**COMPILED STATE REPORTS for 2010-2011**

**NCERA-212**

## 2012 State report to NCERA-212 from Alabama

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In 2011, Alabama soybean producers harvested 295,000 acres of soybeans with an average yield of 33 bu/acre totaling 9.7 million bushels for the State. Approximately 60% of the soybeans were double-cropped after wheat. The relatively late crop, with the help of some timely late-season rains and low disease pressure, resulted in higher yields than was expected because of the drought that hampered production throughout most of Alabama. Average yield was 5 bushels higher in 2011 than in 2010 (28 bu/acre average), but less than our record yields of 2009 (40 bu/acre).

Cercospora leaf blight was a significant problem, especially in south Alabama. Aerial web blight caused minor damage in scattered fields, but was less of a problem then we observed in 2010. Other foliar diseases reported included Septoria brown spot, target spot and downy mildew. Charcoal rot was relatively common as a result of the drought-like conditions experienced during much of the growing season. Bean pod mottle virus was detected in research trials in west-central Alabama but at much lower levels then what was reported in 2010. Soybean mosaic virus was detected but at very low levels compared to the previous year.

The soybean rust monitoring program was continued in 2011. Amazingly, the disease was not detected in Alabama in 2011. Scouting for the disease was terminated in mid-October. Soybean rust likely moved into the state by the end of the calendar year as it was found in both Baldwin and Montgomery counties on kudzu in January of 2012. By comparison, soybean rust was detected in seven counties in Alabama in 2010 and in all 67 counties in the State in 2009.

**2011 Illinois Report – NCERA 212**
**Pensacola, FL, March 2011**
**Carl A. Bradley & Glen L. Hartman**

**2011 Soybean production in Illinois:**
A total of approximately 8.9 million acres of soybean were harvested in Illinois in 2011. The average yield was 47 bu/A, making total production of over 416 million bushels of soybean for Illinois in 2011.

**Soybean research projects in the Bradley lab:**
**Fungicide resistance**
- QoI (strobilurin) fungicide resistance monitoring of *Cercospora sojina* continued. New areas of Kentucky, Tennessee, Missouri, and Louisiana were identified with QoI fungicide-resistant isolates of *C. sojina*.
- The QoI resistance mechanism of *C. sojina* was determined to be the G143A mutation through sequencing the cytochrome b gene. A molecular assay (standard PCR) was developed that will detect this mutation in *C. sojina* cultures and in soybean leaflets with frogeye leaf spot lesions, and a quantitative PCR assay currently is being developed.
- A foliar fungicide trial was conducted at the Univ. IL Dixon Springs Agricultural Center (southeastern IL) that was inoculated with a QoI fungicide resistant strain of *C. sojina*. Results of this trial indicated that several triazole fungicides and thiophanate-methyl (Topsin M) was effective in controlling the QoI fungicide resistant strain. Products that contained both a QoI and a triazole fungicide generally provided intermediate levels of control, while products that contained only a QoI fungicide were not significantly different than the non-treated control for frogeye leaf spot control.
- Field trials were conducted at Dixon Springs, IL and Milan, TN to determine the competitiveness of QoI-resistant and –sensitive *C. sojina* isolates in collaboration with Dr. Melvin Newman (Univ. Tennessee). Preliminary results indicate that QoI fungicides are not effective in controlling frogeye leaf spot, even when QoI resistant *C. sojina* isolates make up only 0.25 of the *C. sojina* population.

**Uniform fungicide trials**
- Uniform seed-applied and foliar-applied fungicide trials were conducted at six locations across the state. Yield responses were variable at each location, and depended largely on disease pressure and the environmental conditions after planting (for the seed-applied fungicide tests)

**Soybean cyst nematode x *Rhizoctonia solani* interactions**
- Field trials were conducted at two locations in Illinois to evaluate interactions between soybean cyst nematode (SCN) and *Rhizoctonia solani*. Preliminary analyses indicate that effects of *R. solani* were more severe on a SCN-susceptible soybean cultivar than a SCN-resistant cultivar.

**Soybean cyst nematode – nematicide seed treatment trial**

- As part of a North Central Soybean Research Program – funded trial, seed-applied nematicides were evaluated for their effects on SCN at two locations in Illinois.

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

**Disease Epidemiology**

- Exogenous PCR controls were used to increase accuracy of multiplexed, quantitative PCR assays for *Phakopsora pachyrhizi*.
- Soybean rust epidemics were evaulated in sequential plantings of soybean cultivars to evaluate the interaction of weather conditions and rust development over time.

**Soybean Resistance**

- Seed transmission of *Soybean mosaic virus* (SMV) and SMV-induced seed coat mottling was found to be controlled by multiple loci.
- A review that focused on host-pathogen interaction of soybean and *Phakopsora pachyrhizi* was completed.
- Terms used to define resistance to *Phakopsora pachyrhizi* in soybean were further explained and validated.
- Comparisons of visual rust assessments and DNA levels of *Phakopsora pachyrhizi* in soybean genotypes varying in rust resistance were compared showing that qPCR provides good quantitiave estimates of disease resistance.
- USDA soybean germplasm accessions were evaluated for resistance to soybean rust in multiple locations in the Southern United States.

**Publications**


Domier, L. L., Hobbs, H. A., McCoppin, N. K., Bowen, C. R., Steinlage, T. A., Chang, S., Wang, Y., and Hartman, G. L. 2011. Multiple loci condition seed transmission of *Soybean mosaic virus* (SMV) and SMV-induced seed coat mottling in soybean. Phytopathology 101:750-756.

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Hartman, G. L., West, E., and Herman, T. 2011. Crops that feed the world 2. Soybean-worldwide production, use, and constraints caused by pathogens and pests. Food Security 3:5-17.

Haudenshield, J. S., and Hartman, G. L. 2011. Exogenous controls to increase negative call veracity in multiplexed, quantitative PCR assays for *Phakopsora pachyrhizi*. Plant Disease 95:343-352.

Miles, M. R., Bonde, M. R., Nester, S. E., Berner, D. K., Frederick, R. D., and Hartman, G. L. 2011. Characterizing resistance to *Phakopsora pachyrhizi* in soybean. Plant Disease 95:577-581.

Paul, C., Hill, C. B., and Hartman, G. L. 2011. Comparisons of visual rust assessments and DNA levels of *Phakopsora pachyrhizi* in soybean genotypes varying in rust resistance. Plant Disease 95:1007-1012.

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Twizeyimana, M., Ojiambo, P. S., Hartman, G. L., and Bandyopadhyay, R. 2011. Dynamics of soybean rust epidemics in sequential plantings of soybean cultivars in Nigeria. Plant Disease 95:43-50.

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Valdés-López, O., Thibivilliers, S., Qiu, J., Xu, W., Nguyen, T., Libault, M., Le, B., Goldberg, R., Hill, C. B., Hartman, G. L., Diers, B. W., and Stacey, G. 2011. Identification of quantitative trait loci controlling gene expression during the innate immunity response of soybean. Plant Physiology doi: 10.1104/pp.111.183327.

Walker, D., Boerma, H., Phillips, D., Schneider, R., Buckley, J., Shipe, E., Mueller, J., Weaver, D., Sikora, E., Moore, S., Hartman, G., Miles, M. R., Harris, D., Wright, D. L., Marois, J. J., and Nelson, R. L. 2011. Evaluation of USDA soybean germplasm accessions for resistance to soybean rust in the Southern United States. Crop Science 51:678-693.

Qi, M., Wang, D., **Bradley, C. A.**, and Zhao, Y. 2011. Genome sequence analyses of *Pseudomonas savastanoi* pv. *glycinea* and subtractive hybridization-based comparative genomics with nine pseudomonads. PLoS One 6:e16451. doi:10.1371/journal.pone.0016451.

Abstracts

Olaya, G., Pearsaul, D., Zhang, G., and **Bradley, C.** 2011. Evaluation of *Cercospora sojina* isolates sensitive and resistant to azoxystrobin using a mycelial growth inhibition assay. Phytopathology 101:S132.

Zhang, G. R., and **Bradley, C. A.** 2011. Survival of *Cercospora sojina* on soybean leaves in Illinois. Phytopathology 101:S203.

Zhang, G. R. and **Bradley, C. A.** 2011. Field resistance of *Cercospora sojina* to QoI fungicides and management with alternative fungicide chemistries. 2011 North Central Division APS Meeting Abstracts.

Frohning, J. R., Niblack, T. L., Ames, K. A., Bond, J. P., and **Bradley, C. A.** 2011. Field evaluation of *Rhizoctonia solani – Heterodera glycines* interactions on soybean. 2011 North Central Division APS Meeting Abstracts.

Zhang, G. R., and **Bradley, C. A.** 2011. Development of baseline *Cercospora sojina* sensitivity levels to quinone outside inhibitor fungicides and monitoring for resistance. Proceedings of the 2011 Southern Soybean Disease Workers Annual Meeting, Pensacola, FL.

Proceedings:

**Bradley, C. A.**, and Zhang, G. R. 2011. Detection and management of strobilurin fungicide-resistant strains of the frogeye leaf spot pathogen of soybean. Proceedings of the 2011 University of Illinois Agronomy Day, Urbana, IL, p. 18.

**Bradley, C. A.** 2011. Paying for fungicides, or making fungicides pay? Proceedings of the 2011 Illinois Corn and Soybean Classic Meeting Series, pp. 2-6.

**2011-2012 Indiana State Report for NCERA 212**

Kiersten Wise and Teresa Hughes

**Purdue personnel involved with soybean disease activities:** Kiersten Wise, Teresa Hughes, Virginia Ferris, Jamal Faghihi, Gail Ruhl, and Tom Creswell

In 2011, approximately 5.3 million acres of Indiana cropland was in soybean production. The average yield was 45 bu/A, which was down from 2010, when average yields were 48.5 bu/A.

The impact of foliar and soil-borne diseases of soybean were minimal in 2011. Hot, dry conditions persisted through much of the growing season, and 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) was observed only in the northwest corner of Indiana, and was not yield limiting. Personnel participated in monitoring for soybean diseases, including soybean rust, and distributed disease observations through the ipmPIPE commentary and the Purdue Pest and Crop Newsletter.

**Soybean research:**

Research on foliar fungicide applications on soybean showed similar results in multi-location trials conducted in Indiana in 2011. These findings showed that yield increases can occur due to fungicide applications in low-disease pressure environments on soybean, but ultimately the most profitable soybean production systems did not include foliar fungicides. Additional trials examine the impact of prophylactic fungicide and insecticide applications on a large scale or "on-farm" setting. Results from 2011 indicate that in these trials, fungicide applications were profitable only 30% of the time, which is similar to small-plot research trials, and indicates that producers could save between $24-36 per acre on fungicide and insecticide costs in soybean fields that do not require disease management. Research continues on the efficacy and profitability of a fungicide application in high management soybean production systems, and also on fungicide timing and the use of biological products to manage white mold.

Collaborative work has also begun to examine the role of sudden death syndrome (SDS) of soybean in fields with soybean cyst nematode (SCN). 2011 research indicates that areas planted to soybeans with a PI88788 source of resistance (susceptible to certain genetic types of SCN) are at higher risk for SDS development. These findings influence management recommendations to soybean producers, and additional research is necessary to understand the how SCN population may affect genetic resistance to SDS.

The results of the 2011 soybean survey of Indiana soybean fields indicate that brown stem rot is more prevalent in Indiana than previously reported. Of 300 samples collected across Indiana, brown stem rot was confirmed in 32% of samples, and was distributed as far south as Pike County, which is outside of the previously confirmed distribution zone. Additionally, 24% of samples had both SDS and brown stem rot present in a single plant, which indicates that interactions exist between these diseases, and

improved management recommendations may be needed to manage diseases simultaneously within a field.

**Refereed Publications:**

Henry, R.S. **Wise, K.A.,** and Johnson, W.G. 2011. Glyphosate's effect upon mineral accumulation in soybean. Crop Manag. doi:10.1094/CM-2011-1024-01-RS.

Henry, R.S. Johnson, W.G., and **Wise, K.A.** 2011. The impact of a fungicide and insecticide on soybean growth, yield, and profitability. Crop Prot. 30:1629-1634.

Peltier, A.J., Bradley, C.A., Chilvers, M.I., Malvick, D.K., Mueller, D.S., **Wise, K.A.,** and Esker, P.D. 20xx. Biology, yield loss, and control of Sclerotinia stem rot of soybean. J. Int. Pest Manag. (accepted).

**Extension Publications:**

Esker, P., Peltier, A., Bradley, C., Chilvers, M., Malvick, D., Mueller, D., and **Wise, K**. 2011. Management of white mold in soybean. North Central Soybean Research Program – Plant Health Initiative, booklet.

Henry, R. Wise, K., Johnson, W., and Krupke, C. 2011. Profitability of fungicides and insecticides in soybean. Purdue Pest and Crop Newsletter. Issue 17.

Wise, K. 2011. Are late-planted soybeans at risk for soybean rust? Purdue Pest and Crop Newsletter. Issue 9.

Wise, K. 2011. Bacterial blight in soybean. Purdue Pest and Crop Newsletter. Issue 13.

**NCERA 212 State Report – Iowa**

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

**Iowa soybean production**

Soybean production is estimated at 466 million bushels. Iowa soybean yield in 2011 averaged 50.5 bushels per acre, compared to 51 in 2010.

**Disease prevalence**

No major disease problems. Diseases observed were frogeye leaf spot (variety specific and only in parts of the state), brown spot, and very little SDS in central and southeast Iowa.

**Research projects**

- USB Project to complement the Corn Systems CAP project – two graduate students looking at different aspects of soybean diseases within this larger project.
- SDS – studying how seed treatments, crop rotation, tillage and planting date affect disease severity.
- White mold – using precision ag to evaluate "patch-specific" management using Cobra, Contans and fungicides; fungicide trials
- Fungicide and insecticide interactions – a statewide (6 location) study looking at the interaction between fungicides and insecticides applied at R3.
- Fusarium root rot
- Phytophthora root rot

**Refereed publications**

Gongora, C. C., and Leandro, L. F. S. 2011. Plant age affects root infection and development of foliar symptoms of soybean sudden death syndrome. Plant Disease, 95:242-247.

Gongora, C., and Leandro, L. F. S. 2011. Effect of soil temperature and plant age at time of inoculation on progress of root rot and foliar symptoms of soybean sudden death syndrome. Plant Disease 95:436-440.

Gongora, C. C., Nutter, F. W. Jr., and Leandro, L. F. S. 2011. Temporal dynamics of root and foliar symptoms of soybean sudden death syndrome at different inoculum densities. European J. Plant Pathology (in press). On-line: DOI: 10.1007/s10658-011-9849-4.

Peltier, A. J., Bradley, C. A., Chilvers, M. I., Malvick, D., Mueller, D. S., Wise, K. A., and Esker, P. E. 2012. Biology, yield loss, and control of Sclerotinia stem rot of soybean. J. Integrated Pest Management. Submitted Dec. 2011.

Mbofung, G. C. Y., Fessehaie, A., Bhattacharyya, M. K., and Leandro, L. F. S. 2011. A new Taqman real-time PCR assay for quantification of *Fusarium virguliforme* in soil. Plant Disease 94:860-866.

**Abstracts**

Bestor, N.R., Mueller, D. S. and Robertson, A. E. 2011. Economic analysis of small plot and on-farm fungicide trials on soybean in Iowa. APS Abstract.

Diaz-Arias, M., Leandro, L. F., and Munkvold, G. 2011. Distribution and frequency of isolation of Fusarium species associated with soybean roots in Iowa. Phytopathology 101:S42.

Diaz-Arias, M., Tylka, G. L., Leandro, L. F., and Munkvold, G. 2011 Interactions between Fusarium root rot pathogens and *Heterodera glycines,* on soybean roots. Phytopathology 101:S42.

Srour, A.Y., Islam, K., Mansouri, S., Bond, J., Leandro, L., F., Malvick, D., and Fakhoury. 2011. Role of rhizosphere microbial communities and nematodes in SDS development and/or suppressiveness in soybean cultivated fields. Phytopathology 101:S171.

Tatalovic, N., Tylka, G. L., and Leandro L. F. 2011. Microscopic observation of the interaction between the soybean sudden death syndrome pathogen and soybean cyst nematode, in soybean roots. Phytopathology 101:S17.

**Extension publications**

Mueller, D. and Sisson, A. Scouting White Mold in Soybean. Iowa State University Extension: CSI 020. September 2011.

Esker, P., Peltier, A., Bradley, C., Chilvers, M., Malvick, D., Mueller, D., and Wise, K. Management of White Mold in Soybean. North Central Soybean Research Program. August 2011.

Mueller, D., Sisson, A., Hodgson, E., Mallarino, A., McGrath, C., O'Neal, M., Pedersen, P., Pilcher, C., Pope, R., Rice, M., Robertson, A., Sawyer, J., Schaefer, K., Simon, K., Tylka, G., and Wright, D. Soybean field guide Second Version Iowa State University Extension: CSI 010. March 2011.

Sisson, A., Mueller, D., Hodgson, E., and Schaefer, K. Early season soybean scouting. Iowa State University Extension: CSI 006. January 2011.

Leandro, L., Mueller, D., Robertson, A., and Sisson, A. Sudden death syndrome-resistant soybean varieties for Iowa Iowa State University Extension: PM 3009. January 2011.

**Other impacts or activities**

First crop scouting competition

**KANSAS**

**2011 ANNUAL REPORT NCERA-212**

**March 2012**

**SOYBEAN DISEASE EXTENSION & RESEARCH IN KANSAS**

**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 3.75 million acres of soybeans in 2011 with an average yield of 27 bushels per acre. This compares to 4.25 million acres in 2010 when the average yield was 32 bushels per acre. The 2011 state average yield was down 17 bushels from the 2009 average of 44 bushels per acre. Most of the state south of Interstate 70 suffered from high heat and season long drought conditions. Estimated statewide losses from charcoal rot were five percent. This is the highest level of charcoal rot since 2006. The total yield lost estimate for soybean diseases was 11 percent in 2011, which is 1.2 percent below the 15 year average. In addition to charcoal rot, seedling blights were responsible for an additional five percent yield loss. SCN caused an estimated one percent yield loss. Losses for all other diseases were estimated at zero to trace levels. Results of a statewide SCN soil survey indicated that approximately 12.6 percent of Kansas soybean fields are currently infested with SCN.

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**Kansas Research Update**

**I. Charcoal rot**

**A.** Influence of soils, nutrition, and water relations upon charcoal rot disease processes in Kansas: Charcoal rot, caused by *Macrophomina phaseolina*, is the most important soybean disease in Kansas. Root colonization and root infection of soybean seedlings was assessed through the use of *M. phaseolina* inoculum under controlled conditions in the greenhouse. Root infection by *M. phaseolina* and microsclerotia longevity in soil is determined by environmental factors such as soil moisture content, soil texture and source of inoculum. The objective of the greenhouse study was to determine the impact of these variables on seedling root infection at the V1 and V2 development stages. Artificial soils with different textures were infested with *M. phaseolina* microsclerotia and soybean seedlings were exposed to different soil moisture regimes including pot saturation, pot (field) capacity, and permanent wilting point. Soil populations and levels of root colonization were assessed by estimating CFUs and root length. Results indicate that soil texture has a significant impact upon root morphology and root length. Root populations of *M. phaseolina* were significantly higher in coarse, sandy soil textures and lower in the fine-textured soils. The effect of water stress on seedling root colonization by *M. phaseolina* indicates that early infection under stress may be more important than previously thought. A field study was also conducted to determine the effect of the aforementioned variables in a 2-year field experiment conducted at two Kansas locations. Pathogen colonization was assessed by measuring colony-forming units (CFUs) from ground root tissue at R2-R4 (post-flowering/early pod

development) and R8 (maturity) stages. Soil populations (pre-planting and post-harvest) of *M. phaseolina*, yield parameters, and plant characteristics were obtained. Results indicated that there are complex and curvilinear relationships between soil physiochemical properties (pH, NPK content, exchangeable cations, and organic matter) and soil texture (sand, soil, and clay composition), which may mitigate disease severity and pathogen levels in host tissue. Results also indicated that in natural *M. phaseolina*-infested soils, cropping history and soil texture play an important role in charcoal rot processes and influence the levels of pathogen soil populations, root colonization at maturity and, more importantly, soybean yield (David Cruz, M.S. student).

**B.** Evaluation of soybean genotypes for resistance to charcoal rot: Charcoal rot, caused by *Macrophomina phaseolina*, significantly reduces yield in soybean more than most other diseases in the midsouthern United States. There are no commercial genotypes marketed as resistant to charcoal rot. Reactions of 27 maturity group (MG) III, 29 Early MG IV, 34 Late MG IV, and 59 MG V genotypes were evaluated for *M. phaseolina* in a non-irrigated, no-till field that had been artificially infested for three years. There was significant variation in root colonization among genotypes and years, indicating the value of screening genotypes over multiple years. Based on CFUI there was no genotype that was consistently immune to charcoal rot each year. However, there were a total of six genotypes (one genotype in MG III, one in Late MG IV, and four in MG V) that were identified as moderately resistant. Some of the commercial and public genotypes were resistant to *M. phaseolina* at levels equal to or greater than the standard DT97-4290, a moderately resistant cultivar. The genotypes identified as having moderate resistance across the three years could be useful as sources for developing resistant soybean genotypes (Mengistu et al., 2011; see Section II).

**II. Seedborne fungi/diseases**

**A**. High quality seed as a main feature for agricultural improvement: The mechanisms of infection, transmission and precise methods for diagnosis of important soybean seed pathogens, such as *Fusarium* spp. and *Phomopsis longicolla* require further study. The objective of this work was to identity seedborne pathogens of soybeans in Kansas. Eight locations and 7 varieties from Kansas were sampled and as a result a total of 78 fungal isolates, including both pathogens, were isolated from soybean seeds. The multi-location screening efforts showed that most *Fusarium* spp. were isolated from soybean seed produced in Cherokee county (southeast Kansas), followed by seed from sites in Pottawatomie, Republic, Reno, and Franklin counties. The soybean variety, KAES 4607, had the highest infection of *Fusarium* spp. and *Phomopsis longicolla*. This variety yielded 11% *Fusarium* spp. on potato dextrose agar (PDA) and 26% on pentachoronitrobenzene (PCNB) media, whereas *Phomopsis longicolla* was recovered at a rate of 4 and 2.5% on the same media, respectively. *F. proliferatum*, *F. oxysporum*, and *F. fujikuroi* have been identified based upon morphological characters and DNA-based molecular detection methods. The next step of the work is to test and score isolates regarding their pathogenicity and virulence. Additional material is being collected from last year's harvest (2011) to broaden isolate sampling. In future studies, these isolates will be used to elucidate the mechanisms of infection and transmissibility of *Fusarium* spp. and *P. longicolla*, use reporter markers (GFP, RdRFP) to trace pathogens

through the plant, and develop a precise molecular diagnostic tool for identification of soybean seed pathogens for seed health testing (Rodrigo Pedrozo, Ph.D. student; see Section III).

**B.** Evaluation of soybean genotypes for resistance to three seedborne diseases: Seedborne diseases of soybeans caused by *Phomopsis longicolla* (Phomopsis seed decay), *Cercospora kukuchii* (purple seed stain), and *M. phaseolina* (charcoal rot) are economically important diseases that affect seed quality. Commercial cultivars marketed as resistant to all three diseases are not available. Reactions of 27 maturity group (MG) III, 30 early MG IV, 33 late MG IV, and 53 MG V genotypes were evaluated for resistance to these pathogens during the 2006 to 2008 growing seasons in a field that had been in no-till production, not irrigated and naturally and artificially infested. There was great variation in seed infection among genotypes and years, indicating the value of screening genotypes over multiple years. Some genotypes were resistant to these pathogens in one, two or in all the three years. Genotypes DP 3478 (Early MG IV) and RO1-769F (MG V) were resistant and DG4460 was moderately resistant to *P. longicolla* infection across three years. Genotypes AG3705 and FFR3990 (MG III) and DC20300, DC7816, Stoddard and Ozark (MG V) were resistant to *C. kikuchii* infection during all three years. Ten genotypes in MG III, eight in early MG IV, seven in late MG IV and 14 in MG V had no seed infection by *M. phaseolina* in all the three years. These results indicate that seed infection comparison to these pathogens among genotypes should be made over several years, or false conclusions about resistance to any of the three pathogens may be made when disease is assessed for limited period of time. The genotypes identified as having resistance to each or combinations of the seedborne diseases across the three years could be useful as a source for resistance in improving soybean seed quality (Mengistu et al., 2012; see Section II).

**III. Sudden death/soybean cyst nematode:**

**A.** Effect of host resistance to *Fusarium virguliforme* and *Heterodera glycines* on soybean productivity: *Fusarium virguliforme*, the soilborne fungus that causes sudden death syndrome (SDS) of soybean, and *Heterodera glycines* Ichinohe, the soybean cyst nematode (SCN), are two economically important pathogens in the Midwest that are often found together in soybean (*Glycine max* (L.) Merr.) fields. This study was conducted to determine the effect of soybean genotype, *F. virguliforme* populations, and *H. glycines* populations upon yield and to examine the interaction between the two pathogens. In 2008 and 2009, four genotypes with different levels of resistance to SDS and SCN were planted at seven environments. *F. virguliforme* and *H. glycines* soil populations were quantified at planting, midseason, and harvest. At the end of the growing season, area under the disease progress curves of SDS, *F. virguliforme* root populations, and *H. glycines* reproductive indices were determined and plots harvested for seed yield. Soil populations of *F. virguliforme* and *H. glycines* at planting, midseason, and harvest varied across environments. As disease pressure increased, the performance of resistant genotypes increased compared to susceptible genotypes. There were negative correlations between yield and disease rating and *F. virguliforme* root populations. *F. virguliforme* soil populations and *H.*

*glycines* populations at planting were positively correlated. It is important to manage both SDS and SCN in fields with a history of the two diseases. This can be achieved through genetic resistance (Lilly Brzostowski, M.S. student; see Section III).

**IV. USDA Oomycete Soybean Seedling Disease Study**

250 oomycete isolates were recovered from 7 Kansas soybean fields that suffered from extensive stand emergence problems in 2007. Included in these 250 isolates were 21 species of *Pythium* and one each of *Aphanomyces* and *Phytophthora*. Six *Pythium* species, *P. irregulare*, *P. ultimum* var. *sporangiiferum, P. acanthicum, P. heterothallicum, P. orthogonon* and *P. ultimum* var. *ultimum* accounted for 80% of the isolates collected.

**V. NCRSP Soybean Nematicide Seed Treatment Study**

Two locations were used for the study. Poor emergence at the northeast Kansas location resulted in no useable yield data and drought stress at the southeast Kansas location resulted in plot yields of less than 10 bushels per acre. End of season nematode data suggested no significant differences between the three nematicidal treatments and the other control treatments.

**II. Publications:**

Mengistu, A., Wrather, A., Little, C.R., Bond, J., Rupe, J., Shannon, G., Newman, M., Canaday, C., Arelli, C., and Chen, P. 2012. Evaluation of soybean genotypes for seedborne diseases in no-till and non-irrigated fields. Plant Health Progress: *In Press*.

Mengistu, A., Arelli, P.A., Bond, J.P., Shannon, G.J., Wrather, A.J., Rupe, J.B., Chen, P., Little, C.R., Canaday, C.H., Newman, M.A., and Pantalone, V.R. 2011. Evaluation of soybean genotypes for charcoal rot. Plant Health Progress: Online (DOI: 10.1094/PHP-2011-0323-01-RS).

Jardine, D.J. and J.H. Long. 2011. Effect of seed treatment fungicides and insecticides on stand and yield of soybeans at Columbus Kansas, 2010. *Plant Disease Management Reports* 5:ST017.

Jardine, D.J. and J.H. Long. 2011. Effect of seed treatment fungicides and insecticides on stand and yield of soybeans at Columbus Kansas, 2010. *Plant Disease Management Reports* 5:ST018.

**2011 Michigan Report – NCERA 212**

**Pensacola, FL, March 2012**

Martin Chilvers, Research Plant Pathologist, MSU

**2011 Soybean production in Michigan:**

1.95 million acres of soybean were sown in 2011 and 1.94 million acres were harvested (down from 2.04 M harvested in 2010). Average state yield was 44 bu/A up 0.5 bu/A on 2010 with a total state production of 85.4 million bushels (USDA-NASS), which is below the state yield and production record of 46 bu/A and 91.5 million bushels respectively, recorded in 2006.

Growing conditions in 2011 were cool and wet at the start of the season, with excessive moisture early in the season around planting. Despite a cool and wet start and generally cool season, soybean production as noted in yield per acre was above average. Soybean sudden death syndrome (SDS) was the disease that created the most cause for concern with extensive development across the lower half of the state. In 2011 SDS was documented across an additional eight Michigan counties, bringing the total to 21 counties with confirmed SDS. Soybean cyst nematode, SDS and Fusarium root rot, and seedling diseases were considered to be the primary causes of yield loss in 2011.

**2011 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 [Esker (PI) Chilvers (Co-PI)]
- Breeding soybeans for multi-disease resistance (Wang)
- Fungicide and biological control of Sclerotinia stem rot (Kirk)
- Biological control of Sclerotinia stem rot (Hao)
- Predicting Sclerotinia stem rot (Hao)
- NCRSP irrigation effects on SDS and field screening methods (Chilvers)
- Michigan SCN survey (Bird)
- Legume IPM-PIPE and soybean rust IPM-PIPE (Chilvers & Jacobs)

**Refereed articles and reports in 2011-12**

Peltier, A.J., Bradley, C.A., Chilvers, M.I., Malvick, D.K., Mueller, D.S., Wise, K.A., Esker, P.D. *Submitted Dec-2011.* Biology, yield loss, and control of Sclerotinia stem rot of soybean. Journal of Integrated Pest Management.

Chilvers, M.I., Warner, F.W., Jacobs, J.L. and Wang, J. *In Press.* Efficacy of nematicide and fungicide seed treatments for soybean cyst nematode and soybean sudden death syndrome in Michigan, 2011. Plant Disease Management Reports.

Chilvers, M.I., Jacobs, J.L. and Boyse, J.F. *In Press.* Triazole foliar fungicide efficacy on Septoria brown spot in soybeans in Michigan, 2011. Plant Disease Management Reports.

Chilvers, MI., Zehr, G.L. and Munoz, J.D. 2011. Foliar fungicide efficacy on brown spot in soybeans in Michigan, 2010. Plant Disease Management Reports. 5:FC006.

**Extension articles in 2011-12**

Chilvers, M. and Silva, G. MSU Extension News. Septoria brown spot of soybeans. September, 26, 2011.

Chilvers, M. MSU Extension News. 2011 wasn't a year for white mold … was it? September, 14, 2011.

Chilvers, M. and Nagelkirk, M. MSU Extension News. Stem Canker and the *Diaporthe-Phomopsis* complex. September, 12, 2011.

Esker, P., Peltier, A., Bradley, C., Chilvers, M., Malvick, D., Mueller, D., and Wise, K. 2011. Management of white mold in soybean. North Central Soybean Research Program – Plant Health Initiative, booklet. Approximately 30,000 units printed.

Chilvers, M., Wang, J. and Byrne, J. MSU Extension News. Soybean sudden death syndrome found in four new counties in 2011. September, 6, 2011.

MacKellar, B., and Chilvers, M. 2011. MSU Extension News. Soybean sudden death syndrome symptoms beginning to develop in Ingham County. August, 16, 2011.

MacKellar, B., Chilvers, M. and Hao, J. 2011. MSU Extension News. White mold becoming evident in southwest Michigan irrigated soybean fields. July, 27, 2011.

MacKellar, B., Chilvers, M. 2011. MSU Extension News. Sudden death syndrome beginning to show symptoms in southwest Michigan soybean fields. July, 1, 2011.

MacKellar, B., Chilvers, M., Bird, G., and Wang, D. 2011. CAT alert. MSU soybean diseases research in Van Buren county will continue to investigate practices to manage sudden death syndrome in 2011. February, 25, 2011.

**Extension presentations and activities 2011-12**

*2012 – To date; 10 presentations delivered to a total of 829 participants, and 3 interviews:*

Field crops: corn, soybeans and wheat. Scouting for disease and disease control. IPM academy. East Lansing, MI. Feb 21. 14 participants

Soybean sudden death syndrome. Corn and soy meeting. Sandusky, MI. Feb 3, 2012. 112 participants

Soybean sudden death syndrome. Corn and soy meeting. Lawrence, MI. Feb 2, 2012. 78 participants

Update on soybean sudden death syndrome, and survey of corn and soy seedling diseases. Mason, MI. Feb 1, 2012.65 participants

Update on soybean sudden death syndrome, and survey of corn and soy seedling diseases. Hillman, MI. Jan 31, 2012.30 participants

Update on soybean sudden death syndrome, and survey of corn and soy seedling diseases. Alma, MI. Jan 30, 2012. 95 participants

Disease control for field crops. Ag Action Day. Kalamazoo, MI. Jan 27, 2012. 90 participants.

Distribution and characterization of sudden death syndrome (SDS) in Michigan and improved diagnostics. Dowagiac, MI. Jan 18, 2012. Presented by Jie Wang, Chilvers graduate student. 80 participants.

Management of white mold in soybeans with Contans. Michigan Farm Radio News. Interview by Nicole Schaendorf. Jan 16, 2012.

Soybean sudden death syndrome research update and Contans for white mold control. Corn and soy meeting. Frankenmuth, MI. Jan 16, 2012. 165 participants.

Soybean sudden death syndrome. Corn and soy meeting. Dundee, MI. Jan 13, 2012. 100 participants.

Soybean sudden death research highlights. Michigan Farm Radio News. Interview by Rob Buttery. Jan 3, 2012.

*2011 – 14 presentations delivered to a total of 1092 participants, and 4 interviews and one website launch:*

Soybean sudden death syndrome, corn and soy seedling diseases and Septoria brown spot of soybean. Agronomy Update for Extension Educators. MSU, pavilion, East Lansing, MI. Dec 20, 2011. 20 participants.

Update on SDS, corn and soybean seedling diseases and more…Integrated Crop and Pest Management Update for Agribusiness. MSU, Pavillion, East Lansing, MI. Dec 16, 2011. 300 participants.

Pioneer tour of the soybean sudden death research plots. Sep 21, 2011.

Update on soybean diseases in 2011. Soybean variety plot field day. Dan Rossman. Brekenridge, MI. Sep 15, 2011. 40 participants.

Soybean diseases: Soybean sudden death syndrome, white mold and septoria. Channel's Farmer Education Day. Mason, MI. Sep 13, 2011. 110 participants.

Field crop pathology update. Field crops team retreat – Extension Educators, MSU crops barn, September, 9, 2011. 14 participants.

Soybean sudden death syndrome and soybean cyst nematode. MSU extension field day, Dundee, MI. Aug, 31, 2011. 24 participants.

How to avoid sudden death and a soybean train wreck. Farm News – Michigan Farm Bureau, Paul Jackson, August, 30, 2011. http://www.michiganfarmbureau.com/farmnews/transform.php?xml=20110830/soybean.xml

Soybean sudden death syndrome and white mold. Michigan State University, Southwest Soybean Disease Research Centre, Decatur MI. Aug, 24, 2011. 90 participants.

Soybean seedling diseases and seed treatments. Michigan State University, Crop Diagnostic School, Saginaw bean and beet farm, MI. Aug, 2, 2011. 90 participants.

Soybean seedling diseases and seed treatments. Farm Journal – Soybean College, Coldwater, MI. Aug, 1, 2011. 150 participants.

Sampling soybeans for diagnostics – Ensure your samples can be tested. Farm Journal, Margy Fischer. Interview. August, 1, 2011. http://www.agweb.com/farmjournal/article/ensure_your_samples_can_be_tested/

Sudden death soybean fungus. ABC57 News, Byan Clund. July, 24, 2011.

'Sudden death' fungus threatens soybean crops in Southwest Michigan. Kalamazoo Gazette, Rosemary Parker. July, 16, 2011.

Soybean diseases: Biology, identification and management of soybean sudden death syndrome and Sclerotinia stem rot. Pest Management Meeting, Montcalm Co. Lakeview, MI. Feb, 4, 2011. 13 participants

Soybean diseases: Biology, identification and management of soybean sudden death syndrome and Sclerotinia stem rot. Pest Management Meeting, Saginaw/Tuscola/Shiawassee/Genesee Co. Frankenmuth, MI. Feb, 1, 2011. 75 participants

Soybean diseases: Biology, identification and management of soybean sudden death syndrome and Sclerotinia stem rot. Pest Management Meeting, Lapeer Co. Attica, MI. Jan, 31, 2011. 51 participants

Website launched to relay field crop pathology extension information and show case Chilvers laboratory research. www.fieldcroppathology.msu.edu Jan, 20, 2011.

Soybean diseases: Soybean sudden death syndrome and Sclerotinia stem rot. Pest Management Meeting, Gratiot/Isabella Co. Alma, MI. Jan, 14, 2011. 90 participants

**2012 Minnesota State Report**

*Report prepared by D. Malvick, March 2, 2012*

*Department of Plant Pathology, University of Minnesota, St. Paul*

University of Minn. Faculty Who Committed Significant Time to Soybean Disease Research

Dr. Dean Malvick. Dept. of Plant Pathology. Univ. of Minnesota
Dr. James Kurle. Dept. of Plant Pathology. Univ. of Minnesota
Dr. James Orf. Dept. of Agronomy and Plant Genetics. Univ. of Minnesota (breeding)
Dr. Senyu Chen. Southern Research & Outreach Center. Waseca, MN (nematology)

**Minnesota Soybean Production and General Disease Status Report for 2011.**

Minnesota harvested 7.02 million acres of soybean in 2011, while corn production increased to 7.7 million acres. The average state soybean yield was 38.5 bushels per acre, which is down 6.5 bushels/acre from 2010 and down 1.5 bushels/acre from 2009. Soybeans were produced in Minnesota from the Iowa border to the Canadian border, which includes maturity groups ranging from 2.2 to 00. Rainfall was frequent and above average from May through mid July, and then the rain stopped in most parts of Minnesota through the end of the growing season and beyond.

This put some drought stress on soybean in many areas. The other significant weather event was widespread killing frost across much of Minnesota on September 15, which was before senescence began in most areas. In most of Minnesota incidence and severity of soybean diseases was lower than has been common over the past decade or more. The most important widespread soybean disease problems were brown stem rot (BSR), seedling diseases, Phytophthora rot, and SCN. SDS was a minor problem and was primarily seen in only scattered very small patches or in irrigated fields.

**Selected Minnesota Research Projects and Progress in 2011.**

- White mold studies once again included investigation of the effects of fungicides and plant spacing on disease development, however, white mold developed at low incidence levels in the irrigated plots due to hot temperatures in July
- Projects have continued to focus on development of reliable field evaluation methods for resistance to SDS. The results in 2011 demonstrated the importance of adequate water in August for development of SDS. All plots had more than adequate rainfall through mid July, but SDS only developed in the inoculated plots with irrigation in August.
- SCN continues to be a significant problem in MN that is spreading. HG types capable of reproducing on PI88788 and Peking sources of resistance being detected more frequently.
- Phomopsis stem infections are widespread in MN as in many other areas, and we are working to improve our understanding of this disease and the pathogen population in Minnesota.
- Dual infection by *F. virguliforme* and *P. gregata* appears to be fairly common in MN fields, and we are working to understand this interaction in greenhouse studies.
- Soybean fungicidal seed treatment studies were focused on evaluation of products for SDS and *Rhizoctonia* management.

- Research by Dr. J. Kurle (soybean pathologist) and by Dr. J. Orf, (soybean breeder) continue to collaborate on identifying and breeding for resistance to SCN, *P. sojae, Fusarium virguliforme, Fusarium solani,* and *Sclerotinia sclerotiorum.*
- BSR continues to be a common problem in MN, and we have studies in progress to understand relative resistance to the A and B types of P. gregata in various soybean germplasms.

**Selected Minnesota Soybean Disease Publications and Abstracts – 2011**

Peer-reviewed Research Articles

- Bienapfl, J.C., Malvick, D.K.,and Percich, J.A. 2011. Specific molecular detection of *Phytophthora sojae* using conventional and real-time PCR. Fungal Biology. 115 733-740.
- Bao, Y., Neher, D.A.,Chen, S.Y. 2011. Effect of soil disturbance and biocides on nematode communities and extracellular enzyme activity in soybean cyst nematode suppressive soil. Nematology 13: 687-699.

Abstracts and Posters

- Floyd, C. and Malvick, D. 2011. Distribution and impact of sudden death syndrome in Minnesota. Presented at the NC-APS Meeting in Omaha, NE. June 2011.
- Impullitti, A.E. and Malvick, D.K. 2011. Soybean response to infection and colonization by the fungal pathogen *Phialophora gregata*. Presented and archived at *Plant Biology 2011*, the annual meeting of the American Society of Plant Biologists (Minneapolis, MN),
- Srour, A,Y. Islam, K., Mansouri, S., Bond, J., Leandro, L., Malvick, D., and Fakhoury, A.2011. Role of rhizosphere microbial communities and nematodes in SDS development and/or suppressiveness in soybean cultivated fields Phytopathology. 101: S171. Presented at the National APS Meeting in Hawaii. August 2011.

**NCERA 212 Soybean Diseases**

**Missouri State Report- 2012**

**2011 Production Summary from Missouri Agricultural Statistics Service:**

"The end of a very unusual growing season is welcomed after late planting, floods, drought and hail," said Gene Danekas, Director of the Missouri Agricultural Statistics Service. "Despite the extreme conditions experienced throughout Missouri, producers are expecting the fourth largest soybean harvest on record." Based on November 1, 2011 conditions, Missouri soybean production was forecast at 359 million bushels, down 8% from last year's crop. A state yield average of 37 bushels per acre is expected, 4.5 bushels per acre below last year. This would be the fourth largest soybean crop on record.

**2011 Soybean Disease Summary:**

Weather, especially extreme weather conditions, was the major problem during the 2011 season. For the third year in a row, wet conditions delayed planting by as much as 20-30 days in many areas of the state. The growing season started off unusually cool and wet. Rains continued until mid- August when conditions changed to unusually hot and dry. Record high temperatures were recorded in many parts of the state during August and drought conditions were prevalent for much of the remainder of the season. For the first time in three years conditions were favorable for harvest and most of the crop was harvested ahead of normal.

Early season seedling blight and root diseases were overshadowed by flooding and saturated soil conditions during the 2011 season. Flooding along the Mississippi River resulted in losses and replanting. Flooding along the Missouri River, especially in northwest Missouri, lead to losses, replanting or in some areas loss of crops for the entire season. Phytophthora root rot was evident both as an early season seedling disease and later in the season as plants were moving into reproductive stages of growth.

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 2011 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 and have not been particularly concerned about sampling fields. However, after the 2008 season, the Nematode Testing Laboratory was inundated with samples for SCN egg counts. This was true again in the fall of 2009. We had stressed SCN and the results of the NCSRP SCN study during fall field days and don't know if this contributed to the increase in farmer samples. The fall of 2010 saw a decrease in farmer samples from 2008-2009 but the number of samples was still higher that it had been prior to 2008. The weather

extremes of 2011 overshadowed most disease issues. The lab saw a slight decline in the number of samples for SCN testing in 2011.

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.

**Research Summary:**

Soybean rust fungicide trial was conducted at one location in central Missouri but soybean rust did not develop before trial was harvested. There were no statistically significant differences in yield between any of the treatments including the untreated control. None of the fungicides showed the stay-green effect that has been evident in past years.

Soybean seed treatment trials were conducted at the Bradford Research Center near Columbia. The earliest planting dates with varieties that had poor "Phytophthora packages" had high losses from Phytophthora seedling blight. Other trials with varieties that had both resistance genes and field tolerance had 95% emergence even at the earliest planting dates.

Missouri participated in the North Central Soybean Research Program's funded research trial "Inproving Management of Soybean Cyst Nematode through Extension Demonstration and Outreach Phase II. Seed treated with four of the seed treatment nematode protection products as well as the untreated check were planted at two locations. There were not statistically significant differences in nematode population levels or yield.

**2012 Report to NCERA-212 from Nebraska**

Loren J. Giesler

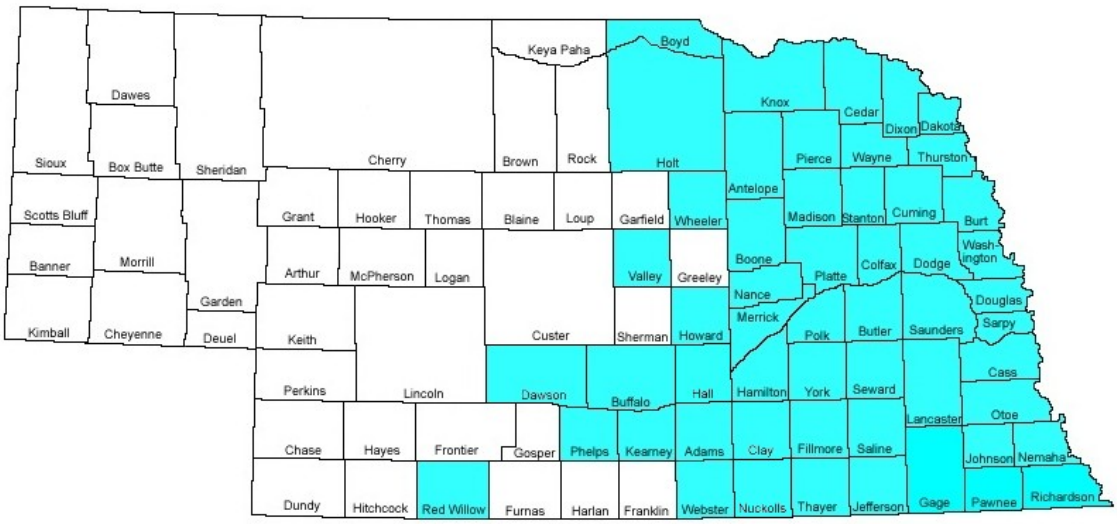
In 2011, Nebraska soybean producers harvested 4.8 M acres of soybean with an average yield of 53.5 bu./A. This was up slightly from yield averages in 2010 (52.5 bu./A). Our record state average yield was 54.5 bu./A (2009). Approximately 46% of our production is irrigated. The yield differences in the two cropping systems in 2011 was 13.2 bu./A increase from irrigation. Once again in 2011, timely rains reduced irrigation costs for many of our producers. Overall, in 2011 we had a low disease pressure across Nebraska.

Wet conditions after planting in 2011 resulted in stand problems in some areas. Phytophthora was a problem in many fields that received early season rains. Our most common seedling disease problems in the diagnostic clinic this year were Phytophthora and Pythium. Soybean rust sentinel plots were not operated in Nebraska during 2011. The most common foliar diseases observed were Bacterial Blight (middle June – early July), Brown Spot, Downy Mildew and Frogeye leaf spot. Bacterial pustule was observed in some field in late August. Of these diseases, bacterial blight (due to stormy conditions early) and frogeye leaf spot were the most severe. We continue to see an increasing number of fields with significant Frogeye development but it is still low overall with the most severely affected areas in the southeastern portion of the state. We observed more Frogeye leaf spot in 2010 compared to 2011.

**Soybean Cyst Nematode (SCN):** An SCN sampling project has been funded for seven 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 six years of this program we have detected SCN in 28 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 2012.

We 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 March, 2012.**




*NCSRP Regional Project:* In 2011, a project on SCN seed treatments was started with funding through NCSRP. All North Central states are involved in this project with the goal being to determine if the nematicidal marketed seed treatments have any effects on yield and SCN population density across the region. In 2011, the team conducted 30 trials.

*Herbicide Effects on SCN Reproduction on Alternative Hosts:* A graduate student in Weed Science has finished a study on herbicide timing and the effect on SCN reproduction on henbit. One interesting observation has been that glyphosate treated henbit resulted in lower SCN egg numbers compared to plants treated with 2-4-D at the same time.

**Sudden Death Syndrome (SDS):** Since 2004 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. We did not observe as much SDS in 2011 as we did in 2010. Brown stem rot was also identified in several fields in 2011.

**Foliar Fungicide Use in Soybean:** We continue to see significant use of fungicides in soybean production in absence of disease management needs. Several consultants are treating all of their soybean acres compared to corn that they only treat the highly susceptible hybrids. Their response is based on high commodity prices and the general trend that use in soybean is more profitable for them than corn applications (common comment from consultants). In 2011 we conducted standardized trials at our four Soybean Management Field Day locations to compare the standard foliar products and standard seed treatments on the market. This field day series is funded by our Nebraska Soybean Board.

**Effects of fungicide and insecticide applications on soybean yield at multiple locations in NE in 2011.**

| | Yield (bu/A) | | | | |
|---|---|---|---|---|---|
| **Treatment and Rate/A** | **Bancroft** | **Clay Center** | **Cortland** | **Elba** | **Average** |
| Non-treated | 58.5 | 72.8 | 52.3 | 64.7 | 62.1 |
| Headline SC 6 fl oz/A | 60 | 64.5 | 54.6 | 64.8 | 60.9 |
| Headline SC 6 fl oz/A + Respect 3 fl oz/A | 63.2 | 73.5 | 56.4 | 68.2 | 65.3 |
| Quilt Xcel 14 fl oz/A | 59.7 | 70.6 | 55.8 | 67.4 | 63.4 |
| Quilt Xcel 14 fl oz/A + Warrior II 1 fl oz/A | 62.2 | 70.6 | 58.1 | 69.6 | 65.1 |
| Stratego YLD 4 fl oz/A | 61.2 | 76.5 | 57.3 | 67 | 65.5 |
| Stratego YLD 4 fl oz/A + Leverage 360 2.8 fl oz/A | 64.9 | 77 | 58 | 67.6 | 66.9 |
| Evito 2 fl oz/A | 60.1 | 73.2 | 55.9 | 63.7 | 63.2 |
| Evito 2 fl oz/A + Mustang Max 3 fl oz/A | 62.1 | 74.1 | 55.3 | 64.9 | 64.1 |
| Mustang Max 3 fl oz/A | 60.6 | 69.8 | 54.5 | 63.1 | 62 |
| LSD (α=0.1) | 1.5 | NS | 2.4 | NS | --- |

**2011 NORTH DAKOTA ANNUAL REPORT NCERA-212**

**March 2012**

**SOYBEAN DISEASE RESEARCH IN NORTH DAKOTA**

Personnel: Berlin Nelson, soybean pathologist and Sam Markell, row crop extension pathologist.

The soybean acreage in North Dakota in 2011 was approximately 4.2 million acres. It was an unusually wet year in the early part of the season and soybean growth was poor for part of the growing season. Many fields were planted late due to wet conditions. The soybean disease research projects in 2011 were: 1) survey for soybean cyst nematode; 2) weed hosts of SCN, 3) incorporation of resistance to *P. sojae* and soybean cyst nematode (SCN) into public soybean lines/cultivars (cooperative study with breeder), 4) evaluation of commercial soybean cultivars for resistance to SCN, and 5) *Pythium* species in roots of soybean in ND.

By 2009, three counties in North Dakota were known to have SCN. As a result of a survey conducted in 2010, six counties were determined to be positive for SCN. In 2011, a survey for SCN and stem diseases was conducted in 20 counties east of the Missouri River by the National Agricultural Statistics Service. Samples were processed by the Plant Diagnostic Laboratory at NDSU. The funding for this survey was obtained from the North Dakota Soybean Council (NDSC). In addition to samples obtained through NASS sampling, NDSU and NDSC facilitated a reimbursement program from growers who sent soil samples in for analysis and contributed data to the survey effort. Approximately 80 samples were sent to the commercial laboratory Agvise for processing, largely thanks to a concerted effort on the part of the Pioneer agronomists.

Results from this survey effort and efforts in the past indicate that 12 counties in ND have samples with some positive egg counts. SCN is now found from the southern border of ND all the way to the Canadian border The spread of SCN continues into the soybean production areas of North Dakota. Other research on SCN included continued investigation on the effect of soil type on reproduction and evaluating common weeds in ND for suitability as hosts for SCN.

In 2011, *Heterodera schachtii*, the sugar beet cyst nematode (SBCN), was identified on sugar beet in the western part of ND in the Yellowstone Valley. Canola cultivars were also shown to be hosts of this nematode. This is a serious concern not only for sugar beet which is primarily grown in the eastern part of the state, but also because little is known about the effect of SBCN on canola production. Furthermore, canola production which occurs across the northern part of the state may serve as a bridge to move SBCN over to the eastern part. Since *H. schachtii* and *H. glycines* can hybridize, there is a question whether the hybrids could be important to crop production.

Developing resistance to Phytophthora root rot in public soybean cultivars and germplasm is a major effort between the soybean breeder and pathologists. Races 3 and 4 are most common in this area, but races that attack the 1k gene are becoming more common. Research on soybean cyst nematode (SCN) is another major emphasis of our program. In cooperation with the soybean breeder we maintain a

screening program for SCN. There are advanced lines in the breeding program with SCN resistance due to this cooperation. In 2011 commercial soybean cultivars were tested in three locations for resistance to SCN, but all sites were abandoned due to flooding or excessive soil moisture and poor plant growth.

A survey for *Pythium* spp in soybean roots was conducted in 2011. Roots were collected from 87 soybean fields in the eastern half of ND and *Pythium* was isolated on selective medium. We have identified 17 species in soybean roots, including several unusual species that were recently proposed as species. An in-depth examination of the pathogenicity of all the species found in soybean is underway.

**Publications Refereed Journals:**

Poromarto, S. H., Nelson, B. D., and T. C. Helms. 2011. Reproduction of soybean cyst nematode on dry bean cultivars over multiple generations. Plant Disease 95:1239-1243.

**Abstracts**

Markell, S., Jantzi, D., Kinzer, K., Hagemeister, K., Jordahl, J., Taylor, C., and Mathew, F. 2011. Geographic expansion of soybean cyst nematode in North Dakota. Third National Meeting of the National Plant Diagnostic Network. Berkeley, CA. November 6-9, 2011. Abstracts available at: http://www.npdn.org/webfm_send/1725

Aldrich-Wolfe, L., Travers, S. E., and Nelson, B. D. Aggressiveness of Sclerotinia sclerotiorum from the north central United States on multiple crops. Phytopathology 101:S5

Poromarto, S., del Rio Mendoza, L. E., and Nelson, B. D. Spatial distribution of soybean cyst nematode in research plots. Phytopathology 101:S144.

Rudolph, K, Bolton, M. D., and Nelson, B. D. Impact of soybean cyst nematode on Rhizoctonia root and crown rot of sugar beet. Phytopathology 101:S157.

**Other publications:**

Poromarto, S. H. 2011. Studies on the Biology of Soybean Cyst Nematode. PhD thesis, North Dakota State University, Fargo, ND.

**Popular Press articles:**

Markell, S., and Nelson, B. 2011. Soybean cyst nematode (SCN) on the move –part 2: Management. North Dakota Soybean Council news. June 2011.

Markell, S., and Nelson, B. 2011. Soybean cyst nematode (SCN) on the move.

North Dakota Soybean Council news. September 2011.

**Extension Activities (Sam Markell):**

Hosted a two-day expense-paid workshop for SCN for crop consultants and agents in North Dakota. Dr. Greg Tylka was the invited expert. Fargo, ND 3/9/11-3-9/12

Extension Talks:

| Date | Title | Location | Event | Estimated Number of Participants |
|---|---|---|---|---|
| 12/08/11 | Soybean Cyst Nematode (SCN) sampling in the Red River Valley Region. | Grand Forks, ND | Prairie Grains Conference | 100 |
| 12/05/11 | Soybean Root Rots and Cyst Nematode | Hillsboro, ND | Traill Co. Soybean Update | 30 |
| 7/18/11 | Soybean Cyst Update | Casselton, ND | Casselton Agronomy Farm Tour | 60 |
| 7/12/11 | Soybean Cyst Nematode: Field Demonstration | Carrington, ND | National Agriculture Statistics Service Training | 30 |
| 7/12/11 | Soybean Cyst Nematode: Importance and Sampling Lecture | Carrington, ND | National Agriculture Statistics Service Training | 30 |
| 3/24/11 | Disease Outlook: 2011 | Fargo, ND | Pesticide Recertification Meeting | 100 |
| 3/9/11 – 3/10/11 | Nematode Issues | Fargo, ND | NDSU/NDSC Nematode Short Course | 50 |
| 3/3/11 | Dry Bean and Soybean Diseases | Fargo, ND | Eastern Crop Scout School | 20 * 6 = 120 |
| 3/1/11 | Broadleaf Crops Disease Outlook | Fargo, ND | Branch Experiment Stations Spring Meeting | 24 |
| 2/16/11 | Soybean and Dry Bean Disease Updates: SCN, White Mold and Rust | Grand Forks, ND | International Crops Expo (ICE) | 85 |
| 2/15/11 | Diseases | Fargo, ND | Syngenta Managers Training: Product Managers, Regional Managers and Sales Managers | 12 |
| 2/9/11 | Hands On: SCN | Moorhead, MN | Best of the Best in Wheat and Soybean Research and Marketing | 17 * 10 = 170 |

| | | | | |
|---|---|---|---|---|
| 2/9/11 | Soybean Cyst Nematode- Where it is and How to Manage it. | Moorhead, MN | Best of the Best in Wheat and Soybean Research and Marketing | 170 |
| 2/8/11 | Hands On: SCN | Grand Forks, ND | Best of the Best in Wheat and Soybean Research and Marketing | 25 * 10 = 250 |
| 2/8/11 | Soybean Cyst Nematode- Where it is and How to Manage it. | Grand Forks, ND | Best of the Best in Wheat and Soybean Research and Marketing | 250 |
| 2/1/11 | Soybean Cyst and White Mold | Lisbon, ND | Ransom County Farm Expo | 30 |
| 1/28/11 | White Mold, SCN, and Root Rots | Valley City, ND | Getting it Right - Soybeans | 60 |
| 1/27/11 | White Mold, SCN, and Plant Health | Cando, ND | Getting it Right - Soybeans | 50 |
| 1/26/11 | Soybean Cyst and Plant Health | Carrington, ND | Getting it Right - Soybeans | 50 |
| 1/25/11 | Soybean Cyst Nematode | Wyndmere, ND | Getting it Right - Soybeans | 82 |
| 1/18/11 | The White Mold Story and SCN | Casselton, ND | Cass County Ag Improvement Association Annual Meeting | 50 |
| 1/5/11 | Dry Bean Discussion: Diseases | Devils Lake, ND | Roundup | 50 |