]
Alabama	280 (+)	41 (-5)	11,480 (+)
Arkansas	2,820 (+)	50 (-1)	141,000 (+)
Delaware	150 (-)	49 (-2)	7,350 (+)
Florida	20 (+)	42 (+10)	840 (+)
Georgia	95 (+)	41* (+12)	3,895 (-)
Kentucky	1,840 (-)	55* (+9)	101,200 (+)
Louisiana	1,020 (-)	53 (+5)	54,060 (+)
Maryland	465 (-)	47 (+2)	21,855 (+)
Mississippi	2,060 (+)	54 (+4)	111,240 (+)
Missouri	5,810 (+)	50 (+5)	290,500 (+)
North Carolina	1,570 (+)	37 (+3)	58,090 (+)
Oklahoma	540 (+)	30 (.)	16,200 (+)
South Carolina	300 (-)	35 (+9)	10,500 (+)
Tennessee	1,620 (+)	50 (+3)	81,000 (+)
Texas	110 (+)	34 (+6)	2,044 (+)
Virginia	560 (.)	42 (+8)	19,040 (+)
TOTAL	**19,260 (+)**		**864,706 (+)**
		Avg. 44.4 (+5.3)	

[a] Difference from 2019 indicated in parentheses as either a decrease (-) or increase (+).
[b] Difference from 2019 indicated in parentheses as either a decrease (-) or increase (+) in addition to the value difference between 2019.
[c] * Denotes a state that set a yield record.
[d] Difference from 2019 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 2020.

	% yield suppression by state																
Disease	**AL[a]**	**AR**	**DE**	**FL**	**GA**	**KY**	**LA**	**MD**	**MS**	**MO**	**NC**	**OK**	**SC**	**TN**	**TX**	**VA**	**AVG**
Anthracnose	0.20	0.10	0.01	0.10	0.50	0.00	0.05	0.01	0.20	0.00	0.10	0.05	0.04	0.30	0.00	0.50	**0.14**
Bacterial diseases	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.00	**0.00**
Brown stem 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	0.00	0.00	0.00	0.00	**0.00**
Cercospora leaf blight	1.50	1.00	0.05	0.50	0.50	0.02	2.50	0.10	1.50	0.50	1.00	0.50	0.60	0.01	0.00	0.50	**0.67**
Charcoal rot	0.00	0.02	0.00	0.10	0.10	0.05	0.10	0.01	0.01	0.10	0.00	1.50	0.10	0.50	0.20	0.01	**0.17**
Downy mildew	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	**0.00**
Frogeye leaf spot	0.00	0.00	0.00	0.20	0.01	0.70	0.05	0.01	0.00	0.05	0.20	0.01	0.02	1.20	0.01	0.25	**0.17**
Fusarium wilt and root rot	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	**0.01**
Other diseases[b]	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	0.10	0.00	**0.01**
Phomopsis seed decay	0.60	0.08	0.50	0.20	0.10	0.05	0.10	1.00	0.06	0.00	1.00	0.75	1.25	0.00	0.00	1.00	**0.42**
Phytophthora root and stem rot	0.00	0.08	0.00	0.01	0.00	0.60	0.05	0.00	0.00	1.00	0.50	0.05	0.00	0.03	0.00	0.00	**0.15**
Pod and stem blight	0.03	0.05	1.00	0.20	1.00	0.05	0.10	0.50	0.00	0.00	1.00	0.05	0.30	0.25	0.00	0.01	**0.28**
Purple seed stain	0.01	0.10	0.05	0.01	0.10	0.03	0.05	0.50	0.30	0.01	0.70	0.50	0.13	0.00	0.10	0.01	**0.16**
Reniform nematode	0.25	0.30	0.00	0.20	0.10	0.00	1.50	0.00	0.04	0.00	0.00	0.00	1.00	0.00	0.00	0.00	**0.21**
Root-knot nematode	0.50	4.00	1.00	0.75	2.00	0.00	2.00	0.05	1.30	0.01	1.00	0.25	3.00	0.01	0.00	1.00	**1.05**
Soybean cyst nematode	0.15	0.50	2.00	0.00	0.00	2.50	0.00	0.50	0.03	3.00	2.00	1.50	1.50	1.80	0.00	2.00	**1.09**
Other nematodes[c]	0.00	0.01	0.50	0.00	0.10	0.00	0.00	0.01	0.00	0.00	0.25	0.00	2.00	0.00	0.00	0.25	**0.20**
Rhizoctonia aerial blight	0.00	0.05	0.00	0.00	0.00	0.00	1.00	0.00	0.40	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.09**
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	0.40	0.30	0.05	0.10	0.00	0.90	0.05	0.05	0.65	1.00	0.50	0.25	0.05	1.00	0.01	0.25	**0.35**
Septoria brown spot	0.10	0.40	0.02	0.01	0.00	0.30	0.25	0.20	0.80	0.01	0.10	0.50	0.05	0.75	0.00	0.10	**0.22**
Southern blight	0.70	0.40	0.00	0.10	0.25	0.00	0.50	0.00	0.80	0.00	0.00	0.01	0.05	0.00	0.01	0.00	**0.18**
Soybean rust	4.10	0.20	0.00	0.75	3.00	0.00	0.30	0.00	0.40	0.01	0.00	0.00	0.01	0.00	0.01	0.00	**0.55**
Stem canker	0.01	0.10	0.00	0.01	0.00	0.70	0.00	0.10	0.00	0.00	0.10	0.01	0.03	0.25	0.00	0.01	**0.08**
Sudden death syndrome	0.00	0.00	0.00	0.01	0.00	0.70	0.01	0.00	0.00	1.50	0.00	0.05	0.01	0.00	0.00	0.10	**0.15**
Taproot decline	0.15	0.30	0.00	0.00	0.00	0.00	1.25	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.14**
Target spot	0.00	0.05	0.00	0.01	0.00	0.30	0.10	0.00	0.00	0.00	0.00	0.00	0.20	0.25	0.00	0.01	**0.06**
Virus Diseases[d]	0.00	0.00	0.00	0.05	0.00	0.03	0.00	0.00	0.00	0.00	0.20	0.01	0.05	0.00	0.00	0.00	**0.02**
Total disease %	**8.71**	**8.05**	**5.19**	**3.37**	**7.76**	**6.94**	**9.96**	**3.04**	**7.08**	**7.20**	**8.68**	**6.07**	**10.40**	**6.35**	**0.44**	**6.02**	**6.58**

[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), red crown rot (MS, NC).
[c]Other nematodes listed included: Columbia lance nematode (NC, SC), lance nematode (DE, MD), lesion nematode (AR, DE), sting nematode (GA), stubby root nematode (DE, SC).
[d]Virus diseases listed included: *Bean pod mottle virus* (KY, NC, SC), *Soybean mosaic virus* (DE, NC, SC), *Soybean vein necrosis virus* (DE, KY, MD, MS, NC), *Tobacco ringspot virus* (KY,

NC, SC).

Table 4. Estimated suppression of soybean yield (Millions of Bushels) as a result of disease during 2020.

	yield suppression by state (millions of bushels)																
Disease	**AL[a]**	**AR**	**DE**	**FL**	**GA**	**KY**	**LA**	**MD**	**MS**	**MO**	**NC**	**OK**	**SC**	**TN**	**TX**	**VA**	**TOTAL**
Anthracnose	0.02	0.14	0.00	0.00	0.01	0.00	0.02	0.00	0.18	0.00	0.06	0.01	0.00	0.21	0.00	0.10	**0.75**
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Cercospora leaf blight	0.15	1.39	0.00	0.00	0.01	0.02	1.15	0.02	1.32	1.17	0.57	0.07	0.06	0.00	0.00	0.10	**6.04**
Charcoal rot	0.00	0.03	0.00	0.00	0.00	0.04	0.05	0.00	0.00	0.23	0.00	0.21	0.01	0.34	0.01	0.00	**0.93**
Downy mildew	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	**0.01**
Frogeye leaf spot	0.00	0.00	0.00	0.00	0.00	0.58	0.02	0.00	0.00	0.12	0.11	0.00	0.00	0.83	0.00	0.05	**1.72**
Fusarium wilt and root rot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	**0.04**
Other diseases[b]	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	**0.01**
Phomopsis seed decay	0.06	0.11	0.04	0.00	0.00	0.04	0.05	0.22	0.05	0.00	0.57	0.11	0.12	0.00	0.00	0.20	**1.57**
Phytophthora root and stem rot	0.00	0.11	0.00	0.00	0.00	0.50	0.02	0.00	0.00	2.35	0.28	0.01	0.00	0.02	0.00	0.00	**3.29**
Pod and stem blight	0.00	0.07	0.08	0.00	0.03	0.04	0.05	0.11	0.00	0.00	0.57	0.01	0.03	0.17	0.00	0.00	**1.15**
Purple seed stain	0.00	0.14	0.00	0.00	0.00	0.03	0.02	0.11	0.26	0.02	0.40	0.07	0.01	0.00	0.00	0.00	**1.07**
Reniform nematode	0.03	0.42	0.00	0.00	0.00	0.00	0.69	0.00	0.03	0.00	0.00	0.00	0.09	0.00	0.00	0.00	**1.26**
Root-knot nematode	0.05	5.56	0.08	0.00	0.06	0.00	0.92	0.01	1.14	0.02	0.57	0.04	0.28	0.00	0.00	0.20	**8.93**
Soybean cyst nematode	0.02	0.70	0.15	0.00	0.00	2.09	0.00	0.11	0.03	7.04	1.13	0.21	0.14	1.24	0.00	0.41	**13.25**
Other nematodes[c]	0.00	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.19	0.00	0.00	0.05	**0.43**
Rhizoctonia aerial blight	0.00	0.07	0.00	0.00	0.00	0.00	0.46	0.00	0.35	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.88**
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	0.04	0.42	0.00	0.00	0.00	0.75	0.02	0.01	0.57	2.35	0.28	0.04	0.00	0.69	0.00	0.05	**5.23**
Septoria brown spot	0.01	0.56	0.00	0.00	0.00	0.25	0.11	0.04	0.70	0.02	0.06	0.07	0.00	0.52	0.00	0.02	**2.37**
Southern blight	0.07	0.56	0.00	0.00	0.01	0.00	0.23	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.57**
Soybean rust	0.42	0.28	0.00	0.00	0.09	0.00	0.14	0.00	0.35	0.02	0.00	0.00	0.00	0.00	0.00	0.00	**1.30**
Stem canker	0.00	0.14	0.00	0.00	0.00	0.58	0.00	0.02	0.00	0.00	0.06	0.00	0.00	0.17	0.00	0.00	**0.94**
Sudden death syndrome	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00	3.52	0.00	0.01	0.00	0.00	0.00	0.02	**4.14**
Taproot decline	0.02	0.42	0.00	0.00	0.00	0.00	0.57	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.53**
Target spot	0.00	0.07	0.00	0.00	0.00	0.25	0.05	0.00	0.00	0.00	0.00	0.00	0.02	0.17	0.00	0.00	**0.56**
Virus Diseases[d]	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	**0.15**
Total disease %	**0.89**	**11.19**	**0.39**	**0.01**	**0.23**	**5.80**	**4.57**	**0.67**	**6.21**	**16.90**	**4.91**	**0.85**	**0.97**	**4.36**	**0.02**	**1.22**	**59.19**

[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), red crown rot (MS, NC).
[c]Other nematodes listed included: Columbia lance nematode (NC, SC), lance nematode (DE, MD), lesion nematode (AR, DE), sting nematode (GA), stubby root nematode (DE, SC).
[d]Virus diseases listed included: *Bean pod mottle virus* (KY, NC, SC), *Soybean mosaic virus* (DE, NC, SC), *Soybean vein necrosis virus* (DE, KY, MD, MS, NC), *Tobacco ringspot virus* (KY, NC, SC).

Table 5. Deviation of the 2020 temperature from the 30-year normal and the total precipitation for 2020 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)												Total precip (in)		
State	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**2020**	**30-year**	**Deviation**
Alabama	5.7	1.9	4.8	-1.9	-1.6	-1.5	-0.5	-0.8	-2.7	1.5	3.1	1.0	77.8 (7)	57.9	**+19.9**
Arkansas	2.3	0.0	2.2	-2.9	-2.3	-1.4	-1.2	-2.1	-3.1	-4.2	3.9	2.2	57.3 (8)	48.8	**+8.6**
Delaware	7.1	6.4	6.0	-0.7	-2.9	2.4	5.0	2.1	0.7	3.4	6.8	3.0	50.2 (8)	43.8	**+6.4**
Florida	3.7	0.7	6.6	1.9	-0.5	-0.9	0.6	-0.4	-1.2	2.7	4.3	-1.5	60.8 (7)	58.1	**+2.7**
Georgia	5.8	1.3	6.4	0.7	-0.4	0.3	3.0	2.3	-0.8	4.6	5.5	0.9	59.9 (6)	45.7	**+14.3**
Kentucky	7.6	2.9	4.9	-3.0	-3.0	-0.2	3.0	-0.1	-0.9	0.8	6.2	2.3	54.7 (8)	46.4	**+8.3**
Louisiana	1.6	0.6	5.2	-1.3	-2.8	-0.4	-0.4	0.4	-1.1	-0.2	3.2	-0.3	82.2 (9)	55.9	**+26.3**
Maryland	7.3	6.4	7.5	-1.5	-2.2	2.4	5.5	2.3	0.4	2.6	7.3	3.2	60.1 (9)	41.9	**+18.2**
Missouri	0.6	-1.1	2.8	-2.3	-2.9	2.5	1.2	-1.7	-0.3	-3.3	5.9	5.3	41.2 (3)	43.9	**-2.8**
Mississippi	2.0	-2.2	5.3	-3.8	-2.8	-2.2	-2.4	-2.6	-3.3	-1.7	1.6	-2.8	69.5 (7)	54.6	**+14.9**
North Carolina	4.9	2.3	3.7	-1.1	-4.8	-3.6	0.9	-1.3	-2.7	2.5	3.9	-0.8	55.8 (8)	46.2	**+9.6**
Oklahoma	3.8	-1.6	2.7	-2.9	-2.3	1.5	-2.8	-2.3	-4.0	-2.9	3.6	2.3	38.6 (6)	36.5	**+2.1**
South Carolina	4.8	0.9	3.8	-0.8	2.6	3.8	-0.1	2.2	4.8	2.6	-6.2	-0.7	56.8 (7)	46.3	**+10.5**
Tennessee	3.9	-0.8	2.2	-4.3	-3.9	-0.4	0.9	-2.7	-2.8	-0.3	4.1	-0.6	70.7 (10)	53.4	**+17.3**
Texas	2.0	-2.7	2.2	-2.6	0.4	0.5	1.3	2.4	-5.3	-0.3	3.4	2.8	20.8 (4)	27.6	**-6.8**
Virginia	5.4	5.1	7.3	0.6	-2.4	1.0	6.6	1.3	-0.5	3.8	7.2	2.9	69.7 (10)	41.6	**+28.2**
Avg.	**4.3**	**1.3**	**4.6**	**-1.6**	**-2.0**	**0.2**	**1.3**	**-0.1**	**-1.4**	**0.7**	**4.0**	**1.2**	--	--	--

[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 over the 30-year normal for the given location.

Systemic Secondary Metabolites Produced by *Xylaria necrophora* are Responsible for the Foliar Symptoms Associated with Taproot Decline of Soybean

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Taproot decline (TRD) is an emerging disease of soybean in the southern United States caused by *Xylaria necrophora*. While the first symptoms to become evident in the field are foliar interveinal chlorosis followed by necrosis, the pathogen is often isolated from necrotic roots and appears restricted to the root system. The foliar symptoms resemble those of sudden death syndrome (SDS) of soybean, a disease caused by the translocation of phytotoxic compounds produced by *Neocosmospora phaseoli* (=*Fusarium virguliforme*) from roots to leaves. Since these two pathogens exhibit a similar lifestyle, we tested the hypothesis that secondary metabolites (SMs) released by *X. necrophora* are capable of producing chlorosis and necrosis on soybean leaves, similar to what is observed on plants diagnosed with TRD in the field. Stem cuttings of soybean (cultivars AG4632, P5414LLS, and Osage) and tomato were challenged with cell-free culture filtrates (CFCFs) from known pathogenic strains of *X. necrophora* and putative non-pathogenic species (*X. arbuscula, X.* cf. *venustula*, and *Colletotrichum siamense*). Chlorophyll content (estimated chemically and digitally) and root development were used as response variables. All cultivars exposed to diluted CFCFs from *X. necrophora* exhibited significantly reduced chlorophyll content and root growth, but no impact on tomato was observed. The cultivar Osage exhibited potential resistance to TRD in greenhouse experiments through direct inoculation, but our results suggest this resistance is unrelated to resistance to SMs. Chlorophyll content was not reduced in any hosts or cultivars exposed to CFCFs of *X. arbuscula* or *C. siamense*. Soybean plants of all cultivars exposed to CFCFs from *X.* cf. *venustula* exhibited lower chlorophyll content than untreated controls, suggesting SMs from *X. necrophora* that are phytotoxic to soybean may also be produced by closely related species.

Meta-analysis of Fungicide Performance for Managing Frogeye Leaf Spot on Soybean in the United States

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Frogeye leaf spot (FLS), caused by *Cercospora sojina*, is a yield-reducing disease of soybean in the United States. Application of foliar fungicides is a primary method used to manage FLS and protect soybean yield. To help define the best options and the economic benefits from using fungicides, multi-state trials were established to evaluate different fungicides for managing FLS. Data from 41 field trials conducted from 2015 to 2019 across eight states (AL, AR, IL, IA, KY, LA, MS, and TN) were gathered. The main goal of this study was to summarize the yield response and explore factors affecting the efficacy and profitability of the following fungicides applied at the R3 growth stage (beginning pod development): azoxystrobin + difenoconazole (AZOX + DIFE), fluoxastrobin + flutriafol (FLUO + FLUT), pyraclostrobin (PYRA), pyraclostrobin + fluxapyroxad + propiconazole (PYRA + FLUX + PROP), tetraconazole (TTRA), thiophanate-methyl (TMET), thiophanate-methyl + tebuconazole (TMET + TEBU) and trifloxystrobin + prothioconazole (TFLX + PROT). A network meta-analytic model was fitted to the log of the means of FLS severity (%) data and to the non-transformed mean yield (kg/ha) for each treatment, including the control. The percent reduction in disease severity relative to the control ranged from 12.4% (PYRA) to 52.7% (TMET + TEBU); the latter not differing from FLUO + FLUT (51.8%), TFLX + PROT (50.4%), AZOX + DIFE (50.3%) and TMET (49.3%). The mean yield response was greatest for AZOX + DIFE (371 kg/ha), FLUO + FLUT (362 kg/ha), TFLX + PROT (359 kg/ha), TMET + TEBU (345 kg/ha), TMET (345 kg/ha), PYRA + FLUX + PROP (326 kg/ha) and TTRA (307 kg/ha), which all performed better than PYRA (141 kg/ha). The inclusion of a baseline disease as moderator variable in the model, representing low- (< 20% severity in the untreated check) or high-disease (≥ 20%) scenario, showed greater yield response (503 to 563 kg/ha) for the high-disease scenario by the five most effective fungicides. The estimates of yield responses were used to calculate the probability (p) of breaking even as a result of the fungicide (product + application) costs of the least (PYRA), intermediate (TTRA) and most (FLUO + FLUT) effective fungicides. The p was higher (> 55%) for TTRA and FLUO + FLUT in high-disease scenarios. Our results may be useful for disease management decisions by considering the technical and economic decisions into account.

Using Metagenomic Tools to Explore the Suppression of Soybean Cyst Nematode Populations in Fields Double-Cropped with Wheat and Soybean

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Plant parasitic nematodes cause losses to all major crops worldwide, representing a significant constraint on global food security. The soybean cyst nematode (SCN) (*Heterodera glycines* Ichinohe) is a major biotic cause of yield losses in soybean. In double cropping (DC) systems, fields have two or more crops growing in sequence in a single growing season. For soybean, the crop is commonly planted following winter wheat. Several reports in the literature suggest potential suppressive effects of wheat residue on SCN population densities.

A field trial was conducted in the 2017-2018 growing seasons to assess the effect of wheat on SCN populations in DC soybean. In each field location (N=9), wheat (WT) was planted in strips alternating with strips maintained in fallow (FL) over winter. Soybean followed all strips after wheat harvest. Double-cropping soybean fields had reduced SCN counts compared to fallow strips at R1 stage (-31.8%) and after soybean harvest (-32.7%). Three field locations with noted SCN suppression were selected for a metagenomics study. Ten subplots were selected (5 WT and 5 FL) from each location. A total of 90 soil samples were selected: 3 fields × 2 treatments × 3 timepoints × 5 replications.

Amplicons were sequenced using an Illumina MiSeq platform (300+300 bp paired-end). Three DNA markers targeted distinct microbial groups: bacteria, fungi and *Fusarium spp*. Primers 515FB/926R targeted the 16S ribosomal RNA gene V4-V5 region (400-500 bp) for bacteria. For fungi, the internal transcribed spacer (ITS2) was targeted using primers ITS86F/ITS4R, returning amplicons of approximately 370 bp. Primers Alfie1/Alfie2 were used to amplify a partial region of the translation elongation factor-1 alpha (EF-1 alpha) gene. This marker was added mainly to provide further resolution when separating *Fusarium* species.

Sequencing data were processed in R using the DADA2 pipeline. Statistical analysis was performed using the Microbiome Analyst (https://www.microbiomeanalyst.ca/). Alpha diversity was estimated using the Shannon's Bray-Curtis diversity index. Subsequently, β-diversity was examined using the Bray–Curtis similarity index from *log*-transformed data (*log* (x + 1)). The Pattern Search function was used to detect differentially abundant amplicon sequence variants (ASVs) across factors. Fungal communities were significantly different between DC and fallow plots at soybean planting and after harvest (P<0.001). Fungal populations were affected by location in all sampling times and by treatments before planting and after soybean harvest. Several enriched fungal and bacterial taxa in wheat plots were previously reported to parasitize SCN cysts and eggs.

Investigating the Effects of Demethylation Inhibitor Fungicides and the Insecticide Malathion on *Corynespora cassiicola* Control

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Target spot of soybean is a foliar disease caused by the ascomycete, *Corynespora cassiicola*. Over recent years, target spot has become an increasing concern to soybean for its ability to decrease yields and the development of resistance to the strobilurin (FRAC group 11) fungicides. Previous research into characterizing herbicide resistance in the ALS inhibitors (HRAC group 2) and microtubule inhibitors (HRAC group 3) has shown that the insecticide malathion can help combat a resistant plant's ability to metabolize herbicides belonging to the aforementioned classes due to sites of action in the cytochrome P450s being similar. Similar to the herbicides mentioned, the site of action of demethylation inhibitor fungicides (DMI) is located in P450 sites. The purpose of this study was to investigate if malathion had an effect on the ability of DMI fungicides to manage *C. cassiicola.* This experiment was composed of three parts: A small plot field trial, a detached leaf assay, and an *in vitro* mycelial growth assay. Two fungicides, Tilt and Domark 230ME, of varying effectiveness against target spot of soybean were used along with labeled rates of Malathion 57%. Across all trials/assays malathion alone did not statistically reduce the amount of target spot compared to non-treated checks. In the small plot trial, Domark 230ME nor Tilt reduced the amount of target spot in the field compared to the non-treated plots. In the detached leaf assay, the treatments Tilt and Tilt + Malathion statistically reduced the amount of target spot compared to the non-treated checks. In the mycelial growth assay, the colony size of *C. cassiicola* was not statistically reduced when malathion was added with Tilt or Domark 230ME. Although malathion had little effect when combined with Tilt or Domark 230EC, it should be further studied in the presence of isolates of *C. cassiicola* that are insensitive to DMI fungicides.

DNA-based Protocol for Rapid Detection of QoI (Strobilurin) Fungicide Resistance in *Cercospora sojina* and a Statewide Survey of Foliar Fungicide Use for Soybean Disease Management in Nebraska

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Over the last five years, yield losses due to frogeye leaf spot disease caused by *Cercospora sojina* in the northern U.S. have more than tripled, going from 0.7 to 2.2 million metric tons lost. Continuous planting and no-till management intensify disease pressure and use of single-site mode of action fungicides seems to be driving fungicide resistance, which is leading to disease control failures. In 2019, QoI fungicide resistance was detected in 10 *C. sojina* isolates from 10 counties in Nebraska. In an effort to understand the prevalence of fungicide resistance, we expanded this survey in 2020 and have amassed a collection of 375 leaf samples from 47 counties throughout the soybean producing region in Nebraska. A preliminary plate-based assay suggests that QoI fungicide resistance is now widespread in Nebraska, but requires confirmation with molecular genetic analysis. A major limitation of this approach is that the plate-based assay takes more than two weeks to conduct, requiring isolation of the fungus from leaves, followed by inoculation of fungicide-amended Petri plates and growth-based assays in the lab. Although platforms exist to enable rapid, in-field detection of mutations that confer *fungicide resistance, no such diagnostic tool has been developed for detection of* QoI resistance in *C. sojina*. To fill this gap, we developed a DNA-based protocol for rapid detection of QoI fungicide resistance in *C. sojina* that utilizes a highly sensitive isothermal DNA amplification method based on ligation-rolling circle amplification. A single reaction is able to detect three possible mutations (G143A, F129L, and G137R) in the cytochrome b gene that confer QoI resistance. Mutations can be detected directly from infected leaf samples in just 2-3 hours, which will enable timely recommendations to growers. While detection of fungicide resistance is key for making recommendations, it is also important to understand how to best communicate results and what information sources are used in making the decision to apply fungicides. Thus, a complementary objective in our research is to obtain information about how the decision to apply fungicides is made in Nebraska. To accomplish this, we are conducting an applicator-focused informational survey to obtain information about foliar fungicide use in Nebraska. We created a 10-question survey comprised of both multiple-choice and short answer questions that takes approximately 10 minutes to complete and is offered as both a paper- and web-based version. Participants are being recruited at row crop-related meetings in which most participants identify as one of the following: farmer/producer, farm manager, Extension educator, crop consultant/agronomist, or agribusiness representative. This survey is currently underway and response data will be analyzed to determine which diseases are thought to be most important and identify factors or sources of information used to make decisions to apply fungicides. Results will help us understand the factors affecting decisions to apply foliar fungicides in Nebraska and will be used to improve communication of recommendations on fungicide use.

Assessing Missouri Soybean Fields for Fungicide-resistant *Cercospora sojina*

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Successful management of *Cercospora sojina*, the causal agent frogeye leaf spot, can be achieved through utilizing resistant varieties and fungicide applications. Fungicides in the Quinone outside Inhibitor (QoI) class are most effective in controlling *C. sojina* in the field. Unfortunately, fungicide-resistant isolates of *C. sojina* have been recovered in many soybean growing areas of the U.S. In Missouri, fungicide-resistant isolates of *C. sojina* were first detected in 2011 and 2012 in 2 counties in southeast Missouri, but no further assessment was conducted. In this study, 15 counties were surveyed between 2019 and 2020 on an effort to understand the geographical distribution of fungicide-resistant *C. sojina* isolates. A total of 121 isolates were collected were collected over two years.

Isolates were collected from fields arbitrarily based on the presence of frogeye leaf spot in counties throughout the state. Samples were brought to the laboratory and isolates were recovered from individual lesions. A poison plate assay was conducted to determine which isolates were resistant to the QoI class of fungicides. The poison plate assay constituted of full-strength PDA amended with technical grade azoxystrobin (96% a.i.) at five different concentrations (0.1 ppm, 1 ppm, 5 ppm, 10 ppm, and 15 ppm) and a control plate with no fungicide. Poison plates grew for 3 weeks and the viability of resistant isolates was confirmed by a sporulation test. Out of 121 isolates tested from 15 counties, 81 were fungicide-resistant representing 13 counties in Missouri, and all isolates from 2 counties were still sensitive to the QoI fungicides. In total, 67.8% of all *C. sojina* isolates tested positive for fungicide resistance to azoxystrobin.

Overall, the widespread recovery of fungicide-resistant *C. sojina* in multiple counties throughout Missouri provides new insight into disease management in the state. The northwest corner of Missouri had the highest concentration of fungicide-resistant isolates, consistent with the recovery of fungicide-resistant *C. sojina* isolates in Iowa and Nebraska. Of note in the study was the detection of fungicide resistance in Greene County in southwest Missouri which could indicate a new expansion path westward for the *C. sojina* pathogen.

Observations from Soybean Rust Monitoring and Fungicide Field Demonstrations in Alabama in 2020

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Soybean rust (SBR) was observed at its highest level in Alabama since the disease was first reported in the U.S. in 2004. The disease was detected in 64 of the 67 counties (Figure 1); however, incidence and severity in individual fields were uncommonly high. What was most concerning was that SBR was found in counties in North Alabama at high levels in early August which is rare, and leaf defoliation by the R5 growth stage was observed in fields in the northern tier counties where it was unlikely fungicides were used by the grower. We estimated over a 4% yield loss statewide from to SBR, partly due to the rapid spread of the disease due to favorable weather conditions during the summer, combined with reduced fungicide use by growers likely due to relatively low commodity prices. Severe losses from SBR were noted in south and central Alabama in commercial fields. Greater losses would likely have been recorded in fields in Baldwin County located along the Gulf Coast, and in surrounding counties, if Hurricane Sandy had not damaged fields so badly in September prior to harvest. SBR was active throughout the year, initially overwintering on kudzu along the Gulf Coast and in neighboring states (i.e. FL, GA), then rapidly spreading northward through Alabama due to relatively wet, mild conditions during the early part of the growing season. The Alabama Cooperative Extension System began sending out SBR alerts to regional agents as well as posting alerts on twitter and in the Alabama Crops Newsletter in May to help notifying growers of the developing SBR epidemic brewing in 2020.

To determine disease severity, fungicide strip demonstrations were established in Brewton and Tallassee, Alabama. At Brewton, a 4 oz rate of Stratego YLD applied at the R3 growth stage increased yield by 41.5% compared to the unsprayed control. At Tallassee, a 7 oz rate of Quadris Top SBX applied at the R4 growth stage increased yield by over 20% compared to the unsprayed control.

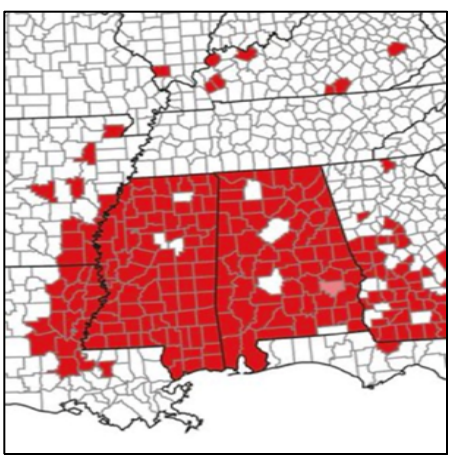

Figure 1. Soybean rust distribution in the southeast in early September 2020.

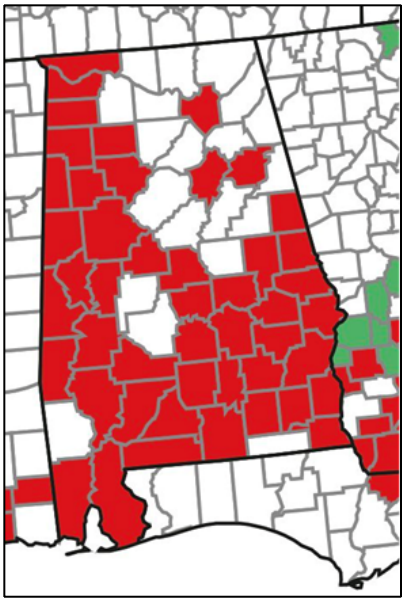

Figure 2. Soybean rust distribution in Alabama on August 13th, 2020.

Field Performance of Two New Commercially Available Premix Fungicides for Management of Foliar Diseases of Soybean in Arkansas

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Eleven large block foliar fungicide trials, ranging in size from 15 – 50 acres, were established in soybean fields in 10 Arkansas counties in 2020. The objectives of this work were to determine the efficacy of two fungicides new to the market and yield impacts associated with different foliar diseases. Each trial contained Miravis Top (Syngenta, Basel, Switzerland) applied at 13.7 fluid ounces per acre and Revytek (BASF, Ludwigshafen, Germany) applied at 8 fluid ounces per acre, and a nontreated control. Trials had three replications and treatments were arranged in a randomized complete block design. Fungicides were applied at R2 – R5, with a ground-driven sprayer equipped with a 30 ft boom, and in a total water volume of 10 gal/A at 40 psi using TeeJet 11002VS tips at 5.0 mph. Five - ten points, depending on the trial, were marked by GPS approximately equidistant throughout each block and disease incidence and severity determined in a 1.5-meter radius around each point at fungicide application and again at R6. Aerial imagery was acquired using a DJI Inspire 1 small unmanned aerial system (DJI, Shenzhen, China) equipped with a multispectral sensor (Sentera Inc., Minneapolis, Minnesota, USA) capturing five individual bands (red, green, blue, red edge, and near infrared) on the day of application and the day disease levels were determined. Grain was harvested with the local farmer's combine and yield monitor and made available for nine of the eleven trials. Yields were adjusted to 13% moisture by volume, buffered by application blocks and the field boundaries, and outliers removed using the interquartile range method prior to analysis. Data were subjected to ANOVA followed by means separation of fixed effects using Tukey's honest significant difference test (HSD) at P=0.05. All analyses and a report for each trial location were completed in an automated model in ArcGIS Pro 2.4 using standard tools and custom script tools (developed using Python 3.6.8 or R 4.0.2). Weather and soils data as well as high resolution field images were included in the reports. Each cooperating farmer and county agent were presented with reports in less than five days from receiving yield data. In trials where yields were provided, two were not analyzed due to herbicide drift and misapplication. Yields for the trials ranged from 33.8 bushels per acre (bu/A) to 71.1 bu/A. Of the three trials where soybeans were R3 in mid-June, one had a significant yield response by fungicide treatment (where brown spot was severe). Of the four trials where soybeans were R3 in mid to late July and early August, three of the four had a significant yield response by fungicide treatment where foliar diseases (frogeye leaf spot, aerial blight, and soybean rust) were moderate to severe. These results point to the value of on farm trials at various locations in the production area as well as the increase in foliar disease pressure on soybean progressing through the reproductive stages later in the normal growing season.

The Impact of Different Cover Crop Rotations on Soilborne Microbial diversity and disease emergence of Soybean-Corn cropping system

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Evidence suggests crop diversification using cover crops may promote soil health by increasing microbial diversity and activity, improving soil structure, and nutrient availability. The use of cover crops and no-till practices aims to improve crop productivity and water use efficiency, in addition to soil properties. However, effects of distinct cover crop recommendations on the soil, soilborne microbial communities, or soilborne pathogens are not well characterized. A long-term study focused on a corn-soybean cropping system in combination with a cover crop rotation was established at Pine Tree Research Station (Colt, Arkansas) in 2016. The goal of this study is to determine the influence of various cover crop/cash crop rotations on soil properties, incidence and severity of soilborne diseases, and their relationship with other spatially variable measures of plant health. Five large blocks containing five strip plots (20 ft × 250 ft) have been planted with corn on even years and soybean on odd years. Each strip plot received the following winter cover crop treatments: winter fallow, cereal (cereal rye or black-seeded oat), legume (winter peas or vetch), the soil health recommendation for the site (current blend: 60% cereal and 40% legume), and alternation between winter cereal (prior to soybean) and legume (prior to corn). Aerial imagery was collected and processed into a georeferenced orthomosaic and vegetation indices calculated. A normalized difference vegetation index was used to identify one "healthy" and one "unhealthy" point within each strip. Points were marked by GPS and soil samples were collected as a composite sample from 12 cores along a two-meter linear pattern around each point. A total of 40 samples were obtained and soil was subsampled for DNA extraction and microbial community quantification. The remaining soil was used in a germination test with two replicates per sample using the corn hybrid LC1987. Germination and root traits were recorded. Two plants per replicate were used for plating on Petri dishes filled with fungal and oomycete semi-selective media (PDA and CMA-PARP) and the remaining roots will be collected for assessing root associated communities. There were not significant differences at germination (P=0.3672), however, there was a trend of higher germination on fallow (53% germination) followed by the winter legume treatment (47% germination). There were no significant differences in root mass (P=0.2713) among treatments. *Pythium sylvaticum* (13 isolates) was isolated from treatments with cereal, legume, and the soil health recommended mix. *Pythium paroecandrum*, and *Pythium irregulare* were isolated with very low frequency from other treatments. Non-pathogenic species found include the fungus *Mortierella* which has been associated with plant growth promotion. Soil samples were subsampled for DNA extraction for future determination of microbial communities present at sample point.

SCN Coalition: Updates and Evolution

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The SCN Coalition is a Public-Private Partnership of soybean checkoff organizations, agrochemical companies and universities. The original mission of the SCN Coalition is to conduct an SCN Resistance Management and Awareness Campaign to educate growers and industry on the reality of SCN resistance development, to slow the development of highly aggressive SCN populations, and to minimize increasing levels of yield loss. Since the launch of The SCN Coalition in February 2018, the campaign has garnered: 21.4 million potential impressions in the ag media, comprising a 15.24% share of discussion; over 900,000 views of the "Let's Talk Todes" video series in the first six weeks after its release in late 2020; and 10,000-plus one-on-one educational interactions with U.S. soybean growers by scientists in the Cooperative Extension services and Universities. To evaluate impact of The SCN Coalition, market research on soybean grower awareness was conducted through a survey of 950 soybean growers in 17 states in late 2020. Preliminary analysis demonstrates high recall of the primary messages of The SCN Coalition (55% to 76%). Compared to baseline data collected in 2015, statistically significant increases in grower utilization of several active management tools were reported (6 to 18%). A data-driven change to the mission of the SCN Coalition is underway, and is broadening from only SCN to include other nematodes and the impact that nematodes have on diseases that impact soybeans. Upcoming anticipated future activities include an expansion of local Extension educational efforts, expansion of 'Let's Talk Todes' and a national soybean nematode conference in 2022.

Evaluating Varieties in the Mississippi State University Official Variety Trial Program for the Presence and Severity of Green Stem

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Green stem, or delayed senesce of soybean, can be a regular problem in Mississippi. On an almost annual basis, green stem delays harvest as a result of excessive green plant material in the form of green stems and leaves that remain on plants even when pods have reached physiological maturity (R8). Numerous factors can result in the production of green stem symptoms. Fungicide application, application of some herbicide products, as well as insect feeding by some stink bug species can all result in the production of green stem in given year. Fungicide applications with products that contain quinone outside inhibitors (QoIs) have previously been correlated to soybean green stem. In addition, applications of products that contain demethylation inhibitors (DMI) have been reported to produce green stem. However, one specific soybean plant characteristic that may have a substantial amount to do with the production of green stem, that has not garnered much attention has to do with cultivar tolerance to green stem. In addition, and more so as it relates to the impact of environment on the response of soybean varieties, stress is rarely considered to be a variable in the incidence or severity of green stem. Temperature, humidity, impact of irrigation, and the number of irrigation events are likely all potential variables that can have a role in the presentation of green stem. As a result, in years when green stem appears to be a greater problem, the cultivars contained in the Mississippi State University Official Variety Trial (OVT) program are evaluated for their response to the environment and inherent production of green stem at the locations that contain the OVT trials. During 2020, eight locations that contained the entries within each soybean maturity group (MG IV early and late Xtend, MG IV and V Enlist, MG IV and V conventional/RoundUp Ready/Liberty Link) were evaluated for plant diseases. Even though variety trial plots were planted at a total of 11 locations during 2020, only eight locations were observed due to early harvest at some of the locations. In addition to the general evaluation of disease, an additional trip to each location was made to evaluate the presence of green stem. Green stem was evaluated at each location by considering the percentage of plants (0-100%) within each plot exhibiting leaves that were still attached to the plant as well as green stems, but pods that had reached R8. The MG IV early Xtend variety set (n=42 entries) from two locations, one overhead irrigated (Brooksville) and one non-irrigated (Raymond) were analyzed and comparisons made between green stem severity with varieties. Based on the observed severity of green stem at the two locations, the average observed green stem at Brooksville was 41.1% (min=1.3%; max=95.0%) compared to the average observed green stem at Raymond which was 72.4% (min=16.7%; max=97.7%). Green stem severity observed at the two locations between cultivars was significant (Brooksville (p<0.0001); Raymond (p<0.0007)). The frequency of the green stem values were different at each location with the bulk of the entries at Brooksville resulting in less green stem than the average in 52% of the varieties observed, while at Raymond 60% of the varieties were observed to have green stem greater than the average. In addition, yield between cultivars was significant at both Brooksville (p<0.0001) and Raymond (p<0.0001). Converse to the green stem situation, yield at Brooksville on average was greater than yield at Raymond as a whole when all 42 entries were considered suggesting that the irrigation may have reduced stress and allowed soybean to achieve a more uniform yield with reduced incidence of green stem.