

**NCERA – 137 Soybean Diseases Technical Committee Meeting  
March 4-5, 2014 – Pensacola Beach, FL**

**NCERA 137 – Soybean Diseases**

Minutes of the Annual Meeting  
Pensacola Beach, FL  
March 4-5, 2013

**Administrative Advisor:**

Dr. Steven Slack  
Director, OARDC  
1680 Madison Ave.  
Wooster, OH 44691

**Chair:**

Dr. Martin Chilvers  
Department of Plant, Soil and Microbial Sciences  
Michigan State University  
East Lansing, MI 48824

**Secretary:**

Dr. Heather Young Kelly  
Department of Entomology and Plant Pathology  
Tennessee University  
Jackson, TN 38301

**Immediate Past Chair:**

Dr. Kiersten Wise  
Department of Botany and Plant Pathology  
Purdue University  
West Lafayette, IN 47907

**Members and guests in attendance:**

**NCERA 137 Meeting**

**2014 – Pensacola Beach, FL**

Carl Bradley, (Univ. Illinois), Albert Tenuta (OMAFRA, Ontario, Canada), Ed Sikora (Auburn), Doug Jardine (Kansas State Univ.), Teresa Hughes (Monsanto), Scott Isard (Penn State Univ.), Loren Giesler (University of Nebraska), Steve Slack (The Ohio State Univ.), Kiersten Wise (Purdue Univ), Laura Sweets (Univ. Missouri), Dean Malvick (Univ. Minnesota), Martin Chilvers (Michigan State Univ.), Daren Mueller (Iowa State University), Damon Smith (Univ. Wisconsin-Madison), Anne Dorrance (The Ohio State Univ.), Don Hershman (Univ. Kentucky), Jim Haudenshield (USDA-ARS @ UIUC), Heather Kelly (Univ. Tennessee), Kelly Whiting (United

Soybean Board), Aardra Kachzoo (Univ. Kentucky), Yannis Tzanetakis (Univ. Arkansas), Feng Qu (Ohio State Univ.), Jim Marois (Univ. Florida), John Rupe (Univ. of Arkansas), Tom Allen (Mississippi State Univ.), Steve Whitham (Iowa State Univ.), Yuba Kandel (Iowa State Univ.), Clayton Hollier (Louisiana State Univ.), Les Domier (USDA-ARS, Univ of Illinois), Travis Faske (Univ. of Arkansas), Saghai Maroof (Virginia Tech.), Trey Price (Louisiana State Univ.), Myra Purvis (Louisiana State Univ.), Patricia Bollich (Louisiana State Univ. AgCenter), Alemu Mengistu (USDA-ARS, Jackson, TN), Reza Hajimorad (Univ. Kentucky), Dennis Delaney (Auburn University), Mary Delaney (Auburn University), Nathan Kleczewski (Univ. of Delaware), Tom Fontana (Ohio Soybean Council), Ray Schneider (Univ. of Louisiana)

### **Minutes:**

The meeting of the NCERA 137 Soybean Diseases Committee was held at the Hilton Pensacola Beach, Pensacola Beach, Florida on March 4-5, 2014. Dr. Martin Chilvers, the committee chair, opened the meeting at 9:00 am on March 4. 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 in attendance. Written reports were also provide and compiled into a PDF document.

**NCERA 137 Impact Statement:** Soybean production continues to play a prominent role in US agriculture. It is the number one crop in terms of harvested acres in several North Central states and second only to corn in value of production. The 2010 cash market value of soybeans increased 32 percent from 29.5 billion to 38.9 billion dollars. With rising production value, new markets for green energy, and soybean oil replacing crude oil in industrial processes, there is a greater demand to improve yield and quality. Soybean yields have remained steady since 2002, with average yields of 43.3 and 43.5 bu/A reported for 2009 and 2010, respectively (USDA Crop Production Report, Feb 2011). The frequency and spread of soybean diseases has played a role in these stagnant yields in several production areas within the North Central region.

**Our mission:** The NCERA 137 Committee monitors the development of soybean diseases and directs science-based information to breeders and agricultural companies across the US. The committee has a system of rapid exchange of information about current and emerging pathogen issues that helps mitigate yield losses and assists growers and companies in cost savings.

### **Objectives and Accomplishments**

**Objective 1. Foster collaborative research and information exchange on 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.**

Accomplishments for objective 1:

a) The 2014 NCERA 137 meeting was held in conjunction with the Southern Soybean Disease Workers (SSDW) and the soybean virus committee (NCERA 200). Meeting jointly with the

southern soybean scientists and soybean virus committee improves the exchange of information and ideas, which help foster collaborative research projects.

b) Members of NCERA 137 and 208 participated in the planning of the 2015 joint meeting in Washington, D.C. (and possibly the virology committee will also join). This meeting will allow the exchange of information across university scientists, industry personnel, and producers, which will ultimately help improve management of diseases. Furthermore, scientists may get to interact with U.S. politicians and officials to better understand what reports, white papers, etc. can be created to better inform those on Capitol Hill about soybean diseases, the research being conducted, and the funding that is needed to continue such research.

c) Members of the NCERA 137 discussed initiating a summary and analysis of soybean seedling disease data.

d) Discussion at the 2014 NCERA 137 meeting may lead to the planning of additional soybean disease meetings.

**Objective 2. Evaluate 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.**

Accomplishments for objective 2

a) Members of the NCERA 137 are working collaboratively to evaluate the effectiveness of seed treatments and foliar fungicide applications against soybean pathogens. Kiersten Wise presented a fungicide seed treatment efficacy table for soybean.

b) Members of NCERA 137 are working on a more 'farmer-friendly' version of a soybean disease compendium that will have soybean disease symptoms and list management options.

c) Les Domier summarized research on the virus survey updates and initiated discussion on virus prevalence in soybean across other states represented at the meeting.

**Objective 3. Develop research projects to study the ecology and epidemiology of soybean diseases important in the north central region.**

Accomplishments for objective 3

a) NCERA 212 members are working collaboratively on on-going multi-state research projects focused on sudden death syndrome, soybean cyst nematode, soybean rust, frog-eye leaf spot, and charcoal rot.

b) Damon Smith summarized research on Soybean Vein Necrosis Virus (SVNV) and initiated a multi-state collaborative to investigate SVNV effect on yield in 2014.

c) John Rupe, Ahmad Fakhoury, and Martin Chilvers presented updates on multi-state research/extension projects focused on soybean seedling diseases.

d) Research projects and data on the following soybean disease topics were given by those listed: Sudden Death Syndrome (SDS) – AFRI project – Kiersten Wise, Carl Bradly, and Leonor Leandro; NCSRP SDS project and Bayer L2026 seed treatment – Daren Mueller; Fungicide efficacy tables (seed and foliar) – Kiersten Wise and Heather Kelly; QoI resistance updates in Frogeye leaf spot pathogen – Carl Bradley, Heather Kelly, and Tom Allen; Charcoal rot research update – Alemu Mengistu, John Rupe, Damon Smith, Terri Hughes; Soybean rust in Alabama – Ed Sikora; iPIPE update – Scott Isard.

**Objective 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 and other new technologies as they are developed.**

Accomplishments for objective 4

a) Members of the NCERA 137 were involved in creating extension publications on SVNV and Charcoal rot of soybean.

b) Members of NCERA 137 participated in developing new webcasts for the Focus on Soybean section of the Plant Management Network ([www.plantmanagementnetwork.com](http://www.plantmanagementnetwork.com)).

c) Members of NCERA 137 are working on a more 'farmer-friendly' version of a soybean disease compendium that will have soybean disease symptoms and list management options.

**Objective 5. Continue to monitor for any new or reemerging pathogens of soybean in the north central region and develop appropriate responses to their emergence as they occur.**

Accomplishments for objective 5

a) Members of NCERA 137 worked together to evaluate the soybean rust pest information platform for extension and education (PIPE) public websites impact on certified crop advisers.

b) Regional surveys of the presence and distribution of important diseases of soybean were concluded, and new surveys were started.

c) Monitoring for fungicide-resistant *C. sojae* and *C. kikuchii* isolates and other pathogens will be continued for the NCERA 137 group in 2014.

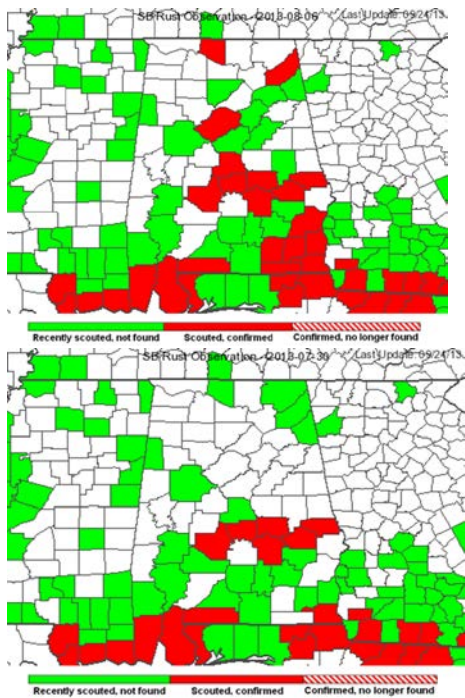
**State Reports:**

Alabama (Ed Sikora):

Alabama soybean producers harvested 420,000 acres of soybeans in 2013 with an average yield of 43 bushels per acre. Due to wet field conditions early in the season a significant number of acres were planted later than normal. By mid-June only 62% of the soybean acreage was planted compared to an 80% average over the previous five year period. Fields were still being planted in mid-August putting them at risk to exposure to soybean rust (SBR) at an early stage of development.

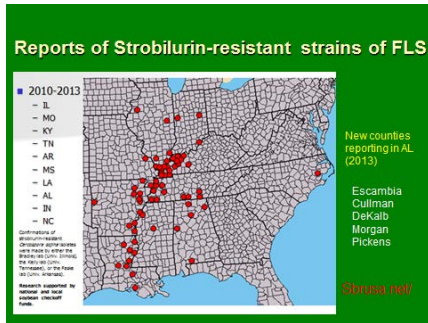
Losses in commercial fields from SBR were observed in North Alabama for the first time. Damage from the disease in previous years was usually restricted to south Alabama. Yield losses up to 40% were estimated in some unprotected or poorly protected fields in 2013. We suspect yield losses from SBR would have been greater if not for a late season drought from mid-August through the end of September.

SBR survived the winter on kudzu in multiple locations, and relatively cool conditions in the spring and early summer period allowed the pathogen to spread rapidly through the state. SBR appeared to move about 3-4 weeks faster in 2013 compared to 2012 based on observations from soybean sentinel plots and commercial fields. Eventually the disease was found in all 67 counties in Alabama for the second consecutive year.



Fungicide applied in a timely manner provided good activity against the disease. Results from small plot work and large-scale strip tests showed fungicides increased yields from 24-50% depending on the products used, time of application, weather conditions, plot location and overall size of test.

Frog-eye leaf spot (FLS) was relatively common in 2013, especially in North Alabama. Results from Dr. Carl Bradley's lab at the University of Illinois confirmed the presence of strobilurin-resistant populations of *Cercospora sojina* in four new counties in the state bringing the total number of counties reporting strobilurin-resistant strains of FLS to five. An interesting find was that one of the fields where a resistant strain was detected was in Escambia County in the southwest region of the state.



*Soybean vein necrosis virus* (SVNV) was first found in Alabama in 2012. In response a survey was conducted in 2013 to determine the distribution of SVNV in the state. Field sampling was conducted in 15 locations across 10 counties with 50 leaves collected from each site and tested using ELISA for SVNV, *soybean mosaic virus* (SMV) and *bean pod mottle virus* (BPMV). SVNV was detected in 14 new counties with the majority found in North Alabama where the survey was focused. Incidence of SVNV within a field ranged from 0-56% of leaf samples tested. Incidence of SMV and BPMV did not occur at incidence levels above of 4% in any field surveyed.



SVNV in Alabama (2013)

Delaware (Nathan Kleczewski):

In 2013, soybean was planted in approximately 165,000 acres of Delaware cropland, ranking 27<sup>th</sup> in the United States. Of this, approximately 155,000 acres were harvested. The average yield was 40 bu/A, which was reduced from 2012, when average yields were 42.5 bu/A.

The impact of soybean diseases on productivity was minimal in 2013. A wet spring resulted in delayed planting of many full season and double-crop soybean fields. Wet conditions favored seedling diseases in some fields, including Pythium and Fusarium seedling blights. Foliar diseases including Septoria brown spot, downy mildew, and Alternaria leaf spot were present throughout the state at low levels. Frogeye leaf spot was present at greater levels than normal throughout the growing season and fungicidal control was required in some instances. Other diseases detected at low levels included Sclerotinia stem rot and sudden death syndrome (SDS). Soybean cyst nematode and root knot nematode were prevalent in Sussex and Kent counties, resulting in significant damage to some fields. Soybean vein necrosis virus (SVNV) was present throughout the state at low levels and associated with reduced yields in three fields. SVNV was detected on mottled pods in all three of these fields, as well as foliage (based on Agdia tests). Dr. Kleczewski participated in monitoring for soybean diseases, including soybean rust, and distributed disease observations through the Weekly Crop Update and Field Crops Disease Management Blog.

#### **Extension Publications:**

Kleczewski, N.M. 2013. The Utility of Seed Treatments in Delaware Soybean Production. Weekly Crop Update. May 30, 2013.

Kleczewski, N.M. 2013. Current Diseases in Full Season Soybeans. Weekly Crop Update. July 18, 2013.

Kleczewski, N.M. 2013. Soybean Vein Necrosis Virus. Weekly Crop Update. August 8, 2013.

Kleczewski, N.M. 2013. Sudden Death Syndrome, Frogeye Leaf Spot, and Soybean Rust. Weekly Crop Update. August 19, 2013.

Kleczewski, N.M. 2013. Scouting Tips for Soybean Rust. Weekly Crop Update. September 10, 2013.

Kleczewski, N.M. 2013. Sclerotinia stem rot of Soybean September 18, 2013.

#### **Florida** (Nicholas S. Dufault)

Florida soybean producers harvested 23,000 acres of soybeans with an average yield of about 45 to 50 bushels/acre. Yield from 2011 and 2012 averaged around 35 to 40 bushels/acre.

Soybean diseases were present during the 2013 growing season. These diseases included, but are not limited to, soybean rust (SBR), downy mildew, frogeye leaf spot, and root rots (e.g. Fusarium & Pythium). Environmental conditions, especially early in the season, were conducive for disease development, however, no major disease outbreaks were recorded.

Many growers in Florida use a preventative spray program for diseases that typically consists of two sprays in the late vegetative stages and early reproductive stages. This spray program has

primarily consisted of tebuconazole, but can include pyraclostrobin and azoxystrobin fungicides. In general, these two sprays have provided adequate disease control for Florida growers and no fungicide failures were reported in 2013.

Overall, disease presence in Florida remained consistent with previous seasons. Some growers expressed more of an interest in disease control, but this was related to changes in the climate and not disease. Diseases continue to be present in Florida's soybean production fields, but their impact has been mitigated by the use of protective fungicide spray programs.

Illinois (Glen Hartman and Carl Bradley):

### **2013 Soybean production in Illinois:**

A total of nearly 9.5 million acres of soybean were planted in the state. The overall average state yield was 49 bu/A, which was a near all-time record high. Illinois ranked as no. 1 for overall soybean production for the U.S. in 2013 with over 461 million bushels.

### **Soybean research projects in the Bradley lab:**

#### **Pathogen Biology**

- Participated in the Oomycete CAP project, to characterize oomycete pathogens from Illinois soybean fields
- Participated in the NCSRP/USB funded soilborne fungi project, to characterize soilborne fungal pathogens that affect soybean seedlings in Illinois
- Evaluated the sensitivity of *Rhizoctonia solani* isolates from soybean to commonly-used fungicide seed treatment active ingredients and determined anastomosis groups of *R. solani* isolates from Illinois
- Tracked the occurrence of QoI fungicide-resistant *C. sojae* isolates in the U.S., and identified the G143A mutation in *C. sojae* isolates as being responsible for QoI resistance
- Initiated a project to monitor for QoI fungicide resistance in *Septoria glycines*

#### **Disease Management**

- Conducted foliar fungicide + insecticide trials at multiple locations in Illinois
- Conducted fungicide seed treatment trials to evaluate their effectiveness in managing *Rhizoctonia* root rot and seedling blight
- Conducted seed-applied nematicides trials to evaluate their effectiveness in managing soybean cyst nematode
- Participated in the NCSRP funded sudden death syndrome (SDS) management project, which identified an experimental seed treatment as having good efficacy in managing SDS

#### **Disease Losses**

- Conducted a survey of university soybean pathologists to determine the amount of soybean yield that is lost due to diseases in the U.S.



## **Soybean research projects in the Hartman lab:**

### **Pathogen/Pest Biology**

- Reported on *Phakopsora pachyrhizi* adapting to soybean genotypes with *Rpp1* or *Rpp6* rust resistance genes
- Reported on *Colletotrichum chlorophyti* infecting soybean seed

### **Epidemiology of Diseases**

- Estimated soybean genetic gain for yield in the northern United States by comparing cropping history and soilborne diseases
- Reported on the effect of fungicide application and cultivar on soybean green stem disorder

### **Soybean Resistance**

- Reported on a program to evaluate commercial soybean cultivars for pathogen and pest resistance
- Registered eight soybean germplasm lines resistant to soybean rust
- Identified single nucleotide polymorphisms in *Glycine latifolia* using a heterologous reference genome sequences
- Reported on the inheritance of soybean aphid resistance in 21 soybean plant introductions
- Showed that glyceollin is an important component of soybean plant defense against *Phytophthora sojae* and *Macrophomina phaseolina*
- Reported on the *Fusarium virguliforme* phytotoxin on soybean gene expression
- Reviewed the genetic mechanisms of host-pathogen interactions for charcoal rot in soybean

### **Peer- Reviewed Publications for 2013**

Chang, S., Hartman, G. L., Singh, R. J., Lambert, K. N., Hobbs, H. A., and Domier, L. L. 2013. Identification of high quality single nucleotide polymorphisms in *Glycine latifolia* using a heterologous reference genome sequence. Theoretical and Applied Genetics DOI 10.1007/s00122-013-2079-8.

Chawla, S., Bowen, C. R., Slaminko, T. L., Hobbs, H. A., and Hartman, G. L. 2013. A public program to evaluate commercial soybean cultivars for pathogen and pest resistance. Plant Disease 97:568-578.

Diers, B. W., Kim, K. S., Frederick, R. D., Hartman, G. L., Unfried, J. R., Schultz, S. J., and Cary, T. R. 2013. Registration of eight soybean germplasm lines resistant to soybean rust. Journal of Plant Registrations 8:96-101.

Fox, C., Cary, T., Colgrove, A., Nafziger, E., Haudenschild, J. S., Hartman, G. L., Specht, J., and Diers, B. W. 2013. Estimating soybean genetic gain for yield in the northern United States - influence of cropping history. Crop Science 53:2473-2482.

Fox, C., Kim, K. S., Cregan, P. B., Hill, C. B., Hartman, G. L., and Diers, B. W. 2013. Inheritance of soybean aphid resistance in 21 soybean plant introductions. Theoretical and Applied Genetics (in press).

Hill, C. B., Bowen, C. R., and Hartman, G. L. 2013. Effect of fungicide application and cultivar on soybean green stem disorder. Plant Disease 97:1212-1220.

Lygin, A., Zernova, O., Hill, C. B., Kholina, N., Widholm, J. M., Hartman, G. L., and Lozovaya, V. 2013. Glyceollin is an important component of soybean plant defense against *Phytophthora sojae* and *Macrophomina phaseolina*. *Phytopathology* 103:984-994.

Paul, C., Hartman, G. L., Marios, J. J., Wright, D. L., and Walker, D. R. 2013. First report of *Phakopsora pachyrhizi* adapting to soybean genotypes with *Rpp1* or *Rpp6* rust resistance genes in field plots in the United States. *Plant Disease* 97:1379.

Radwan, O., Li, M., Calla, B., Li, S., Hartman, G. L., and Clough, S. J. 2013. Effect of *Fusarium virguliforme* phytotoxin on soybean gene expression suggests a role in multidimensional defence. *Molecular Plant Pathology* 14:293-307.

Radwan, O., Rouhana, Hartman, G., and Korban, S. S. 2013. Genetic mechanisms of host-pathogen interactions for charcoal rot in soybean. *Plant Molecular Biology Reporter* DOI 10.1007/s11105-013-0686-9.

Yang, H.-C., Stewart, J. M., and Hartman, G. L. 2013. First Report of *Colletotrichum chlorophyti* Infecting Soybean Seed in Arkansas, United States. *Plant Disease* 97:1510.

#### Indiana (Kiersten Wise):

Purdue personnel involved with soybean disease activities: Kiersten Wise, Teresa Hughes (formerly of USDA/Purdue), Virginia Ferris, Jamal Faghihi, Gail Ruhl, and Tom Creswell

In 2013, approximately 5.1 million acres of Indiana cropland was in soybean production. The average yield was 50 bu/A, which increased from 2012, when average yields were 44 bu/A. The impact of foliar and soil-borne diseases of soybean was moderate in 2013. Cool, wet conditions in the early spring resulted in seedling disease problems across most of the state. Foliar diseases such as brown spot, frogeye leaf spot, and downy mildew were present, but at low levels throughout the state. Sudden death syndrome (SDS), brown stem rot, and charcoal rot were statewide, and may have limited yield in some fields. Soybean vein necrosis virus (SVNV) was present, and was widespread across the state. Questions remain as to if this disease limited yield in 2013. QoI fungicide-resistant strains of *Cercospora sojina* were confirmed in 3 counties in Indiana in 2013. Personnel participated in monitoring for soybean diseases, including soybean rust, and distributed disease observations through the Purdue Pest and Crop Newsletter.

#### **Soybean research:**

Projects continued in 2013 to address the following areas:

Understand the relationship between soybean cyst nematode and sudden death syndrome, and determine management practices to reduce impact of each pest in soybeans.

Fungicide timing and efficacy for foliar diseases of soybean.

Determine environmental and production factors that influence charcoal rot development in soybean.

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

Indiana participated in multi-state soybean seedling sampling projects to determine the prevalence and distribution of soil-borne fungi and fungal-like organisms associated with seedling blight.

#### **Books:**

Mueller, D.S., Wise, K.A., Dufault, N.S., Bradley, C.A., Chilvers, M.I., eds. 2013. *Fungicides for Field Crops*. American Phytopathological Society Press, Minneapolis, MN.

#### **Extension Publications:**

Wise, K. 2013. Foliar disease update for soybean. Purdue Pest and Crop Newsletter. Issue 19.

Wise, K. 2013. Sudden death syndrome and brown stem rot in soybean. Purdue Pest and Crop Newsletter. Issue 19.

Wise, K. 2013. Are late-planted soybeans at risk for soybean rust? Purdue Pest and Crop Newsletter. Issue 23.

Wise, K. 2013. New resources available to help manage white mold of soybean. Purdue Pest and Crop Newsletter. Issue 14.

Wise, K. 2013. Soybean Vein Necrosis Virus in Indiana. Purdue Pest and Crop Newsletter. Issue 17.

Wise, K. 2013. Fungicide Efficacy for Control of Soybean Diseases. BP-162-W

#### Iowa (Daren Mueller):

Personnel involved: Leonor Leandro, Daren Mueller, Alison Robertson, Greg Tylka, X.B. Yang

#### **DISEASE PREVALENCE**

The major soybean problem in 2014 was soybean cyst nematode and soybean viruses such as soybean vein necrosis virus and tobacco streak virus. Other diseases such as stem canker, charcoal rot, SDS and white mold were also present at lower levels.

#### **PUBLICATIONS**

##### Books and Refereed Publications

1. Diaz-Arias, M. M., Munkvold, G. and Leandro, L. F. S. 2013. Distribution and frequency of isolation of *Fusarium* species associated with soybean roots in Iowa. *Plant Disease* 97(12):1557-1562. <http://dx.doi.org/10.1094/PDIS-11-12-1059-RE>.
2. Diaz-Arias, M. M., Leandro, L. F. S. and Munkvold, G. 2013. Aggressiveness of *Fusarium* species and impact of root infection on growth and yield of soybean. *Phytopathology* 103(8):822-832. DOI: 10.1094/PHYTO-08-12-0207-R

3. Ellis, M. L., Diaz-Arias, M. M., Cruz, D. R., Munkvold, G. and Leandro, L. F. S. 2013. First report of *Fusarium commune* causing damping-off, seed rot, and seedling root rot on soybean (*Glycine max*) in the United States. *Plant Disease* 97(2):284-285.
4. Leandro, L. F. S., Robertson, A. E., Mueller, D. S., and Yang, X.B. 2013. Climatic and environmental trends observed during epidemic and non-epidemic years of soybean sudden death syndrome in Iowa. *Plant Health Progress*, May Issue, Pages: PHP-2013-0529-01-RS
5. Luckew, A. S., Leandro, L. F. S., Bhattacharyya, M.K., Nordman, D. J., Lightfoot, D. A. and Cianzio, S. R. 2013. Usefulness of 10 genomic regions in soybean associated with sudden death syndrome resistance. *Theoretical and Applied Genetics* 126(9): 2391-403. DOI:10.1007/s00122-013-2143-4.
6. Kyveryga, P., Blackmer, T. M., and Mueller, D. S. 2013. When do foliar pyraclostrobin fungicide applications produce profitable soybean yield responses? Online. *Plant Health Progress* doi:10.1094/PHP-2013-09XX-01-RS.
7. Mueller, D.S., Wise, K.A., Dufault, N.S., Bradley, C.A., Chilvers, M.I. 2013. *Fungicides for Field Crops*. The American Phytopathological Society Press, St. Paul, MN.
8. Pudake, R.N., Swaminathan, S., Sahu, B.B., Leandro, L.F., and Bhattacharyya, M.K. 2013. Investigation of the *Fusarium virguliforme* fvto1 mutants revealed that the FvTo1 toxin is involved in foliar sudden death syndrome development in soybean. *Current Science* 59(3):107-117. DOI: 10.1007/s00294-013-0392-z
9. Smith, D.L., Watson, Q., Willis, D.K., German, T.L., Phibbs, A., Mueller, D.S., Dittman, J.D., Saalau-Rojas, E., Whitham, S.A. 2013. First Report of Soybean Vein Necrosis Disease Caused by *Soybean vein necrosis-associated virus* in Wisconsin and Iowa. *Plant Disease* 97:693

### Abstracts

1. Abdelsamad, N. and L. F. Leandro. 2013. Flooding duration affects severity of soybean sudden death syndrome. *Phytopathology* 103:S2.2
2. Abeysekara, N. and Robertson, A.E. 2013. Analysis of genetic changes underlying pathotype shift in *Phytophthora sojae* isolates recovered from a soybean cultivar rotation study. *Phytopathology* 103(Suppl. 3):S3.1
3. Cruz, D., Ellis, M. L., Leandro, L. F. and G. P. Munkvold. 2013. Characterization of the interaction between soybean cultivars and isolates of *Fusarium oxysporum* causing seedling disease. *Phytopathology* 103:S2.31
4. Ellis, M. L., Leandro, L. F. and G. P. Munkvold. 2013. PCR-RFLP fingerprinting of the intergenic spacer region to determine the lineage of fungi in the *Fusarium oxysporum* complex isolated from soybean. *Phytopathology* 103:S2.40
5. Ellis, M. L., Cruz Jimenez, D. R., Linn, B. F., Leandro, L. F. and G. P. Munkvold. 2013. Genotypic and phenotypic characterization of isolates in the *Fusarium oxysporum* species complex from soybean roots. *Phytopathology* 103:S2.39
6. Han, G., Leandro, L. F., Helmers M. and D. Mueller. 2013. Effect of different drainage systems on soybean root rot. *Phytopathology* 103:S2.56

7. Radwan, O. Leandro, L. F. and S. Covert. 2013. Genome expression of soybean roots and leaves in response to *Fusarium virguliforme* toxins. *Phytopathology* 103:S2.117
8. Tatalovic, N., Tylka, G. L. and L. F. Leandro. 2013. Effect of watering regime and *Fusarium virguliforme* (Fv) infection on location of soybean cyst nematode (SCN) syncytia in soybean roots. *Phytopathology* 103:S2.143
9. Clifton, E.H., E.W. Hodgson, G.L. Tylka, and A.J. Gassmann. 2013. Determining pest and pesticide interactions as a means to optimize soybean yield. Proceedings of the Entomological Society of America's 61st Annual Meeting, November 10-13, 2013, Austin, Texas.
10. Matthiesen, R. and Robertson, A.E. 2013. Pathogenicity of *Pythium* species affecting corn and soybean in Iowa at three temperatures using two assay methods. *Phytopathology* 103(Suppl.)S2. 92.
11. Matthiesen, R. and Robertson, A.E. 2013. Fungicide sensitivity of *Pythium* species affecting corn and soybean in Iowa at three temperatures. *Phytopathology* 103(Suppl. 3):S3.6
12. Matthiesen, R. and Robertson, A.E. 2013. Efficacy of metalaxyl and ethaboxam on reducing corn seedling blight in naturally infested soil at two temperatures. *Phytopathology* 103(Suppl. 3):S3.5
13. McCarville, M., D. Soh, G.L. Tylka, G.C. MacIntosh, E.W. Hodgson<sup>1</sup> and M.E. O'Neal. 2013. Soybean aphid feeding affects soybean cyst nematode reproduction. Proceedings of the 2013 North Central Branch, Entomological Society Annual Meeting.
14. McCarville, M., D. Soh, G.L. Tylka, G.C. MacIntosh, E.W. Hodgson<sup>1</sup> and M.E. O'Neal. 2013. Soybean aphid feeding increases soybean cyst nematode reproduction. Proceedings of the Entomological Society of America's 61<sup>st</sup> Annual Meeting, November 10-13, 2013, Austin, Texas.
15. Olson, L.K., G.L. Tylka, J. Jordhal, S. Meyer, J. Goltz, J. Kringler, T. Helms, and S. Markell. 2013. Increasing awareness of soybean cyst nematode in North Dakota. *Phytopathology* 103(S4):107-108.
16. Robertson, A., Chilvers, M., Bestor, N. 2014. Scouting for *Pythium* root rot in soybean. CSI 0024. Iowa State University Extension and Outreach.
17. Rojas, A., Jacobs, J.I., Napieralski, S., Bradley, C.A., Chase, T., Esker, P.D., Giesler, L. Jardine, D., Nelson, B.D., Malvick, D., Markell, S., Robertson, A.E., Rupe, J.C., Sweets, L., Wise, K. and Chilvers, M. Diversity of oomycetes associated with soybean seedling diseases in the U.S. *Phytopathology* 103(Suppl.)S2.123.
18. Tatalovic, N., G.L. Tylka, and L.F. Leandro. 2013. Effect of watering regime and *Fusarium virguliforme* (Fv) infection on location of soybean cyst nematode (SCN) syncytia in soybean roots. *Phytopathology* 103(S4):143.
19. Tylka, G.L. 2013. Nematode-protectant seed treatments: New options for nematode management in row crops. *Phytopathology* 103(S4):9.
20. Tylka, G.L., M.T. McCarville, C.C. Marett, G.D. Gebhart, D.H. Soh, M.P. Mullaney, and M.E. O'Neal. 2013. Direct comparison of soybean cyst nematode reproduction on resistant soybean varieties in greenhouse and field experiments. *Journal of Nematology* 45: 279-330.

21. Wise, K.A., Mueller, D.S., Bestor, N., Giesler, L., Bradley, C.A. 2013. Analysis of yield benefits from foliar fungicide and insecticide applications in soybean. World Soybean Research Conference: Plant Protection: Plant Pathology/Disease Control. Durban, South Africa

#### Extension publications

1. Mueller, D. and Sisson, A. et al. 2013. Corn Field Guide 2nd Ed. Iowa State University Extension: CSI 001.
2. Tylka, G.L. and M. P. Mullaney. 2013. Soybean cyst nematode-resistant soybeans for Iowa. Iowa State University Extension Publication PM 1649, 22pp.
3. Tylka, G.L., G.D. Gebhart, C.C. Marett, and M.P. Mullaney. 2013. Evaluation of soybean varieties resistant to soybean cyst nematode in Iowa - 2012. Iowa State University Extension, publication IPM 52, 32 pp.

#### Integrated Crop Management News articles

1. Hodgson, E. and Sisson, A. 2013. Bean leaf beetle survival just above average. Iowa State University Integrated Crop Management (ICM) News, May 2, 2013
2. Mueller, D. and Wiggs, S. Evaluation of fungicides and insecticides on soybean in 2012, Iowa State University Integrated Crop Management (ICM) News, January 14, 2013
3. Mueller, D. and Leandro, L. Sudden Death Syndrome and Heavy Spring Rains: Another Bad Year?, Iowa State University Integrated Crop Management (ICM) News, June 4, 2013
4. Mueller, D. and Sisson, A. Hail and fungicides update 2013, Iowa State University Integrated Crop Management (ICM) News, July 17, 2013
5. Mueller, D. and Sisson, A. Soybean vein necrosis virus identified in Iowa, Iowa State University Integrated Crop Management (ICM) News, July 18, 2013
6. Mueller, D. Soybean diseases starting to wake up, Iowa State University Integrated Crop Management (ICM) News, August 21, 2013
7. Mueller, D. and McGrath, C. Be on the lookout for green stem syndrome in soybeans. Iowa State University Integrated Crop Management (ICM) News, September 27, 2013
8. Mueller, D. and Saalau, E. Tobacco streak virus on soybean confirmed in Iowa. Iowa State University Integrated Crop Management (ICM) News, September 27, 2013
9. Robertson, A. and Mueller, D. Sign up now for Late Season Disease Workshop, Iowa State University Integrated Crop Management (ICM) News, August 14, 2013
10. Robertson, A., Mueller, D. and Saalau, E. Stalk breakage and rot caused by Physoderma in Iowa. Iowa State University Integrated Crop Management (ICM) News, September 20, 2013
11. Tylka, G. 2013. Increased early SCN activity may be problematic for soybean producers. Iowa State University Integrated Crop Management News (5 June 2013).
12. Tylka, G. 2013. Sample fields for soybean cyst nematode. Iowa State University Integrated Crop Management News (25 October 2013).
13. Tylka, G. 2013. Hundreds of SCN-resistant soybean varieties available for 2014. Iowa State University Integrated Crop Management News (31 October 2013).
14. Tylka, G. 2013. Get the latest information on performance of SCN-resistant soybeans. Iowa State University Integrated Crop Management News (18 December 2013).

## Research Reports

1. Mueller, D. and Wiggs, S. 2013. Evaluation of foliar fungicides and insecticides on soybeans. Iowa State University, Multiple Research Farms. 2012 report.
2. Robertson, A., Hodgson, E., Mueller, D., and Wiggs, S. 2013. Evaluation of fungicide and insecticide seed treatments on soybean in 2012. Iowa State University, Southeast Research Farm. 2012 report.
3. Tylka, G.L., M. Batista da Silva, R. Rusk, J. DeJong, and J. Sievers. 2013. Effects of seed treatments and a soil-applied nematicide on corn yields and nematode population densities. 2012 Annual Report of the Iowa State University Northwest Iowa Research and Demonstration Farm, pp. 26-28.
4. Tylka, G.L., M. Batista da Silva, and K. Pecinovsky. 2013. Effects of seed treatments and a soil-applied nematicide on corn yields and nematode population densities. 2012 Annual Report of the Iowa State University Northeast Iowa Research and Demonstration Farm, pp. 52-54.

## Presentations

1. 80 extension presentations to 6,000 people
2. 32 radio and print media interviews

## Other impacts or activities

- We distributed 9,734 soybean pest related publications through Iowa State University in 2013; 5,538 of these dealt with soybean diseases.
- We distributed 57,100 soybean pest related publications directly to agribusiness in 2013; 26,576 of these dealt with soybean diseases.
- Three of our learning presentations with content related to soybean diseases were downloaded 1,021 times in 2013.
- Our soybean disease-related publications were viewed more than 83,000 times at Iowa Soybean Association's online research library in 2012. 2013 numbers not available but assumed to be similar.
- We worked with an agricultural scouting app developer, ScoutPro, to update their soybean disease content to include information on four additional pathogens.
- Coordination of multi-state printing and distribution of the new Scouting for Pythium Root in Soybean publication.
- Conducted the Soybean Disease Diagnostics and Management Clinic, ISU Extension
- Annual crop scouting competition, approximately 36 attendees. Began planning expansion of crop scouting competition to additional Midwest states; shared resources with colleagues in those states who will be coordinating competitions.

## **RESEARCH PROJECTS**

### Fusarium root rot

USB – seedling disease project, P.I. Jason Bond

Research focuses on characterizing phenotypic and genotypic variation in *Fusarium oxysporum* isolated from soybean roots

### SDS

Funding:

USDA – AFRI, transgenic approaches for SDS, P.I. Madan Bhattacharyya  
NCSRP, IPM and Communications for SDS, P.I. Daren Mueller  
Iowa Soybean Association - Various P.I. Leonor Leandro, Daren Mueller

Research focuses on the biology and management of soybean sudden death syndrome. Projects include: integrated management for SDS; effects of cover crops and tillage on SDS, development of high-throughput DNA-based gene silencing technology for soybean; identification of *Fusarium virguliforme* pathogenicity factors, development of transgenic approaches for SDS, and the role of ethylene on SDS. We also studied the effect of glyphosate and other herbicides on sudden death syndrome and yield.

### Oomycete pathogens of soybean

Funding:

USDA-NIFA OSCAP (Oomycetes of Soybean) P.I. Brett Tyler  
USB Soybean Seedling Disease P.I. Jason Bond and John Rupe

We developed a simple survey tool to collect data on attendees understanding of soybean seedling diseases, methods farmers may have incorporated into their production practices to manage yield losses, and the perceived benefit the practices have had on their production in terms of bu/Acre. The tool will be used by the EN throughout 2014 at various Extension meetings pertaining to seedling disease. At the time of this report, data had been collected from Iowa and South Dakota. Ninety six and 87% respondents in IA and SD, respectively, had changed of production practices based on what they had learned about seedling diseases at Extension meetings. Ninety-four percent and 49% now use seed treatments, 53% and 33% plant resistant varieties and 15% and 4% adjusted planting date, in IA and SD respectively. As a result of these management practices, in IA, 41% and 41% of respondents estimated an average increase in yield of 1-2 and 3-5 bu/acre, respectively. In SD, data were very similar with 40 and 39% of respondents estimating an average yield increase of 1-2 and 3-5 bu/acre, respectively.

### Phytophthora root rot

Funding:

Iowa Soybean Association (multiple)  
United Soybean Board (multiple)

Research is focused on RPS genes and quantitative trait loci for resistant to Phytophthora root rot in soybean. We are also looking at how seed treatments can be used in an IPM system for this disease.

### Other projects



- USB Project to complement the Corn Systems CAP project – two graduate students looking at different aspects of soybean diseases within this larger project.
- Charcoal rot – completed one of the locations for the USB/NCSRP charcoal rot epidemiology and cultivar screen studies.
- White mold – evaluated foliar fungicides
- Statewide foliar fungicide study
- Started studying soybean vein necrosis virus and green stem disorder
- Effects of fungicide after hail injury

Kansas (Doug Jardine):

**Kansas Personnel:** Doug Jardine (Soybean Pathology - Extension), Chris Little (Soybean Pathology - Research), Tim Todd (Nematology), Harold Trick (Plant Biotechnology), Bill Schapaugh (Soybean Breeding)

**Production Summary:** Kansas soybean producers harvested 3.54 million acres of soybeans in 2013 with an average yield of 36 bushels per acre. This was a decrease of 210,000 acres from 2012. The 2013 yield was up 9 bushels compared to 2012, but well below the record yield of 44 bushels per acre set in 2009. Following a wet start to the growing season, most of the state suffered from high heat and dry conditions through June and July. The first half of August was cooler and wetter than normal, but high heat returned late in the month with many days above 100° F. The cooler, wetter first half of August was responsible for the most significant outbreak of sudden death syndrome (SDS) ever recorded in Kansas. On a statewide basis, losses were estimated at 0.5%, however, in the Missouri, Kansas, Republican and Arkansas River Valleys where the disease is endemic, losses in some fields were in the 25 – 50% range. The high heat of late August and early September combined with minimal rainfall, resulted in significant charcoal rot development, especially in southeastern Kansas. Estimated statewide losses from charcoal rot were 4%. In addition to SDS and charcoal rot, seedling blights were responsible for an additional 5% yield loss. The total yield lost estimate for soybean diseases in 2013 was 11.3%, which was down nearly 8% from 2012 and very close to the 10 year average of 11.1%. SCN caused an estimated 1.5% yield loss. No other diseases had estimates above 0.1%.

---

## Kansas Research Update

### I. Charcoal rot:

USB Collaborative Charcoal Rot Project: *Charcoal Rot Cultivar Evaluation Using Adapted and Exotic Sources of Resistance:*

(1) To assess the impact of planting date, seeding rate and soil population densities of SCN and *M. phaseolina* on charcoal rot severity, a field study was conducted in Rossville, Kansas during the 2013 growing season. SCN samples were collected from each plot and are being processed for total egg counts ( $\text{g}^{-1}$  soil) at harvest. In addition, total *M. phaseolina* soil and root/stem CFUs and charcoal rot severity data were obtained at harvest. Once all data is available, SCN

population densities will be related to *M. phaseolina* population densities, root/stem CFUs, and disease severity.

(2) To identify variability in pathogenic ability in the charcoal rot pathogen (*M. phaseolina*) population and determine if this variability will affect screening procedures, a total of ~300 isolates from several hosts from Kansas (and a few other locations) have been tested using 'Pharoah' soybean to assess their relative pathogenicity in a "detached leaf assay" test. Initial results indicated that corn ( $n = 174$ ) and sunflower ( $n = 15$ ) isolates exhibited significantly greater zones of chlorosis than did the soybean ( $n = 285$ ) or sorghum ( $n = 273$ ) isolates. Isolates from sunflower exhibited greater water-soaking than did isolates from soybean, sorghum, or corn. In addition, we observed wide variability in lesion formation between *M. phaseolina* isolates on detached soybean leaves, which suggests wide variability in general pathogenicity.

## **II. Seedling diseases and soybean seedborne fungi:**

### USB/NCSRP Collaborative Seedling Diseases Project: *Identification and Biology of Seedling Pathogens of Soybean:*

(1) For the regional study, a collection of soybean seedlings from Kansas was completed. Five sites (Manhattan, Topeka, Rossville, Scandia, and Columbus, Kansas) were sampled in May and June 2013. Fungal genera from the 2013 sampling have been isolated from soybean seedlings, stored as pure cultures, DNA has been extracted, and most identifications have been completed. As in 2012, isolates for 2013 have been obtained from diseased seedlings from each site (125 isolates total) and were sent to SIU for further processing. These (and additional) isolates were also identified at KSU using ITS and translation elongation 1-alpha factor PCR at the same time. During the identification process, isolates will be fed into the pathogenicity assays (see item (2) below). For both 2012 and 2013, *Fusarium* was the most frequently isolated fungus at 45 and 67%, respectively. However, it was clear that there were differences in the species composition, which could be due to different host genotypes and other macro- and micro-environmental factors that differed between years.

A correspondence analysis was conducted to examine the relationships between primary seedling disease characteristics (e.g. asymptomatic, chlorotic, seedlings with reddish-brown lesions, and stunted seedlings) and fungi isolated from the seedlings. The results of the combined 2012 and 2013 data show that certain fungi, such as *Phoma*, *Chaetomium*, *Trichoderma*, and *Rhizopus*, corresponded with asymptomatic seedlings, whereas *Fusarium oxysporum*, *F. proliferatum*, and *F. solani* corresponded to chlorotic and seedlings with reddish-brown lesions.

(2) In order to test the pathogenicity of *Fusarium* isolates, a seed imbibement assay has been developed for purposes of inoculation. A modified rolled towel technique is being used to compare pathogenicity of *Fusarium* spp., with emphasis upon *F. proliferatum* and *F. equiseti*. We have found that the rolled towel assay is the most useful and high-throughput for our lab. In addition, a greenhouse pathogenicity assay was developed to compare isolates using a

disease severity index in addition to the use of initial stand, final stand, and seedling weights. In general, it was shown that isolates of *F. fujikuroi*, *F. graminearum*, *F. oxysporum*, *F. subglutinans*, and *F. proliferatum* are pathogenic to soybean, whereas isolates of *F. semitectum* and *F. equiseti* are not.

(3) Isolates collected from Kansas soybean seed were tested against fludioxonil. Thirty-nine isolates were grown on fludioxonil (0.01, 0.1, 1.0, 10, 100 µg A.I./ml). Relative growth reduction percentage for each fungicide concentration was determined using the effective fungicide concentration that inhibited mycelial growth by 50%. We considered isolates resistant if their EC50 values were greater than 100 µg ml<sup>-1</sup>. As a result, several isolates of *F. fujikuroi*, *F. oxysporum*, and *F. proliferatum* were shown to be "resistant" to the fungicide. Currently, isolates are being tested for tolerance to azoxystrobin.

(4) Temperature is being modified using a growth chamber. So far, three temperature regimes have been tested (20, 25, and 30°C). In general, the initial results do not show significant differences due to temperature regimes in this test when isolates were grouped together by species. Although, when the data from the *F. fujikuroi* inoculations are analyzed alone with mock- and non-inoculated treatments, the 30°C temperature did result in a significant increase in disease severity index. This did not appear to be the case with the other species. However, when isolates were analyzed by temperature, there was an overall significant temperature impact where the 30°C treatment resulted in increased DSI compared to the 20°C treatment, which may be due to temperature stress on the seedlings. However, there was not a significant isolate\*temperature interaction.

The effect of pH is also being evaluated. At pH 3.5, there was a decrease in DSI values; however seedlings do not grow in a healthy manner at this pH. The difference between pH 6.5 and 7.5 was non-significant. In this test, there were no clear species or isolate differences when exposed to these pH levels. In contrast with temperature, however, there was a highly significant isolate\*pH interaction ( $P < 0.0001$ ). As expected, these results mirrored those of the analysis by species, in that pH 3.5 had the greatest effect upon DSI. But, some differences were observed among isolates. In particular, *F. proliferatum* showed a peak DSI in 3 of 4 isolates at pH 6.5 versus 3.5 and 7.5 (which were lower), whereas DSI generally increased as pH increased in isolates of *F. fujikuroi*, *F. graminearum*, *F. oxysporum*, and *F. subglutinans*.

In order to test water potentials, PDA media supplemented with NaCl and KCl are being used to germinate conidia and compare colony growth among isolates. So far, it is evident that *F. equiseti* is capable of growing at much lower water potentials, as tested in vitro, than other species. However, there is considerable isolate to isolate variation for this trait. The challenge is to modify water potential in an in vivo setting without damaging seedlings. This will be explored further in the coming year.

### III. SDS and SCN:

## Effect of host resistance to *Fusarium virguliforme* and *Heterodera glycines* on sudden death syndrome disease severity and soybean yield:

*Fusarium virguliforme*, the soilborne fungus that causes sudden death syndrome (SDS), and *Heterodera glycines*, the soybean cyst nematode (SCN), are economically important pathogens that often occur concomitantly in Kansas soybean fields. To examine *F. virguliforme* and *H. glycines* interactions across multiple environments, four soybean genotypes with different levels of resistance to SDS and SCN were planted at three to four locations in northeastern Kansas in 2008 and 2009. Pathogen population densities were quantified at planting (Pi), midseason (Pm), and harvest (Pf). At harvest, SDS AUDPC, *F. virguliforme* root population densities, *H. glycines* reproductive factors (RF), and yield were determined. The performance of resistant (R) genotypes varied with environment and disease pressure, but SDS-R genotypes were associated with 36% greater yields than SDS-susceptible (S) genotypes in high SDS environments. Even moderate levels of SCN resistance reduced SDS disease severity in SDS-S genotypes. Negative correlations ( $P \leq 0.05$ ) were observed between yield and AUDPC, and yield and *F. virguliforme* root population densities. A regression model that combined both of these covariates explained 57% of the yield variation. Disease severity was positively correlated with *H. glycines* Pi, but negatively correlated with RF. The data emphasize the importance of combining SDS and SCN host resistance in fields with a history of both diseases.

### **Seed Treatment Trials**

Seed treatment trials to evaluate fluopyram were established at Topeka and Parsons, KS. Phytotoxicity on emerging seedlings was observed at the 0.25 and 0.15 mg rate. At Topeka, a significant outbreak of SDS occurred. All rates of fluopyram had SDS DSI's that were significantly less ( $P \leq 0.05$ ) compared to the untreated check. Regression analysis indicated a significant negative interaction between DSI and yield ( $P = 0.007$ ,  $R^2 = 44.2\%$ ). A significant negative interaction between charcoal rot rating and DSI ( $P = 0.047$ ,  $R^2 = 27.1\%$ ) was found suggesting that infection by *F. virguliforme* may inhibit charcoal rot development. Yields for the 0.25 and 0.15 mg rates of fluopyram were not different from the untreated check suggesting that the early season phytotoxicity may have affected yield. Conditions at Parsons were ideal for the development of charcoal rot. No measureable differences in charcoal rot levels could be discerned among any of the treatments.

### **V. Publications:**

Brzostowski, L.F., Schapaugh, W.T., Rzodkiewicz, P.A., Todd, T.C., and Little, C.R. 2014. Effect of host resistance to *Fusarium virguliforme* and *Heterodera glycines* on sudden death syndrome disease severity and soybean yield. Plant Health Progress: Online (DOI: 10.1094/PHP-RS-13-0100).

### **VI. Presentations, Abstracts, etc:**

Rojas, A., Jacobs, J.L., Napieralski, S., Bradley, C.A., Chase, T., Esker, P.D., Giesler, L., Jardine, D., Nelson, B.D., Malvick, D., Markell, S., Robertson, A.E., Rupe, J.C., Sweets, L., Wise, K., and M.I. Chilvers. 2013. Diversity of oomycetes associated with soybean seedling diseases in the U.S. APS Annual Meeting, Austin, TX Abstract 191-O.

Little, C.R. An introduction to the biology and management of *Macrophomina phaseolina* in Kansas agroecosystems. (Wichita State University, Department of Biology, Wichita, Kansas; September 23, 2013)

Pedrozo, R., and Little, C.R. Identification and aggressiveness of *Fusarium* species from soybean seed in Kansas, USA. 30th International Seed Testing Association Congress, Antalya, Turkey; June 12-18, 2013

Little, C.R. Multi-environment soybean cultivar evaluations for charcoal rot resistance. Soybean Breeders Workshop, Kansas City, Missouri; February 12, 2013

Kentucky (Don Hershman and Aardra Kachroo):

### **2013 Soybean Production In Kentucky**

Soybean production for Kentucky during 2013 was estimated at a record 81.2 million bushels, an increase of 38 percent from 2012. Both acres for harvest and yield were up from the previous year. Yield was estimated at 49.5 bushels per acre, 9.5 bushels above a year ago and the highest yield on record, surpassing the 2009 crop at 48.0. Acreage for harvest as beans was estimated at 1.64 million acres, up 170,000 acres from the previous year.

High yields were the norm due to abundant moisture and relatively moderate temperatures during the growing season. However, in spite of relatively moist conditions, disease pressure was relatively light. One exception was that significant frogeye leaf spot developed in the region of Kentucky east of I-65. Overall, losses due to diseases in Kentucky during 2013 were estimated at 7.66%. Greatest losses were caused by soybean cyst nematode (3.0%), followed by Diaporthe/Phomopsis complex seed rot, pod and stem blight, and sudden death syndrome at 1% loss, respectively. The complete disease loss estimation is published in the 2014 Proceedings of the Southern Soybean Disease Workers Annual Meeting held at Pensacola Beach Florida on March 5-6, 2014.

### **Soybean Research in Kentucky:**

#### **Kachroo:**

Research involved the identification and characterization of molecular components of soybean defense signaling pathways that mediate resistance to bacterial blight and Phytophthora rot. In addition, a role for glycerol-3-phosphate in regulating soybean systemic immunity was demonstrated.

We identified two gene families that encode membrane-localized proteins, which directly bind multiple *Pseudomonas syringae* effector proteins and are essential for soybean resistance to both bacterial blight and Phytophthora rot. For example, the four members of the GmRIN4 family interact with each other as well as the AvrA, AvrB, AvrC, AvrD effectors. Importantly, the GmRIN4 isoforms differentially regulate resistance derived from the cognate R loci, Rpg2, Rpg1-b, Rpg3 and Rpg4, respectively. We also showed that the AvrB effector specifically induces the phosphorylation of the GmRIN4b isoform, and this promotes its dissociation from the Rpg1-b protein and the GmRIN4a isoform. Phosphorylation of GmRIN4b in turn activates Rpg1-b and the derived resistance signaling. Notably, GmRIN4a and GmRIN4b negatively regulate soybean basal defense to *P. sojae*. Consequently, soybean plants silenced for GmRIN4a or GmRIN4b exhibit enhanced resistance to *P. sojae*. Like the GmRIN4 isoforms, GmNDR1 (a and b) isoforms also regulate resistance to *P. syringae* and bind some of the encoded effectors. However, unlike GmRIN4, GmNDR1 proteins only regulate resistance derived from the Rpg2 locus. Notably, GmNDR1 proteins regulate the virulence activities of some *P. syringae* effectors and are positive regulators of soybean basal resistance to *P. sojae*.

#### **Hershman:**

1. Fungicide Efficacy Trials were carried out at the UK Research and Education Center.
2. Soybean cyst nematode and other diseases were studied as part of a poultry litter project (Edwin Ritchey, University of Kentucky, PI).
3. Studies (with Co-PI, Reza Hajimorad, University of Tennessee, Knoxville) looking into the potential for Soybean Vein Necrosis Virus to be seed transmitted and yield effects.
4. Participated in a regional survey monitoring *Cercospora sojina* isolates for resistance to strobilurin fungicides (Carl Bradley, University of Illinois, PI).
5. Soybean Rust Monitoring: Fifty-two hundred leaves representing 52 samples, from five counties were observed for SBR from early-June to Oct 5, 2013. SBR was detected in Caldwell County on Sept 26 (4% incidence, 1% severity), Muhlenberg County in doublecrop soybean on September 30 (5% incidence; 1% severity) and Todd County on October 1 (doublecrop soybean @5% incidence and severity). In all three instances, the disease was found too late in the season to cause any damage to any fields in the state.

#### **Extension Publications:**

Hershman, D. 2013. Stem Canker of Soybean. PPFS-AG-S-7 (revision)

Hershman, D. 2013. Soybean Foliar Spots and Blights. PPFS-AG-S-19 (revision)

Hershman, D. 2013. Soybean Cyst Nematode Management Recommendations for Kentucky. PPFS-AG-S-24 (revision)

#### **Research Publications:**

Kachroo A, Robin GP. (2013) Systemic signaling during plant defense.<<http://www.ncbi.nlm.nih.gov/pubmed/23870750>> Current Opinions in Plant Biology

16:527-33.

Selote D, Shine MB, Robin GP, Kachroo A. (2013) Soybean NDR1-like proteins bind pathogen effectors and regulate resistance signaling.<<http://www.ncbi.nlm.nih.gov/pubmed/24372490>> New Phytologist doi: 10.1111/nph.12654.

Selote D, Robin GP, Kachroo A. (2013) GmRIN4 protein family members function nonredundantly in soybean race-specific resistance against *Pseudomonas syringae*.<<http://www.ncbi.nlm.nih.gov/pubmed/23278373>> New Phytologist 197:1225-35.

#### **General Communications to Stakeholders:**

1. General disease information and management recommendations were made available to stakeholders via a grain crops blog, the Kentucky Pest News Newsletter, and a host of regional and county field days and grain production meetings. In addition, disease samples submitted to the Plant Disease Diagnostic Laboratories (Princeton and Lexington) were diagnosed and management information was distributed to clientele. Over 600 soil samples were submitted for soybean cyst nematode analysis. SCN population data were provided to involved growers and each received current management recommendations for KY.

2. Information on SBR monitoring sites and data on positive SBR observations were uploaded into the national SBR PIPE website ([www.sbrusa.net](http://www.sbrusa.net)) for the purposes of updating the public SBR observation map and for providing the data necessary to run SBR predictive models. Results of local, regional and national findings, as well as SBR risk assessments and management recommendations, were provided to stakeholders on a weekly to bi-weekly basis (June-Oct) using a variety of methods including: 1) listserv, 2) toll free hotline, 3) text messaging, 4) grains crop blog, 5) twitter.

Kachroo and Hershman provided updates during meetings of the Kentucky Soybean Promotion Board.

#### Louisiana (Clayton Hollier):

The Crop Loss Assessment Lab (Hollier and Bollich) oversaw the planting, maintenance and scouting of the 21 soybean sentinel plots and the approximately 40 naturally-growing kudzu sites. Soybean rust was found in January not only on kudzu that survived the warm winter but also on 6-inch tall volunteer soybean seedlings. Development was quite rapid with the early spring greenup. It appeared that the development of rust would be greater than in all previous years, but a late spring, early summer drought slowed the rust development. Soybean rust was found in 56 of the 64 civil parishes of Louisiana.

For the last three years, the sentinel plots in Louisiana have been soybean disease plots, not only for rust determination. This means that notes are taken on all diseases present with visit. This gives our growers a better view of disease development statewide.

Fungicide plots are used for the evaluation of product efficacy, while yield loss evaluations are performed as a compilation of all diseases present as they are in a grower field. We are not trying to evaluate yield loss disease by disease. That can be futile.

Michigan (Martin Chilvers):

**2013 Soybean production in Michigan and soybean diseases:**

“Soybean yield, at 44 bushels, was up 1 bushel per acre from last year. Soybean harvested acres at 1.89 million acres was down 100,000 acres from last year. Production, at 83.2 million bushels, was down 3 percent from 2012.” (USDA-NASS). There was some delay in planting with a wet and delayed spring.

With regards to disease, soybean sudden death syndrome (SDS) was noted in many new fields, especially across the southern part of the state. White mold is an annual concern for Michigan soybean producers, with some heavy losses across the state. Soybean vein necrosis virus was present but at lower incidence and prevalence than in 2012. Charcoal rot was present in some fields. In some locations heavy rainfalls shortly after planting lead to seedling disease, especially for those that used untreated seed. Phytophthora root rot was found scattered across the state. Soybean cyst nematode is prevalent in Michigan, being found in approximately 50% of fields.

**2013 soybean research projects in Michigan:**

- Integrated management of oomycete diseases of soybean and other crop plants [Tyler (PI) Chilvers (Co-PI)]
- Identification and biology of seedling pathogens of soybean [Bond (PI) Chilvers (Co-PI)]
- Mapping distribution of soybean sudden death syndrome caused by *Fusarium virguliforme* and assessment of pathogen virulence and fungicide sensitivity to facilitate management and breeding efforts (Chilvers)
- Improved management of Sclerotinia stem rot in the north central region [Grau (PI) Chilvers (Co-PI)]
- Breeding soybeans for multi-disease resistance (Wang and Chilvers)
- NCSRP and Bayer Crop Science SDS management and ILeVo seed treatment (Chilvers)
- Seed treatment profitability trial (Chilvers)
- Foliar fungicide profitability trial (Chilvers)

**Refereed articles and reports in 2013:**

Sikora, E.J., Allen, T.W., Wise, K.A., **Chilvers M.I.** et al. 2014. A coordinated effort to manage soybean rust in North America: a success story in soybean disease monitoring. Plant Disease (Featured Article). *In Press*

Byrne A.M. and **Chilvers, M.I.** *Submitted Dec 11, 2013.* Efficacy of foliar fungicides for white mold control in soybeans in Michigan, 2013. Plant Disease Management Reports.

Byrne A.M., **Chilvers, M.I.**, Serven, B.L. and Dietz, T.S. *Submitted Dec 11, 2013.* Foliar fungicide efficacy on brown spot of soybeans in Michigan, 2013. Plant Disease Management Reports.



Jacobs, J.L. and **Chilvers, M.I.** 2013. First report of *Soybean vein necrosis virus* on soybeans in Michigan. Plant Disease 97:1387.

**Chilvers, M.I.** and Serven, B.L. 2013. Foliar fungicide efficacy on brown spot of soybeans in Michigan, 2012. Plant Disease Management Reports 7:FC037.

Mueller, D., Wise, K., Dufalt, N., Bradley, C. and **Chilvers, M.I.** (Edited) 2013. Fungicides for Field Crops. APS Press. 120 pages. (**Sold 14,341 copies in first 9 months, nearly ¾ of total APS sales per year**)

#### **Abstracts:**

A. Rojas, J. L. Jacobs, S. Napieralski, C. A. Bradley, T. Chase, P. D. Esker, L. Giesler, D. Jardine, B. D. Nelson, D. Malvick, S. Markell, A. E. Robertson, J. C. Rupe, L. Sweets, K. Wise, **M. I. Chilvers**. Diversity of oomycetes associated with soybean seedling diseases in the U.S. American Phytopathological Society Annual Meeting, Austin, TX, Aug 10-14, 2013.

J. Wang, J. L. Jacobs, **M. I. Chilvers**. Temporal dynamics of soybean root colonization by *Fusarium virguliforme*. Diversity of oomycetes associated with soybean seedling diseases in the U.S. American Phytopathological Society Annual Meeting, Austin, TX, Aug 10-14, 2013.

Urrea, K.E., Rupe J.C., Rothrock, C.S., Steger, A., Anders, M., **Chilvers, M.I.**, Rojas, J.A. Effect of crop rotation on *Pythium* spp. population composition in Arkansas soybean fields. American Phytopathological Society Annual Meeting, Austin, TX, Aug 10-14, 2013.

Rojas, J.A., Napieralski S., Jacobs, J.L., **Chilvers, M.I.**, Bradley, C., Chase, T. Esker, P. Giesler, L., Jardine, D., Nelson, B., Malvick, D. Markell, S. Robertson, A., Rupe, J., Sweets, L., Wise, K. Diversity of oomycetes associated with soybean seedling disease in the U.S. Oomycete Molecular Genetics Network Meeting, Asilomar, CA, Mar 9-12, 2013.

#### **2013 –Interviews, webinars, extension articles and live presentations delivered to a total of 1,560 participants:**

Corn and soybean fungicides: To spray or not to spray. Integrated Crop and Pest Management Update, MSU Pavilion. Dec 13, 2013. 350 participants

Pythium, seedling diseases of soybean and more... Chilvers, M.I. Integrated Crop Management conference, Iowa State University. Dec 4, 2013. 346 participants

Soybean sudden death prevalent in 2013. Michigan Farm News, Oct 3, 2013.

[https://www.michfb.com/MI/Farm\\_News/Content/Crops/Soybean\\_sudden\\_death\\_prevalent\\_in\\_2013/](https://www.michfb.com/MI/Farm_News/Content/Crops/Soybean_sudden_death_prevalent_in_2013/)

Interview: Soy and corn seedling and root rot diseases. Ralph Pearce of the Canadian Country Guide. Aug 20, 2013.

Channel field day Aug 21, 2013. Soybean diseases. 100 participants

Decatur field day Aug 20, 2013. SDS, SCN and more. 62 participants

IPM breakfast Aug 9, 2013. Edmore, MI. 10 participants

Soybean diseases update. D.F. Seeds, Inc. Aug, 8, 2013. 300 participants

Soybean disease, field crop update to be held Aug. 20 in Decatur. Kalamazoo Gazette. Aug, 2, 2013.

Field tour of soybean and dry bean SDS plots for North Central Soybean Research Program board of directors July, 30, 2013. 35 participants

Provided diseased plant samples for use in Farm Journals – Soybean College, run at B&M consulting, Coldwater, MI. July, 25, 2013.

Phytophthora root and stem rot showing up in soybeans. MSUE News for Ag. July, 10, 2013.

Article picked up by Plant Management Network

<http://www.plantmanagementnetwork.org/pub/php/news/2013/PhytophthoraRoot/>

White mold in soybean, identification and management – MI Farm Radio July, 9, 2013.

Interview by Rob Buttery.

Septoria Brown Spot and Bacterial Blight. In The Row. July, 11, 2013. 3000 growers.

Bacterial Blight and Septoria Brown Spot. MSUE News for Ag. July, 9, 2013.

Integrated pest management breakfast. Soybean and corn diseases. Centerville, MI. June 18<sup>th</sup>, 2013. 26 CCA and industry representatives.

White mold management in soybeans. In The Row. May, 21, 2013. 3000 growers.

Interview: Soybean Seedling Diseases Cause 37-Million-Bushel Yield Decrease Each Year. Beat the Odds - Healthy Soybean Seedlings Preserve Yields. Edith Munroe. Corn and Soybean Digest, Mar, 6, 2013.

Fungicides, labels and FRAC codes. IPM Academy, Okemos, MI. Feb 20, 2013. 25 participants.

Pathology update: SDS, seedling diseases, SVNaV and fungicides. IPM, Lawrence, MI. Jan 31, 2013. 41 participants.

Pathology update: SDS, seedling diseases, SVNaV and fungicides. IPM, Alma, MI. Jan 29, 2013. 91 participants.

Soybean pathology update. Michigan Soybean Promotion Committee – SMaRT, Frankenmuth, MI. Jan 22, 2013. 200 participants.

Seedling disease, growers pay the price in lost soybean yield. Interview by Edith Munro, Corn and Soybean Digest. March 2013.

#### Mississippi (Tom Allen):

A total of 21 soybean sentinel plots were planted throughout MS. Sentinel plots served soybean farmers by acting as an early warning system for the purposes of economically damaging soybean diseases. However, in addition, during the 2013 season a frogeye leaf spot susceptible variety, Armor DK 4744, was planted in soybean sentinel plots throughout the state to increase the opportunity to collect frogeye leaf spot infected leaf samples and screen for the presence of fungicide resistance. The overwintering situation for soybean rust was followed into the winter of 2014 when it was determined that all kudzu had succumbed to low temperatures and all green leaf material was eradicated from the state.

Soybean rust was detected in all 82 counties in MS (72 on soybean; 10 on kudzu). Although the disease was detected earlier than normal (July on soybean) and we were able to find the disease in all 82 counties, yield loss as a result of soybean rust was still low save for what may have occurred in a few fields in southwestern MS (specifically Lincoln County). Conversely, AL reported some yield losses greater than 25% as a result of early infection and farmers not applying a fungicide in a timely manner.

As a final report for the 2013 soybean season several economically important diseases were observed in either sentinel plots or commercial soybean fields:

**Foliar fungal diseases:**

- aerial web blight
- brown spot
- Cercospora blight
- downy mildew
- frogeye leaf spot
- soybean rust
- target spot

**Soilbore diseases:**

- charcoal root rot
- Phytophthora root rot
- red crown rot
- southern blight
- stem canker
- sudden death syndrome

**Viruses:**

- Bean pod mottle virus*
- Soybean mosaic virus*
- Soybean vein necrosis-associated virus*

**Nematodes:**

- reniform nematode
- root-knot nematode
- soybean cyst nematode

**Extension and Education related activities as a result of disease monitoring:  
Mississippi Crop Situation Blog ([www.mississippi-crops.com](http://www.mississippi-crops.com)) updates (n=19)**

**March 19, 2013**

Allen, T. 2013. The fungicides. Mississippi Crop Situation Blog.

**March 29, 2013**

Allen, T., and Irby, T. 2013. Soybean disease monitoring: soybean sentinel plot update and 2013 soybean rust fungicide list. Mississippi Crop Situation Blog.

**May 14, 2013**

Allen, T., Bond, J., Eubank, T., and Irby, T. 2013. Soybean seedling issues: seedling disease versus herbicide injury. Mississippi Crop Situation Blog.

**May 22, 2013**

Catchot, A., and Allen, T. 2013 Scout schools set. Mississippi Crop Situation Blog.

**June 1, 2013**

Allen, T., and Irby, T. 2013. Soybean fungicide management considerations for 2013. Mississippi Crop Situation Blog.

**June 22, 2013**

Irby, T., Allen, T., and Catchot, A. 2013. Double crop soybean: seeding rates and seed treatments. Mississippi Crop Situation Blog.

**July 5, 2013**

Allen, T. 2013. Soybean disease update: July 5, 2013. Mississippi Crop Situation Blog.

**July 11, 2013**

Allen, T. 2013. Soybean rust detected in a soybean sentinel plot in Pearl River County. Mississippi Crop Situation Blog.

**July 17, 2013**

Allen, T. 2013. Soybean disease update and frogeye leaf spot fungicide suggestions: July 17, 2013. Mississippi Crop Situation Blog.

**July 28, 2013**

Allen, T., and Irby, T. 2013. Soybean frogeye leaf spot: management decisions for the disease following an R3/R4 strobilurin application. Mississippi Crop Situation Blog.

**August 9, 2013**

Allen, T. 2013. Not everything is at it seems.....fungicide phytotoxicity and plant diseases. Mississippi Crop Situation Blog.

**August 18, 2013**

Allen, T. 2013. Soybean disease update: August 18, 2013. Mississippi Crop Situation Blog.

**August 29, 2013**

Allen, T. 2013. Frogeye leaf spot fungicide preliminary data (updated 8/30/2013). Mississippi Crop Situation Blog.

**August 31, 2013**

Allen, T. 2013. Foliar soybean disease update: August 31, 2013. Mississippi Crop Situation Blog.

**September 5, 2013**

Allen, T. 2013. Sudden death syndrome look alike part I: red crown rot. Mississippi Crop Situation Blog.

**September 14, 2013**

Catchot, A., Gore, J., Cook, D., Allen, T., and Irby, T. 2013. Managing late season stink bugs in Mississippi soybean. Mississippi Crop Situation Blog.

**September 21, 2013**

Allen, T. 2013. Soybean disease update: September 21, 2013. Mississippi Crop Situation Blog.

**September 27, 2013**

Allen, T., Sabanadzovic, S., and Catchot, A. 2013. Soybean viruses cause important diseases too. 9/27/2013

**December 24, 2013**

Allen, T. 2013. East Mississippi soybean variety trial report. Mississippi Crop Situation Blog.

**Radio Interviews 2013 (15 soybean minutes; 22 soybean rust reports; 1 national audience):**

**Soybean rust reports (n=15):**

Overwintering soybean rust situation. Mississippi Radio Network, April 1, 2013.

Frogeye leaf spot, strobilurin-resistant isolate update. Mississippi Radio Network, April 8, 2013.

Early season sentinel plot planting progress. Mississippi Radio Network, April 17, 2013.

Early season disease update and sentinel plot progress. Mississippi Radio Network, April 24, 2013.

Soybean disease update and herbicide injury/seed disease situation. Mississippi Radio Network, May 13, 2013.

Soybean disease update and sentinel plot monitoring situation. Mississippi Radio Network, May 20, 2013.

Soybean fungicide suggestions for the R3/R4 timing. Mississippi Radio Network, June 5, 2013.

General soybean disease update. Mississippi Radio Network, June 10, 2013.

General soybean disease update. Mississippi Radio Network, June 20, 2013.

Soybean disease and nematode update. Mississippi Radio Network, June 27, 2013.

Soybean rust/disease update. Mississippi Radio Network, July 12, 2013.

Soybean disease monitoring and soybean rust update. Mississippi Radio Network, August 12, 2013.

Sudden death syndrome in Mississippi soybean fields. Mississippi Radio Network, August 22, 2013.

Red crown rot of soybean detected in additional MS counties. Mississippi Radio Network, August 29, 2013.

End of season soybean disease update. Mississippi Radio Network, September 2, 2013.

**Soybean minute reports (n=22):**

Seed applied fungicide and inoculant combinations. Mississippi Radio Network, April 23, 2013.

Soybean sentinel plot placement and emergence progress. Mississippi Radio Network, May 15, 2012.

Southern blight showing up in soybean, general disease update, soybean rust report. Mississippi Radio Network, May 23, 2013.

Construction of the rainout shelter at the DREC. Mississippi Radio Network, May 24, 2013.

Soybean fungicide options for the 2013 season. Mississippi Radio Network, June 3, 2013.

Early-season soybean diseases can be confused with herbicide injury. Mississippi Radio Network, June 12, 2013.

Fungicide selection for the R3/R4 application. Mississippi Radio Network, June 14, 2012.

Seed applied fungicides in a double-crop situation. Mississippi Radio Network, June 20, 2013.

Fungicide use in dryland, non-irrigated soybean situations. Mississippi Radio Network, June 27, 2013.

Root-knot nematode damage in the Mississippi soybean production system. Mississippi Radio Network, July 5, 2013.

Downy mildew of soybean: no management practice necessary. Mississippi Radio Network, July 10, 2012.

Soybean nematode update and sampling procedures. Mississippi Radio Network, July 12, 2013.

Diseases of minor importance in the MS soybean production system. Mississippi Radio Network, July 13, 2013.

Frogeye leaf spot update and fungicide. Mississippi Radio Network, July 27, 2013.

Soybean disease update with specifics regarding soybean rust. Mississippi Radio Network, August 12, 2013.

Fungicide phytotoxicity observations in Mississippi soybean fields. Mississippi Radio Network, August 14, 2013.

Soybean root diseases. Mississippi Radio Network, August 22, 2013.

Soybean viruses observed throughout the Mississippi soybean production system during the 2013 season. Mississippi Radio Network, September 3, 2013.

Late season soybean rust observations and what this means for disease management. Mississippi Radio Network, September 10, 2013.

Soybean disease wrap up. Mississippi Radio Network, September 17, 2013.

Nematode management practices for the end of the soybean season. Mississippi Radio Network, September 23, 2013.

Soybean variety suggestions to management frogeye leaf spot. Mississippi Radio Network, October 1, 2013.

**Radio interviews (national audience):**

General soybean seedling diseases and seed treatment products. Ag PhD Radio, Sirius XM Channel 80, December 2, 2013.

**Presentations (n=20)**

**Graduate student presentations (either serving as committee member or advisor, grad student is listed with an asterisk (\*)):**

T.H. Wilkerson\*, J.T. Irby, B.R. Golden, and **T.W. Allen**. 2013. Efficacy of fungicides against *Cercospora sojina* in Mississippi soybean.

J. Standish\*, M. Tomaso-Peterson, **T.W. Allen**, B. Moore, and S. Sabanadzovic. 2013. A survey of frogeye leaf spot in Mississippi soybean production fields and future studies of QoI resistance.

Fungicide timing strategies to prevent foliar disease and benefit yield. 57<sup>th</sup> Annual Tri-State Soybean Forum, Stoneville, MS, January 4, 2013.

Presentation made to soybean farmers regarding the 2012 disease situation and the potential for fungicide resistance to develop within MS. Delta Ag Expo, Cleveland, MS, January 17, 2013.

2012 row crop disease situation. Aberdeen, MS Producer meeting, January 24, 2013.

Foliar fungicide applications in soybean: how important is timing? Proceedings of the 2013 Conservation Systems Conference, Baton Rouge, LA, January 31 – February 1, 2013.

Nematode management in Mississippi. Dow Telone Research Working Group Meeting, Buras, LA, February 6, 2013.

Strobilurin resistance: fungicide use and preventing the development of strobilurin-resistant fungi. General Pest Management Workshop, Raymond, MS, February 12, 2013.

Soybean fungicide management practices for MS soybean farmers. Baldwin Area Farmer Meeting, Baldwin, MS, February 13, 2013.

Disease management in corn, cotton, and soybean. Producer's Advisory Council, Verona, MS, February 21, 2013.

Corn and soybean disease management. Presentation made to Benton and Marshall County farmers, Holly Springs, MS, March, 5, 2013.

Soybean rust survey responses from the 2012 season. Presentation made to the NCERA-208 meeting, Pensacola Beach, FL, March 8, 2013.

Fungicide timing strategies: targeting yield enhancement in Mississippi soybean. Proceedings of the Southern Soybean Disease Workers meeting, Pensacola Beach, FL, March 9-10, 2013.

Scouting for plant disease in corn, cotton, and soybean. MS Row Crop Scout School, Starkville, MS, June 5, 2013.

Scouting and managing plant diseases in corn and soybean. Greenwood Farm Club Meeting, Greenwood, MS, June 6, 2013.

Corn and soybean disease update. Pontotoc Experiment Station Field Day, Pontotoc, MS, July 11, 2013.

Fungicide timing strategies: targeting yield enhancement in Mississippi soybean. DREC Field Day, Stoneville, MS, July 18, 2013.

Mid-season disease management. Mississippi Agricultural Industry Council CCA Training, Orange Beach, AL, July 24, 2013.

Corn and soybean disease management. Wayne County Farmer Meeting, Waynesboro, MS, September 24, 2013.

Managing frogeye leaf spot in soybean. Row Crop Short Course, Starkville, MS, December 3, 2013.

**Proceedings (n=3):**

**Allen, T. W.** 2013. Foliar fungicide applications in soybean: how important is timing? Proceedings of the 2013 Conservation Systems Conference, Baton Rouge, LA, January 31 – February 1, 2013.

**Allen, T. W.,** Cook, D., Catchot, A., Gore, J., and Buehring, N. 2013. Fungicide timing strategies: targeting yield enhancement in Mississippi soybean. Proceedings of the Southern Soybean Disease Workers meeting, Pensacola Beach, FL, March 9-10, 2012.

Tomaso-Peterson, M., **Allen, T. W.,** and Standish, J. 2013. Fungal diversity by plant section in the Mississippi soybean production system. *Phytopathology* 103:S2.146

**Refereed publications associated with MS disease monitoring efforts (n=2):**



Sikora, E. J., **Allen, T. W.**, Wise, K. A., Bergstrom, G. Bradley, C. A., Bond, J. Brown-Rytlewski, D., Chilvers, M. Damicone, J., DeWolf, E., Dorrance, A., Dufault, N., Esker, P., Faske, T. R., Giesler, L., Goldberg, N., Golod, J., Gomez, I. R. G., Grau, C., Grybauskas, A., Franc, G., Hammerschmidt, R., Hartman, G. L., Henn, A., Hershman, D., Hollier, C., Isakeit, T., Isard, S., Jacobson, B., Jardine, D., Kemerait, B., Koenning, S., Langham, M., Malvick, D., Markell, S., Marois, J. J., Monfort, S., Mueller, D., Mueller, J. Mulrooney, R., Newman, M., Osborne, L., Padgett, G. B., Ruden, B. E., Rupe, J., Schneider, R., Schwartz, H., Shaner, G., Singh, S., Stromberg, E., Sweets, L., Tenuta, A., Vaiciunas, S., Yang, X. B., Young-Kelly, H., Zidek, J. 2014. A coordinated effort to manage soybean rust in North America: a success story in soybean disease monitoring. *Plant Dis.* 98:??-??

**Allen, T. W.**, Sikora, E. J., and Hollier, C. 2014. A continuing saga: soybean rust in the continental United States, 2004 to 2013. *Outlooks on Pest Management* 25:167-174.

Missouri (Laura Sweets):

**2013 Production Summary (data from Missouri Agricultural Statistics Service):**

The 2013 season was another challenging one for soybean producers in Missouri. The spring was unusually wet and cool which delayed planting. By May 19, planting was 16 days behind 2012 and 9 days behind average. Wet conditions continued through mid-July. Then precipitation decreased dramatically with the remainder of the season drier than normal. Temperatures remained cool so yield reductions were not as great as they had been with the drought of 2012.

Soybean production for 2013 in Missouri was estimated at 197 million bushels. The average yield, at 53.5 bushels per acre, was up 5.5 bu/A from 2012. Of the 5.6 million acres planted in 2013, 5.55 million acres were harvested.

**2013 Soybean Disease Summary:**

For the second year in a row, weather, especially extreme weather conditions, was the major problem during the growing season.

Although March was relatively dry, April, May and much of June were significantly wetter than normal. Planting was delayed throughout the state. Poor stands and uneven stands were common. Phytophthora root rot, Pythium damping-off and other root rots certainly contributed to the poor stands but environmental conditions were a major factor.

Mid-season conditions turned dried and continued cool. Foliage diseases were neither widespread nor severe. Septoria brown spot was unusually low in both incidence and severity. Frogeye leaf spot was also quite low in incidence and severity. Downy mildew came in quite late in the season but during September was very prevalent in the upper canopy of many fields. Soybean rust was not confirmed in Missouri during the 2013 season.

Soybean cyst nematode continues to be a major problem in soybean production throughout the state. Growers seem to believe that resistant varieties have controlled SCN. Although there have been documented cases particularly in the southwest region of the state of SCN populations achieving high reproduction rates on PI-88788 varieties.

Symptoms of sudden death syndrome were not particularly widespread in areas in which this disease is usually a problem. It showed up later than expected and was not as severe as expected.

The most unusual disease issue of 2012 was the extremely widespread occurrence of soybean vein necrosis virus. This virus had been reported from seed production fields in southeast Missouri for several years prior to 2012 but in 2012 it was found in soybean production fields throughout the state. Although the incidence was quite high both in number of fields with symptomatic plants and in the number of plants showing symptoms within a field, the severity on infected plants appeared low. Thrips levels were also unusually high in soybean fields throughout the state. During the 2013 season soybean vein necrosis virus could be found in most regions of the state but it was not nearly as prevalent nor severe as it had been in 2012.

#### **Research Summary:**

Soybean seed treatment trials were conducted at the Bradford Research Center near Columbia. The earliest planting date with a variety that had a poor "Phytophthora package" had some losses from Phytophthora seedling blight. The second date of planting showed little benefit from any of the seed treatments. Trials with seed treatment products for soybean cyst nematode and sudden death syndrome were also tested.

#### Nebraska (Loren Geisler):

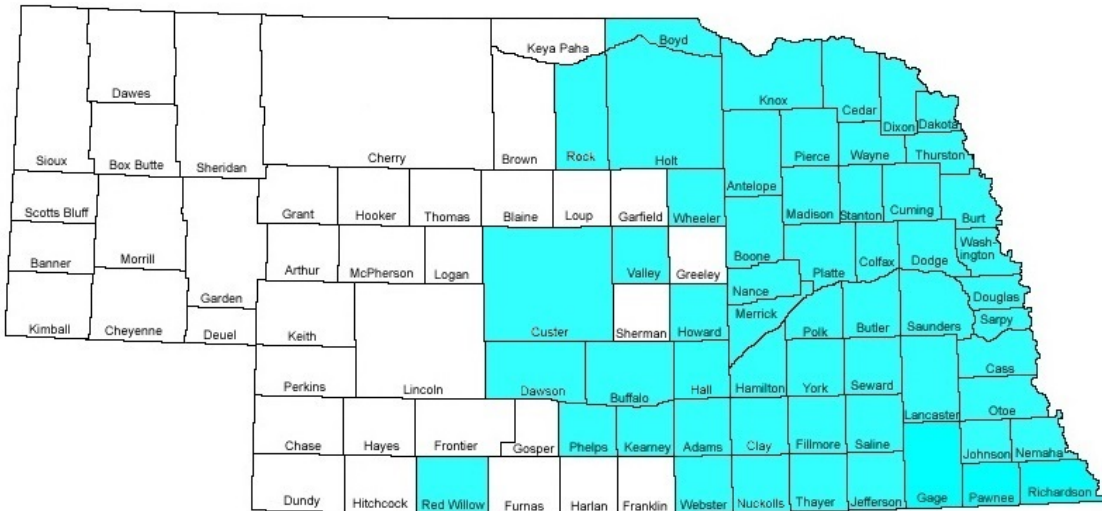
In 2013, Nebraska soybean producers harvested 4.76 M acres of soybean with an average yield of 53.0 bu./A. This was up from yield averages in 2012 (41.5 bu./A). Approximately 45% of our production is irrigated. The yield differences in the two cropping systems in 2013 was 14.6 bu./A increase from irrigation. Timely rains reduced irrigation costs for many of our producers. Overall, in 2013 we had a low disease pressure across Nebraska.

Wet conditions after planting in 2013 resulted in stand problems in some areas. Pythium was our most common seedling disease problem in 2013 due to cool, wet soil conditions. The conditions for Pythium overlap with PPO herbicide injury which can make diagnosis a problem in some field scenarios. Phytophthora was a problem in many fields that received heavy rains later in the season. IN addition, we did see more Sudden Death Syndrome and Brown Stem Rot in the reproductive stages. The most common foliar diseases observed were Bacterial Blight, Brown Spot, Downy Mildew (very little) and Frogeye leaf spot (still mostly in the southeastern portion of the state).

**Soybean Cyst Nematode (SCN):** An SCN sampling project has been funded for 9 years by the Nebraska Soybean Board. This project has resulted in detection of SCN further west in Nebraska and more producers are learning how to manage this problem. Over the last nine years of this program we have detected SCN in 30 new counties in Nebraska. Every year we have found several producers with very high SCN populations (over 30,000 eggs/100cc soil) in their fields that do not know they have the problem. This program will continue in 2014.

We continue have started to perform variety evaluation for SCN resistant varieties similar to evaluations done at Iowa State University by Dr. Greg Tylka. Company interest in this program varies but we have been able to put in the top varieties from each company. Our goal with this program is to have field evaluation data, with yield and SCN reproduction factors for all entries.

**Distribution of Nebraska counties with confirmed SCN as of January, 2014.**



**Sudden Death Syndrome (SDS) and Brown Stem Rot (BSR):** In 2004, SDS was confirmed in Nebraska for the first time. Since this time we have observed a steady increase in spread and severity of this disease. We are still on the low end as far as impact for this disease, but we are increasing our awareness programs for management of this problem. As more producers adopt early planting strategies we are continuing to observe more SDS. The majority of fields have a very low percentage of the field affected and most producers are not targeting management of this problem. In 2013, we observed a similar level of BRS which is more than we had observed in previous years.

**Soybean Viruses:** We have not observed significant problems with soybean viruses for several years. We have had several fields that look like Soybean Vein Necrosis Virus but we have not had it confirmed when tested. We did see Tobacco Ringspot Virus in a couple fields. Dark lesions on the pods and discoloration at the nodes (brown) with split stems is a symptom we observed in several fields over the past couple years, which may have been incorrectly identified.

**Sclerotinia Stem Rot and the Sclerotinia Initiative:** In 2013 we observed more white mold in soybean than we have had for several years. Many growers were interested in using fungicides for this but it was too late. Late season applications did not improve yields when attempted as all research has shown. (Note – some still tried).

Funding through the Sclerotinia initiative continues to support very innovative and creative research that could not be funded by several other sources. Jim Steadman continues to work in this area and is very appreciative of the funding source to further the knowledge base toward a resistance source identification and development.

### **Publications:**

Werle, R., Bernards, M., Giesler, L. J., Lindquist, J. L. 2013. Influence of Two Herbicides on Soybean Cyst Nematode (*Heterodera glycines*) Reproduction on Henbit (*Lamium amplexicaule*) Roots. *Weed Technology* 27:41-46.

### North Dakota (Berlin Nelson Jr. and Sam Markell):

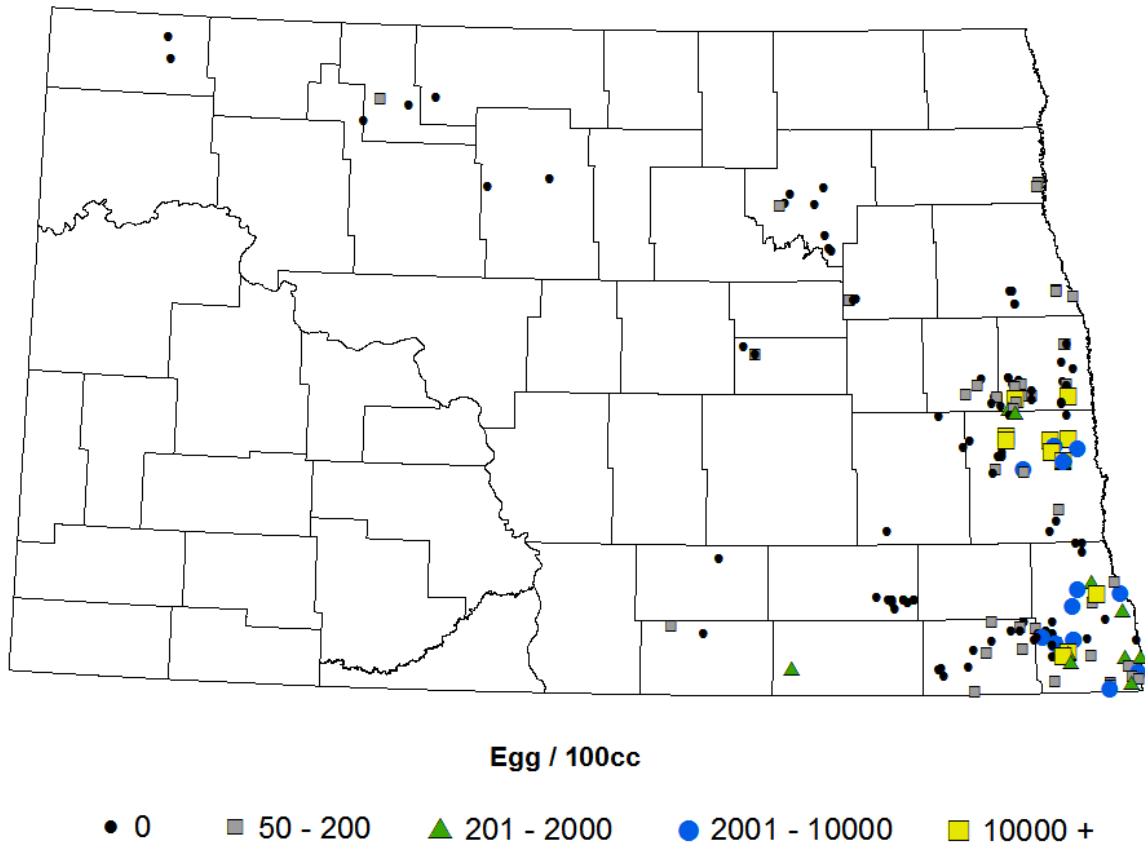
The soybean acreage in North Dakota in 2013 was approximately 4.6 million acres. It was a warmer and drier summer with soybean yields averaging about 30 bu/A. Research emphasis in the state was focused on soybean cyst nematode, seedling diseases, and root rots. A study on the HG types of soybean cyst nematode is currently in progress. A study on weed hosts of SCN was also continued and concluded in 2013. Cooperation with the soybean breeder also was continued to identify breeding lines with resistance to soybean cyst nematode and *Phytophthora* root rot races 3 and 4. A cooperative effort with the dry bean breeder to incorporate resistance to soybean cyst nematode into dry bean germplasm is in progress. Crosses with pinto, black and kidney bean types with sources of resistance were made and screening has identified resistant progeny. The importance of *Pythium* species as pathogens of soybean in the region was investigated over a three year period. The most common species isolated in the wet growing season of 2011 were *P. ultimum*, an unknown *Pythium* species, *P. heterothallicum*, *P. irregulare*, *P. attrantheridium* and *P. sylvaticum*. Twenty one species from North Dakota soils were shown to cause damping-off of soybean. Seven of those species had not previously been evaluated for pathogenicity on soybean and three were newly reported in the United States. Other research on soil borne pathogens examined the effect of *Fusarium tricinctum* on growth of soybean in the field. Field experiments in 2013 showed that *F. tricinctum* caused a reduction in seed germination and growth of the plants, plus reduced root mass and seed yield of soybean. An investigation on the genetic diversity of *Sclerotinia sclerotiorum* in the United States using microsatellites and mycelial compatibility groups was completed.

To assess distribution of SCN in North Dakota, a grower-based survey was conducted. Growers were given SCN sample bags at SCN field days and/or Extension county agents offices, sent in samples, they received data, and we received a spatial coordinate and egg level. Cost of

samples was reimbursed by the North Dakota Soybean Council. Approximately 200 samples were processed; egg levels varied from 0 to 108,000 eggs/100 cc and positives were observed in 14 counties (Figure 1). Additional research projects included SCN seed treatment evaluations, SCN variety evaluations, foliar, in-furrow and seed applied fungicide evaluations.

No soybean rust was observed. Soybean fields were scouted and evaluated for soybean diseases approximately every ten days throughout the growing season.

**Figure 1.** Location and egg level of samples submitted as part of the 2013 North Dakota soybean cyst nematode survey.



### Publications Refereed Journals:

### Abstracts

C. Qiu, C. and Nelson Jr., B. D. 2013. Genetic Variation and Aggressiveness of *Sclerotinia sclerotiorum* in the United States. (Abstract). Phytopathology 103 (Suppl. 2):S2.117

Chitrampalam, P., Qiu, C., Aldrich-Wolfe, L., and Nelson, B. D. 2013. Prevalence of inversion negative and inversion positive MAT alleles in *Sclerotinia sclerotiorum* from across the United States. (Abstract) *Phytopathology* 103(Suppl. 2):S2.27

Brueggeman, R. S., Qiu, C. and Nelson, B. D. 2013. High density genotyping of *Sclerotinia sclerotiorum*. ( Abstract) *Phytopathology* 103 (Suppl. 2):S2.21.

Shin-Yi L. M., Hobbs, H. A., Nelson, B. D., Eastburn, D., Hartman, G. L., and Domier, L. L. 2013. Identification of RNA viruses infecting *Sclerotinia sclerotiorum*. ASV Annual Meeting - July 20-24, 2013– The Pennsylvania State University

Olson, L. K., Tylka, G. L., Jordahl, J., Meyer, S., Goltz, J., Kringler, J., Helms, T., and Markell, S. 2013. Increasing awareness of soybean cyst nematode in North Dakota. 2013 Annual Meeting of the American Phytopathological Society. Austin, TX. August 10-14, 2013. *Phytopathology* S2.107-108.

### **Proceedings**

Markell, S. 2013. Identifying and Managing Soybean Diseases. Proceedings of the 2013 Manitoba Agriculture Conference. Winnipeg, MB, Canada. December 11-12, 2013. Available at [https://umanitoba.ca/faculties/afs/agronomists\\_conf/](https://umanitoba.ca/faculties/afs/agronomists_conf/) Accessed March 10, 2014.

### **Popular Press articles:**

Nelson, B., Osorno, J. 2013. Genetics of resistance in dry bean to soybean cyst nematode. *Northarvest Bean Grower* 19 (2):26.

Nelson, B. and Gramig, G. 2013. Soybean cyst nematode and weeds. *North Dakota Soybean Grower Magazine*. September 2013. Page 13.

### **Extension Activities:**

**Programs:** In 2013, six major program Extension program efforts were coordinated (or-coordinated) by Dr. Sam Markell

### **Signature Program Leader – Crops Team: Soybean Cyst Nematode**

In 2013, an SCN signature program. A signature program is a premier programming effort adopted by the Extension service that encourages significant involvement of agents, and supports them with presentation tools, evaluation tools, and other logistical support. This program is one of only two signature programs that the crops team (the largest team in the ND Extension Service) has.

**Cass County Soybean Cyst Nematode Field Day. August 29<sup>th</sup>, 2013.**

This field day was created to provide producers information about this invasive pest of soybeans during the field season. Dr. Markell served as a co-coordinator of the event with John Kringler, Cass County agent. His roles included demonstration plot design, interviews for advertising, and approximately 70% of the teaching at the event.

**Richland County Soybean Cyst Nematode Field Day. August 28<sup>th</sup>, 2013.**

This field day was created to provide producers information about this invasive pest of soybeans during the field season. Dr. Markell served as a co-coordinator of the event with Jason Goltz, Richland County agent. His roles included demonstration plot design, interviews for advertising, and approximately 70% of the teaching at the event.

**LaMoure County Soybean Cyst Nematode Field Day. August 27<sup>th</sup>, 2013.**

This field day was created to provide producers information about this invasive pest of soybeans during the field season. Dr. Markell served as a co-coordinator of the event with Al Ulmer, LaMoure County agent. His roles included demonstration plot design, interviews for advertising, and approximately 70% of the teaching at the event.

**Soybean Cyst Nematode and Nematodes that Feed on Corn Hands on Course in Ames, IA. July 25-27<sup>th</sup>.** This trip was designed to give North Dakota County Extension Agents and Crop Consultants a first-hand look at Soybean Cyst Nematode where the pathogen has been established for decades. Dr. Markell conceived, secured funding for, and coordinated the event.

**Soybean Cyst Nematode and Nematodes of Corn Short-Course. Fargo, ND. March 6-7<sup>th</sup>, 2011.** Soybean Cyst Nematode (SCN) is the most devastating soybean pathogen in the United States. SCN is an invasive plant pathogen that was recently introduced to North Dakota and continues to spread. This event was created to educate the county agents and crop consultants about SCN identification and management. Dr. Markell facilitated this intensive, invitation-only, two-day nematode short-course. He worked with the North Dakota Soybean Council, who provided travel funding for 35-40 attendees and Dr. Greg Tylka (Iowa State University). Dr. Markell facilitated the program from concept to completion, and taught as needed.

**Presentations:**

**32 Soybean talks given to 2,057 audience members**

<b>2013 – Extension Presentations</b>				
<b>Date</b>	<b>Title</b>	<b>Location</b>	<b>Event</b>	<b>Estimated Number of Participants</b>
12/04/13	Broadleaf Crop Update	Fargo, ND	Northern Ag Expo	250
12/04/13	Soybean Cyst Nematode – Yield Loss Concerns	Fargo, ND	Northern Ag Expo	45

<b>2013 – Extension Presentations</b>				
<b>Date</b>	<b>Title</b>	<b>Location</b>	<b>Event</b>	<b>Estimated Number of Participants</b>
12/03/13	Dealing with Soybean Cyst Nematode and Nematodes in Corn	Fargo, ND	Northern Ag Expo	75
11/21/13	Diseases of Sunflowers, Canola, Corn and Soybeans	Bismarck, ND	Benchmark Seeds -Agronomy Day	50
11/20/13	Plant Pathology Update	Fargo, ND	SBARE	35
10/24/13	2013 Crop Disease Update	Fargo, ND	Extension Fall Conference	56
10/23/13	Soybean Cyst Nematode and its Friends	Fargo, ND	Extension Fall Conference	21
9/5/13	Dry bean Resistance Breeding and Soybean Cyst Nematode	Carrington, ND	Carrington Research Extension Center Row Crop Tour	70
8/29/13	Soybean Cyst Nematode	Ransom County	Ransom County Plot Tour	30
8/29/13	Soybean Cyst Nematode: Detection and Management	Arthur, ND	Cass County Nematode Tour	40
8/29/13	Genetics and Resistance (for Ted Helms)	Arthur, ND	Cass County Nematode Tour	40
8/28/13	Soybean Cyst Nematode: Detection Management and Breeding	Fairmount, ND	Richland County SCN Tour	30
8/28/13	Genetics and Resistance (for Ted Helms)	Fairmount, ND	Richland County Nematode Tour	30
8/27/13	Soybean Cyst Nematode: Detection Management and Breeding	Verona, ND	LaMoure County Nematode Tour	50
8/27/13	Genetics and Resistance (for Ted Helms)	Verona, ND	LaMoure County Nematode Tour	50
8/22/13	Soybean Diseases in Stressed Conditions	SHARE Farm, Richland County	SHARE/Bagg Farm Field Day	195
7/25/13	Soybean Cyst Nematode in North Dakota	Ames, IA	Soybean Cyst Nematode and Nematodes that Feed on Course	30



<b>2013 – Extension Presentations</b>				
<b>Date</b>	<b>Title</b>	<b>Location</b>	<b>Event</b>	<b>Estimated Number of Participants</b>
			Hands On Course in Iowa	
7/19/13	Crop Diseases in North Dakota	Fargo, ND	Bismarck State University Students	24
7/19/13	Crop Diseases in North Dakota	Fargo, ND	North Dakota State College of Science Students	19
7/16/13	Soybean Diseases in North Dakota	Carrington, ND	Carrington Research Extension Center Field Day	45
3/27/13	Soybean Cyst Nematode and Charcoal Rot	Moorhead, MN	CSAG Consulting Annual Education Day	15
3/26/13	Soybean Cyst Nematode	Wahpeton, ND	MKAP Day	50
3/6/13	Soybean Cyst Nematode, Nematodes on Corn, and Why They Matter	Fargo, ND	Soybean Cyst Nematode and Nematodes that Feed on Corn Short Course	31
3/5/13	Soybean and Dry Bean Diseases	Fargo, ND	Eastern Crop Scout School	100
2/27/13	Row Crop Disease Update	Mandan, ND	West Centrol Crop Consulting Annual Educational Day	75
2/21/13	Diseases in Dry Years	Grand Forks, ND	International Crop Expo	60
2/7/13	Soybean Cyst Nematode: Where Its At	Moorhead, MN	Best of the Best in Wheat and Soybean Research and Extension	140
2/6/13	Soybean Cyst Nematode: Where its At	Grand Forks, ND	Best of the Best in Wheat and Soybean Research and	240

2013 – Extension Presentations				
Date	Title	Location	Event	Estimated Number of Participants
			Extension	
1/31/13	Soybean Diseases: 2013	Rugby, ND	Getting it Right: Soybeans	50
1/31/13	Soybean Disease and Management	Rugby, ND	Towner County Crop Improvement Annual Meeting	15
1/30/13	Soybean Cyst Nematode and Other Diseases	Carrington, ND	Getting it Right: Soybeans	50
1/29/13	Soybean Cyst Nematode and Management Strategies	Edgely, ND	Getting it Right: Soybeans	46

Ohio (Anne Dorrance):

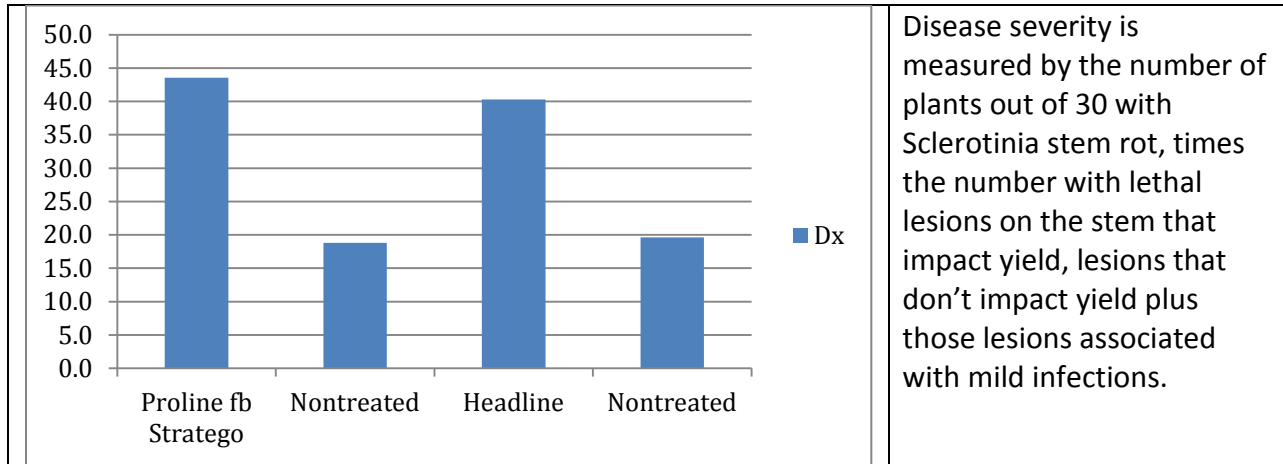
During 2013, soybean producers harvested soybean on 4.43 M acres with a record high of 49 bu/A. The spring was very, very cool with numerous articles early on to delay planting until more optimum soil temperatures were prevalent.

There was some early replant from those fields which were planted under the really cold wet conditions. In contrast, fields that were planted in early June, received very little rain until the end of July and then there was a lot of flooding injury through parts of central Ohio as several big storms had moved through the area. Mid-season Phytophthora stem rot, sudden death syndrome, white mold, and frogeye leaf spot were observed in a number of fields midseason! Finally at the end, Phomopsis seed rot was found at levels of 10% on some varieties, indicative of both a susceptible variety but also late season rains that promote infection. Numbers of SCN found in some soil samples from Ohio continue to be troubling. We have some fields in the state where rotation is not going to solve the issue, as counts are well above 20,000 eggs/cup of soil.

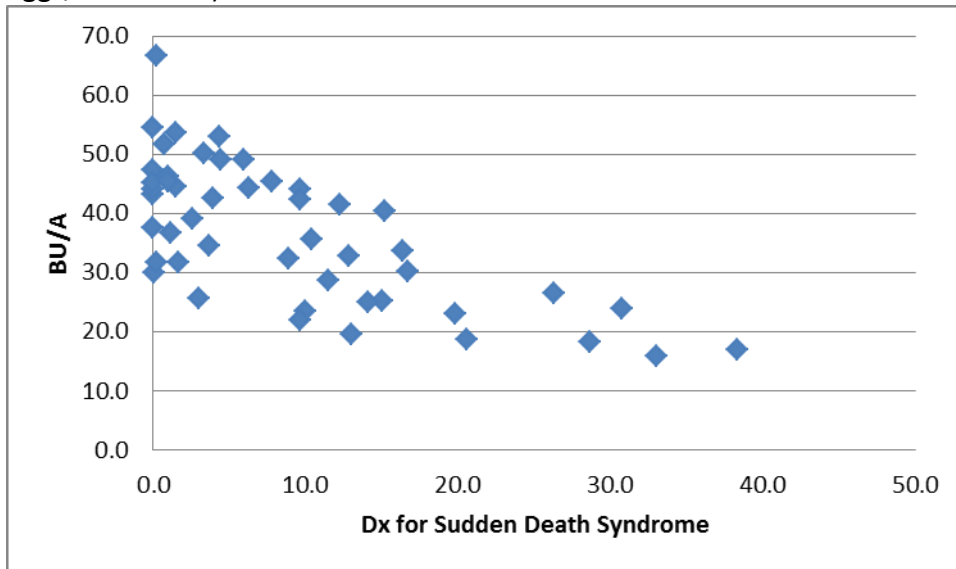
**Frogeye leaf spot:** Leaves with frogeye leafspot were collected from more than 10 separate locations around Ohio during 2013. These were sent to the Bradley Lab at University of Illinois for evaluation of fungicide sensitivity. All of these samples from Ohio were still sensitive to strobilurin fungicides.

**Sclerotinia stem rot:** Several areas of the state continue to have issues with Sclerotinia stem rot or white mold in soybean. For this disease application timings are made at R1 to R2, first flower to full bloom. Conditions for infection are closed, thick canopy, cool wet conditions, fogs, during flowering. This year, we applied fungicides when there were 3 to 5 blossoms on most of the plants, and after a week of rain. Overall disease severity scores were low to moderate at 20.1 for two separate studies. However, where we applied a strobilurin, we significantly increased the amount of disease to 45. This is in the literature and we have seen

this before, but never to this extent. Interestingly, yields were not significantly different across the treatments, primarily due to the high variability across the plots.



**Sudden Death Syndrome:** We evaluated 48 entries in the North Central Soybean Research program SDS trial in one location in Ohio last summer. More than 1/3 had very high levels of resistance to SDS. This location has moderately high levels of SCN (approximately 5,000 eggs/100 cc soil).



*Phytophthora sojae*: Numerous novel QTL for resistance to *Phytophthora sojae* were identified in a Plant Introductions from South Korea and China.

**Publications:**

1. Dorrance, A.E. 2013. *Phytophthora sojae* on soybean. In *Phytophthora: A Global Perspective*. Editor K. Lamour. CAB International. Chapter 9. Pp. 79-86.
2. Lee, S., Mian, R.M.A., Sneller, C.H., Wang, H., Dorrance, A.E., and McHale, L. 2014. Joint linkage QTL analysis for partial resistance to *Phytophthora sojae* using six nested inbred populations with heterogenous conditions. *Theor. Applied Genet.* 127:429-444.

3. Han, J., Domier, L.L., Dorrance, A.E., and Qu, F. 2013. First report of Soybean vein necrosis-associated virus in Ohio Soybean Fields. *Plant Dis.* 97: 693.
4. Lee, S., Mian, R.M.A., McHale, L., Sneller, C.H., and Dorrance, A.E. 2013. Identification of quantitative trait loci conditioning partial resistance to *Phytophthora sojae* in soybean PI 407861A. *Crop Sci.* 53: 1022-1031.
5. Ellis, M.L., McHale, L.K., Paul, P.A., St. Martin, S.K., and Dorrance, A.E. 2013. Soybean germplasm resistant to *Pythium irregulare* and molecular mapping of resistance quantitative trait loci derived from the soybean accession PI 424354. *Crop Sci.* 53: 1008-1021.
6. Lee, S., Mian, R. McHale, L., Wang, H., Wijeratne, A., Sneller, C. and Dorrance, A.E. 2013. Novel quantitative trait loci for partial resistance to *Phytophthora sojae* in soybean PI 398841. *Theo. Applied Genetics.* 126: 1121-1132.

**Ontario (Albert Tenuta):**

Personnel involved: Albert Tenuta, Field Crop Pathologist, OMAF, Ridgetown, ON  
Horst Bohner, Soybean Agronomist, OMAF, Stratford

**Summary**

Soybeans continue to be the largest row crop in Ontario with an estimated 2.55 million acres seeded in 2013. Current high prices compared to other crops including corn suggest even higher acreage in 2014. The majority of the 2013 crop was seeded by May 20th while some areas could not finish until well into June due to excess moisture. Unfortunately, some unseeded acreage occurred due to excess rainfall. Spring frosts resulted in some limited damage but most of the crop had not emerged by the frost dates. Heavy down pours did occur in some areas and reduced plant stands which required replanting in some fields. Saturated soils resulted in more root rots than normal. Thin stands, white mold, soybean aphids, soybean cyst nematode, and Japanese beetles were some additional challenges faced by soybean growers in 2013. Excess water continued to be a problem into July for some resulting in tile run soybean, root rots, and pale crops. The relatively wet spring was followed by a dry August in the main soybean growing areas. Generally, a wet spring followed by a lack of moisture during August reduces soybean yield potential, but for the majority of growers, 2013 yields turned out to be higher than anticipated. The average yield across the province was 46 bu/ac. The five year provincial average is 44 bu/ac. Although, harvest started with dry conditions the fall quickly turned wet. Areas with heavier textured soils, poorly drained fields, or regions experiencing continual showers struggled to get soybeans harvested. Favorable growing conditions, improved soybean genetics, as well as increased use of SCN resistant varieties have contributed the upward trend in yields. Soybeans are also more intensely managed today than they were 20 years ago. Visit [gosoy.ca](http://gosoy.ca) for the 2013 soybean performance trials. Variety selection is the single biggest decision a producer can make to improve yields.

**Growing Season:** Cool, wet conditions in June and July meant that root nodules took longer than normal to fix nitrogen from the air. This resulted in an obvious pale green color to the crop which has not been evident in recent previous years as the growing seasons were warmer and dryer during the late vegetative stage of development. The majority of soybean yield is set

during the last half of July and the month of August, but September can be very important in determining yield. Growing conditions during that time have more impact on yield than growing conditions during the early stages of plant development. By the end of July many fields, especially in the central region were not in good shape. However, August and September had better weather conditions which coincided with the plant's reproductive growth stages, so much of the crop recovered. Soybean aphids were found across a wide geography but spraying was not required for the majority of the acreage in the southwest. Considerable acreage did reach threshold in eastern Ontario. In some cases aphid numbers dropped naturally due to insect predator feeding and weather conditions highlighting the importance of crop scouting in determining the need to employ expensive control treatments.

**Soybean Cyst Nematode (SCN):** SCN continues to spread across the province with confirmed sites all the way to Quebec. A Huron SCIA project conducted to raise awareness of SCN saw 103 soil samples submitted to AAFC of which 54% had SCN present and 25% of the samples submitted had levels considered high. This is a strong reminder that every soybean grower should test for SCN. Once SCN is detected appropriate management strategies can be undertaken to limit yield losses (Photo to right).

**White Mold (WM)** WM is a serious soybean disease and can reduce yields by up to 75%. The disease is favored by cool moist conditions during flowering. It was a severe problem in isolated fields in the southwest and more of a general problem throughout eastern Ontario. Considering the relatively wet conditions experienced in some regions, WM pressure was actually lower than feared in the southwest. This was probably due to the low level of disease inoculum over the last few years. Make careful note of which fields were affected this year and plan accordingly for the next susceptible crop. There are large differences in variety tolerance to WM. Seeding rates should be kept low in fields with a history of the disease and the use of wider rows will help to lower moisture levels within the canopy.

**Japanese beetle:** Japanese beetle is rarely enough of a problem in soybean fields to require control measures. Populations are generally localized. However, if insect numbers are high they can defoliate soybean plants quickly over just a few weeks (Photo to right). A few fields in Ontario required control measures for Japanese beetle this year.

**Cercospora:** This leaf blight and purple seed stain are caused by a fungal pathogen which overwinters in soybean residue and seed coats. Infection of plants occurs during warm wet weather. Although yield losses are usually minimal from Cercospora, purple seed stain can significantly reduce seed quality. Purple seed stain was widely found in many soybean seed samples this harvest. Management strategies for this disease include crop rotation, tillage, and an application of a foliar fungicide.

**Challenges and Opportunities for 2014:** It's estimated that up to 20% of Ontario fields are below ideal levels for potassium (K). Applying potassium in the spring before planting is an acceptable practice for fields with low soil test levels. Any field with less than a 100 ppm K may

suffer significant yield losses, especially in dry years. A 50 bu/ac crop removes 70 lbs/acre of K. Sometimes plants show K deficiency due to the presence of Soybean Cyst Nematodes (photo at right). Always check for SCN if K deficiency symptoms are present in a field.

Good prices and relatively high yields over the last few years are expected to push acreage higher again in 2014. Shorter crop rotations will mean soybean growers have to be vigilant in selecting disease resistant varieties, scouting their crop, and applying inputs when and as required.

#### South Dakota (Emmanuel Byamukama):

Personnel involved with soybean disease activities: Emmanuel Byamukama, Thomas Chase, Connie Tande, Connie Strunk, Marie Langham, Kay Ruden, Krishna Acharya, Rawnaq Chowdhury, and Greg Redenius.

Soybean acreage in South Dakota in 2013 was 4.6 m acres (3% decrease from 2012 acreage) giving 40.0 bu/acre yield. This is an increase of 10 bu/acre from 2012 primarily due to higher moisture in 2013 compared to 2012, which was a drier year.

The 2013 soybean growing season was characterized by low disease pressure throughout the season with exception of few individual fields that had high stem canker incidence (see figure below). Several fields had between low to moderate level of seedling diseases caused mainly by *Phytophthora sojae*. Very low foliar diseases were observed throughout the season. Only brown spot, bacterial leaf blight, and *Cercospora* leaf spot were observed at very low levels to impact yield. A few stem and root rots were observed also at low incidence including white mold, brown stem rot, charcoal rot and sudden death syndrome. Many samples were submitted to the Plant Diagnostic Clinic for soybean cyst nematode testing partly because of the awareness of the SCN problem on soybeans and the negative impact SCN has on yield. SCN is now found in 28 counties in South Dakota.

#### **Soybean research:**

The following projects have been initiated :

*Heterodera glycines* type testing. This project aims at determining the most common HG types present in South Dakota.

Characterization of *Phytophthora sojae* races prevalent in South Dakota. This project will determine *P. sojae* races commonly found in South Dakota and also test for fungicide sensitivity.

Effectiveness and profitability analysis of foliar and seed treatment fungicides in the management of soybean diseases

#### **Extension publications: Crops Newsletter articles**

Byamukama E., 2013. Damping-off occurring in South Dakota soybean fields. Published 6/26/2013. iGrow. <http://igrow.org/agronomy/soybeans/damping-off-occurring-in-south-dakota-soybean-fields/>

Byamukama E., 2013. Phytophthora root and stem rot appearing in soybeans. Published 7/31/2013. iGrow. <http://igrow.org/agronomy/soybeans/phytophthora-root-stem-rot-appearing-in-soybeans/>

Byamukama E. and Tande C. 2013. Soybean sudden death syndrome and corn crazy top confirmed in South Dakota. Published 8/28/2013. iGrow. <http://igrow.org/agronomy/corn/soybean-sudden-death-syndrome-corn-crazy-top-confirmed-in-south-dakota/>

Byamukama E. and Strunk, C. 2013. Soybean cyst nematode: One cyst is the threshold for action. Published 9/25/2013. iGrow. <http://igrow.org/agronomy/soybeans/soybean-cyst-nematode-one-cyst-is-the-threshold-for-action/>

Byamukama E., and Langham M. 2013. Be aware of the “green stem” disorder in soybeans. Published 10/2/2013. iGrow. <http://igrow.org/agronomy/soybeans/be-aware-of-the-green-stem-disorder-in-soybeans/>

Byamukama E. 2013. What should I spray? Plant disease management now and later. Published 10/2/2013. iGrow <http://igrow.org/agronomy/wheat/what-should-i-spray-plant-disease-management-now-later/>

Tennessee (Heather Young Kelly):

Personnel involved in soybean disease extension and/or research: Heather Young Kelly, Jamie Jordan, Wesley Crowder, Alice Cochran, Kurt Lamour, Alemu Mengistu, Vince Panelone, Fred Allen, Angela McClure

In Tennessee 1.5 million acres of soybean were harvested, with an average yield of 46 bu/A. Soil borne and foliar diseases in soybean had some impact on yield. Cool, wet conditions in the spring and into the summer resulted in some seedling disease problems, downy mildew, and sudden death syndrome. The cooler temperatures did to reduce some of the foliar diseases such as brown spot, frogeye leaf spot, and Cercospora blight as the season progressed.

Although environmental conditions were close to ideal for soybean rust (SBR), spores were not deposited in the state until September. SBR was first confirmed in Giles county the second week in September 2013, approximately 2 weeks earlier than in 2012 and a total of 9 counties were confirmed by end of October. It was estimated SBR caused 0.5% yield loss in Tennessee in 2013, mainly in middle Tennessee where the disease was present during reproductive growth stages. In 2013, 15 sentinel plots were monitored for soybean rust and frogeye leaf spot and strobilurin/QoI fungicide resistance, as well as other soybean diseases and insect pests. QoI fungicide resistant strains of *Cercospora sojina* (cause of frogeye leaf spot) were confirmed in

10 counties, with 7 of 10 being new reports. Disease observations were distributed throughout the year via the UTCrops.com newsletter/blog.

Soybean research projects in 2013 included:

Monitoring the genetic diversity of *C. sojina* populations in Tennessee

Investigating the effect of different fungicides on strains of *C. sojina* (i.e. genetic diversity and fungicide resistance)

Developing a fungicide forecast model to better guide fungicide application timing for management of frogeye leaf spot

A total of 72 commercial soybean varieties were screen for disease resistance at 3 locations in Tennessee

Multiple seed treatments and foliar fungicides tested for disease management

Results were, or will be, published in extension and/or peer-reviewed journals, newsletters, etc.

Wisconsin (Damon Smith):

**University of Wisconsin-Madison personnel involved in soybean disease extension and research:** Damon Smith, Craig Grau, Shawn Conley, Carol Groves, John Gaska, Brian Hudelson, Ann MacGuidwin, Quinn Watson, Chris Bloomingdale, Jaime Wilbur  
**Wisconsin Department of Agriculture, Trade and Consumer Protection personnel involved in soybean disease research:** Anette Phibbs

### **2013 soybean production in Wisconsin**

In Wisconsin a total of 1.62 Million acres of soybeans were planted in 2013 with 1.61 million acres harvested. Planted acreage was down from a record high in 2012, when 1.70 million acres were harvested. Statewide average yield in 2013 was level with 2012 at 41.5 bushels per acre.

The spring was very wet in Wisconsin forcing some very late planting of soybean in the state. Weather turned hot and dry in July, then turned very cool and wet in August. These weather conditions led to moderate levels of brown spot throughout the season. Downy mildew was also present, but did not result in yield loss. Sudden death syndrome was high in the southern areas of the state and where weather kept fields wet early in the season and caused yield loss in those fields. White mold was present at high levels in pockets in the southern and southeastern portion of the state. Soybean vein-necrosis virus was widespread across the major soybean production areas of the state, but severity in fields was low to moderate. Soybean cyst nematode was confirmed in 90% of the soybean production area in 2013.

### **2013 soybean disease research efforts and research publications**

1. Determining the Importance of Soybean Vein Necrosis Disease in Wisconsin



2. Verification of insect transmission of *Soybean Vein Necrosis-associated Virus* and detection *in planta*
3. Determining the Importance of *Phytophthora sansomeana* on soybean in Wisconsin
4. Continued development of Sclerotinia stem rot-resistant soybean germplasm
5. The effect of light quantity and quality on apothecial development in the plant parasitic fungus *Sclerotinia sclerotiorum*

## 2013 soybean disease-related publications

### Peer-reviewed

Smith, D.L. Fritz, C. Watson, Q. Willis, D.K. German, T.L. Phibbs, A., Mueller, D., Dittman, D., Saalau-Rojas, E., Whitham, S.A. 2013. First Report of Soybean Vein Necrosis Disease Caused by *Soybean vein necrosis-associated virus* in Wisconsin and Iowa. *Plant Dis.* 97:693.

Abd-Elmagid, A., Garrido, P.A., Hunger, R., Lyles, J.L., Mansfield, M.A., Gugino, B.K., Smith, D.L., Melouk, H.A., Garzon, C.D. 2013. Discriminatory simplex and multiplex PCR for four species of the genus *Sclerotinia*. *Journal of Microbiological Methods* doi: 10.1016/j.mimet.2012.12.020.

### Extension

Smith, D.L. and Proost, R. 2013. Fact Sheet: A3878 – Fungicide resistance management in corn, soybean, and wheat in Wisconsin. UW Extension - Cooperative Extension Service. University of Wisconsin.

Cullen, E., Davis, V., Jensen, B., Nice, G., Renz, M., and Smith, D.L. 2013. A3646 – Pest Management in Wisconsin Field Crops. UW Extension - Cooperative Extension Service. University of Wisconsin.

Smith, D.L. and Proost, R. 2013. Fact Sheet: What's on your seed? UW Extension - Cooperative Extension Service. University of Wisconsin.

Marburger, D., Conley, S.P., Gaska, J., MacGuidwin, A., and Smith, D.L. 2013. The relationship between the causal agent of SDS and SCN in Wisconsin. UW Extension - Cooperative Extension Service. University of Wisconsin.

Groves, C. and Smith, D.L. 2013. Fact Sheet: XGT1012 – Brown stem rot of soybean. UW Extension - Cooperative Extension Service. University of Wisconsin.

Groves, C. and Smith, D.L. 2013. Fact Sheet: XGT1013 – Charcoal rot of soybean. UW Extension - Cooperative Extension Service. University of Wisconsin.

Fritz, C. and Smith, D.L. 2013. Fact Sheet: XGT1017 – Soybean vein necrosis diseases. UW Extension - Cooperative Extension Service. University of Wisconsin.

Groves, C. and Smith, D.L. 2013. Fact Sheet: XGT1015 – Sudden death syndrome of soybean. UW Extension - Cooperative Extension Service. University of Wisconsin.

Smith, D.L. 2013. Late Season Soybean Disease Update. Wisconsin Crop Manager – August 29.

Smith, D.L., Davis, V., and Conley, S.P. Is that Soybean Mosaic Virus or Herbicide Injury? Wisconsin Crop Manager – August 13.

Smith, D.L. 2013. White Mold Management in Soybeans. Wisconsin Crop Manager – July 16.

Smith, D.L. 2013. Early Season Soybean Diseases. Wisconsin Crop Manager – June 13.

Smith, D.L. 2013. Soybean Planting into Cool Wet Soil. Wisconsin Crop Manager – May 16.

Smith, D.L. 2013. White mold management in 2013: Was it product or timing? Soy Sentinel. Vol. 10. No. 2.

Smith, D.L. 2013. Soybean vein necrosis disease in Wisconsin. Soy Sentinel. Vol. 10. No. 2.

MacGuidwin, A., Smith, D.L., and Conley, S.P. 2013. You can't beat the pest if you don't test. Soy Sentinel. Vol. 10. No. 1.

#### Videos

White Mold in Soybean. 2013. UW Extension – Cooperative Extension Service. University of Wisconsin. <http://fyi.uwex.edu/fieldcroppathology/videos/>

Sudden Death Syndrome in Soybean. 2013. UW Extension – Cooperative Extension Service. University of Wisconsin. <http://fyi.uwex.edu/fieldcroppathology/videos/>

Soybean Vein Necrosis. 2013. UW Extension – Cooperative Extension Service. University of Wisconsin. <http://fyi.uwex.edu/fieldcroppathology/videos/>

#### **Business Meeting:**

##### **Motion to approve the minutes from 2013:**

Dr. John Rupe moved for minutes approval, Dr. Doug Jardine seconded it. The motion passed with majority vote.

#### **Administrative Update:**

The 2013 year was a tough year for NIFA and the experiment station directors. The turn of the calendar and the passing of the Farm Bill should bring some anticipated stability to the roller coaster in DC. There should be money for soybean diseases in new AFRI proposals, including the CARE program. Really the only program that received a reduced budget is the new Crop Protection Program (CPP) that is a conglomeration of several IPM-related programs merged into one.

Dr. Steve Slack was able to share with several NIFA representatives the story of the NCERA 208 committee, including how we stabilized the response to the first soybean rust find. Ten years later, Dr. Slack anticipates that we can now consider soybean rust much like other soybean diseases. He shared the Soybean Rust Impact videos (see details below) with representatives in DC and they were really well received.

**Plant Disease Feature Article:**

Thanks to the efforts of Drs. Kiersten Wise, Ed Sikora and Tom Allen, the NCERA 208 committee once again pulled together a multi-state publication. This one was a feature article in Plant Disease titled "A coordinated effort to manage soybean rust in North America: a success story in soybean disease monitoring." This article was accepted in February 2014. Dr. Wise was acknowledged with an award for her efforts to pull off such an article.

**A thanks to Dr. Don Hershman:**

Dr. Hershman has shown great leadership, collaboration, and foresight over his career. The group unanimously thanks Don for his contributions over the past years and wish him well in the next chapter of his life after his December retirement.

**Discussion on ending NCERA-208 (merging with NCERA-137 (formerly 212)):**

There are pros and cons with ending this committee. Some feel the timing is right, some disagree. Some of the arguments that favored merging with the NCERA-137 committee included:

- Impact statements are already written from the 2013 award.
- Soybean rust will be treated like other diseases and by merging with 137, it will continue to be part of discussions with the national soybean working groups.
- The paperwork (according the Dr. Slack) for merging the two groups is not too bad.

Arguments for continuing as a separate committee included

- We should wait until the life of latest NCERA-208 committee 5-year plan is expired and re-evaluate then.
- Significant paperwork has been completed to renew the NCERA-208 committee and get the 2013 award.
- Travel money will go away for committee that disbands
- Someone will have to file a report to terminate 208.

At the end, it was decided, with the encouragement of Dr. Slack, to merge with NCERA-137. Daren Mueller made a motion for NCERA-208 to merge with NCERA-137, if NCERA-137 was willing. Ray Schneider seconded the motion. And the motion passed.

Once the NCERA-208 committee decided to merge with NCERA-137, the NCERA-137 committee voted to either accept this merger or not. Dr. Ed Sikora made the motion to merge the NCERA-208 committee with the NCERA-137 committee on September 30, 2014, [amendment]

contingent on NCERA-137 being renewed (Dr. Carl Bradley made this amendment)]. Dr. John Rupe seconded the motion.

Dr. Slack then reminded the group that the NCERA-137 committee will need to rewrite NCERA-137 objectives to have a national flavor.

**Secretary nominations:**

The floor was open for nominations for secretary of the NCERA-137 committee (no new secretary was appointed for the NCERA-208 committee). Dr. Nathan Kleczewski was nominated. Dr. Anne Dorrance made a motion to appoint Dr. Kleczewski as the incoming secretary. Dr. Don Hershman seconded and closed the nominations. Dr. Kleczewski was unanimously elected by the group.

**Meeting Locations:**

It was discussed by the group that the next meeting occur in Washington DC to accommodate travel restrictions for Dr. Martin Draper and increase our visibility in DC. Dr. Carl Bradley suggested meeting before or after the 2015 Commodity Classic in Phoenix to raise our visibility with commodity groups. Dr. Heather Young made a motion to meet in the DC area and Dr. Doug Jardine seconded it. The vote passed. The group discussed keeping the same approximate time (March) as well.

**Dr. Dufault moved to close the meeting and the entire group unanimously seconded it.**