

## KANSAS SOYBEAN COMMISSION FINAL REPORT OF PROGRESS

Principal Investigators: Schapaugh, W. - Agronomy  
Todd, T. - Plant Pathology  
Trick, Harold - Plant Pathology

Title: "Breeding and Management of Soybean for Improved Performance"

Amount of Funding: \$263,847

Department Heads: Gary Pierzynski, John Leslie, Lyle Lomas

Progress Report: FINAL FY2015 (March , 2014 - February 28, 2015)

Accomplishments for FY 2015:

### **Variety Development/Genetics**

- The 2014 field crosses were harvested and all non-GMO progeny produced from these crosses have been sent to our winter nursery for generation advance. We continue the conversion and increase of one high yielding elite conventional line into a RR1 cultivar. We completed evaluations of over 2000 experimental K-lines and another 350 experimental lines from other states in over 10,000 replicated yield trials. Productivity and precision of the 2014 trials was above average.
- Our most advanced material performed well in the Uniform Testing program in 2014 and will be entered into additional tests in 2015. This included three maturity group IV and two maturity group V lines. Three of five of the lines are resistant to SCN. Plans are to advance 23 advanced lines into the Uniform Testing program in 2015.
- Transgenic events Y-25 and Prp-17 continue to show SCN resistance in subsequent generations. We are currently in the process of backcrossing both of these traits into KS4607 and have seeds of the F1 population.

### **SCN and Insect Breeding and Management**

- One hundred nineteen entries from the Kansas Soybean Variety Performance Test (KSVPT) were evaluated in replicated greenhouse trials for their reaction to two SCN populations that vary in virulence to the common resistance source PI 88788. Most entries (~60%) were moderately resistant, with fewer than 5% of entries displaying a high level of resistance. The mean female index (FI) across all Performance Test entries was 33 for the HG Type 7 population (FI on PI 88788 = 8.8). Field ratings of SDS severity on KSVPT entries were positively correlated with SCN female indices ( $r = 0.42$ ,  $P < 0.0001$ ). HG Type determinations have been completed for approximately one-quarter of SCN populations collected from a recent survey of Kansas soybean fields, with more than 50% of SCN populations in the state continuing to exhibit moderate to high levels of virulence (FI > 10) on PI 88788. Female indices averaged 22% on PI 88788 but were consistently greater (mean FI = 43%) on a PI 88788-derived cultivar. No populations to date have been able to reproduce on PI 437654 or its derived cultivar.

## **Heat and Drought Tolerance**

- Field evaluations from 2011 through 2014 continue to characterize the relationships between spectral reflectance, seed yield, drought stress and other physiological traits, and develop molecular markers associated with important reflectance measurements. In an effort to apply remote sensing to breeding for drought and heat stress, we collected 100,000 spectral and canopy temperature (CT) observations on 1400 genotypes grown at 8 locations in 6000 plots in 2014. The populations included genotypes from the KS4895 X Jackson population developed by the University of AR, some slow wilting selections from the University of MO, NAM populations and breeding lines from the KS program. This data is being analyzed. A portion of the analysis is characterizing the relationship of NDVI (spectral reflectance characteristic) to physiological parameters related to drought stress, such as wilting and shoot nitrogen. This includes evaluating 89 progeny from the population KS4895 X Jackson. We have canopy temperature data for this population as well. Graduate student, Randi Clark, will be summarizing the spectral and CT data and relating that information to the agronomic and drought stress characteristics of the 89 genotypes. These studies have continued to suggest that spectral reflectance data is a good candidate for exploration into optimized phenotyping techniques and with further research and validation datasets, may be a suitable indirect selection technique for breeding programs.

## **Opportunities for training and professional development**

- Five graduate students worked on projects related to the objectives of this project. One graduate student, Hatice Aslan, completed her M.S. degree in Spring 2015.

## **Dissemination of results**

- Extension publications, news releases, and experiment station reports, field days, extension meetings and tours are used to share the results of this project. Web pages have been developed to disseminate information on new releases and germplasm and pests. Distribution of results of genotype characterization for resistance published online. Distribution of SCN survey results to clientele will provide much-needed information for making informed decisions by producers regarding variety selections for SCN management and by soybean breeders for the development of varieties with improved levels of resistance. Effects of high temperature stress on soybean, and evaluations of host plant resistance were published at scientific conferences and published in peer reviewed publications.

## **Publications for 2014**

### **Journal articles**

- Christenson, Brent, W.T. Schapaugh, Nan An, Kevin Price and Allan Fritz. 201\_. Predicting Soybean Relative Maturity and Seed Yield Using Canopy Reflectance. Crop Sci. (In Review).
- N.R. Keep, W.T. Schapaugh Jr., P.V.V. Prasad and J.E. Boyer. 201\_. Characterizing changes in physiological traits in soybean with breeding advancements. Crop Sci. (In Review).

- Predeesh Chandran, John C. Reese, Dechun Wang, William Schapaugh, Shah Alam Khan, and Leslie R. Campbell. 201\_. Characterization of soybean resistance to soybean aphid (Hemiptera: Aphididae) Biotypes. (In review).
- Brent S. Christenson, William T. Schapaugh, Jr., Nan An, Kevin P. Price, and Allan K. Fritz. 2014. Characterizing Changes in Soybean Spectral Response Curves with Breeding Advancements. *Crop Sci.* 54:1585–1597.
- S. M. Pathan, J.-D. Lee, D. A. Sleper, F. B. Fritschi, R. E. Sharp, T. E. Carter, R. L. Nelson, C. A. King, W. T. Schapaugh, M. R. Ellersieck, H. T. Nguyen, J. G. Shannon. 2014. Two Soybean Plant Introductions Display Slow Leaf Wilting and Reduced Yield Loss under Drought. *Journal of Agronomy and Crop Science* DOI: 10.1111/jac.12053.
- Rincker, K., R. Nelson, J. Specht, D. Sleper, T. Cary, S.R. Cianzo, S. Casteel, S. Conley, P. Chen, V. Davis, C. Fox, G. Graef, C. Godsey, D. Holshouser, Guo-Liang Jiang, S.K. Kantartzi, W. Kenworthy, C. Lee, R. Mian, L. McHale, S. Naeve, J. Orf, V. Poysa, W. Schapaugh, G. Shannon, R. Uniatowski, D. Wang, and Brian Diers. 2014. Genetic improvement of U.S. soybean in maturity groups II, III, and IV. *Crop Sci.* 54:1-14.
- L.F. Brzostowski, W.T. Schapaugh, P.A. Rzdokiewicz, T.C. Todd and C.R. Little. 2014. Effect of host resistance to *Fusarium virguliforme* and *Heterodera glycines* on sudden death syndrome disease severity and soybean yield. *Plant Health Progress* doi:10.1094/PHP-RS-13-0100.

### **Thesis**

- Aslan, Hatice, Using remote sensing in soybean breeding: estimating soybean grain yield and soybean cyst nematode populations. M.S. Thesis, Spring 2015.

### **Conference papers and presentations**

- Predeesh Chandran, John C. Reese, Brian W. Diers, Dechun Wang, William T. Schapaugh. Influence of soybean aphid biotypes on chlorophyll loss of various soybean genotypes. Entomological Society of America Annual Meeting 2014.
- Brent Christenson, William T. Schapaugh Jr., P.V. Vara Prasad, Nan An, Allan K Fritz. 2014. Characterizing Soybean Maturity and Seed Yield Using Optimized Phenotyping with Canopy Reflectance. ASA Abstr.
- Randi Clark, William T. Schapaugh Jr., Jesse Poland, Larry C. Purcell and Andy King. 2014. Characterizing Drought Resistance in Soybean Using Spectral Reflectance Indices. ASA Abstr.

### **Acknowledgment**

The researchers cooperating in this project greatly appreciate the opportunity to interact with the Kansas Soybean Commission. We also appreciate the financial support of the Kansas Soybean farmer to develop new varieties, germplasm and information that improves soybean production.