

Nebraska Soybean Board

Year-End Summary Research Report Form For Multi-Year Projects

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 will impact soybean production.

Note that this form must be submitted with the 4th Quarter Report in all multi-year projects.

Project Title: Soybean Breeding and Genetics Studies for Nebraska

Principal Investigator: George Graef

Year of Multi Year: of (For example: Year 1 of 3, Year 2 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 impacts of the educational activity?

From October 2017 through September 2018 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. During 2018, there were new license agreements for 22 soybean varieties from our breeding program.

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 2017 USDA Uniform Regional Tests in MG I, MG II, and MG III. We had the top 10 lines in the MG II Uniform Regional tests. The #1 line, U14-910097, also has excellent SCN resistance and phytophthora resistance. The top MG I lines also have excellent SCN and phytophthora resistance, as well as IDC tolerance. We have top-yielding entries in the MG III test as well, including lines with excellent SCN resistance.

We advanced 72 lines in the 2018 USDA Uniform Regional Tests and SCN tests. For advanced lines in the increase and purification process, we grew 39 increase plots, 14 variety purification plots, and 4 breeder seed increase plots. We also grew 21 increase plots for top-yielding lines in our LibertyLink program. There is much interest in those lines, and I sent 6 of the top lines to our Chile nurse for purification blocks and production of breeder seed for the 2018-19 season.

One graduate student completed his research this year and graduated in August. His work involved characterization of the node accrual rate in soybean and identification of genes controlling that trait. There is no documentation of variation in pyllochron in soybean, so this work documenting phenotypic variation in the rate of node accrual in soybeans in the field, as well as identification of genetic control of the trait, is important and could lead to development of higher yielding soybeans better adapted to changing climate conditions.

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

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. Results from multi-location yield tests of extreme lines show we have recovered increased seed protein and seed oil, with no negative relationship with yield in these populations. That is significant, especially for soybean producers in the western soybean production areas where seed protein tends to be lower, and 60% or more of soybean production enters the export market.

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 (or soon will be) 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. Seeds of new soybean lines have been shared with companies through license agreements for both direct commercialization and for use in their breeding programs.

5. Did the NE soybean checkoff funding of your project, leverage additional State or Federal funding support? 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

Please e-mail this report to the Agriculture Research Division (jmonagham2@unl.edu).