Minutes of the NCERA – 137 Soybean Diseases Technical Committee Meeting
March 7-8, 2017 – Pensacola Beach, FL

Administrative Advisor: Dr. Terry Niblack, Ohio State University
Chair: Dr. Damon Smith, Department of Plant Pathology, University of Wisconsin-Madison, Madison, WI 53706
Secretary: Dr. Daren Mueller, Department of Plant Pathology and Microbiology, Iowa State University, Ames, IA 50011
Immediate Past Chair: Dr. Nathan Kleczewski, Department of Plant and Soil Sciences and Cooperative Extension, University of Delaware, Newark, DE 19716

Members and guests in attendance:
Damon Smith, Mehdi Kabbage, Jaime Willbur, Megan McCaghey (University of Wisconsin-Madison); Daren Mueller, Ed Zaworksi, Yuba Kandel, Kaitlyn Bissonnette (Iowa State University), Tessie Wilkerson, Tom Allen (Mississippi State University); Anne Dorrance, Terry Niblack (Ohio State University); Guohong Cai (USDA Purdue University); Heather Kelly, Binbin Lin, Rachel Guyer (University of Tennessee); Marty Chilvers (Michigan State University); Dean Malvick (University of Minnesota); Albert Tenuta (Ontario Ministry of Ag); Ed Sikora (Auburn University); Nathan Kleczewski (University of Delaware); Carl Bradley (University of Kentucky); Travis Faske, John Rupe, Terry Spurlock (University of Arkansas); Trey Price, Patricia Borlich, Clayton Hollier (LSU Ag Center); and Doug Jardine (Kansas State University); Emmanuel Byamukama (South Dakota State University), and Kelly Whiting (United Soybean Board)

The meeting of the NCERA 137 Soybean Diseases Committee was held in Pensacola Beach Florida at the Hilton hotel on March 7-8, 2017. Dr. Damon Smith welcomed attendees at 1:00pm on March 7. Group introductions followed the welcome. Brief oral reports on the status of the soybean crop and prevalent diseases were given for each state with a member present.

Brief State Reports

- Alabama – soybean rust early, then no rainfall for extended period shut it down, frogeye started then got shut down
- Arkansas – early on seedling diseases, herbicide injury (PPO), rootknot nematode, stem canker (food grade), Phytophthora root rot not as widespread, end of season charcoal rot, frogeye not as bad until August, CLB, target spot, no taproot decline
- Delaware – late planting, some stem canker, Phomopsis end of year, BSR first time (type B), SCN and southern rootknot nematodes most damaging
- Iowa – SDS, low levels of white mold, frogeye came in late
- Kansas – Old Milwaukee kind of year – just doesn't get any better than this, 48 bu ave., 2016 was worse frogeye ever, SDS hard to find (ILeVO adoption very high), above average amount of Phytophthora (but less than 2015)

- Kentucky – tied record yield, record rains in areas for parts of the year, August no rain, frogeye in group IV, southern stem canker (took out entire fields, variety related), some target spot, soybean rust earliest detected
- Ohio – record yield (54 bu), Phytophthora stem rot, spotty white mold, minor SDS, frogeye came in late and heavy, 80% of acres infested with SCN
- Michigan – white mold in fields, SDS not super bad, green stem disorder
- Minnesota – SDS, brown stem rot significant in places, white mold patchy, Rhizoctonia outbreaks in fields, SCN across the state
- Mississippi – light frogeye year, some Phytophthora root rot, more southern blight than normal, SCN in limited geographies but fungus that kills nematode also present, CLB more intense (increasing), soybean rust was earlier than normal and then got hot and dry, charcoal rot in areas, target spot present (may be yield losses), seed quality issues, taproot decline light
- Missouri (K. Whiting) – SDS, charcoal rot, SCN north, rootknot south
- Ontario – Phytophthora early, SDS much later than normal, SCN in most main soybean fields, in Quebec, white mold not, some frogeye in seed,
- Louisiana – four flooding events, and drought, aerial blight statewide, fungicide resistant problems – Rhizoctonia resistant to SDHI (and strobilurin), CLB worse in NE Louisiana, frogeye present but not as bad as previous years in Trey's area but very severe in Clayton's area, light year for taproot decline, rootknot nematode, rust late
- Tennessee – any and every disease in soybean, cover crops increased – Phytophthora worse in some fields with rye, SDS in some irrigated fields, stem canker low, frogeye little lower, brown spot and target spot more prevalent, CLB was a little earlier than usual, charcoal rot in some fields, soybean rust came in earliest ever but rain stopped after that

USB Update – Kelly Whiting

- wants to revise the growth stages
- hopes that we hit low water mark with funding
- USB has a new strategic plan which will make funding for "supply" more competitive; shifting more to "demand", 16 strategic objectives (supply has 1/16 of the pie; was 1/3); have to share revenue with 15 other objectives (e.g., technology)
- Lost annual disease survey but brainstorming on ways to still collect info

Crop Protection Network and iPIPE Twitter Update – Daren Mueller

- Encourage everyone to use Twitter (@soydisease, @corndisease, @cottondisease) when they find diseases in the field, include county and state
- CPN expanded into corn and wheat; still developing soybean disease pubs
- System in place to get peer-reviewed Extension publications (nice note from Dr. Doug Jardine on how these pubications are used in Kansas)
- Encouraging people to get "support" (not fiscal) from their adminstration, which is needed to include their logo on the CPN webpage.

Update on Phytophthora Projects – Anne Dorrance

- Tolerance is not a correct term for Phytophthora
- Functional analysis of candidate genes especially those associated with key pathways;
- Mapped QTL in adapted and plant introductions to key soilborne pathogens
- Potential new virus vector for gene silencing
- *Phytophthora sansomeana* – several hosts (including corn); larger oospores; showing up more frequently
- Lots of pathotypes of Phytophthora; R genes generally not working

Frogeye leaf spot research and fungicide resistance – Heather Kelly

- Molecular studies looking at FLS resistance
- Population genetics study
- Sentinel plot sentinel plots – monitor diseases in general and now includes testing spore traps in 2016; finding some trends for spore deposition

**Dean Malvick is opening a package loudly

Soybean cyst nematode Coalition update – Albert Tenuta

- New survey of farmers and their thoughts on SCN
- SCN conference in Florida was effective bringing industry, researchers and soybean checkoff boards together
- Now developing the second collation – identifying barriers, targeting key players, developing key messages, figuring out where they are going and getting stakeholder involvement

Seed treatments for SCN – Kaitlyn Bissonnette

- Clariva (27 site years, 12 reps each; ILeVO (18 site years, 12 reps each);
- Neither product worked work consistently
- Q from Dorrance: can Tylka's lab go back and look at populations years later to see if bacteria is degrading nematode over time

Update on rootknot nematode – Travis Faske

- Increased field calls for rootknot nematode
- Soybean checkoff paid for nematode sampling; people collecting soil take a quiz on how to sample and include certificate (if they pass) with soil sample
- SCN reduced to 30% of fields, rootknot at 35%, finding lesion and reniforme too
- Some resistant lines for rootknot nematode are misidentified
- herbicide resistant varieties are not classified for resistance
- Not all varieties of grain sorghum are good rotation crop (nematode can reproduce at different levels on different varieties)
- AgLogic (temic) is available in 2017

Day 2

Breeding for white mold resistance – Megan McCaghey

- Finding some lines with good resistance using a holistic approach to screening lines (greenhouse, field)
- May be overlooking resistance if not using holistic approach

Defense mechanisms for white mold – Mehdi Kabbage

- Soybean used as the model for resistance pathways
- Metalomics study to identify what is going on inside the genome after infection
- Amended plants using VIGS, side note: plants also drought tolerant
- Red stem phenotype associated with resistance (anti-microbial compounds in red area – poacic acid)

Apothecia prediction model for white mold and meta-analysis of fungicides – Jaime Willbur

- Multiple states, multiple years of data for meta-analysis (2009-2016)
- Yield affected at ~20-25 DSI (not a lot of disease in upper canopy); beginning at 65 DSI approximately a 10 bu/a loss for every 10-unit increase in DSI
- Prediction model based on weather prior to flowering; 2 models – one for irrigated one for non-irrigated; temperature 30-40 days prior to flowering most important for apothecia development
- Continue to validate in 2017, launching an integrated app to help farmer make fungicide management decision

Taproot decline update – Tom Allen

- Taproot is looks like a lot of other diseases, shows up in vegetative stages
- *Xylaria arbuscula*; same pathogen that causes black root rot of apple
- Distribution in fields is usually evenly distributed, different than other diseases
- Small sampling size – showed an 18% yield loss in most severe situation they saw; real loss depends on field situation – minimal to ~5%
- Increased disease in no-till production, rotation after corn lowers disease

Target spot – Tom Allen, Terry Spurlock, Travis Faske and Trey Price

- Target spot severe in 2016
- Fungicides do not work on target spot (at least the ones that were evaluated); fungicide resistant strains found
- Several varieties are very susceptible to target spot

Business Meeting

Motion to approve the minutes from 2016: Dr. Tom Allen moved to approve. Dr. Clayton Hollier seconded. The motion passed with unanimous vote.

Administrative Report:

- State of things amongst administrators is “pessimistic”
- New secretary of agriculture, Sonny Perdue, hard to know what to know the direction he will go
- Encourage collaboration, seeing ample evidence of this throughout meeting
- Encourage us to get minutes in within 30 days

Secretary Nomination:
A nomination for secretary was submitted by Dr. Tom Allen. The nominee was Dr. Travis Faske, but he cannot lead a meeting February (breeders meeting) so the nomination is contingent on the location being in Pensacola. Dr. Faske accepted the nomination. With no other nominations, Dr. Tom Allen made the motion that Dr. Faske should be the incoming secretary (2018) and future committee chair (2019). Dr. Clayton Hollier seconded the motion. Dr. Faske was elected unanimously by voice vote.

Meeting Location:
Dr. Damon Smith suggested that NCERA 137 might again meet in conjunction with the Southern Soybean Disease Workers meeting to be held on March 6-7, 2018 in Pensacola Beach Florida. Dr. Albert Tenuta made the motion that NCERA 137 meet starting in the afternoon on March 6, 2018 in Pensacola Beach with the meeting to proceed to the morning of March 7, 2018. The Southern Soybean Disease Workers meeting would commence on the afternoon of March 7, 2017. Dr. Heather Kelly seconded the motion. The motion passed unanimously by voice vote. Dr. Mueller will work with representatives of the Southern Soybean Disease Workers to plan the 2017 NCERA 137 meeting.

Discussions about 2019 meeting locations also were started. Suggestions that Dr. Mueller discuss with breeders how to best accommodate their needs. Perhaps inviting them to our meeting here. Vote shows a preference to keep meeting in Pensacola in 2019.

Other Announcements:
Dr. Damon Smith – encourages everyone to go back and make sure all the appropriate people are signed up within the NMISS system

Include 1-2 impact statements in state report; we will need at least one impact statement for each objective.

APS sponsoring webinar on Impact Statements coming soon – Marty Draper is the speaker

Adjournment:
A motion to adjourn the 2017 NCERA 137 was made by Dr. Daren Mueller at 11:40am. The motion was seconded by Dr. Travis Faske.

Objectives for NCERA 137

1. Foster collaborative research and information exchange on new and emerging soybean diseases among scientists in the North Central Region including soybean breeders and entomologists that will lead to improved disease screening protocols, additional sources of disease resistance genes and ultimately, improved host plant resistance

   The focus of the NCERA 137 meeting was once again on regional projects, protocols that were shared across state lines, and generating ideas that were shared with participants. Multi-state projects that are focused on Phythophthora root rot, seedling diseases, white mold and sudden death syndrome were highlighted in the 2017 meeting. We also included colleagues from the southern states who have been working on emerging and re-emerging diseases such as target spot and taproot decline.

2. Compare findings on the impacts of changing production practices such as earlier planting dates, new sources of host plant resistance, increased use of fungicide seed treatments and foliar fungicides, and other new or improved crop production technologies on soybean diseases that could be adopted for other production areas in the region.

   See answer to #1.

3. Compare data from studies of the ecology and epidemiology of soybean diseases important in the North Central Region.

   One example of this was the studies from Wisconsin focused on white mold. These projects have included data from multiple states and the model from this project may potentially impact the entire region where white mold is a problem.

4. Improve knowledge transfer about soybean diseases and their management in the North Central Region to researchers, Extension faculty, producers and the agribusiness community through the use of web sites, podcasts, social media (Twitter and Facebook) and other new technologies as they are developed.

   Information about many soybean diseases were shared by the participants of the 137 group in 2016. These can be found in the individual state reports. Also, the Crop Protection Network has published many multi-state publications on important soybean diseases. (www.cropprotectionnetwork.org).

5. Continue to monitor and share information for any new or reemerging pathogens of soybean in the North Central Region and develop appropriate responses to their emergence as they occur.

   This continues to be a way the soybean pathology group works together. In 2016, we tested a new way to track diseases; through social media. A request was made in the NCERA 137 meeting to increase the participation of tracking diseases through Twitter.

2016 STATE REPORTS – NCERA 137

Arkansas

Travis Faske, Extension Plant Pathologist, University of Arkansas Systems Division of Agriculture
University of Arkansas personnel involved with NCERA 137 objectives: Travis Faske and John Rupe

For the 2016 cropping season 3.1 million acres of soybean were planted with 3.1 million acres harvested. The average yield was 47 bu/A, which is two bushel lower than 2015. Six producers exceeded 100 bu/A yield contest again in 2065 with the highest average yield of 118 bu/A. Wet weather in August was the main cause for lower yield with persistent cloudy weather during R3/R3 when beans were maturing.

Spring planting season started warmer than normal with good moisture in April and wetter in May. June was dry and hot, but the end of July was wet, warm and we had some 14-21 d of consecutive cloudy rainy weather in mid-August. There were a few calls on PPO herbicide injury during the early part of the season. Root-knot nematode is our most problematic issue and most widespread across the state. Other soilborne issues consisted of stem canker and charcoal rot in the central and southern part of state, respectively. Of the foliar disease CLB was more widespread than FLS in central Arkansas, but by August there was a significant issue with target spot in central and northeast Arkansas. There were a few reports of Phytophthora root rot and SBR but neither had a significant impact on production.

PUBLICATIONS

Abstracts:

- Faske, T. R. and Hurd, K. 2016. Movement of fluopyram in sandy soil to affect *Meloidogyne incognita* motility. Phytopathology 106:S4.38.
- Faske, T. R, Hurd, K. and M. Emerson. 2016. Fluopyram: A new nematicide for nematode management in cotton. Society of Nematologist Annual Meeting; July 17-22; Montreal, Quebec. Pp. 111-112.
- Jackson, C. S., Faske, T. R. M., Emerson, and K. Hurd. 2016. Assessment of ILeVO for management of *Meloidogyne inco*gnita in soybean. Society of Nematologist Annual Meeting; July 17-22; Montreal, Quebec. Pp. 111-112.
- Allen, T.W., Faske, T.R., Hollier, C.A., Price, P.P., Spurlock, T.N., and Young, H. 2016. Nuts, Bolts, Frogeye Leaf Spot and the UUOT. Proceedings of the Southern Soybean Disease Workers Annual Meeting; March 9-10; Pensacola, FL. Pp. 37.
- Jackson, C., Faske, T. R., Emerson, M, and Hurd, K. 2016. Assessment of ILeVO for management of root-knot nematodes in soybean. Proceedings of the Southern Soybean Disease Workers Annual Meeting; March 9-10; Pensacola, FL. Pp. 26.

Proceedings: (2)

- Allen, T. W., Bradley, C. A., Damicone, J. P., Dufault, N. S., Faske, T. R., Hollier, C. A., Isakeit, T., Kemerait, R. C., Kleczewski, N. M., Koenning, S. R., Mehl, H. L., Mueller, J. D., Overstreet, C., Price, P. P., Sikora, E. J., Spurlock, T.N., and Young, H. 2016. Southern United States Soybean Disease Loss Estimates for 2015. Proceedings of the Southern Soybean Disease Workers Annual Meeting; March 9-10; Pensacola, FL. Pp. 11-16.
- Robbins, R. T., Chen, P., Shannon, G., Kantartza, S. K., Li, Z., Faske, T. R., Vielie, J., Jackson, L., Grub, E. E.,

Dombek, D. G. 2016. Reniform nematode reproduction on soybean cultivars and breeding lines in 2015. Proceedings of the Beltwide Cotton Conferences; January 5-7; New Orleans, LA. National Cotton Council, Memphis, TN. Pp 131-143.

Refereed Technical Publications: (14)

- Faske, T. R., Emerson, M. and Hurd, K. 2016. Evaluation of foliar fungicide for management of frogeye leaf spot of soybean in Arkansas, 2015. PDMR 10: FC227.
- Hurd, K., Faske, T. R., and M. Emerson 2016. Evaluation of ILeVO at three rates for suppression of root-knot nematode in a greenhouse trial in Arkansas, 2015.PDMR 10: N016
- Emerson, M., Faske, T. R., and Hurd, K. 2016. Evaluation of experimental fungicide for management of frogeye leaf spot of soybean in Arkansas, 2015. PDMR 10:FC237
- Emerson, M., Faske, T. R., and Hurd, K. 2016. Evaluation of Helmstar fungicide for management of frogeye leaf spot of soybean in Arkansas, 2015. PDMR 10:FC236
- Emerson, M., Faske, T. R., and Hurd, K. 2016. Evaluation of Domark fungicide for management of frogeye leaf spot of soybean in Arkansas, 2015. PDMR 10:FC235
- Emerson, M., Faske, T. R., and Hurd, K. 2016. Evaluation of foliar fungicides for management of frogeye leaf spot of soybean in Arkansas, 2015. PDMR 10:FC234
- Emerson, M., Faske, T. R., and Hurd, K. 2016. Evaluation of Aproach Prima foliar fungicide for management of frogeye leaf spot of soybean in Arkansas, 2015. PDMR 10:FC233
- Emerson, M., Faske, T. R., and Hurd, K. 2016. Evaluation of Stratego YLD for management of frogeye leaf spot of soybean in Arkansas, 2015. PDMR 10:FC232
- Emerson, M., Faske, T. R., and Hurd, K. 2016. Evaluation of premix fungicides for management of frogeye leaf spot of soybean in Arkansas, 2015. PDMR 10:FC231
- Faske, T. R., Emerson, M. and Hurd, K. 2016.Evaluation of Triazole Fungicides for Management of Strobilurin-Resistant Frogeye Leaf Spot of Soybean in Arkansas. Pp.50-51 *in* J. Ross, ed. Arkansas Soybean Research Studies 2014. Arkansas Agriculture Experiment Station Research Series 631, Fayetteville, AR
- Kirkpatrick, T. L., Rowe, K., Faske, T. R. and Emerson, M. 2016. Comprehensive Disease Screening of Soybean Varieties in Arkansas. Pp. 58-61 *in* J. Ross, ed. Arkansas Soybean Research Studies 2014. Arkansas Agriculture Experiment Station Research Series 631. Fayetteville, AR
- Jackson, C. S., Faske, T. R., and Kirkpatrick, T. L. 2016. Assessment of fluopyram for management of *Meloidogyne incognita* on soybean. Pp. 65-67 *in* J. Ross, ed. Arkansas Soybean Research Studies 2014. Arkansas Agriculture Experiment Station Research Series 631, Fayetteville, AR
- Rothrock, C. S., Faske, T. R. and Spurlock, T. N. 2016. Spatial distribution of *Rhizoctonia solani* in soybean fields under rice-soybean rotation and the value of fungicides for the suppression of early-season colonization of soybean plants; a prelude to control of aerial blight of soybean. Pp. 68-71 *in* J. Ross, ed. Arkansas Soybean Research Studies 2014. Arkansas Agriculture Experiment Station Research Series 631, Fayetteville, AR

Extension Publications: (1)

- Faske, T. R. Target spot of soybean: What do we know (11/20 blog article)

Delaware

Nathan Kleczewski, Extension Plant Pathologist, University of Delaware

University of Delaware personnel involved in soybean disease extension and research: Nathan Kleczewski, Andy Kness, Don Siefrit, Colin Scanlan

2016 soybean production and major diseases in Delaware

In Delaware a total of 165,000 acres of soybeans were planted in 2016, down 10,000 acres from 2015. Statewide averages were 46 bu/A, up from 40.0 bu/A in 2015. Approximately 48,000 acres were irrigated, and yielded 51.4 bu/A vs 41.5 bu/A for dryland beans.

2016 started with wet, cool weather that delayed planting in many parts of the state. Indeed, double cropped beans, which are typically planted behind small grains, were planted around the same time as full season beans in many fields. Overall the growing season was favorable for soybean production, with few major diseases present during the growing season. Diseases observed at detectable levels included stem diseases such as charcoal rot. Delaware had a first report of Brown stem rot this season as well. Molecular tests indicated that this was type B. Foliar diseases were nearly absent, sans low levels of Septoria brown spot in some fields. Flushes of late season rains spurned some pod and seed disease, especially Phomopsis seed decay. Viruses were low, but Soybean Vein Necrosis Disease was prevalent, especially in double cropped systems. Seed and seedling diseases were present at low levels, and were predominantly due to fusarium infection. Soybean cyst nematode and root knot nematodes were the most damaging pests/pathogens encountered in 2016.

Impact Statements

1. Conducted a third year of a survey on SVNV in Delaware and Maryland. Showed that double crop beans may be more severely affected by the virus. Characterized thrips populations in the region to better understand what species may be transmitting the virus and if any population shifts are associated with symptom differences in cropping systems.
2. Composed a soybean disease scouting guide for the Midatlantic with Hillary Mehl VT
3. Conducted soybean trials for fungicide use on soybeans.
4. Assisted Damon Smith (UWis) with the development of his white mold model by providing data on model accuracy under New Jersey growing conditions.

Research Publications, Extension Articles, and Videos

Abstracts and Posters *(Total of 1)*

- N.M. Kleczewski, B. Cissel, and J. Whalen. Effect of Variety and Cropping System on Soybean Vein Necrosis Disease in Delaware. Potomac Meeting of the American Phytopathological Society, Philadelphia, PA, 2015.

Extension/Outreach publications/blogs/web articles (*Total of 21*)

- **Kleczewski, N.M.** and K. Everts**.** 2017. 2016 Applied Plant Pathology Research Book.
- Mehl, K, Zhou, T, and **Kleczewski, N**. 2017. Midatlantic Soybean Disease Scouting Guide. Available online at: http://reader.mediawiremobile.com/USB/issues/200013/viewer
- **Kleczewski, N.M.**, Mehl, H. et al. 2017. Pest Management Guide: Field Crops. Virginia Tech Cooperative Extension (updated annually). (Available online at: http://pubs.ext.vt.edu/456/456-016/456-016.html)

- Field crops disease management blog – **8 articles** pertaining to soybean disease management located at: http://extension.udel.edu/fieldcropdisease/
- Weekly Crop Update- **12 articles** pertaining to soybean disease management. Online archives located at: http://extension.udel.edu/weeklycropupdate/

Indiana
Kiersten Wise

Purdue personnel involved with soybean disease activities: Kiersten Wise, Virginia Ferris, Jamal Faghihi, Gail Ruhl, Tom Creswell, Guohong Cai

In 2016, approximately 5.65 million acres of Indiana cropland were in soybean production. The average yield was 57.5 bu/A, which was higher than yields reported in previous years.
The impact of soil-borne diseases of soybean was again high in 2016. Excessive rainfall and cool, wet conditions in May resulted in seedling disease problems across most of the state. Warm temperatures in late May and June led to an increase in Phytophthora root and stem rot. Sudden death syndrome (SDS) was patchy in areas, but was not as severe as in past years. Warm, wet conditions in late summer contributed to higher levels of foliar diseases such as brown spot, and frogeye leaf spot, and stem diseases such as pod and stem blight and anthracnose. Seed quality was impacted in some areas by late season weather conditions and fungal diseases. Personnel participated in monitoring for soybean diseases, including soybean rust, and distributed disease observations through the Purdue Pest and Crop Newsletter.

Soybean research at Purdue:
Projects continued in 2016 to address the following areas:

Examined impact of production factors, such as planting date, fungicide seed treatment, irrigation, herbicide program, and variety selection on sudden death syndrome development in soybean.

Evaluated fungicide factors contributing to increased soybean yields, including seed and in-furrow treatments and foliar applications of fungicide.

Examined resistance of soybean germplasm to Soybean Vein Necrosis Virus.

Indiana participated in a multi-state sampling project to determine the prevalence and distribution of Diaporthe species.

Publications:

- Kandel, Y., Mueller, D.S., Hart, C.E., Bestor, N.R.C., Bradley, C.A., Ames, K.A., Giesler, L.J., and Wise, K.A. 2016. Analyses of yield and economic response from foliar fungicide and insecticide applications to soybean in the North Central United States. Plant Health Progress doi:10.1094/PHP-RS-16-0038.
- Rojas, J.A., Jacobs, J., Napieralski, S., Karaj, B., Bradley, C., Chase, T., Esker, P., Giesler, L., Jardine, D., Malvick, D., Markell, S., Nelson, B., Robertson, A., Rupe, J., Smith, D., Sweets, L., Tenuta, A., Wise, K., and Chilvers, M. 2016. Survey of oomycete species associated with soybean seedlings in the U.S.—Part I: Identification and pathogenicity characterization. Phytopathology (In Press).
- Rojas, J.A., Jacobs, J., Napieralski, S., Karaj, B., Bradley, C., Chase, T., Esker, P., Giesler, L., Jardine, D., Malvick, D., Markell, S., Nelson, B., Robertson, A., Rupe, J., Smith, D., Sweets, L., Tenuta, A., Wise, K., and Chilvers, M. 2016. Survey of oomycete species associated with soybean seedlings in the U.S.—Part II: Diversity and ecology. Phytopathology dx.doi.org/10.1094/PHYTO-04-16-0176-R.
- Batzer, J.C., Kandel, Y.R., Bradley, C.A., Chilvers, M.I., Tenuta, A.U., Wise, K.A., Hernandez, E.,

and Mueller, D.S. 2016. Effect of seed treatment on early season brown spot caused by Septoria glycines of soybean. Plant Health Progress. doi:10.1094/PHP-RS-16-0035.

- Wise, K.A., Faghihi, J., and Ferris, V. 2016. Impact of soybean cultivar resistance on soybean cyst nematode and sudden death syndrome. Crop, Forage and Turfgrass Management. doi:10.2134/cftm2016.0009.
- Keough, S., Han, Jinlong, Shuman, T., Wise, K., and Nachappa, P. 2016. Quantitative analysis of *Soybean Vein Necrosis Virus* in thrips vector, *Neohydatothrips variabilis* and the effect on vector life history and host preference. Journal of Economic Entomology. DOI: http://dx.doi.org/10.1093/jee/tow145.
- Kandal, Y. Wise, K.A., Bradley, C.A., Tenuta, A.U., and Mueller, D.S. 2016. Effect of planting date, seed treatment, and cultivar on plant population, sudden death syndrome, and yield of soybean. Plant Disease 100:1735-1743.
- Kandel, Y.R., Wise, K.A., Bradley, C.A., Chilvers, M.I., Tenuta, A.U., and Mueller, D.S. 2016. Fungicide and cultivar effects on sudden death syndrome and yield of soybean. Plant Disease 100:1339-1350.
- Dorrance, A.E., Kurle, J., Robertson, A.E., Bradley, C., Giesler, L., Wise, K. and Concibido, V.C. 2016. Pathotype diversity of *Phytophthora sojae* in ten states in the United States. Plant Disease 100:1429-1437.
- Sexton, Z., Hughes, T.J., and Wise, K.A. 2016. Analyzing isolate variability of *Macrophomina phaseolina* from a regional perspective. Crop Protection 81:9-13.

Extension Publications:

- Wise, K., Mueller, D., Bradley, C., Chilvers, M., Freije, A., Giesler, L., Sisson, A., Smith, D., and Tenuta, A. 2016. Soybean Disease Management: Soybean seed treatments: questions that emerge when plants don't. Crop Protection Network. CPN 1016.
- Wise, K., Mueller, D., Bradley, C., Chilvers, M., Freije, A., Giesler, L., Sisson, A., Smith, D., and Tenuta, A. 2016. Soybean Disease Management: Soybean stem zone lines: fact or fiction. Crop Protection Network. CPN 1015.
- Wise, K., Mueller, D., Johnson, B., Legleiter, T., Bradley, C., Chilvers, M., Giesler, L., Sisson, A., Smith, D., Tenuta, A. 2016. Soybean Disease Management: Using ILeVO with preemergence herbicides. Crop Protection Network. CPN 1013.
- Chilvers, M., Bradley, C., Freije, A., Giesler, L., Mueller, D., Sisson, A., Smith, D., Tenuta, A, and Wise, K. 2016. Soybean Disease Management: Scouting for soybean sudden death syndrome in soybean. Crop Protection Network. CPN 1012.
- Mueller, D., Bradley, C., Chilvers, M., Freije, A., Giesler, L., Sisson, A., Smith, D., Tenuta, A., and Wise, K. 2016. Soybean Disease Management: Sudden death syndrome. Crop Protection Network. CPN 1011.
- Wise, K., and members of the NCERA-137 Soybean Disease Committee. 2014, 2015, revised 2016. Fungicide Efficacy for the Control of Soybean Seedling Diseases BP-163-W
- Wise, K. and members of the NCERA-137 Soybean Disease Committee. 2013 2014, revised 2016. Fungicide Efficacy for Control of Foliar Soybean Diseases. BP-162-W

Iowa
Daren Mueller

Iowa State personnel involved with soybean disease activities: Daren Mueller, Alison Robertson, Leonor Leandro, and Greg Tylka

Soybean production in Iowa in 2016 was approximately 572 million bushels. This is a record high production, topping the previous record of 554 million bushels set in 2015 by 3 percent. The Iowa soybean crop yielded 60.5 bushels per acre in 2016. This yield is also a new record high, 7 percent above the previous record of 56.5 bushels per acre set in 2015. The harvested acreage of 9.45 million is down 50,000 acres from the November 1 estimate, and 350,000 acres below 2015. Soybean planted acreage, at 9.50 million, is down 50,000 acres from November 1, and 350,000 acres below 2015. https://www.nass.usda.gov/Statistics_by_State/Iowa/Publications/Crop_Report/2017/IA_Crop_Production_Annual_01_17.pdf

In general, we had good growing conditions early in the season and did not see many diseases during this time. Warm and wet conditions later in the summer led to foliar diseases such as frogeye leaf spot and Cercospora leaf blight and stem diseases such as pod and stem blight and Anthracnose. However, the most damaging diseases were once again sudden death syndrome, soybean cyst nematode and white mold.

Research highlights

We evaluated soybean cultivars for resistance to soybean cyst nematode at nine locations across Iowa.

We evaluated seed treatments for management of sudden death syndrome, helping farmers identify which product would be most effective for management of this disease.

We evaluated 12 commercial seed treatments at 3 locations in Iowa. At each location, an inoculated and non-inoculated trial was done. There were few treatment effects detected compared to naked seed.

We identified QTL in several germplasm lines of soybean for resistance to multiple *Pythium* species.

We are in the process of evaluating interactions between *Fusarium* species and *Pythium* species to improve our understanding of the seedling disease complex on soybeans.

We showed that cold stress soon after planting increases susceptibility of soybean to infection by *Pythium* spp. A seed treatment mitigates susceptibility. Consequently, seed treatments are likely an effective management tool that could be used to protect stand when cold, wet conditions are forecast soon after planting.

We compared fungicide sensitivity of 4 species of *Pythium* recovered from across the North Central Region between 2011 and 2012. Most isolates were sensitive to fungicides commonly used in seed treatments.

Publications

Peer-reviewed

- Abeysekara, N.S., Matthiesen, R.L., Cianzio, S., Bhattacharrya, M., and Robertson, A.E. 2016. Identification of novel sources of partial resistance in soybean using an inoculum mixture of three *Phytophthora sojae* isolates. Crop Science 56:2322-2335.
- Akintayo, A., N. Lee, V. Chawla, M. Mullaney, C. Marett, A. Singh, A. Singh, G. Tylka, B. Ganapathysubramanian and S. Sarkar. 2016. An end-to-end convolutional selective autoencoder approach to soybean cyst nematode eggs detection. Proceedings of the Knowledge Discovery and Data Mining 2016 Workshop: Data Science for Food, Energy and Water August 14, 2016, San Francisco, CA, USA. ISBN 978-1-4503-2138-9, DOI: 10.1145/1235
- Batzer, J.C., Kandel, Y.R., Bradley, C.A., Chilvers, M.I., Tenuta, A.U., Wise, K.A., Hernandez, E., and Mueller, D.S. 2016. Effect of seed treatment on early season brown spot caused by *Septoria glycines* of soybean. Plant Health Progress. 17:223-228.
- Beeman, A. Q., Z. Njus, S. Pandey, and G. L. Tylka. 2016. Chip technologies for screening chemical and biological agents against plant-parasitic nematodes. Phytopathology 106:1563-1571.
- Beeman, A. Q., Harbach, C. J., Marett, C. C., and Tylka, G. L. 2016. Soybean cyst nematode HG type test results differ among multiple samples collected from the same field but the management implications are the same. Plant Health Progress 17:160-161. doi: 10.1094 / PHP-BR-16-0033.
- Bloomingdale, C., Irizarry, M.D., Groves, R.L., Mueller, D.S., Smith, D.L. 2016. Seasonal dynamics of thrips (Thysanoptera) populations in Wisconsin and Iowa soybean fields. J. Economic Entomology tow242. doi: 10.1093/jee/tow242
- da Silva, M. P., Tylka, G. L., and Munkvold, G. P. 2016. Seed treatment effects on maize seedlings coinfected with *Fusarium* spp. and *Pratylenchus penetrans*. Plant Disease 100:431-437.
- Groves C., German T., Dasgupta R., Mueller D., Smith D.L. 2016. Seed transmission of soybean vein necrosis virus: the first tospovirus implicated in seed transmission. PLoS ONE 11(1): e0147342. doi: 10.1371/journal.pone.0147342.
- Harbach, C.J., Allen, T.W., Bowen, C.R., Davis, J.A., Hill, C.B., Leitman, M., Leonard, B.R., Mueller, D.S., Padgett, G.B., Phillips, X.A., Schneider, R.W., Sikora, E.J., Singh, A.K., and Hartman, G.L. 2016. Delayed senescence in soybean: Terminology, research update, and survey results from growers. Plant Health Progress. 17:76-83.
- Huang, X., Das, A., Sahu; B. B., Srivastava, S. K., **Leandro**, L. F. S., O'Donnell, K., and M. K. Bhattacharyya. **2016**. "Identification of Hypervariable Elements in an Asexual Pathogen". **PLOS ONE** 11(6): 1-23
- Irizarry, M.D., Groves, C.L., Elmore, M.G., Bradley, C.A., Dasgupta, R., German, T., Jardine, D.J., Saalau-Rojas, E., Smith, D.L., Tenuta, A.U., Whitham, S.A. and Mueller, D.S. 2016. Re-emergence of *Tobacco streak virus* on soybeans in the United States and Canada. Plant Health Progress. 17:92-94.
- Kandel, Y.R., Mueller, D.S., Hart, C.E., Bestor, N.R.C., Bradley, C.A., Giesler, L.J., and Wise, K.A. 2016. Analyses of yield and economic response from foliar fungicide and insecticide applications to soybean in the north central United States. Plant Health Progress. 17:232-238.
- Kandel, Y.R., Wise, K.A., Bradley, C.A., Chilvers, M.I., Tenuta, A.U., and Mueller, D.S. 2016. Fungicide and cultivar effects on sudden death syndrome and yield of soybean. Plant Disease. 100:1339-1350.
- Kandel, Y.R., Wise, K.A., Bradley, C.A., Tenuta, A.U. Leandro L.F.S., and Mueller, D.S. 2016. Effect of planting date, seed treatment, and cultivar on sudden death syndrome of soybean. Plant Disease. 100:1735-1743.
- Liu, M., Li, S., Swaminathan, S., Sahu, B. B., **Leandro**, L. F. S., Cardinal, A. J., Bhattacharyya, M. K., Song, Q., Walker, D. R., and S. R. Cianzio. **2016**. Identification of a soybean rust resistance gene in PI 567104B. **Theoretical and Applied Genetics**. 129 (5):863. DOI: 10.1007/s00122-015-2651-5

- Kurle, J., Dorrance, A.E., Robertson, A.E., Bradley, C., Giesler, L., and Wise, K. 2016. Pathotype diversity of *Phytophthora sojae* in ten states in the United States. Plant Dis. 100:1429-1437.
- Matthiesen, R., Abeysekara, N., Maroof, S., and Robertson A.E. 2016. Combining isolates to screen for novel sources of resistance to *Phytophthora sojae* in soybean. Plant Dis. 100:1424-1428.
- McCabe, C., Singh, A. K., **Leandro**, L. F. S., Cianzio, S. R., and M. A. Graham. **2016**. Identifying New Sources of Resistance to Brown Stem Rot in Soybean. **Crop Science.** 56:2287–2296 (2016). doi: 10.2135/cropsci2015.08.0492
- Rogovska, N., Laird, D., **Leandro**, L., and D. Aller. **2016.** Biochar effect on severity of soybean root disease caused by Fusarium virguliforme. **Plant and Soil**. DOI**:** 10.1007/s11104-016-3086-8
- Sahoo, D.K., Abeysekara, N.S., Cianzio, S., Robertson, A.E., and Bhattacharrya, M.K. 2017. A novel *Phytophthora* resistance gene mapped tightly to the *Rps4/6* region in soybean. PLoS ONE 12(1): e0169950. doi:10.1371/journal.pone.0169950
- Serrano, M., Mueller, T. and Robertson, A.E. 2016. Comparison of soybean seed treatments in replicated strip trials at 10 locations in Iowa, 2014. Plant Disease Management Reports 9: FC169.
- Sisson, A.J., Kandel, Y.R., Hart, C.E., Asmus, A., Wiggs, S.N., Mueller, D.S. 2016. Effect of foliar fungicide and insecticide on hail-damaged soybean. Plant Health Progress. 17:141-148.
- Tylka, G. L. 2016. Understanding soybean cyst nematode HG types and races. Plant Health Progress 17:149-151. doi:10.1094/PHP-PS-16-0615.

NCERA Soybean Items (2016)

C.R. Little (Kansas State University)

2016 Kansas soybean disease issues

The soybean disease loss estimate for 2016 was 4.2%, well below the long-term average of 11.6%. Diseases contributing significantly to the total include seedling blights (2%), SCN (1%), Phytophthora root rot (0.5%), charcoal rot (0.2%), SDS (0.2%), Cercospora-purple seed stain (0.1%) and frogeye leaf spot (0.1%). While only at 0.1%, this was the highest level of frogeye since it entered the state many years ago. Numerous fields in northeast and north central Kansas planted to susceptible varieties would have benefited from a spray, but many growers were reluctant to use a fungicide in 2016 because of low commodity prices.

Kansas Research Update

I. Research updates:

1. Analyzed the soybean seed "core mycobiome" using next-generation sequencing. Numerous fungal species. *Fusarium* spp. were detected in every seed sample tested.

2. Examined the pathogenicity of thirteen species of Fusarium. *F. proliferatum* was the most pathogenic. *F. proliferatum* isolates showed optimum growth at 0.99 a_w, 30°C, and pH 5.5. *F. proliferatum* CFUs/g of soil were greater in sorghum-soybean rotation plots than in soybean-soybean, soybean-wheat, or wheat-wheat. *F. proliferatum* is highly variable among fields. However, within a field, hot spots exist in terms of soil populations and recovery from seedlings.

3. Increased soil phosphorus (ppm) and tissue (%) was correlated with reduced SDS disease severity.

4. There was reduced *M. phaseolina* CFU/g root tissue after a mustard green manure cover crop.

5. Collaborated on sequencing five isolates of *Macrophomina* genomes isolated from soybean, corn, sorghum, cotton, and sunflower.

II. Publications:

Adee, E., Ruiz Diaz, D.A., and ***Little, C.R.*** 2016. Effect of soil test and phosphorus fertilization on soybean sudden death syndrome severity. Crop, Forage, & Turfgrass Management 2: Online. (https://dl.sciencesocieties.org/publications/cftm/abstracts/2/1/cftm2015.0193/preview)

III. Abstracts:

Pedrozo, R., Jumpponen, A., and Little, C.R. 2016. Metabarcoding the soybean seed core mycobiome. Phytopathology 106: S4.14.

<u>Impacts:</u>

Objective 1: Scientists from Kansas State University, the University of Illinois and USDA-ARS sequenced the genomes of five isolates of *Macrophomina phaseolina.* Information from the current study will lead to further understanding of the molecular interactions between *M. phaseolina* and different plant species and will assist in designing effective genetic control strategies for charcoal rot disease.

Objective 2: Determined that mustard, grown as a cover crop, reduced the levels of *Macrophomina phaseolina* (charcoal rot) in the roots of the subsequent soybean crop.

Objective 3: Using next-generation sequencing techniques, the presence of numerous fungal species in soybean seeds was verified, with *Fusarium* spp. being detected in every seed sample tested.

Kentucky

Carl Bradley, University of Kentucky

Overview of 2016 growing season and impact of diseases:
Soybean was harvested from 1,790,000 acres in Kentucky in 2016, with an average overall yield of 50 bu/A. This overall yield average tied the highest average yield observed in Kentucky, which was also achieved in 2013.

The growing season started out fairly dry, but July brought record-breaking rainfall. Wet weather continued through July and most of August, but the weather turned dry after that.

Due to the wet weather, frogeye leaf spot was severe on susceptible varieties. In UK fungicide trials, yield responses to fungicides exceeded 20 bu/A with products that had high levels of efficacy on frogeye leaf spot. Southern stem canker was severe in some fields, with 100% loss in a few fields. The fields most severely-affected by southern stem canker received high levels of rainfall, were planted to susceptible varieties, and were on soybean-on-soybean (non-rotated) ground. Target spot also was present in Kentucky, but it is not known how much yield loss it caused, if any. Soybean rust was observed in Kentucky in late September, but likely did not cause yield loss due to the dry weather that occurred in September and October.

Louisiana
Trey Price, Extension/Research Plant Pathologist, LSU AgCenter

LSU AgCenter Personnel Involved in Extension and Research: Trey Price, Myra Purvis, Hunter Pruitt, Clayton Hollier, Patricia Bollich, Ray Schneider, Clark Robertson, Ronnie Levy, Blair Buckley, Charlie Overstreet

2016 Louisiana Disease Summary

2016 was a challenging year for soybean producers in Louisiana. Four separate catastrophic flooding events occurred during the growing season. Early on the Red River in NWLA flooded delaying planting. March flooding in NELA and SELA took established plantings and further delayed others. During late summer, massive floods in SOLA severely affected soybean yield and quality. Frequent rainfall events in NELA and CENLA during July and August significantly affected seed quality of early-planted and mature soybean.

Early during the season, seedling diseases were light with primary culprits of *Rhizoctonia solani* and *Pythium* spp. Numerous complaints of herbicide injury also were fielded early on in the season. Aerial blight was a problem statewide throughout the entire season. In SWLA QoI resistance in *R. solani* continues to be a problem and appears to be becoming more widespread. For the first time, SDHI field failures against R. solani were documented in an isolated area near Mowata. BASF subsequently confirmed resistance to this chemistry type in isolates of the pathogen. Cercospora leaf blight was a problem statewide and particularly heavy in NELA. Purple seed stain as high as 50% was also observed in NELA. Results from two variety trial locations should provide clues to whether the two diseases are correlated. Frogeye leaf spot (FLS) was ubiquitous, but not as severe as previous years. Resistant varieties and triazole fungicides remain effective on FLS. Target spot developed late during the season and was only severe in isolated areas of extreme NELA. Taproot decline (TRD) was widespread and light to moderate in NELA. Efforts are underway to estimate yield losses due to TRD. Additionally, many field, greenhouse, and laboratory projects have been initiated to elucidate unknown aspects of TRD. Southern rootknot nematode (RKN) infestations appear to be increasing in severity, particularly in NELA. Southern blight was often found in conjunction with RKN infestations. Soybean rust was present very early throughout the state, but hot weather during the peak growing season kept the disease in check. Frequent rainfall events during July and August resulted in saturated soils, and many field calls were related to “wet feet” and not disease. Horrific harvest conditions for early-planted soybean resulted in severe weathering and in some cases green stem making some areas unharvestable. Most later-planted soybean had better yield and quality.

Throughout the 2016 growing season, we responded to approximately 300 phone calls and text messages, many of which resulted in field visits, laboratory diagnostics, or collaborative opportunities. We participated in 13 grower meetings and 7 field days throughout the year to extend results of our research efforts to stakeholders.

Selected Publications

- Albu, S., T. Price, V. Doyle, B. Padgett, and R. Schneider. 2016. The G143A mutation is responsible for strobilurin fungicide resistance in *Cercospora* cf. *flagellaris*, a leaf blight and purple seed stain pathogen of Louisiana soybean. Plant Health Progress. 17:3 197. doi:10.1094/PHP-BR-16-0043.
- Albu, S., R. W. Schneider, P. Price, and V. P. Doyle. 2016. *Cercospora* cf. *flagellaris* and *sigesbeckiae* are associated with Cercospora leaf blight and purple seed stain on soybean in North America. Phytopathology. 106:11 1376-1385. doi:http://dx.doi.org/10.1094/PHYTO-12-15-0332-R.
- Allen, T. A.,…P. Price, et al. 2016. Southern United States soybean disease loss estimates for 2014. Proc. Southern Soybean Dis. Workers. March 9-10, 2016 – Pensacola, FL. 11-15. Presentation &

Paper

- Allen, T. A., T. Faske, C. Hollier, P. Price, T. Spurlock, and H. Young. 2016. Nuts, bolts, frogeye leaf spot, and the UUOT. Proc. Southern Soybean Dis. Workers. March 9-10, 2016 – Pensacola, FL. 24. Presentation & Abstract
- Levy, R.,…P. Price, et al. 2015. 2016 Soybean variety yields and production practices. Pub. 2269 11/15 rev.
- Price, P., M. Purvis, and H. Pruitt. 2016. A quantifiable disease severity rating scale for frogeye leaf spot of soybean. Plant Health Progress. 17:1 27. doi:10.1094/PHP-BR-15-0054.
- Price, P. 2016. Section 4.10, Phomopsis seed decay. In A Farmer's Guide to Soybean Diseases. Eds. D. Mueller, K. Wise, A. Sisson, D. Smith, E. Sikora, C. Bradley, and A. Robertson. 55.
- Price, P., M. A. Purvis, and H. Pruitt. 2016. The effect of selected fungicides and application timings on Cercospora leaf blight in Louisiana, 2015. 10:FC007.
- Price, P., M. A. Purvis, and H. Pruitt. 2016. The effect of selected fungicides applied to soybean at R1, R3, and R5 on Cercospora leaf blight in Louisiana, 2015. 10:FC008.
- Price, P., M. A. Purvis, and H. Pruitt. 2016. The effect of fungicide mode-of-action and variety on frogeye leaf spot in two Louisiana locations, 2015. 10:FC216.
- Tomaso-Peterson, M., T. Allen, P. Price, R. Singh, and T. Spurlock. 2016. Characterization of taproot decline in southern soybean. Proc. Southern Soybean Dis. Workers. March 9-10, 2016 – Pensacola, FL. 24.

Michigan
Martin Chilvers

Michigan experienced a dry June and July. White mold was sporadic across the state, primarily an issue in fields with high fertility practices, such as use of manure or starter fertilizer. Heavy August rains brought on late SDS development. Late rains also drove issues with green stems, affecting harvest, and the increase in Phomopsis seed decay and purple seed stain, an issue with food grade beans. Research efforts are focusing on soybean sudden death syndrome, white mold, soybean seedling disease and soybean cyst nematodes.

Minnesota

Report prepared by D. Malvick, March 2017
Department of Plant Pathology, University of Minnesota, St. Paul

University of Minnesota Faculty Who Focus Significant Time on Soybean Disease Research
Dr. James Kurle and Dr. Dean Malvick, Dept. of Plant Pathology; and Dr. Aaron Lorenz Orf. Dept. of Agronomy and Plant Genetics (breeding).

General Soybean Production and Disease Status Report for Minnesota - 2016
In 2015, 7.5 million acres of soybean were harvested in Minnesota over the production area that extends from the Iowa to Manitoba borders. The average state yield was 52.5 bu/ acre, which is the greatest yield on record for Minnesota.. In most parts of the state it was a good year for soybean production with adequate or excess rainfall, generally moderate temperatures, and minimal environmental crop stress. Disease and crop challenges varied over this large area. The most common diseases reported were sudden death syndrome, white mold, Rhizoctonia root rot, and brown stem rot. Other diseases reported were Septoria brown spot, bacterial blight, and pod and stem blight, and seedling diseases.

Selected Examples of Minnesota Research Impacts/Discoveries

- Validated effective tactics to manage soybean sudden death syndrome (SDS)
- Identified biological characteristics of field locations where SDS does/doesn't occur
- Revealed characteristics of *Diaporthe* species causing stem diseases of soybean
- Analyzed *Phytophthora sojae* population in Minnesota and revealed pathotypes that exist and the resistance genes that may provide effective resistance.

Soybean Disease Publications and Abstracts Published in 2016

Peer-reviewed Research Articles

Dorrance, A.E. et al., 2016. Pathotype diversity of *Phytophthora sojae* in eleven states in the United States. *Plant Disease*, 100:1429–1437.

Abstracts and Posters

- Srour, A., Fakhoury, A., Bond, J., Leonardo, L., and Malvick, D. 2016. Linking microbial taxa in SDS-suppressive soils of soybean fields. 2016. www.apsnet.org/meetings/Documents/2016_meeting_abstracts/aps2016_548.htm
- Malvick, D., and Floyd, C. 2016. Identity, characteristics, and fungicide sensitivity of isolates in the *Diaporthe* species complex associated with soybean stem disease in Minnesota. www.apsnet.org/meetings/Documents/2016_meeting_abstracts/aps2016_548.htm
- Malvick, D., and Floyd, C. 2016. Multi-year evaluation of tactics to manage soybean sudden death syndrome. Proceedings from NC-APS meeting.

Nebraska

Loren J. Giesler

In 2016, Nebraska soybean producers harvested 5.2 M acres of soybean with an average yield of 61.0 bu/A. Approximately 54% of our soybean acres are irrigated at this time. Average increase in yield with irrigation was 12.4 bu./A for 2016. Wet conditions early in the year resulted in many fields being planted later than normal but these fields still yielded very well. Overall, it was a great year for soybean production, with limited disease activity. **Soybean Cyst Nematode** continues to be the number one disease affecting production. **Sudden Death Syndrome** was not as severe in 2016 as it was in 2015 but is becoming a more common problem for our producers. **Frogeye leaf spot** is now distributed from the southern to northern border, but not uniformly distributed and is still not commonly managed as a yield reducing disease in Nebraska. We have had 3 years of significant **white mold** (*Sclerotinia sclerotiorum*) in the northern portion of the state.

North Dakota
Sam Markell

Major diseases:
The geographical expansion of soybeans continues in ND, with over 6 M acres planted in 2016. Similarly, soybean cyst nematode (SCN) continues to occur in North Dakota. Egg level on first detection are commonly high (in excess of 10,000 eggs/100 cc). The majority of varieties available in maturity groups less than 0.8 are susceptible, placing growers in a precarious position if they are not managing SCN. Exacerbating the problem 0.75M to 1.0 M acres of dry edible beans are grown in the regions.

Roots rots (seedling diseases and Phytophthora) were common. White mold was sporadic but did cause localized yield loss. Downy mildew occurred in levels that likely caused some yield loss, but only in the North Central part of the state. Other economic loss to foliar diseases is very rare in North Dakota annually.

Research Publications:

- Yasmin, T, Nelson, B. D., Hobbs, H. A., McCoppin, N. K., Lambert, K. N., Domier, L.L. 2016. Molecular characterization of a new soybean-infecting member of the genus Nepovirus identified by high-throughput sequencing. Arch Virol: doi:10.1007/s00705-016-3152-9
- Rojas, A., Jacobs, J. L., Napieralski, S., Karaj, B., Bradley, C. A., Chase, T., Esker, P., Giesler, L., Jardine, D., Malvick, D., Markell, S., Nelson, B. D., Robertson, A., Rupe, J. C., Smith, D., Sweets, L., Tenuta, A., Wise, K., and Chilvers, M. I. 2016. Oomycete species associated with soybean seedlings in North America – Part II: Diversity and ecology in relation to environmental and edaphic factors. Phytopathology: doi.org/10.1094/PHYTO-04-16-0176-R
- Yan, G., Plaisance, A., Chowdhury, I., Baidoo, R., Upadhaya, A., Pasche, J., Markell, S. Nelson, B. and Chen, S. 2016. First Report of the Soybean Cyst Nematode *Heterodera glycines* Infecting Dry Bean (*Phaseolus vulgaris* L.) in a Commercial Field in Minnesota. Plant Dis. http://dx.doi.org/10.1094/PDIS-09-16-1257-PDN.
- Rojas, A., Jacobs, J. L., Napieralski, S., Karaj, B., Bradley, C. A., Chase, T., Esker, P., Giesler, L., Jardine, D., Malvick, D., Markell, S., Nelson, B. D., Robertson, A., Rupe, J. C., Smith, D., Sweets, L., Tenuta, A., Wise, K., and Chilvers, M. I.. 2016. Oomycete species associated with soybean seedlings in North America – Part I: Identification and pathogenicity characterization. Phytopathology. http://dx.doi.org/10.1094/PHYTO-04-16-0177-R
- Jain S, Chittem K, Brueggeman R, Osorno JM, Richards J., and Nelson Jr., B. 2016. Comparative Transcriptome Analysis of Resistant and Susceptible Common Bean Genotypes in Response to Soybean Cyst Nematode Infection. PLoS ONE 11(7): e0159338. doi: 10.1371/journal.pone.0159338

Extension Publications:

- Friskop, A., Markell, S., and Khan, M. 2016. 2017 North Dakota Field Crop Plant Disease Management Guide. North Dakota Cooperative Extension Service Publication PP-622.
- Kandel, H., Helms, T., Markell, S., Ostlie, M., Schatz, B., Endres, G., Aberle, E., Indergaard, T., Zwinger, S., Neilsen, J., Schaubert, S., Cooper, K., Besemann, L., Eslinger, H., T., Rickertsen, J., Olson, R., Eriksmoen, E.,, Tarasenko, T., Effertz, J., Hanson, R., Hakanson, T., Henry, L., Bergman, J., Pradhan, G., Link, E., Link, A., Tjelde, T., and Jacobs., J. 2016. North Dakota Soybean Variety Trial Results for 2015 and Selection Guide. North Dakota Cooperative Extension Service Publication A843-16.

Trade Magazine Articles:

- Yan, G., Nelson, B., and Markell S. 2016. New virulent types of soybean cyst nematode appearing in North Dakota soybean fields. North Dakota Soybean Grower Magazine. Vol. 5 (6):12-13.
- Yan, G., Nelson, B., and Markell, S. 2016. New Virulent Types of Soybean Cyst Nematode Appearing in North Dakota Soybean Fields. North Dakota Soybean Grower Magazine. Vol. 5 (6): 13.

Extension Presentations:

2016- Extension Presentations				
Date	**Title**	**Location**	**Event**	**Estimated Number of Participants**
11/30/16	Management of white mold and downy mildew	Fargo, ND	Northern Ag Expo	40
11/30/16	Diseases: Pesticide Recertification	Fargo, ND	Northern Ag Expo	285
10/18/16	A crash course in Soybean Cyst Nematode	Fargo, ND	NDSU Fall Extension Conference	15
9/8/16	Soybean cyst nematode and other diseases	LaMoure, ND	LaMoure County Soybean Plot Tour	12
8/31/16	Sudden Death Syndrome of soybean tour overview, basics, details, and future concerns.	Rosemount, MN	Sudden Death Syndrome Short-Course	33
8/25/16	SCN and dry bean diseases I	Carrington, ND	Carrington Research Extension Center Row Crop Tour	25
8/25/16	SCN and dry bean diseases II	Carrington, ND	Carrington Research Extension Center Row Crop Tour	15
7/22/16	Introduction of plant pathology and plant diseases in Eastern ND	Fargo, ND	NDSCS Field Day	25
7/22/16	Introduction to plant pathology and plant diseases in Western ND	Fargo, ND	BSC Field Day	25
7/20/16	Crop disease updates	Minot, ND	North Central Research Extension Center Field Day	75
7/20/16	Pest clinic	Minot, ND	North Central Research Extension Center Field Day	75
7/18/16	Soybean cyst nematode	Casselton, ND	Agronomy Seed Farm field day	60
6/28/16	Canola Disease Update	Minot, ND	Canola Day	104
3/24/16	Broadleaf crop disease updates	Fargo, ND	Centrol Round	75

2016- Extension Presentations				
Date	**Title**	**Location**	**Event**	**Estimated Number of Participants**
			Table	
3/9/16	North Dakota Disease Updates	Pensacola, FL	NCERA-137	30
2/24/16	Hands on: Soybean diseases	Fargo, ND	Eastern Crop and Pest Management School	130
2/23/16	Broadleaf crops disease updates	Fargo, ND	West Central Spring Agronomy Update	125
2/17/16	Broadleaf crops disease update	Grand Forks, ND	International Crop Expo	90
2/5/16	The big race to bean SCN 10 hands-on sessions of 35-40 people each	Moorhead, MN	Best of the Best in Wheat and Soybean Research	220
2/5/16	SCN and other disease issues in soybean	Moorhead, MN	Best of the Best in Wheat and Soybean Research	220
2/4/16	The big race to bean SCN 10 hands-on sessions of 35-40 people each	Grand Forks, ND	Best of the Best in Wheat and Soybean Research	330
2/4/16	SCN and other disease issues in soybean	Grand Forks, ND	Best of the Best in Wheat and Soybean Research	330
2/3/16	Soybean cyst nematode and production issues	Lisbon, ND	Ransom County 2016 Farm Expo	50
1/21/16	Session leaders panel: Q & A	Fargo, ND	Sow What Now?	125
1/21/16	Resistance discussion 4	Fargo, ND	Sow What Now?	35
1/21/16	Resistance discussion 3	Fargo, ND	Sow What Now?	30
1/21/16	Resistance discussion 2	Fargo, ND	Sow What Now?	30
1/21/16	Resistance discussion 1	Fargo, ND	Sow What Now?	30
1/15/16	The scouting report: Disease update	Fargo, ND	Northarvest Bean Day	350
1/14/16	Row crop diseases	Linton, ND	Emmons County Crop Improvement Meeting	15
1/8/16	Broadleaf plant diseases	Fargo, ND	CCA Training Prep	26

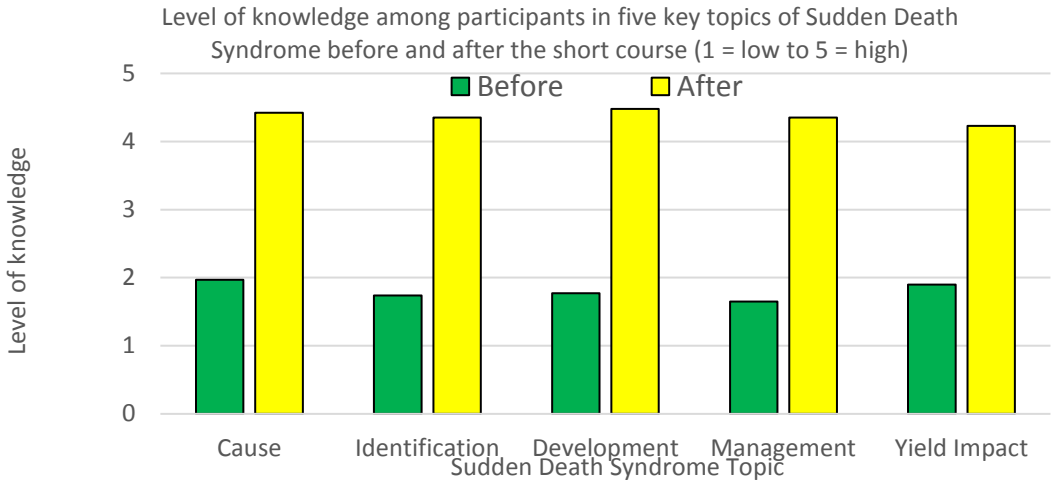
Extension Programs:

Sudden Death Syndrome Short Course. Rosemount, MN. August 30-31st, 2016.
In response to the threat posed to North Dakota soybean growers by Sudden Death Syndrome, caused by the invasive pathogen *Fusarium virguliforme,* a short-course on the disease for 'first responders' was developed jointly by NDSU (Sam Markell Ph.D.) and the University of MN

(Dean Malvick, Ph.D.). Thirty two North Dakota Extension agents, crop consultants, seedsman and other agriculture professionals attended. Funding was provided through a competitive grant from the North Dakota Soybean Council.

A pre- post-survey was distributed to measure learning (Figure 1) and potential economic impact. The 27 participants reported that they scouted or provided management information for approximately 434,000 soybean acres, and estimated that 12% of those acres (52,080 acres) would experience yield loss from SDS in the next five years. If this short course prevented even 5% yield loss on those acres, the value of the course would be $1,041,600 (assuming an average yield of 40 bu/a and an average price of $10 / bu on 52,080 acres).

Figure 1. Knowledge level before and after attending the Sudden Death Syndrome Short-Course



Ohio Report

Anne E. Dorrance, Professor and Research-Extension Plant Pathologist, The Ohio State University

The Ohio State University personnel involved in soybean disease extension and research:
Dorrance Lab: Deloris Veney (Research Assistant), Jonell Winger (Research Assistant), Anna Stasko (Graduate Research Associate), Jaqueline Huzar Novakowski (Graduate Research Associate), Meredith Eyre (Graduate Research Associate), Cassidy Gedling (Graduate Research Associate), Kelsey Scott (Graduate Research Associate), Amilcar Loyo Vargas (Graduate Research Associate); Linda Weber (Research Assistant)
Dr. Feng Qu, Associate Professor. Lab members: Junping Han (Research Assistant), Xiaolong Yao (Visiting Scholar), Shaoyan Zhang, Qin Guo, and Fides Zaulda (Graduate Research Associates).
Dr. Chris Taylor, Associate Professor, Lab Graduate Students, Rachel Medina (M.S., 2016), Krystel Navarro (M.S., 2016), Ellie Walsh (Ph.D., 2016) and Tim Frey,
Dr. Terry Niblack, Professor
Niblack lab: Horacio Nicora Lopez (Graduate Research Associate, co-advise Dorrance)

2016 Soybean Production and Major Issues in Ohio

Anne Dorrance

1. Major Diseases. Disease conditions during 2016: The field season was again a bit challenging, especially during planting. Consistent rains during May – moved most of the crop to later planting dates – after which little rain fell following planting. Lower seedling disease levels as a result. A dry July – also held the crop but rains in August boosted yields above the previous year. White mold was again very spotty with only a few fields reaching measurable yield losses. There were also reports and losses due to Phytophthora stem and root rot which reached over 10,000 acres, no quantitative resistance. Also a lot of late season reports on frogeye leaf spot, but it came in too late to affect yield. Sudden death syndrome was at very low levels in fields with a long history of this disease- but more widespread than it has been in the past.
2. There were 4,850,000 and 4,840,000 planted and harvested, respectively to soybean in Ohio during 2016, which is an increase of 100,000 from the previous year. More importantly, a statewide record yield average of 54.5 bu/A as of March 5, 2017 from the National Agricultural Statistics Service.
3. **Important State Impacts for 2016/2017**.
    a. From seedlings with symptoms of damping-off that were recovered from affected fields, recovered a number of Pythium spp. that were metalaxyl insensitive again in 2016.
    b. Scouted fields and made recommendations to <u>not</u> spray fungicides to manage frogeye leaf spot due to lack of disease pressure in 2016.
    c. Evaluated a large number of seed treatment compounds for efficacy towards *Phytophthora sojae* and *Pythium* spp. Continued to expand list of available products with good efficacy towards one or more these pathogens.
    d. Narrowed the list of candidate genes within QTL for *F. graminearum and P. sojae* along with markers to use in introgressing this trait into high yielding varieties.

e. Identified a very high correlation between the number of SCN cysts collected by traditional methods compared to the high throughput mechanized soil sampler. This removes the soil sampling as a limiting factor for monitoring SCN populations.
f. Identified a wide distribution of both SCN and Macrophomina in Ohio, with population densities of 94% of the 117 fields with SCN levels below 2,000 eggs/100 cc of soil.
g. Identified shifts in *P. sojae* populations in the Midwest, but more importantly that there is greater diversity in US populations than previously thought.
h. Suppression of RNA interference can occur in nematode feeding sites. This may impact the efficacy of using RNA interference approaches to control nematodes. (Taylor Lab)

4. Publications:

- Smrtnik, E., Niblack, T., Paul, P., Dorrance, A.E. and Bruns, D. 2016. Comparison of two soil sampling methods for estimating population densities of *Heterodera glycines* cysts. Plant Health Prog. 17:167-171.
- Schneider, R., Rolling, W., Song, Q., Cregan, P., Dorrance, A., and McHale, L. 2016. Genome wide association mapping of partial resistance to *Phytophthora sojae* in soybean plant introductions from the Republic of Korea. BMC Genomics. 17:607.
- Han, J., Domier, L.L., Cassone, B.J., Dorrance, A.E., and Qu, F. 2016. Assessment of common soybean-infecting viruses in Ohio, USA, through multi-site sampling and high-throughput sequencing. Plant Health Progress doi:10.1094/PHP-RS-16-0018
- Lopez-Nicora, H.D., Simon, A.C.M., Dossman, B.C., Paul, P.A., Dorrance, A.E., Lindsey, L.E. and Niblack, T.L. 2016. Distribution and abundance of *Heterodera glycines* and *Macrophomina phaseolina* in Ohio. Plant Health Progress doi:10.1094/PHP-S-15-0049.
- Stasko, A.K., Wickramasinghe, D., Nauth, B.J., Acharya, B., Ellis, M.L., Taylor, C.G., McHale, L., and Dorrance, A.E. 2016. High density mapping of resistance QTL towards *Phytophthora sojae*, *Pythium irregulare*, and *Fusarium graminearum* in the same soybean population. Crop Sci. 56: 2476-2492
- Dorrance, A.E., Kurle, J., Robertson, A.E., Bradley, C.A., Giesler, L, Wise, K., and Concibido, V.C. 2016. Pathotype diversity of *Phytophthora sojae* in eleven states in the United States. Plant Dis. 100: 1429-1437.
- Stewart, S., Robertson, A.E., Wickramasinghe, D., Draper, M.A., Michel, A., and Dorrance, A.E. 2016. Population structure among and within Iowa, Missouri, Ohio, and South Dakota populations of *Phytophthora sojae*. Plant Dis. 100: 367-379.

Extension Bulletins:

- Smith, D., Chilvers, M., Dorrance, A., Hughes, T., Mueller, D., Niblack, T., Wise, K. 2016. Soybean Disease Management: Charcoal Rot. Crop Protection Network. CPN 1004. http://cropprotectionnetwork.org/soybean/charcoal-rot/.

Posters:

- Huzar Novakowiski, J., Martin, C. and Dorrance, A.E. 2016. Evaluation of chemical treatments and host resistance for management of Sclerotinia stem rot in Ohio. Phytopathology 106: S1.4
- Stasko, A.K., Nauth, B.J., Taylor, C.G., and Dorrance, A.E. 2016. Analysis of soybean promoters' involvement in quantitative resistance to *Phytophthora sojae*. Phytopathology 106 (suppl 1) S1.8
- Ye, H., Song, L., Cheng, P., Ali, L., Patil, G., Valliyodan, B., Vuong, T.D., Murphy, M., Prince, S., Yungbluth, D., Shannon, J.G., Chen, P., Dorrance, A.E. and Nguyen, H.T. 2016. Genetic Improvement

of flooding tolerance and understanding the underlying mechanism in soybean. Soybean Molec. Meetings 2016.

- Gedling, C., Ali, M.E., Gunadi, A., Finer, J., Dorrance, A. and Qu, F. 2016. Apple latent spherical virus: an emerging VIGS construct for functional analysis in soybean genomics. Soybean Molec. Meetings 2016
- Xie, W., Stasko, A.K., Scott, K., Taylor, L., Cassone, B., Dorrance, A.E., and Taylor, C.G. 2016. An RNAi approach for functional analysis of quantitative resistance genes using hairy roots. Soybean Molec. Meetings 2016
- Stasko, A., and Dorrance, A.E. 2016. Expression of soybean PIN proteins during infection with Phytophthora sojae. Soybean Molec. Meetings 2016
- Verhoff, S., Lee, S., Dorrance, A., and McHale, L.K. 2016. Characterization of a major QTL on chromosome 18 associated with quantitative resistance to Phytophthora root and stem rot in soybean. Soybean Molec. Meetings 2016
- Eyre, M., Culman, S., and Dorrance, A. 2016. The effect of soil fertility on seedling disease development of soybean in Ohio. APS Annual Meeting, Tampa Florida.
- Huzar Novakowiski, J., Winger, J., Paul, P. and Dorrance, A. 2016. Evaluation of host resistance and chemical control to manage white mold of soybean in Ohio.
- Vargas, A., Eyre, M., and Dorrance, A. 2016. Evaluation of oxathiapiprolin toward *Phytophthora sojae* and *Phytophthora sansomeana*.
- Scott, K., Vargas, A., Eyre, M., and Dorrance, A. 2016. Efficacy of three soybean fungicide seed treatments against Pythium species in seed plate and growth chamber assays.
- Weber, L, and Dorrance, A. 2016. Resistance quinone outside inhibitor fungicides in Cercospora sojina in Ohio. American Phytopathological Society Annual Meeting; 2016 Jul 30-Aug 3; Tampa, FL.
- Scott, K., Eyre, M., and Dorrance, A. 2016. Screening soybean germplasm for resistance towards Pythium spp.
- Lopez-Nicora, H., Carr, J., Dorrance, A., and Niblack, T. 2016. Evaluating soybean production in fields infested with Heterodera glycines and Macrophomina phaseolina with spatial regression analysis.
- Lewandowski, M., Dorrance, A., Canas, L, Kleinke, B., Roche, E., Schoenhals, J., Williams, S., Peduto Hand, F., Jasinksi, J., Gardiner, M., Paul, P., Londo, A. 2016. Master in Plant Health Management: education and training to meet 21st century trends and challenges in Extension and Industry.

Invited Presentations:

- Dorrance, A.E. 2016. Seedling pathogens of soybean, their diversity and best practices for breeding for resistance. Soybean Breeders Workshop, St. Louis MO. February 2016.
- Dorrance, A.E. 2016. Evaluation of QGU42-oxathiapiprolin for efficacy towards Oomycetes that affect soybean and corn in Ohio. Presented at DuPont-Pioneer Seed Treatment Meeting, Johnston, IA June 2016.
- Qu, F. 2016. Interrogating soybean disease resistance genes using virus-induced gene silencing. Soybean Precision Genomics Workshop. University of Missouri-Columbia, Aug 2016.
- 12 – In state meetings to share data directly with producers a
- 16 articles in C.O.R.N. newsletter

Ontario

Albert Tenuta

The 2016 Ontario soybean crop was the third largest at 2.715 million acres with 2014 being the largest at 3.06 million and 2015 at being number two. The 2016 crop year was a year of extremes with some regions being incredibly dry resulting in poor yields or in the most extreme cases total crop failures. For most regions, a dry spring with few diseases followed by timely rains in August resulted in amazingly high yields in parts of southwestern Ontario.

Early season Phytophthora and Pythium seedling diseases on heavy clay soils areas with chronic issues were again observed this season. The dry conditions were favorable for soybean cyst nematode but overall yields were above average due to the hot conditions and timely August rains. Sudden Death Syndrome symptoms were associated with SCN but were delayed this year (most prominent after the August rains). Weather conditions were not favorable for white mold in most of the province but areas in Eastern Ontario (Ottawa Valley) and St. Lawrence lowlands, the disease was observed but had little impact on yield. Frogeye leaf spot was observed on a few very susceptible varieties in small regions with some seed infection of food grade soybeans occurring.

South Dakota

Febina Mathew, Field Crops Pathologist, South Dakota State University
Emmanuel Byamukama, Extension Plant Pathologist, South Dakota State University
Connie Strunk, Extension Specialist, South Dakota State University
Connie Tande, Plant Disease Diagnostician, South Dakota State University

South Dakota State University personnel involved in soybean disease extension and research: Febina Mathew, Emmanuel Byamukama, Connie Strunk, and Connie Tande.

2016 soybean production and major diseases in South Dakota

In South Dakota total of 5.2 Million acres of soybean were planted in 2015 with 5.17 million acres harvested (USDA-NASS 2016). Soybean production reached an average yield of 49.5 bushels per harvested acre in 2016, compared to 46 bushels per harvested acre in 2015.

Most soybean acres were planted by mid-to-late May in South Dakota in 2016. However, most south central areas received rainfalls in late May to mid- June, resulting in planting delays. Weather became hot and dry in July, then turned cool and wet in August and September. These weather conditions led to moderate levels of bacterial diseases and Septoria brown spot throughout the season. White mold, Brown stem rot, and Stem canker were scattered across the state and impacted a small portion of the acreage in South Dakota. Sudden death syndrome was observed at a moderate level in one field. Soybean cyst nematode continues to be constrain to soybean yield, with prevalence for SCN submitted samples running at 32% for 2016. As of 2016, SCN has been confirmed in 30 counties (located eastern-most of the state)

Impact Statements

1. Disease alerts and disease updates were communicated to growers, agronomists, crop consultants throughout the season
2. Growers, agronomists, and crop consultants were availed information on SCN biology and management. Growers continue to submit soil samples for SCN testing free of charge courtesy of the South Dakota Soybean Research and Promotion Council.
3. Efficacy of foliar fungicide application in soybeans was demonstrated, with our small plots showing limited yield gain as a result of fungicide application

Research Publications, Extension Articles, and Videos

Refereed Journals *(Total of 2)*

- Kontz, B., Adhikari, S., Subramanian, S., and **Mathew, F.** 2016. Optimization and application of a quantitative polymerase chain reaction assay to detect *Diaporthe* species in soybean plant tissue. Plant Dis. 100: 1669-1676.
- Acharya, K., **Tande, C.,** and **Byamukama, E**. 2016. Determination of *Heterodera glycines* virulence phenotypes occurring in South Dakota. Plant Disease 100:2281-2286.

Abstracts *(Total of 16)*

- Hauswedell, B., Dunbar, M., **Mathew, F.**, Kleinjan, J., and Varenhorst, A. 2016. Developing management recommendations for the use of seed treatments for soybean in South Dakota.

12th Annual AgOutlook Conference and Tradeshow, South Dakota Soybean Association, Sioux Falls, SD. December 8, 2016

- Okello, P., Osborne, S., and **Mathew, F.** 2016. Effect of N-P-K fertilizer rates and soybean cyst nematode on Fusarium root rot of soybean. 12th Annual AgOutlook Conference and Tradeshow, South Dakota Soybean Association, Sioux Falls, SD. December 8, 2016 (Poster).
- Posch, J., Varenhorst, A., Rozeboom, P., and **Mathew, F.** 2016. Determining the impact of co-infestations of *Diaporthe longicolla* and soybean aphid on soybean. 12th Annual AgOutlook Conference and Tradeshow, South Dakota Soybean Association, Sioux Falls, SD. December 8, 2016 (Poster).
- Chowdhury, R., **Byamukama, E.**, and **Mathew, F.** 2016. Exploring interaction between soybean cyst nematode and *Phytophthora sojae* on soybean. 12th Annual Ag Outlook Conference and Tradeshow, South Dakota Soybean Association, Sioux Falls, SD. December 8, 2016 (Poster).
- Posch, J. P., Varenhorst, A. J., Rozeboom, P., and **Mathew, F.** 2016. Exploring the disease caused by a soil-borne fungus on soybean in the presence of other pests. Phytobiomes: From Microbes to Plant Ecosystems, Santa Fe, NM. November 8-12, 2016 (Poster).
- Dunbar, M. W., Hauswedell, B., **Mathew, F.**, Kleinjan, J., and Varenhorst, A. J. 2016. Developing management recommendations for the use of fungicide and insecticide seed treatments for soybeans in South Dakota. International Congress of Entomology, Orlando, FL. September 26, 2016 (Poster).
- Neupane, S., Ma, Q., **Mathew, F.**, Varenhorst, A., Andersen, E. J., and Nepal, M. P. 2016. Comparative genomics of disease resistance genes in soybean (*Glycine max*) and common bean (*Phaseolus vulgaris*). Botanical Society of America – Botany 2016, Savannah, GA. July 30-August 3, 2016 (Poster).
- Okello, P., Adhikari, A., Varenhorst, A., Osborne, S., **Byamukama, E.**, and **Mathew, F.** 2016. Interaction between *Fusarium* and soybean cyst nematode on soybean. American Phytopathological Society Annual Meeting, Tampa, FL. July 30-August 3, 2016 (Talk).
- Okello, P., Singh, A., Hyronimus, L., Weber, A., and **Mathew, F.** 2016. Screening soybean germplasm for resistance to multiple *Fusarium* species. American Phytopathological Society Annual Meeting, Tampa, FL. July 30-August 3, 2016 (Poster).
- Posch, J., Varenhorst, A., and **Mathew, F.** 2016. Exploring the interactions of soybean cyst nematode with stem canker pathogens on soybean. American Phytopathological Society North Central Meeting, Minneapolis, MN. June 8, 2016 (Talk).
- Posch, J., Varenhorst, A., Rozeboom, P., and **Mathew, F.** 2016. Determining the interaction between the stem canker fungus *Diaporthe longicolla* and the soybean aphid *Aphis glycines* on soybean. American Phytopathological Society North Central Meeting, Minneapolis, MN. June 8, 2016 (Poster).
- Dunbar, M. W., Hauswedell, B., Varenhorst, A., **Mathew, F.**, and Kleinjan, J. 2016. Developing management recommendations for the use of seed treatments for soybean in South Dakota. Entomological Society of America, North Central Branch Meeting, Cleveland, OH. June 5-8, 2016 (Poster).
- Okello, P., Singh, A., and **Mathew, F.** 2016. Screening soybean germplasm for resistance to Fusarium root rot. American Society of Plant Biologist Midwestern section meeting, Brookings, SD. March 19-20, 2016 (Poster).
- **Byamukama, E., Tande, C**., and Acharya, K. 2016. Partnering with the State Soybean Commodity Board to Promote Diagnosis and Management of SCN in South Dakota. National Plant Diagnostic Network 4th National Meeting, Washington DC.
- **Tande, C.**, **Mathew, F.,** Ali, S., Johnson, P., Ball, J., Tilmon, K., Chirumamila, A., Bachmann, A.,

Johnson, O. P., Fuller, B., Burrows, R., Varenhorst, A., Patrick, B., and **Byamukama, E.** 2016. Plant disease and pest diagnostics: It is more than you think. National Plant Diagnostic Network 4th National Meeting, Washington DC.

- Chowdhury, R., Adhikari, S., **Byamukama, E**., and Subramanian, S. 2016. Developing a host-based quantitative PCR assay to detect *Phytophthora sojae* causing root rot of soybean. NC-APS meeting, St. Paul, MN.

Extension/Outreach publications *(Total of 9)*

- **Mathew, F.**, Varenhorst, A., and Kleinjan, J. 2016. To treat or not to treat soybean seeds? The Soybean Leader Magazine. March/April 2016.
- Yabwalo, D., Geppert, R., and **Byamukama, E**. 2016. 2015 soybean foliar fungicide trial summaries. iGrow online.
- **Byamukama, E., Tande, C.,** and **Mathew, F**. Sudden death syndrome developing in soybeans. Published on 8/25/2016 http://igrow.org/agronomy/soybeans/sudden-death-syndrome-developing-in-soybeans/
- **Byamukama, E., Mathew, F**. 2016. Planning a fungicide application? Published on 7/14/2016 http://igrow.org/agronomy/soybeans/planning-a-fungicide-application/
- **Byamukama, E**. Late season soybean diseases: Know what is killing your soybeans. Published on 9/1/2016 http://igrow.org/agronomy/soybeans/late-season-soybean-diseases-know-whats-killing-your-soybeans/
- **Byamukama, E**., **Tande, C**. and **Mathew, F.** 2016. White mold starting to develop in soybeans. Published on 8/11/2016 http://igrow.org/agronomy/soybeans/white-mold-starting-to-develop-in-soybeans/
- **Byamukama, E**., Yabwalo, D., and Geppert, R. 2016. Did it pay to apply foliar fungicides in soybeans in 2015? Published on 1/22/2016. http://igrow.org/agronomy/soybeans/did-it-pay-to-apply-foliar-fungicides-in-soybeans-in-2015
- **Byamukama, E**. and **Tande, C.** 2016. Test for the soybean cyst nematode before planting soybeans this spring. Published on https://igrow.org/agronomy/soybeans/test-for-the-soybean-cyst-nematode-before-planting-soybean-this-spring/
- **Byamukama, E. Mathew, F., Tande, C.,** and **Strunk**, **C**. 2016. Scout and soil test for the soybean cyst nematode. Published on 7/7/2017 http://igrow.org/agronomy/soybeans/scout-and-soil-test-for-the-soybean-cyst-nematode/

Tennessee

Personnel involved:
Heather Kelly (Assistant Professor-Plant Pathologist), Jamie Jordan (Research Associate II), Wesley Crowder (Research Specialist I), Binbin Lin (Post-doctoral Associate), Sandesh Shrestha (Graduate student)

Major diseases:
Above normal rainfall and high temperatures promoted diseases some at greater severity than usual, including target spot. Diseases observed included frogeye leaf spot, septoria brown spot, target spot, and cercospora leaf blight. A cool, wet spring also promoted a higher than normal levels of sudden death syndrome and some seedling diseases caused by *Phytophthora* where cover crop was planted. Soybean cyst nematode continues to cause yield loss in all the major soybean production counties. Other diseases noted at minor levels included southern stem canker and anthracnose.

Production:
Soybean were harvested on more than 1.5 million acres in Tennessee in 2014. Moderate temperatures and above normal rainfall created good to excellent yields in most counties across the state and there was a final state average yield of 46 bushels/acre (Jan 2015 USDA crops report). Soybean prices were lower than previous years and most producers received less than $11.00 per bushel for their crop. Projected cash receipts for soybeans in 2014 are around 690 million dollars.

State impacts:
Disease management strategies, fungicide resistance information, and the foliar fungicide efficacy table discussed at every production meeting, grain conference, field days, and consultants meeting that University of Tennessee was involved in (total attendance >3,000) and the county agent in-service training (total attendance 68). This information and hands on training in diagnosing diseases was also given at UT summer soybean scout schools (total attendance 89). Information and presentations given on disease management was promoted in blog articles (~2,600 page views) news.utcrops.com, on the UTcrops.com, and launched a mobile-friendly field guide on soybean diseases guide.utcrops.com (>10,000 page views) and searchable soybean cultivar database containing disease ratings and yield (search.utcrops.com).

Publications:
Papers or extended abstracts published in conference proceedings
(*indicates student, **indicates Post-Doctoral Associate)

1. **Kelly, H.M**. 2016. Decision models for fungicide applications for frogeye leaf spot in soybean. Phytopathology (Nov. Suppl. issue). Annual American Phytopathological Society Meeting, Tampa, FL Aug. 2016. Poster

2. **Lin, B., Yu, H., Mengistu, A. and **Kelly, H.** 2016 Fitness and competition studies of QoI resistant and sensitive Cercospora sojina isolates, the causal agent of frogeye leaf spot. Phytopathology (Nov. Suppl. issue). Annual American Phytopathological Society Meeting, Tampa, FL Aug. 2016.

Advisor of post-doctoral researcher - presentation

3. *Jordan IV, J. W., Mengistu, A., and **Kelly, H.** Using color spectrophotometry to evaluate disease severity of *Macrophomina phaseolina* in soybean. Phytopathology (Nov. Suppl. issue). Annual American Phytopathological Society Meeting, Tampa, FL Aug. 2016.

Major advisor of PhD student - poster

4. *Shrestha, S., Cochran, A., Lamour, K. Mengistu, A., Castro-Rocha, A., and **Kelly, H.** 2016. Population structure of *Cercospora sojina* collected from different soybean cultivars in Milan and Jackson, Tennessee. Phytopathology 106:4S, S2.6-S2.17. Southern Division of American Phytopathological Society Meeting, Balm, FL Feb. 2016.

Major advisor of PhD student - poster

5. **Lin, B. and **Kelly, H.** 2016. Competition studies of QoI resistant and sensitive *Cercospora sojina* isolates, the causal agent of frogeye leaf spot. Phytopathology 106:4S, S2.6-S2.17. Southern Division of American Phytopathological Society Meeting, Balm, FL Feb. 2016.

Advisor of post-doctoral researcher - presentation

6. *Butler, S., Mueller, T., Kruger, G., and **Kelly, H.** 2016. Influence of application technology on foliar fungicide efficacy in *Cercospora sojina* infected soybean. Phytopathology 106:4S, S2.6-S2.17. Southern Division of American Phytopathological Society Meeting, Balm, FL Feb. 2016.

Major advisor of MS student - presentation

7. *Jordan, J. and **Kelly, H.** 2016. Application thresholds in controlling *Cercospora sojina,* the causal agent of frogeye leaf spot. Phytopathology 106:4S, S2.6-S2.17. Southern Division of American Phytopathological Society Meeting, Balm, FL Feb. 2016.

Major advisor of PhD student - presentation

Scholarly activity published through a refereed electronic venue

(*indicates student, **indicates Post-Doctoral Associate)**:**

1. ***Jordan IV, W. J., Crowder, W., and Kelly, H. M. 2016. Field evaluation of maturity group III soybean cultivars for frogeye leaf spot and fungicide in Tennessee, 2015. Plant Disease Management Report. Volume 10(2), Field Crops Section.**

2. ***Jordan IV, W. J., Crowder, W., and Kelly, H. M. 2016. Field evaluation of maturity group IV early soybean cultivars for frogeye leaf spot and fungicide in Tennessee, 2015. Plant Disease Management Report. Volume 10(2), Field Crops Section.**

3. ***Jordan IV, W. J., Crowder, W., and Kelly, H. M. 2016. Field evaluation of maturity group IV late soybean cultivars for frogeye leaf spot and fungicide in Tennessee, 2015. Plant Disease Management Report. Volume 10(2), Field Crops Section.**

4. ****Lin, B. and Kelly, H. M. 2016. Field evaluation of early maturity group V soybean cultivars to frogeye leaf spot and fungicide in Tennessee, 2015. Plant Disease Management Report. Volume 10(2), Field Crops Section.**

5. **** Lin, B. and Kelly, H. M. 2016. Field evaluation of late maturity group IV Liberty Link soybean cultivars to frogeye leaf spot and fungicide in Tennessee, 2015. Plant Disease Management Report. Volume 10(2), Field Crops Section.**

6. ****Lin, B, Jordan*, W. J., and Kelly, H. M. 2016. Field evaluation of fungicide efficacy on frogeye leaf spot and target spot, 2015. Plant Disease Management Report. Volume 10(2), Field Crops Section.**

Articles published in popular press:
Soybean South
Get a jump on resistance* – *contributor, May 1, 2016

Great American Insurance Group
Plant Detective* – *contributor, June 23, 2016

***Progressive Farmer* (Circulation >550,000)**
Disease or Chemical Injury? June 23, 2016

Delta Farm Press
Mobile-friendly soybean disease field guide available Aug. 25, 2016

Wisconsin

Damon Smith, Extension Plant Pathologist, University of Wisconsin-Madison

University of Wisconsin-Madison personnel involved in soybean disease extension and research: Shawn Conley, Carol Groves, Scott Chapman, John Gaska, Brian Hudelson, Ann MacGuidwin, Chris Bloomingdale, Jaime Wilbur, Megan Mccaghey, Brian Mueller, Cristina Zambrana

Wisconsin Department of Agriculture, Trade and Consumer Protection personnel involved in soybean disease research: Anette Phibbs and Adrian Barta

Wisconsin saw 1.95 million acres of soybeans harvested in 2016. However, the state is ranked #16 in the country for soybean production. The soybean crop was established on time and the season was very conducive for soybean growth and production. A state-wide average yield of 55 bu/a was recorded in 2016, which was 5.5 bu/a higher than 2016, making it an all-time record. This resulted in 107.5 million bushels of soybeans were harvested statewide in 2016, also a record.

Disease continues to be a significant yield-reducer in Wisconsin. Better than 94% of the soybean acreage is infested with soybean cyst nematode (SCN). In 2016, stem disease were of significant concern. White mold has continued to be the number 1 stem disease in the state and was found throughout much of the soybean production area. Yield was not generally affected by white mold in the southern region, however, yield reductions as high as 50-60% were estimated by UW personnel who scouted fields in the far northern reaches of Wisconsin. In addition to white mold, stem canker and pod and stem blight were also observed. Other significant disease concerns included sudden death syndrome (SDS) which cause 5-10% yield reductions in the southwest portion of the state, and was found for the first time in the north-central region. Virus issues were fairly minimal, only several cases of *Soybean vein necrosis virus* were observed in 2016.

Impact Statements

1. Worked as a collaborator and editor in the multistate group, Crop Protection Network, to generate the full-length text, *A Farmer's Guide to Soybean Diseases*.
2. Successfully validated a white mold fungicide decision tool based on a prediction model for apothecial development. This tool will be validated again in 2017.
3. A soybean germplasm line with a high-level of resistance to white mold has been identified for release as a commercial, food-grade, non-GMO cultivar in 2018.

Research Publications, Extension Articles, and Videos
Refereed Journals

1. Marburger, D.A., Smith, D.L., and Conley, S.P. 2016. Revisiting planting date and cultivar effects on soybean sudden death syndrome. Plant Dis. 100:2152-2157.
2. Groves C., German T., Dasgupta R., Mueller D., Smith D.L. 2016. Seed Transmission of Soybean vein necrosis virus: The First Tospovirus Implicated in Seed Transmission. PLoS ONE 11(1): e0147342. doi:10.1371/journal.pone.0147342.
3. Smith, D.L. 2016. Response to "On seed transmissibility of Soybean vein necrosis-associated virus in symptomless soybean seedlings." Plant Health Prog. 17:185.

4. Irizarry, M. D., Groves, C. L., Elmore, M. G., Bradley, C. A., Dasgupta, R., German, T. L., Jardine, D. J., Saalau Rojas, E., Smith, D. L., Tenuta, A. U., Whitham, S. A., and Mueller, D. S. 2016. Re-emergence of Tobacco streak virus infecting soybean in the United States and Canada. Plant Health Prog. 17:92-94.

Books

1. A Farmer's Guide to Soybean Diseases. 2016. Daren Mueller, Kiersten Wise, Adam Sisson, Damon Smith, Edward Sikora, Carl Bradley, and Alison Robertson (eds.). APS Press, St. Paul, MN. 155 pgs.

Abstracts

1. **Willbur, J., Lucas, H., Mueller, B., Chapman, S., Kabbage, M., and Smith, D.L. 2016. Validation and refinement of a predictive model for *Sclerotinia sclerotiorum* apothecial development in soybean fields. Phytopathology 106:S4.5**
2. **McCaghey, M., Willbur, J., Grau, C., Chapman, S., Diers, B., Groves, C., Rnajan, A., Kabbage, M., and Smith, D.L. 2016. Development and evaluation of germplasm lines resistant to Sclerotinia stem rot. Phytopathology 106:S4.87.**
3. **Fall, M. Chilvers, M., Byrne, A., Willbur, J., and Smith, D.L. 2016. Effect of soybean canopy closure on Sclerotinia sclerotiorum apothecia production, ascospore release, and primary plant infection of soybean. Phytopathology 105:S4.142.**

Videos

1. *Soybean white mold (Sclerotinia stem rot)*. 2016. Invited webinar recording. Pest Management Network, Focus on Soybean series http://www.plantmanagementnetwork.org/edcenter/seminars/soybean/WhiteMold/
2. *Soybean disease forecasting.* 2016. Invited webinar recording. Pest Management Network, Focus on Soybean series http://www.plantmanagementnetwork.org/edcenter/seminars/soybean/SoybeanDiseaseForecasting/

Extension/Outreach publications

1. Marburger, D., Smith, D.L., and Conley, S.P. 2016. Don't delay soybean planting to manage sudden death syndrome (SDS): Yield loss can result. UW Extension - Cooperative Extension Service. University of Wisconsin.
2. Bradley, C., Chilvers, M., Freije, A., Giesler, L., Mueller, D., Sikora, E., Sisson, A., Smith, D.L., Tenuta, A., and Wise, K. 2016. Fact Sheet: CPN1017 – Frogeye leaf Spot. Crop Protection Network.
3. Mueller, D., Bradley, C., Chilvers, M., Freije, A., Giesler, Sisson, A., Smith, D.L., Tenuta, A., and Wise, K. 2016. Fact Sheet: CPN1011 – Sudden Death Syndrome. Crop Protection Network.
4. Mueller, D., Bradley, C., Chilvers, M., Freije, A., Giesler, Sisson, A., Smith, D.L., Tenuta, A., and Wise, K. 2016. Fact Sheet: CPN1012 – Scouting for Sudden Death Syndrome: Scouting Card. Crop Protection Network.
5. Wise, K., Mueller, D., Johnson, B., Legleiter, T., Bradley, C., Chilvers, M., Freije, A., Giesler, Sisson, A., Smith, D.L., Tenuta, A. 2016. Fact Sheet: CPN1013 – Using iLeVO with preemergence herbicides. Crop Protection Network.
6. Wise, K., Mueller, D., Bradley, C., Chilvers, M., Freije, A., Giesler, Sisson, A., Smith, D.L., Tenuta, A. 2016. Fact Sheet: CPN1015 – Soybean stem zone lines: Fact and fiction. Crop Protection Network.

7. Wise, K., Mueller, D., Bradley, C., Chilvers, M., Freije, A., Giesler, Sisson, A., Smith, D.L., Tenuta, A. 2016. Fact Sheet: CPN1016 – Soybean seed treatments: Questions that emerge when plants don't. Crop Protection Network.
8. Bradley, C., Chilvers, M., Giesler, Mueller, D., Sisson, A., Smith, D.L., Tenuta, A., Wise, K. 2016. Fact Sheet: CPN4001 – Fungicide resistance in field crops FAQs. Crop Protection Network.
9. Johnson, Legleiter, T. Chilvers, M., Conley, S., Dorrance, A., Freije, A., Friskop, A., Giesler, L., Hartzler, B., Jardine, D., Knezevic, S., Krupke, C., Loux, M., Mueller, D., Owen, M., Robertson, A., Sisson, A., Smith, D.L., Tenuta, A., and Wise, K. 2016. CPN4002 – Cover crops dos and don't's. Crop Protection Network.
10. Jensen, B., Nice, G., Renz, M., and Smith, D.L. 2016. A3646 – Pest Management in Wisconsin Field Crops. UW Extension - Cooperative Extension Service. University of Wisconsin.
11. Smith, D.L. 2016. 2016 Wisconsin pest management update tour slides now live! Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – November 11.
12. Smith, D.L. 2016. Phomopsis seed decay – An increasing issue for delayed soybean harvest in Wisconsin. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – October 3.
13. Smith, D.L. 2016. Question of the week: What is up with all of this white mold on soybeans? Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – August 24.
14. Smith, D.L. and Conley, S.P. 2016. Research results: Don't delay soybean planting to manage SDS. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – August 11.
15. Smith, D.L. 2016. Wisconsin crop disease update, no rust, some white mold. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – August 11.
16. Smith, D.L. and Willbur, J. 2016. Wisconsin white mold risk map – July 27, 2016. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – July 27.
17. Smith, D.L. and Willbur, J. 2016. Wisconsin white mold risk map – July 22, 2016. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – July 22.
18. Smith, D.L. and Willbur, J. 2016. Wisconsin white mold risk map – July 15, 2016. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – July 15.
19. Smith, D.L. and Willbur, J. 2016. Wisconsin white mold risk map – July 8, 2016. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – July 8.
20. Smith, D.L. 2016. 2016 DATCP soybean Phytophthora survey update. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – July 6.
21. Smith, D.L. and Willbur, J. 2016. Wisconsin white mold risk map – July 5, 2016. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – July 5.
22. Smith, D.L. and Willbur, J. 2016. Time to start watching for white mold in soybeans. Wisconsin Field Crops Pathology Blog/Wisconsin Crop Manager – June 30.