DS VB

11/2/2017

Nebraska Soybean Board
Year-End Research Findings Report

Please use this form to summarize the practical benefits of your research project and what has been accomplished. Your answers need to convey why the project is important and how the results impact soybean production.

Project Title: Soybean Breeding and Genetics Studies for Nebraska

Contractor & Principal Investigator: George Graef

Please check/fill in appropriate box: ■ ***Continuation research project***
☐ ***Year __ of __ research project (for example: Year 1 of 2)***

1. What was the focus of the research project or educational activity?

This project involves applied research and development to (1) Produce high-yielding soybean varieties adapted to Nebraska and the Midwest; (2) Develop germplasm and cultivars for use in specialty markets; (3) Develop germplasm and cultivars with improved compositional quality; and (4) Evaluate and develop germplasm and cultivars that are resistant to iron deficiency chlorosis, soybean mosaic virus, bean pod mottle virus, phytophthora root rot, sclerotinia stem rot, and soybean cyst nematode.

2. What are the major findings of the research or educational activity?

From October 2016 through September 2017 we shared seeds from seven of our new high-yield lines for testing and evaluation by companies, USDA, and other universities through Material Transfer Agreements (MTAs) for evaluation and crossing.

We continue to make great progress improving yield in soybeans for our Nebraska production environments and across the north central region. Our lines topped the 2016 USDA Uniform Regional Tests in MG I, MG II, and MG III. We had the top 10 lines in the MG II Uniform Regional Prelim IIB tests. The #1 line, U14-910097, also has excellent SCN resistance and phytophthora resistance. Early reports from one company evaluating this line throughout the region show that it topped tests in Nebraska, Ohio, and Wisconsin.

We advanced 57 lines in the 2017 USDA Uniform Regional Tests. For advanced lines in the increase and purification process, we grew 49 increase plots, 4 variety purification plots, and 4 breeder seed increase plots.

Two graduate students completed their research this year and graduated in August and December. A third is completing his Ph.D. and will be done in January or February 2018. Their work involved projects with (1) breeding and selection for drought tolerance, (2) soybean seed compositional quality to increase protein and oil in the seed and decrease soluble sugars and identifying genes controlling those traits, and (3) characterization of the node accrual rate in soybean and identification of genes controlling that trait. We have lines from several populations in the early stages of the program that have other seed composition traits, including reduced allergens and increased total protein and oil.

Nebraska Soybean Board
Year-End Research Findings Report

Please use this form to summarize the practical benefits of your research project and what has been accomplished. Your answers need to convey why the project is important and how the results impact soybean production.

3. ***Briefly summarize, in lay terms, the impact your findings have had, or will have, on improving the productivity of soybeans.***

The progress in yield is important because we continue to develop and select from our Nebraska environments top-yielding lines for Nebraska that yield significantly better than the high-yield checks. Their performance holds up over years in Nebraska and is superior across the northcentral region, as shown by the Uniform Soybean Test results. With our multi-location evaluation program at high-yield farm sites in Nebraska, we identify high yield potential and are able to make significant gains in yield with each breeding cycle. Our high-yield lines are used by other programs as parents, and thus contribute to increasing genetic gain and expanding the genetic base in those programs as well. In addition, with over 5.5 million acres of soybean in Nebraska now, our program remains unique in that it develops soybean varieties specifically adapted to Nebraska production environments.

Our seed composition results are important because we have shown that 60% seed protein concentration and 26% seed oil concentration are obtainable, the lines were used to expand the NIR calibrations available to researchers throughout the US, and we are following up with more detailed evaluation of the extreme seed compositions and effects on yield and other important agronomic traits. The multiple, large populations, recently evaluated as part of graduate student research projects, have produced hundreds of lines with increased total protein and oil together, with reduced carbohydrates in the seeds. During 2016 we grew seed increases of more than 100 of the lines with the most extreme composition traits to follow up with extensive, multi-location tests during 2017 and 2018 to evaluate seed yield and composition in these new phenotypes. A new M.S. student is evaluating lines from the seed composition studies that have extreme seed composition types, with both higher and lower levels of total protein and oil concentration and soluble sugars. We are evaluating relationships with yield and agronomic traits in those unique lines.

We also have developed a collection of some of the most IDC-tolerant soybean lines available. Together with improved yield and seed composition, resistance to IDC will improve productivity and value on millions of soybean production acres. Many of our high-yield lines have other resistances, like phytophthora root rot, SCN, SMV, and BPMV as well.

4. ***Describe how your findings have been distributed to (a) farmers and (b) public researchers. List specific publications, websites, press releases. etc.***

We share our performance data with Nebraska Crop Improvement, NuPride and others, including companies and germplasm suppliers, who request information on our new soybean lines. The data for advanced lines in regional tests is shared with all public researchers through the USDA Uniform Soybean Tests Northern States, the SCN Regional Test.

5. Did the checkoff funding for your project leverage any additional state or Federal funding? Please list sources and dollars approved.

We developed an industry-university partnership that returned significant revenues to the university and the soybean board to strengthen and support ongoing soybean breeding research and development. We lead and participate in several important regional and national soybean research projects with NCSRP and USB funding. A group of us in the North Central region

Nebraska Soybean Board
Year-End Research Findings Report

Please use this form to summarize the practical benefits of your research project and what has been accomplished. Your answers need to convey why the project is important and how the results impact soybean production.

received funding for "Increasing the rate of genetic gain for yield in soybean breeding programs." I lead the USB program on genetic diversity to improve yield and seed protein concentration. Our team has developed new lines that increase the genetic diversity of the commercial soybean germplasm pool and have superior yield and seed protein concentration compared with the standard, high-yield check cultivars in the tests. Our drought work on this Nebraska-funded project and our NCSRP-funded work evaluating over 500 soybean accessions from the USDA Soybean Germplasm Collection is leading to other collaborations where we plan to conduct a study with a group of those accessions to evaluate them for drought tolerance in Nebraska environments and prepare a proposal for USDA-NIFA or other federal funding after the 2018 season.

This form must accompany the fourth quarter (final report)