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Proceedings of the 44th Annual Meeting, Southern Soybean Disease Workers (March 8-9, 2017, Pensacola Beach, Florida)

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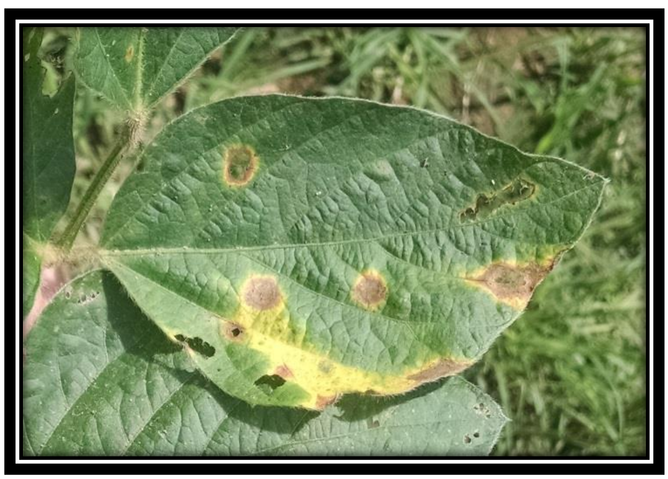

44th Annual Meeting
March 8 – 9, 2017
Pensacola Beach, Florida

PROCEEDINGS

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PROCEEDINGS OF THE SOUTHERN SOYBEAN DISEASE WORKERS 44th ANNUAL MEETING

March 9-10, 2016

Pensacola Beach, Florida

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

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44th Annual Meeting of the Southern Soybean Disease Workers

Agenda for March 9 – 10, 2017, Pensacola Beach, Florida

Wednesday March 8, 2017

11:30 – 12:50 **Registration**

12:50 – 1:00 **Introductions** Terry Spurlock, SSDW President

Contributed Papers

1:00 – 1:30 **Soybean cyst nematode: current status, challenges and opportunities**, G. Tylka and K. Bissonnettee

1:30 - 1:45 **Updates of the 2nd SCN Coalition**, Albert Tenuta

1:45 – 2:00 **Developing management zones for nematodes in soybean**, C. Overstreet, E. C. McGawley, D. M. Xavier-Mis, and M. Kularathna

2:00 – 2:15 **Microbial communities associated with long-term tillage and fertilizer management practices**, A. Y. Srour, J. Hackman, R. L. Cook, J. P. Bond, and A. M. Fakhoury

2:15 – 2:30 **Microbial profile of SDS-suppressive soils in soybean fields**, A. Y. Srour, L.F.S. Leonardo, D. K. Malvick, J. P. Bond, and A. M. Fakhoury

2:30 – 2:45 **Understanding the phytobiome; using strip trials and spatial analysis to determine concomitant maladies in soybean fields**, T. N. Spurlock and T. L. Kirkpatrick

2:45 – 3:00 **Update on the importance and management strategies of root-knot nematode in Arkansas**, T. Faske

3:00 – 3:30 Break **– 30 min**

Student Papers

3:30 – 3:45 **The effect of abamectin on maturity group V soybean varieties (*Glycine max*) in root-knot (*Meloidogyne incognita*) nematode Infested fields of Alabama,** W. Groover, D. Dodge, K. Lawrence, E. Sikora, D. Delaney

3:45 – 4:00 **Reniform nematode in the variable soil texture of a Commerce silt loam soil**, D. M. Xavier-Mis, C. Overstreet, E. C. McGawley, and M. Kularathna

4:00 – 4:15 ***Catenaria anguillulae*: Potential biological control agent to aid in the management of *Heterodera glycines* (Soybean Cyst Nematode)**, D. R. Dyer, N. Xiang, and K.S. Lawrence

4:15 – 4:30 **New charcoal rot management strategies: supplementing secondary nutrients**, T.H. Wilkerson, M. Tomaso-Peterson, B.R. Golden, S. Lu, A.B. Johnson, and T.W. Allen

March 9, 2017

Student Papers

8:30 – 8:45	**The effects of cover crops on soil-borne seedling pathogens: a metagenomics study**, J. J. Hackman, A.Y. Srour, J. P. Bond, R. L. Cook, and A. M. Fakhoury
8:45 – 9:00	**Plant growth characteristics and yield of soybean as a result of fungicide-associated phytotoxicity**, W. J. Mansour, M. Tomaso-Peterson, A. Henn, J. A. Bond, J. T. Irby, and T. W. Allen
9:00 – 9:15	**Evaluating thiophanate-methyl sensitivity as an alternative control option for QoI-resistant populations of Cercospora sojina in Mississippi**, H. Renfroe, N. Brochard, M. Tomaso-Peterson, and T. Allen
9:15 – 9:30	**Target spot and potential resistance to QoI fungicides in Mississippi soybean**, N. Brochard, M. Tomaso-Peterson, T. W. Allen, B. H. Bluhm, B. Dhillon, and T. R. Faske

Target Spot Symposium (9:30 – 10:15)

9:30 – 10:00	**Intro and research summary from UGA on Target Spot**, TBD
10:00– 10:15	Panel Discussion

10:15– 10:45	**Break – 30 min**

Contributed Papers

10:45 – 11:00	**Soybean rust: a threat to the soybean crop in the Midwest?**, E. Sikora
11:00 – 11:15	**Effect of variety, seed treatment, and in-furrow fungicide on taproot decline of soybean**, P. Price, T. W. Allen, H. Pruitt, M. A. Purvis, M. Tomaso-Peterson, and T. Wilkerson
11:15 – 11:30	**Coupling spore traps and quantitative PCR assays for detection of *Cercospora sojina*, the causal agent of soybean frogeye leaf spot**, B.Lin, A. Mengistu, H. Yu and H. Kelly
11:30 – 11:45	**Frogeye leaf spot management: the UUOT part deux**, Allen, T.W., Faske, T.R., Hollier, C.A., Mueller, D., Price, P., Spurlock, T.N., and Kelly, H

11:45 – 12:00	**Business Meeting**

Southern United States Soybean Disease Loss Estimates for 2016

Allen, T.W.[1], Bradley, C.A.[2], Damicone, J.P.[3], Dufault, N.S.[4], Faske, T.R.[5], Hollier, C.A.[6], Isakeit, T.[7], Kemerait, R.C.[8], Kleczewski, N.M.[9], Kratochvil, R.J.[10], Mehl, H.L.[11], Mueller, J.D.[12], Overstreet, C.[6], Price, P.P.[13], Sikora, E.J.[14], Spurlock, T.N.[15], Thiessen, L.[16], Wiebold, W.J.[17], and Young, H.[18]

[1]Mississippi State University, Stoneville, MS; [2]University of Kentucky, Princeton, KY; [3]Oklahoma State University, Stillwater, OK; [4]University of Florida, Gainesville, FL; [5]University of Arkansas, Lonoke, AR; [6]Louisiana State University, Baton Rouge, LA; [7]Texas A&M University, College Station, TX; [8]University of Georgia, Tifton, GA; [9]University of Delaware, Newark, DE; [10]University of Maryland, College Park, MD; [11]Virginia Tech, Suffolk, VA; [12]Clemson University, Blackville, SC; [13]Louisiana State University, Winnsboro, LA; [14]Auburn University, Auburn, AL; [15]University of Arkansas, Monticello, AR; [16]North Carolina State University, Raleigh, NC; [17]University of Missouri, Columbia, MO; [18]University of Tennessee, Jackson, TN

Since 1974, soybean disease loss estimates for the southern United States have been published in the annual proceedings of the Southern Soybean Disease Workers (SSDW). Summaries of the results from between 1977 and 2010 have been published in numerous refereed scientific journals (8,10-13,15-22). Disease loss estimates from 2010 to 2015 have been published annually in the SSDW proceedings (2-7,9) and most recently in a publication to be in print during 2017 in Plant Health Progress that includes the southern as well as norther disease loss estimates (1). In addition, a website through the University of Illinois Extension Service is available and summarizes the estimated yield losses from both the northern and southern U.S. from 1996 through 2014. The website can be accessed at:

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

Various methods were used to obtain the disease losses, and most individuals relied on more than one. The methods employed included: field surveys, plant disease diagnostic clinic samples, variety trials, and 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". In the case where individuals have retired, another individual was contacted to aid in continuing the disease loss estimates project. The production figures for each state were collected from the USDA/NASS website in mid-January 2017. Production losses were based on estimates of yield in the absence of disease. The formula used to derive production losses was: potential production without disease loss = actual production ÷ (1-percent loss) (decimal fraction). Rounding errors may occur in the tables provided below, specifically Table 2 and 3, due to the presence of "trace" estimates of disease which were estimated to be approximately 1×10^{-9}. 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.

Soybean acreage in the sixteen southern states covered in this report in 2016 increased compared to that reported in 2015 by 1.1% (2). Eleven states reported an overall reduction in harvested yield between the 2016 and 2015 season. The 2016 average per acre soybean yield was 39.4 bushels per acre, a 1.3% increase in average yield compared to the 2015 average yield (38.9 bu/A). In

2016, more than 894 million bushels were harvested from approximately 19.9 million acres from 16 southern states accounting for a 6.9% increase in the total harvest. The 2016 total acres harvested, average yield in bushels per acre, and total production in each state are presented in Table 1. Percentage loss estimates from each state are specific as to causal organism or the common name of the disease (Table 2). The total average percent disease loss for 2016 was 7.7%, a slight increase compared to 2015, but nonetheless a decrease from the estimated losses encountered during the 2014 season. (8.16%). In terms of the top five diseases, soybean cyst nematode, root-knot nematode, and frogeye leaf spot occupied the top three spots in 2015 as well as 2016 and accounted for approximately 41% of the total losses in the southern U.S. during 2016. Cercospora blight and charcoal rot rounded out the remainder of the top five most important diseases during 2016. Notable differences between 2015 and 2016 occurred in Septoria brown spot and the category "other diseases" which was generally dominated by the occurrence of target spot in several of the reporting states. Breaking the diseases down into plant categories (nematode diseases, root diseases, foliar diseases, seedling diseases, and seed diseases) highlights the importance of specific groups of diseases. Diseases included in the category "other diseases" could not be separated into separate categories, but as a whole the increases in target spot as reported from numerous states likely accounted for a greater percentage of "foliar" diseases within the specific category. As a whole, nine states reported a decrease in percent disease losses compared to 2015. In terms of the disease losses in millions of bushels, the 2016 disease losses accounted for 89.29 million bushels in lost potential production, or a 0.3% increase over the losses incurred during the 2015 production season (88.98).

Table 1. Soybean production in 16 southern states in 2016.

State	Acres (1,000's)	Bu/Acre	Yield in Bu (1,000's)
Alabama	410	32	13,120
Arkansas	3,100	47	145,700
Delaware	163	41.5	6,764
Florida	29	36	1,044
Georgia	240	30	7,200
Kentucky	1,780	50	89,000
Louisiana	1,190	48.5	57,715
Maryland	515	41.5	21,372
Mississippi	2,020	48	96,960
Missouri	5,540	49	271,460
North Carolina	1,660	35	58,100
Oklahoma	470	29	13,630
South Carolina	405	31	12,555
Tennessee	1,630	45	73,350
Texas	145	31	4,495
Virginia	600	36	21,600
TOTAL	**19,897**		**894,066**
		Avg. 39.4	

Acknowledgments

Funding was not provided to assemble the disease loss estimates for 2016. In the past, the United Soybean Board provided funds to collate the losses across the region as part of a larger effort to collect losses from the entire soybean producing area in the U.S. The members of the SSDW Disease Loss Estimate Committee see value in collecting the estimates and will continue to seek funding sources to support the effort in the future.

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Table 2. Estimated percentage loss of soybean yield due to diseases from 16 southern states during 2016.

	% yield suppression by state																
Disease	**AL[a]**	**AR**	**DE**	**FL**	**GA**	**KY**	**LA**	**MD**	**MS**	**MO**	**NC**	**OK**	**SC**	**TN**	**TX**	**VA**	**AVG**
Anthracnose	0.01	0.05	0.01	0.10	0.25	0.03	0.25	0.002	0.03	0.05	0.05	0.05	0.005	0.50	0.00	0.10	**0.09**
Bacterial diseases	0.00	0.03	0.00	1.20	0.00	0.00	0.10	0.001	0.0001	0.00	0.02	0.05	0.005	0.0001	0.00	0.01	**0.09**
Brown stem rot	0.00	0.00	0.01	0.10	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	**0.01**
Cercospora leaf blight	0.10	0.80	0.00	1.00	0.25	0.08	3.50	0.25	1.70	0.25	0.20	0.50	0.40	0.50	0.00	1.00	**0.66**
Charcoal rot	1.00	1.50	0.01	0.00	0.0001	0.50	0.50	0.01	2.20	0.00	0.001	0.50	0.50	1.30	0.00	0.10	**0.51**
Diaporthe/Phomopsis complex (seed rot)	0.10	0.05	0.10	0.00	0.00	0.03	0.10	0.01	0.02	0.00	1.50	0.10	2.00	0.50	0.00	0.50	**0.31**
Downy mildew	0.00	0.00	0.00	0.20	0.00	0.01	0.00	0.00	0.00	0.05	0.00	0.00	0.01	0.00	0.00	0.01	**0.02**
Frogeye leaf spot	0.35	1.00	0.001	0.10	0.25	1.30	1.50	0.02	1.25	0.50	0.40	0.10	0.01	2.80	0.10	1.00	**0.67**
Fusarium wilt and root rot	0.001	0.03	0.01	0.00	0.0001	0.00	0.00	0.05	0.00	0.05	0.00	0.00	0.001	0.0001	0.00	0.10	**0.02**
Other diseases[b]	0.00	0.20	0.00	0.00	0.00	0.10	2.50	0.001	2.75	0.00	0.03	0.00	0.10	1.50	0.05	0.10	**0.46**
Phytophthora root and stem rot	0.00	0.10	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.50	0.70	0.20	0.01	0.00	0.00	0.01	**0.16**
Pod and stem blight	0.01	0.05	0.01	0.00	1.00	0.08	0.20	0.001	0.02	0.10	1.00	0.50	0.50	0.00	0.00	0.10	**0.22**
Purple seed stain	0.05	0.01	0.01	0.00	0.0001	0.01	0.50	0.001	0.02	0.00	0.10	0.10	0.20	0.05	1.00	0.10	**0.13**
Reniform nematode	0.25	0.00	0.00	0.20	0.25	0.00	1.50	0.00	1.80	0.00	0.001	0.00	0.50	0.01	0.00	0.00	**0.28**
Root-knot nematode	0.50	3.80	0.50	1.10	3.00	0.01	2.50	0.75	1.15	0.05	0.70	0.50	2.00	0.0001	0.00	1.00	**1.10**
Soybean cyst nematode	0.25	0.80	0.50	0.00	0.10	2.50	0.10	1.00	0.60	5.00	2.00	2.00	2.00	2.50	0.00	3.00	**1.40**
Other nematodes[c]	0.00	0.00	0.00	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.25	0.00	2.00	0.00	0.00	0.50	**0.18**
Rhizoctonia aerial blight	0.00	0.05	0.00	0.00	0.00	0.00	1.50	0.001	0.80	0.00	0.01	0.00	0.0001	0.00	0.00	0.00	**0.15**
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	1.00	0.20	0.10	0.00	0.10	1.00	0.25	0.04	0.50	0.05	0.10	0.50	0.02	1.50	0.00	0.50	**0.37**
Septoria brown spot	0.00	0.10	0.10	0.80	0.00	0.40	0.10	0.02	1.30	0.00	0.05	1.50	0.20	1.50	0.00	0.10	**0.39**
Southern blight	0.001	0.05	0.00	0.10	0.25	0.00	0.10	0.01	0.015	0.00	0.30	0.05	0.10	0.00	0.00	0.01	**0.06**
Soybean rust	0.10	0.00	0.00	0.80	0.10	0.00	0.10	0.00	0.04	0.00	0.00	0.00	0.05	0.05	0.10	0.00	**0.08**
Stem Canker	0.10	0.20	0.10	0.10	0.00	0.50	0.00	0.002	0.02	0.00	0.10	0.10	0.001	0.50	0.00	1.00	**0.17**
Sudden death syndrome	0.001	0.07	0.00	0.00	0.00	0.30	0.10	0.002	0.00	1.00	0.00	0.05	0.01	1.00	0.00	0.00	**0.16**
Virus Diseases[d]	0.25	0.00	0.01	0.50	0.00	0.08	0.00	0.25	0.06	0.00	0.20	0.05	0.01	0.00	0.00	0.10	**0.09**
Total disease %	**4.07**	**9.09**	**1.47**	**6.30**	**5.65**	**7.43**	**16.00**	**2.43**	**14.28**	**7.60**	**7.71**	**6.85**	**10.63**	**14.21**	**1.25**	**9.35**	7.77

[a]Rounding errors may exist. Tr = formally reported as trace (0.000000001) was not reported for the 2016 estimates. As a result of that, some numbers presented carry decimal places beyond the hundredths place.

[b]Other diseases listed included: Black root rot (NC), Phymatotrichopsis root rot (TX), red crown rot (MS), taproot decline (AL, AR, LA, MS), target spot (AR, KY, LA, MS, NC, TN, VA).

[c]Other nematodes listed included: Columbia lance nematode (LA, NC), sting nematode (GA, VA), stubby root nematode (VA).

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

Table 3. Estimated suppression of soybean yield (Millions of Bushels) as a result of disease during 2016.

	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	0.00	0.09	0.00	0.00	0.04	0.03	0.17	0.00	0.04	0.09	0.03	0.01	0.00	0.46	0.00	0.02	**0.97**
Bacterial diseases	0.00	0.05	0.00	0.02	0.00	0.00	0.07	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	**0.16**
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	**0.01**
Cercospora leaf blight	0.02	1.37	0.00	0.01	0.04	0.08	2.38	0.05	2.07	0.45	0.12	0.06	0.05	0.46	0.00	0.24	**7.40**
Charcoal rot	0.21	2.56	0.00	0.00	0.00	0.48	0.34	0.00	2.68	0.00	0.00	0.06	0.06	1.20	0.00	0.02	**7.62**
Diaporthe/Phomopsis complex (seed rot)	0.02	0.09	0.01	0.00	0.00	0.03	0.07	0.00	0.02	0.00	0.93	0.01	0.24	0.46	0.00	0.12	**1.99**
Downy mildew	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	**0.11**
Frogeye leaf spot	0.07	1.71	0.00	0.00	0.00	1.25	1.02	0.00	1.52	0.91	0.25	0.01	0.00	2.58	0.00	0.24	**9.57**
Fusarium wilt and root rot	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.02	**0.18**
Other diseases[b]	0.00	0.34	0.00	0.00	0.00	0.10	1.70	0.00	3.35	0.00	0.02	0.00	0.01	1.38	0.00	0.02	**6.93**
Phytophthora root and stem rot	0.00	0.17	0.00	0.00	0.00	0.48	0.34	0.00	0.00	0.91	0.43	0.02	0.00	0.00	0.00	0.00	**2.36**
Pod and stem blight	0.00	0.09	0.00	0.00	0.14	0.08	0.14	0.00	0.02	0.18	0.62	0.06	0.06	0.00	0.00	0.02	**1.41**
Purple seed stain	0.01	0.02	0.00	0.00	0.00	0.01	0.34	0.00	0.02	0.00	0.06	0.01	0.02	0.05	0.03	0.02	**0.60**
Reniform nematode	0.05	0.00	0.00	0.00	0.04	0.00	1.02	0.00	2.19	0.00	0.00	0.00	0.06	0.01	0.00	0.00	**3.37**
Root-knot nematode	0.10	6.49	0.04	0.01	0.43	0.01	1.70	0.16	1.40	0.09	0.43	0.06	0.24	0.00	0.00	0.24	**11.41**
Soybean cyst nematode	0.05	1.37	0.04	0.00	0.01	2.40	0.07	0.21	0.73	9.07	1.24	0.25	0.24	2.31	0.00	0.71	**18.69**
Other nematodes[c]	0.00	0.00	0.00	0.00	0.01	0.00	0.07	0.00	0.00	0.00	0.16	0.00	0.24	0.00	0.00	0.12	**0.59**
Rhizoctonia aerial blight	0.00	0.09	0.00	0.00	0.00	0.00	1.02	0.00	0.97	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**2.09**
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	0.21	0.34	0.01	0.00	0.01	0.96	0.17	0.01	0.61	0.09	0.06	0.06	0.00	1.38	0.00	0.12	**4.04**
Septoria brown spot	0.00	0.17	0.01	0.01	0.00	0.38	0.07	0.00	1.58	0.00	0.03	0.19	0.02	1.38	0.00	0.02	**3.87**
Southern blight	0.00	0.09	0.00	0.00	0.04	0.00	0.07	0.00	0.02	0.00	0.19	0.01	0.01	0.00	0.00	0.00	**0.42**
Soybean rust	0.02	0.00	0.00	0.01	0.01	0.00	0.07	0.00	0.05	0.00	0.00	0.00	0.01	0.05	0.00	0.00	**0.22**
Stem Canker	0.02	0.34	0.01	0.00	0.00	0.48	0.00	0.00	0.02	0.00	0.06	0.01	0.00	0.46	0.00	0.24	**1.65**
Sudden death syndrome	0.00	0.12	0.00	0.00	0.00	0.29	0.07	0.00	0.00	1.81	0.00	0.01	0.00	0.92	0.00	0.00	**3.22**
Virus Diseases[d]	0.05	0.00	0.00	0.01	0.00	0.08	0.00	0.05	0.07	0.00	0.12	0.01	0.00	0.00	0.00	0.02	**0.42**
Total loss	**0.85**	**15.53**	**0.10**	**0.08**	**0.78**	**7.12**	**10.89**	**0.51**	**17.39**	**13.79**	**4.79**	**0.85**	**1.25**	**13.11**	**0.04**	**2.21**	**89.29**

[a]Rounding errors may exist. Tr = formally reported as trace (0.000000001) was not reported for the 2016 estimates. As a result of that, some numbers presented carry decimal places beyond the hundredths place.
[b]Other diseases listed included: Black root rot (NC), Phymatotrichopsis root rot (TX), red crown rot (MS), taproot decline (AL, AR, LA, MS), target spot (AR, KY, LA, MS, NC, TN, VA).
[c]Other nematodes listed included: Columbia lance nematode (LA, NC), sting nematode (GA, VA), stubby root nematode (VA).
[d]Virus diseases listed included: *Bean pod mottle virus* (AL, DE, KY, MS, NC, OK), *Soybean mosaic virus* (AL, DE, MS, NC, OK), *Soybean vein necrosis virus* (AL, DE, KY, MS, NC, OK, VA), *Tobacco ringspot virus* (KY, NC).

Soybean cyst nematode: current status, challenges and opportunities

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The soybean cyst nematode (SCN), *Heterodera glycines*, was first discovered in North America in 1954. Although a great deal has been learned about SCN biology, ecology, and management, it continues to be a serious soybean pest. Challenges in managing SCN include high levels of reproduction, long-term persistence in the absence of hosts, strong influence of edaphic factors on population dynamics, synergistic interactions with other pests and pathogens, and lack of genetically diverse resistance in commercially available soybean varieties. In areas where SCN is prevalent, many SCN populations have developed elevated levels of reproduction on SCN-resistant varieties with the main source of resistance available, PI 88788. There is great potential for widespread adoption of varieties with sources of resistance other than PI 88788 as well as varieties with engineered SCN resistance, when such varieties become available. Also, opportunities for using nematode-protectant seed treatments for more integrated management of SCN are developing. Continued research is needed to understand the nematode's basic biology, to discover the molecular basis of feeding-site development, to determine the mechanisms of interactions of SCN with other pathogens and pests, and to understand the basis of the effects of soil pH and moisture on SCN reproduction. The future of sustained, profitable soybean production in North America will be determined, in part, by how well the aforementioned challenges are overcome and the opportunities embraced.

Developing management zones for nematodes in soybean

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The Southern root-knot nematode (*Meloidogyne incognita*) and reniform nematode (*Rotylenchulus reniformis*) are major pests of soybean in Louisiana. Changes in soil texture within a field have been shown to impact the response of nematicides in cotton from both of these nematode species. This has allowed the development of management zones in the field where zones can be assigned specific rates or types of nematicides. This study was conducted to determine if management zones could be developed for soybean similar to that previously described for cotton. A field was selected at the Northeast Research Station at St. Joseph, LA which had variable soil texture since it included a Commerce Silt Loam (a fine silt soil) and a Bruin silt loam (a coarse silt soil). Apparent electrical conductivity (EC_a) ranged in the test site from 15.4-117.9 mS/m for the $EC_{a\text{-deep}}$ readings. Four treatments were included in the experiment including Telone II at 3 gal/a applied preplant, Avicta Complete Bean as a seed treatment, the combination of the Telone and Avicta, and an untreated. Each treatment was replicated 40 times to ensure inclusion within the various soil zones within the field. *R. reniformis* and *M. incognita* were present throughout the field. Avicta Complete Bean was not significant in any of the zones with either nematode populations or yield. Telone had a significant effect on population development of *R. reniformis* in zones 1 and 2 which had the lowest $EC_{a\text{-deep}}$ values and in zone 1 for *M. incognita*. Telone provided a 20.3 and 12.6 bushel per acre increase in zones 1 and 2, respectively. There were no significant differences in yield with the fumigant within zones 3-5. This study indicates that fields with variable soil texture as measured by EC_a have the potential to be divided into management zones for nematode problems in soybean.

Microbial communities associated with long-term tillage and fertilizer management practices

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A field study was established in 1970 near Belleville, IL to determine the effect of tillage and fertilizer management on corn and soybean yield, and soil abiotic factors. In this study, taking advantage of advances in Next-Gen Sequencing, we are trying to answer two main questions: how tillage and fertilizer treatments affect the microbial consortia harbored in the soil? And what role these biotic factors play in shaping soil edaphic properties in relation to corn and soybean yield. The 45 year study consisted of continuous corn (1970-1990) and a corn-soybean rotation (1991-2015). Two tillage regimes (chisel tillage [CT], and no-till [NT]) and three fertilizer treatments (no fertilization, N-only, and NPK) were distributed in a randomized split-plot design. Soil samples were taken from the rhizosphere of the plants and high-throughput sequencing was performed on the MiSeq platform to identify and quantify community members of bacteria, fungi, oomycetes and fusaria. Our results indicate that tillage management was a dominant factor in shaping the soil microbial community structure. Further analysis is currently taking place to better understand the effect of different management practices on the soil in various agroecosystems.

Microbial profile of SDS-suppressive soils in soybean fields

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Sudden death syndrome (SDS) caused by *Fusarium virguliforme (Fv)* is an endemic problem that causes substantial losses in soybean yields. In production fields, SDS often develops in patches with spots apparently conducive to SDS, surrounded by areas that seem to be naturally suppressive to the disease. The molecular basis of this phenomenon is poorly understood. Here, we investigate the association between microbial profiles in the soil and SDS suppressiveness by analyzing the microbial composition of soil samples collected from SDS infested fields in IL, IA and MN. A consortium of bacterial and fungal species, including members of the *Fusarium oxysporum sp*. complex, Actinomycetales, *Trichoderma spp*, Firmicutes, Chloroflexi, *Pseudomonas*, *Metacordyceps*, *Penicillium*, *Purpureocillium* and *Myceliophtora*, were well represented in soils with low SDS incidence. On the other hand, diseased soils were dominated by *Fusarium solani spp*., *Phallus rugulosus*, *Stachybotrys*, and others. Our study paves the way for a better understanding of soil conditions that are conducive to the incidence and development of SDS.

Understanding the phytobiome; using strip trials and spatial analysis to determine concomitant maladies in soybean fields

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Evidence suggests yield follows relative changes in soil texture where pest populations, nutrient deficiencies, and changes in moisture content may influence plant stress. Harvest yields in soybean fields are typically variable and likely caused by multiple issues. The objective of this work was to determine if methodologies utilizing large plot strip trials across variable areas of field stress offer an opportunity to decode combinations of stresses. Two fields, 1EF and W1B, were chosen for strip trial placement at Rohwer Station, Arkansas, USA based on known populations of southern root-knot nematode (RKN), *Meloidogyne incognita*. Both locations were planted with Armor DK 4744 soybeans. Two hundred points were marked by GPS position, 10 strips of 10 marks, two rows wide, and spaced approximately 16 rows apart in field 1EF and 11 rows apart in field W1B. These marked "anchor" points served as untreated controls. Treatments of nematicides (Telone II, applied prior to planting at 3 gal/A in field 1EF and Ilevo, applied as a seed treatment in field W1B at a rate of 0.25 mg/seed), fungicides applied at R4 (Quadris, 15.5 oz/A, Topsin XTR, 20 oz/A, Quadris Top SB 14 oz/A, and Stratego YLD, 4 oz/A), and combinations of each nematicide x fungicide were applied in the rows intermittent the GPS marks, replicated three times. Additional GPS marks were added in the treatment strips, 10 per strip and strips were two rows wide. Frogeye leaf spot, *Cercospora sojina*, was rated at R5 on a percentage scale in the upper third of the soybean canopy at each GPS mark. Root galling was also determined. Soil fertility levels and nematode populations were determined at the anchor points just after harvest. Data were recorded in a CALC spreadsheet and saved with the .dbf file extension (openoffice.org) associated with a shapefile (.shp) representing the GPS marked data points. Shapefiles for both fields were imported into ArcGIS 10.1 (ESRI, Carlsbad, CA) and points extracted and re-grouped by treatment using the query function. Spatial analysis was completed in GeoDa 1.8 (L. Anselin, The Center for Spatial Data Science, University of Chicago). Analysis of variance and two sample t-tests were done in SAS 9.4 (SAS Institute, Cary, NC). Soil potassium levels varied across space in each field using Moran's I (P=0.001) and correlated to FLS levels in untreated strips. Surprisingly, in W1B, there was a spatial correlation of RKN populations, below optimal K levels, and severity of FLS, P=0.03 and P=0.01 respectively. Spatial analysis indicated K levels correlated to FLS (P=0.01) and FLS correlated to yield differences across the untreated points in 1EF (P=0.031). Due to these associations, K levels were krigged, the K surface model sampled by treatment points using the sample tool in ArcMap, and treatment points separated above and below 130 ppm K in both fields. Where Ilevo was applied in W1B, the levels of FLS were lower than where not used (P=0.0001) and strips of Telone II lessened FLS in 1EF (P=0.05) and increased yield 7 bu/A (P=0.01) in areas of lower K. Galling in 1EF was *NS* among treatments. These findings indicate the "strip and anchor point method" was successful in identifying the presence of concomitant disorders/diseases. The value of analyzing product efficacy within areas of varying field level stresses using this method or similar will be realized in better integrated pest management strategies.

Update on the Distribution and Management of Root-Knot Nematodes in Arkansas

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The southern root-knot nematode, *Meloidogyne incognita*, is one of the most important pathogens affecting soybean production in the southern United States. During the past three cropping seasons a statewide soybean nematode survey was sponsored by the Soybean Promotion Board and conducted by the Nematode Diagnostic Lab in Hope, AR. Based on the number of samples processed, there has been a significant increase in the incidence of the southern root-knot nematode compared to that of the soybean cyst nematode, *Heterodera glycines*, since the last survey some 30 years ago. Generally, management strategies rely on an integrated approach that includes host plant resistance, crop rotation and nematicides. Currently, the number of commercially available soybean cultivars that have a suitable level of resistance and good yield potential are limited. This availability is unlikely to change and more likely to decline with the increased use and development of herbicide resistant soybean cultivars. Since 2010, there has been a renewed interest in peanut, *Arachis hypogea*, production in the state, which is an excellent non-host crop. But, it isn't a suitable crop in all soybean production areas of the state. Grain sorghum, *Sorghum bicolor*, has been used as a rotational crop, but has been recently confirmed to vary greatly in their susceptibility to *M. incognita*. Thus, selecting the most resistant hybrid is important when managing root-knot nematodes. Nematicides applied as a seed treatment are among the most popular delivery systems for nematicides use in the state. Seed treatments provide early season suppression of nematode infection in soils where root-knot nematodes population densities are low, but are less consistent when population densities are moderate to high. Other options like the re-registration of aldicarb for use on soybean in a few southeastern states may be helpful in the mid-South to manage root-knot nematode at moderate and high population densities. Improvements in the availability of resistant cultivars and hybrids in a crop rotation sequences paired with nematicide use will be important factors in the future management of the southern root-knot nematode on soybean in Arkansas and the mid-South.

The effect of abamectin on maturity group V soybean varieties (*Glycine max*) in root-knot (*Meloidogyne incognita*) nematode infested fields of Alabama

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Variety selection and nematicide application are core components of nematode management and sustainable production. *Meloidogyne incognita* is a threat to sustainable soybean production, and diminishes yield in the Southeastern United States. Five maturity group V varieties, including a root-knot resistant and two root-knot susceptible varieties, were evaluated for response to the nematicide Avicta 500 FS in four *M. incognita* infested locations in Alabama. Variety yields and nematode population density varied by location. The nematicide treatment increased the yield of a root-knot susceptible variety significantly more than it did for other varieties. Avicta significantly reduced this susceptible varieties' nematode population density at two locations, and increased yield by 39% and 48% at another two locations. Nematicide treatment did not increase yield of a moderately root-knot resistant variety at any location, but did increase yield of a soybean cyst nematode (*Heterodera glycines*) resistant variety at one location. The nematicide did not significantly increase yield of the root-knot resistant variety at any location; however, the resistant variety consistently produced yields near the Alabama State average (41 bushels per acre) even at the location with the highest nematode population density. Variety selection and nematicide application are economically important decisions that must be made based upon site-specific nematode population density to appropriately maximize yield.

Reniform nematode in the variable soil texture of a Commerce silt loam soil

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In Louisiana, reniform nematode (*Rotylenchulus reniformis*) has been detected in all major soybean producing parishes including areas with Commerce silt loam (CSL) soils. Variability of soil texture within this soil type has been shown to impact the response to nematicides and development of populations of *R. reniformis* on cotton. Field tests were conducted in a CSL field in 2015 and 2016 to evaluate the influence of Telone II on *R. reniformis* among the different soil textures on soybean. The field was divided into 14m plots and the plots were categorized in zones according to apparent electrical conductivity ($Ec_{a\text{-}deep}$) data. The nematicide was applied as a fumigant on the designated plots, one week before planting. Soil samples for nematode counts were taken at planting and after harvest. There was a significant interaction between year and soil texture zones and year and nematicide, so the data for each year was analyzed separately. Overall, there was a significant reduction in nematode reproduction in the plots where the nematicide was applied. However the impact of fumigation on nematode populations was greater in 2016, when all six zones had significantly lower reniform levels. A significant yield increase in plots treated with the nematicide was observed in 2016 but this improvement was not noticed in 2015. The effects of soil texture and nematicide in *R. reniformis* reproduction and pathogenicity on soybeans were confirmed in this study.

Catenaria sp: Potential biological control agent to aid in the management of *Heterodera glycines* (Soybean Cyst Nematode)

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A *Catenaria* sp. fungus was observed infesting the bodies of *Heterodera glycines* (SCN) J2s that were in greenhouse cultures at Auburn University's Plant Science Research Center. Sporangia formed inside the bodies of the SCN J2's. Zoospores were released outside the cuticle of the nematode through a germination tube. The fungus identified by morphological characteristics to be a *Catenaria* sp. The objectives of this research was to determine the best isolation medium, the optimum fungal growth temperature, define the infection rates on SCN, and determine the effect of the *Catenaria* sp. on the nematode in greenhouse tests. An individual SCN J2 nematode colonized with *Catenaria* sp. was placed on different selected media, allowed to grow for 7 days and then accessed for growth. The media used were 0.4% Beef Extract Agar (BEA), Potato Dextrose Agar (PDA), Potato Carrot Agar (PCA), Oatmeal Agar (OA), or Corn Meal Agar (CMA). Results of the tested media found only BEA had the ability to support growth of *Catenaria* sp. Isolates were transferred to new 0.4% BEA plates and incubated at temperatures of 10, 20, 25, 30, 35, and 40°C for 15 days to determine the best growth temperature. Optimum growth temperature was determined to be 30 to 35°C ($P \leq 0.1$) with mycelial growth covering the 9 cm petri dish. To determine the infection rates of *Catenaria* sp. on SCN J2s and eggs, both alive and heat killed SCN J2s and eggs were placed into different wells of a 96-well plate. One SCN J2 colonized with *Catenaria* sp. was added to each well. Fifty percent of the heat-killed SCN J2s were infested with *Catenaria* sp. after 20 days. Significantly fewer heat-killed SCN eggs and SCN live juveniles and eggs were colonized. Greenhouse tests were conducted to first determine the effect of inoculation rates, measured with an OD_{600} value, of *Catenaria* sp. on SCN. In the greenhouse test, soybeans that were planted into nematode infested soil were inoculated with three rates; 0.377, 0.566, and 0.754 of the *Catenaria* sp. to measure its effect on the nematode populations. All three rates significantly reduced the number of SCN cysts when compared to the untreated control ($P \leq 0.1$).

New charcoal rot management strategies: supplementing secondary nutrients

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Macrophomina phaseolina (Tassi) Goid is a ubiquitous soilborne fungal pathogen that causes charcoal rot (CR) of soybean. Typically, CR occurs as a result of low soil moisture, and high temperatures, but has also been observed in fields regardless of environment and likely as a result of other stress-related situations. The current management options include crop rotation, utilizing cultural practices to reduce stressful field situations, and planting resistant cultivars which are lacking. The objective of this research was to determine if supplementing soil availability of secondary nutrients, specifically calcium (Ca) and magnesium (Mg), at three different timings (pre-plant, at-plant and pre-plant fb at-plant) would minimize the effects of *M. phaseolina*, and subsequently reduce the incidence of the fungus in plant roots. From 2014 through 2016, non-irrigated, *M. phaseolina*-inoculated field trials were conducted in Stoneville, MS with a CR-susceptible and a CR-moderately resistant cultivar. Treatment applications consisted of 1,000 lb/acre of Ca and Mg alone and in combination, in addition to two controls: a non-inoculated, non-treated and an inoculated, non-treated (n=11 treatments). Numerous variables were measured at multiple growth stage timings (V3, R3, R5, R7, and R8) and included plant heights, root weight, disease severity as assessed by observing microsclerotia in roots, colony forming units from ground tissue samples, and yield. A steady increase in disease severity occurred from R3 through R8 for the susceptible cultivar. However, a 6% decrease in disease over time was observed with an application of calcium and magnesium applied at planting when compared to the inoculated control in the charcoal rot-susceptible cultivar. Disease evaluations taken from the root tissues of the moderately resistant cultivar at R5 showed a 4 to 29% reduction from evaluations observed in roots at R3. Numerically, the moderately resistant cultivar, reduced disease severity by 9% over the season with a pre-plant application of calcium when compared to the inoculated control, but no significant benefit was observed with the AUDPC values. In both cultivars, an increase in disease severity was observed with all treatments beginning at R5 and continuing to R8. Numerical reductions in CFUs between 27% and 36% were observed at reproductive growth stages as a result of magnesium applications when compared to the inoculated control. No significant benefit was observed with yield; however, numerical differences occurred between treatments and negative impacts were observed with some treatments. An application of calcium and magnesium applied at planting significantly reduced yield by 12% when compared to an application of calcium alone at planting. Magnesium applied at-planting provided a 3% increase over the inoculated control in the moderately-resistant cultivar, albeit not significant. An at-planting application of calcium numerically increased yield by 1% with the susceptible cultivar when compared to the inoculated nontreated. Results obtained from this research do not support applications of secondary nutrients as a management option for charcoal rot of soybean.

The Effects of Cover Crops on Soil-borne Seedling Pathogens: A Metagenomics Study

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Seedling pathogens associated with corn and soybean cause extensive economic losses for growers worldwide. Different management practices such as the use of fungicides, crop rotation, tillage and cover crops are commonly used to mitigate the pathogens' impact in monoculture systems. However, not much is known about how these factors affect the microbial communities present in the soil. This metagenomics study attempts to investigate how (7) species of cover crops and two different types of tillage; conventional and no-till, affect soil microbial communities. The sequencing of samples was performed using the Illumina Mi-Seq platform, with a return of 14^6 bp reads in total, using 250 bp PE reads. Four different primer sets were used to generate four libraries for the phylogenic identification of species of fungi, bacteria, oomycetes, and fusaria: the ITS regions the elongation factor-1a (EF1a), and the V4 region of the 16s rDNA. The goal of this analysis is to examine how cover crops along with other factors, such as tillage and crop rotation, suppress or support certain microbial profiles that are conducive to the incidence of seedling pathogens of corn and soybean.

Plant growth characteristics and yield of soybean as a result of fungicide-associated phytotoxicity

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A renewed interest in frogeye leaf spot (FLS) can be tied to the widespread observation of quinone outside inhibitor (QoI) resistance as a result of the G143A substitution detected within the *Cercospora sojina* Hara fungal population. Subsequently, growers have been urged to utilize fungicide products that contain multiple modes of action (MOA) to manage FLS instead of stand-alone QoI products. In situations where FLS-susceptible varieties are planted, soybean growers will likely make at least one fungicide application with a mixed MOA fungicide that likely includes a demethylation inhibitor (DMI). One major drawback to applying products that contain a DMI can be the development of phytotoxicity on soybean leaf tissue. Phytotoxicity is oftentimes the result of systemic activity caused by a "curative" fungicide and not unique to the DMI-based fungicide products.

To address concerns in the soybean community regarding the potential impact of phytotoxicity on yield, field trials were conducted during 2015 and 2016. The fungicides included dodine (1.5 pint/A of Elast), prothioconazole (3 fl oz/A of Proline), tebuconazole (4 fl oz/A of Monsoon), and trifloxystrobin + prothioconazole (4 fl oz/A of Stratego YLD). Applications of each treatment were made as separate fungicide applications and also tank mixes with each of three foliar nutrients in an attempt to reduce observable phytotoxicity. Applications were made at the R3 growth stage in 15 gallons/A of water and included an adjuvant (0.25% NIS v/v as Induce). Visual assessments of FLS and phytotoxicity were made pre- and several times post-application (7, 14, and 21 days post). Foliar tissue samples were collected from the upper portion of the plant canopy 10 days post-application in order to test for nutrient uptake within the plant. A 2 ft. section of plants from one of the middle two rows was hand-harvested at physiological maturity (R8). Plant heights, number of pods, and number of nodes per plant were recorded to determine the plant growth effects of phytotoxicity. Observable FLS was not significantly different in the non-treated when compared to all treatments. In addition, dodine resulted in significantly greater phytotoxicity than the non-treated, a difference of 52.7 %. Regardless of fungicide and foliar nutrient tank mix combinations, phytotoxicity was not significantly different when compared to the fungicide treatment applied alone. Although the statistical analysis suggested significant increases in phytotoxicity following application with some treatments, there were no significant differences in yield. Nutritional analysis from the plant tissue revealed significant differences in nutrient uptake in the micronutrient boron. Furthermore, boron was significantly correlated with observable phytotoxicity. However, this relationship between boron and phytotoxicity was not a strong, positive linear correlation. In addition, plant heights, number of pods, and number of nodes per plant were not significantly different from the non-treated.

Evaluating thiophanate-methyl sensitivity as an alternative control option for QoI-resistant populations of *Cercospora sojina* in Mississippi

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Cercospora sojina Hara, the causal agent of frogeye leaf spot (FLS) in soybean was first reported in the United States in 1924. FLS is primarily a foliar disease with symptoms that appear as circular to angular lesions with reddish-brown margins. Under high disease pressure, yield losses due to FLS may exceed 30%. Quinone outside inhibitor (QoI) fungicides have previously been widely used to manage FLS; however they may no longer be an effective option. Over the past seven years, farmers in Mississippi have communicated to extension personnel a control failure with QoI fungicides against FLS. Research conducted in 2013–2014 in Mississippi showed approximately 93% of the C. sojina population to be QoI-resistant. As a result of widespread QoI-resistance other fungicide classes were evaluated for control of FLS. Of those, thiophanate-methyl (TM) is labeled for FLS control in soybean and is in the methyl benzimidazole carbamate (MBC) class which targets microtubule production in the β-tubulin 2 gene (*TUB*2). Previous research has shown instances where other fungi, exhibiting resistance to QoI fungicides express dual resistance to MBCs. Due to the need for alternative fungicides for FLS control, as well as dual resistance documented in other fungal populations, the objective of this study was to evaluate sensitivity of Mississippi *C. sojina* isolates to TM, and subsequently establish a baseline sensitivity of *C. sojina* isolates from Mississippi as a reference for future screening.

An *in vitro* bioassay was performed on fourteen QoI-resistant *C. sojina* isolates and thirteen QoI-sensitive isolates collected throughout Mississippi. Technical grade TM was diluted to achieve final concentrations of 0, 0.001, 0.01, 0.1, 1, 10, and 100 µg/ml. The concentration of TM that effectively inhibited mycelial growth by 50% (EC_{50}) was determined. Genomic DNA was extracted from fresh mycelium of *C. sojina* isolates. Primers CercUN-F and CercUN-R were used to amplify the *TUB2* gene fragment. The *TUB2* amplicons were purified and sequenced. Resultant sequences were aligned in Mega 6 to determine the presence or absence of amino acid substitutions at positions 198 and 200 in *TUB2*, the binding site of TM.

All isolates showed complete inhibition of mycelial growth at 10 µg/ml; therefore we conclude the *C. sojina* isolates are sensitive to TM. EC_{50} values ranged from 0.66 to 5.52 µg/ml with a mean of 3.2 µg/ml. The amino acids contained at positions 198 and 200 were glutamic acid and phenylalanine, respectively. These amino acids bind with TM which results in sensitivity. Resistance to TM is conferred when glycine, alanine, lysine (position 198), or tyrosine (position 200) are substituted. The results of this study show that TM may be an effective alternative management option for *C. sojina* in Mississippi soybean.

Target Spot and Potential Resistance to QoI fungicides in Mississippi Soybean

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Target spot is a foliar disease of soybean caused by the fungus, *Corynespora cassiicola*. Symptoms of target spot, as generally observed in the lower to middle canopy, initially appear as round to irregular, reddish-brown lesions surrounded by a yellowish-green halo on leaves varying in size from 10 to 15 mm in diameter. In addition, target spot produces teardrop-shaped lesions on pods, petioles and stems. Target spot appears in most soybean growing regions, but has not warranted much attention as yield losses have not been reported. Recently, target spot incidence has increased as perhaps a result of non-target effects of widespread fungicide use. Quinone outside inhibitor (QoI) fungicides are the primary fungicide class used in foliar disease management in the Mid-south soybean; therefore, the QoI fungicides were investigated for resistance within *C. cassiicola*. To date, QoI resistance has been reported in *C. cassiicola* on tomato and cucumber. Due to an increase in target spot incidence in AR and MS soybean during 2016 and reports of QoI resistance in other crops, the objective of this research was to assess potential QoI resistance in *C. cassiicola* populations from soybean in AR and MS. Eighty-seven *C. cassiicola* isolates were collected from soybean across nine MS counties. A subset of 20 isolates were chosen to determine their sensitivity to the QoI fungicides *in vitro*. Hyphal plugs (5 mm) from the edge of a ten-week-old colony were transferred to potato dextrose agar (PDA) plates amended with rates (0, 1, and 10 ppm) of azoxystrobin (AZ). All AZ-amended PDA plates contained 60 µg/ml of SHAM. Plates containing the fungal plugs were placed in the dark for 7 days before measuring colony diameter. Relative growth was determined as a percentage compared to the control concentration for each isolate. A similar study was conducted with fluxapyroxad, prothioconazole, and pyraclastrobin against four AR isolates. Genomic DNA was extracted for a selected group of eight MS isolates evaluated as above. A partial fragment of the cytochrome *b* gene (*CYT b*) was amplified using primers developed at the Univ. of AR, to confirm the presence or absence of the G143A. No inhibition of mycelial growth was observed when *C. cassiicola* isolates were exposed to the greatest concentration of AZ. While a similar response was observed for all AR isolates to pyraclastrobin and prothioconazole, fluxapyroxad provided the greatest suppression of fungal growth. These phenotypic results indicated a lack of QoI sensitivity. To confirm these observations at the molecular level, sequences of *CYT b* showed only three of the eight *C. cassiicola* isolates from MS and one of the four isolates from AR contained the G143A substitution. These data confer resistance to QoI fungicides in at least a few isolates collected in the mid-South. Given these observations, a limited level of fungicide resistance has occurred and continued use of non-target fungicides, especially in the absence of disease, means target spot management will be difficult to achieve. Consequently, as a result of these specific findings a disease that was once of minor importance may likely become a major disease in soybean.

Soybean Rust: a Threat to the Soybean Crop in the Midwest?

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Has soybean rust (SBR) ever been a threat to the soybean crop in the Midwest since its arrival in 2004? Well, not really. Last year (2016) looked like it could be "The Year." However, as was the case every year since 2005, the disease never broke-out of the south early enough in the growing season (mid to late August) to pose a threat to soybeans in the north-central region. As usual, environmental conditions restricted the pathogen to the southeast where it only caused minimal damage. SBR has made some late runs into the Midwest in 2005 and 2006, and most notably in 2009 when the disease was found in 16 states and in over 570 counties in the U.S. However, in each case SBR arrived (or was first detected) in the Midwest after the point in the soybeans crops development where the disease could cause significant damage.

SBR was first identified in the continental U.S. in November 2004 (Schneider *et al.*, 2005). Early predictions based on high levels of overwintering inoculum suggested that without effective management, losses in soybean could exceed 80%. While these loss estimates have not yet been approached in the U.S., yield losses from the disease have occurred sporadically in southern states.

What weather patterns or events could trigger and outbreak of SBR in the Midwest? I suggest four factors that all need to occur in a given season for a SBR problem to develop for the soybean crop in the Midwest:

1) A relatively mild winter along the Gulf Coast, absent of prolonged freeze events to allow SBR survival on kudzu in the region.
2) A relatively warm spring with moderate temperatures and adequate moisture for SBR development on kudzu in the south.
3) A cooler than normal summer with multiple cold fronts that provide moisture and favorable wind patterns for SBR spread northward.
4) One or more early season (June/July) tropical storms.

*We could add the absence of drought conditions during the growing season in the south that would restrict movement of the disease out of the region.

In some years such as in 2016 we have seen mild winters followed by a relatively cool, wet spring that allowed early season development of SBR in the south. But typically these favorable conditions have been followed by summer months with average temperatures in the 90's and often coupled with drought conditions. Also, since 2005, there have been only three major early-season hurricanes (Emily and Dennis in 2005, and Bertha in 2008), but the path of these storms had little to no effect on SBR development or spread in those given years.

Effect of variety, seed treatment, and in-furrow fungicide on taproot decline of soybean

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Taproot decline of soybean is a newly-described disease occurring in the southern United States. Symptoms of the disease may be noticeable from V1 to R6, and the most obvious indications of infection are foliar interveinal chlorosis and necrosis. If affected plants are pulled, breakage usually will occur at the soil line. Plants that have died earlier in the season are often found adjacent to symptomatic plants. Upon excavation, infected tap and lateral roots will appear blackened and rotted and are often in close proximity to soybean stem sections from previous seasons. If stems and tap roots are split lengthwise near the crown, a white, cottony mycelial growth is evident within the pith. Anecdotal evidence during previous seasons has indicated that varieties tolerant to taproot decline may be commercially available.

In 2016, 32 soybean varieties, selected arbitrarily from the LSU AgCenter official variety trial seed supply, were planted in two locations: Winnsboro, LA and Stoneville, MS. Plots were two (LA) or three (MS) rows wide with one (LA) row inoculated at planting with millet or two (MS) rows inoculated with millet or corn cob grit infested with the taproot decline pathogen. In the same locations, a trial was planted with AsGrow 4632 treated with Vibrance, Acquire, Stamina, or Vortex. In-furrow fungicides, Sercadis, Ridomil, Headline, or Topguard Terra also were applied at planting. Four fungicide modes-of-action were represented, and one-half of each plot was inoculated at planting. Observations were recorded throughout the growing season post-planting and included: stand counts, plant height, disease incidence, soybean mortality, and grain yield at physiological maturity.

In Louisiana, stand, plant height, and yield were reduced significantly in 10, 14, and 16 varieties, respectively. Reductions in stand, height, and yield ranged as high as 36, 23, and 72%, respectively. Stand vs. height and height vs. yield were positively correlated in the Louisiana location. Respective disease incidence and mortality were as high as 20 and 10% and were significantly greater in inoculated plots of 27 and 10 varieties. Mortality was positively correlated with stand and height reduction in Louisiana. In Mississippi, stand and plant height were reduced significantly up to 91 and 28% in 17 and 11 varieties, respectively, when comparing inoculated to non-inoculated rows. Results indicate that field inoculation was successful and that commercial sources of resistance may be available for producers to effectively manage taproot decline.

There were no significant effects of seed treatment or in-furrow fungicide on taproot decline incidence in either location.

Coupling Spore Traps and Quantitative PCR Assays for Detection of *Cercospora sojina*, the Causal Agent of Soybean Frogeye Leaf Spot

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Frogeye leaf spot (FLS), caused by *Cercospora sojina* Hara, is a common disease of soybean in most soybean-growing countries of the world. Significant yield losses of soybean (10–60%) have been attributed to FLS under hot and humid growing conditions. We present a novel trapping approach using Vaseline coated slides placed at a 45° angle within a passive, wind-vane spore trap used in combination with a rapid molecular method to detect the presence of wind-blown inoculum. Spore traps were run from mid-July to early October 2015 at the Milan Research and Education Center in Tennessee. Preliminary data from 2015 suggests that there was two major peaks of inoculum during the 2015 season. In 2016, multiple spore traps were deployed at 3 locations: (1) non-treated tilled and no-till research plots in Milan, TN sampled weekly, (2) on the edge of large soybean sentinel plots in 4 different counties in TN sampled weekly, and (3) on the edge of small plot research trial in Jackson, TN sampled weekly and twice a week. DNA per spore trap was extracted from Vaseline coated slides and qPCR was conducted using species specific primers/probes to estimate the number of spores based on a standard curve developed from known *C. sojina* DNA concentrations. FLS severity ratings were recorded at each reproductive growth stage from R1 (first bloom) through R7 (beginning maturity) using percent leaf area affected at locations 1 and 2. Comparing data from spore traps located in Jackson, TN there was no significant difference between sampling twice per week or once per week when comparing weekly totals. Although, weekly sampled traps had significantly greater number of spores from the entire season than those sampled twice a week. Additionally, there was no significant difference between spore amounts collected from tilled and no-till plots although area under the disease progress curve was significantly greater in no-till plots. Spore trap data collected from different counties varied in trends and resulted in several major peaks of inoculum during the season most likely influenced by variety susceptibility to FLS, field history, and weather conditions. In combination with disease-conducive weather forecasting, variety and field history information, application of the assays may be helpful to time fungicide applications for disease management.

Frogeye leaf spot management: the UUOT part deux

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Following the success of first annual UUOT, a second year was conducted and expanded to include an additional state. Since the initial identification of quinone outside inhibitor (QoI)-resistant *Cercospora sojina* in 2010 managing frogeye leaf spot has become a difficult topic. Annually states continue to report QoI resistant frogeye leaf spot and at present 13 states have reported isolates that contain the G143A substitution including AL, AR, DE, IL, IN, KY, LA, MO, MS, NC, OH, TN, and VA. On an annual basis, countless efficacy trials are conducted throughout the U.S. to determine the effect of application timing as well as product chemistry on QoI-resistant *C. sojina* populations. Even though numerous fungicide products are labeled for managing FLS ($n \geq 55$), additional trials are necessary due to a changing landscape of chemical offerings. In addition, anecdotal statements continue to be made by agricultural professionals regarding the presence of fungicide resistance and how using some agricultural products could potentially reduce the yield losses attributed to FLS fungicide resistant fungal populations. In fact, in some cases ag-related professionals have suggested that QoI-resistant *C. sojina* does not occur and fungicide efficacy can be improved by tank mixing different components to increase or improve efficacy. Fungicide efficacy trials were conducted with eight candidates to determine the effect on FLS severity and yield at eight locations (using a FLS-susceptible variety as either Armor DK 4744 (n=6 locations) or Dyna-Gro 37RY47 (n=1 location) or Pioneer 22T69 (n=1 location)). The fungicide products applied alone included copper hydroxide (as CuproFix; 2 lb/A), mancozeb (as Koverall; 2 lb/A), tetraconazole (as Domark; 4 fl oz/A), potassium phosphite + tebuconazole (as Viathon; 2 pt/A), and azoxystrobin + propiconazole + thiophanate-methyl (as Quadris + Tilt + Topsin; 4 fl oz/A + 4 fl oz/A + 10 fl oz/A). In addition, tank mixes included several different product combinations: a fungicide and a nutritional product applied as azoxystrobin + 5-0-0 (N-B-Mo) (as Quadris, 4 fl oz/A + Manniplex B Moly, 2 qt/A), and two tank mix combinations with a fungicide and an insecticide including azoxystrobin + diflubenzuron (as Quadris + Dimilin, 4 fl oz/A + 2 fl oz/A) or trifloxystrobin + prothioconazole + flubendiamide (as Stratego YLD + Belt, 4 fl oz/A + 2 fl oz/A). Fungicide efficacy was judged at each location by rating FLS severity using either a 0 to 9 scale or estimating percent of disease in entire plots. Plots were harvested and yield was analyzed in SAS following tests of normality. Averaged across all locations in 2016, the three-way MOA (azoxystrobin + propiconazole + thiophanate-methyl) application resulted in a 4.6 bu/A increase over the non-treated followed by Stratego YLD + Belt with a 3.4 bu/A increase. Averaged over the two years of trials, the three-way MOA resulted in a 4.4 bu/A increase over the non-treated.

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