

## 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 # and Title:** Soybean Breeding & 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 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) Produce germplasm and cultivars with improved compositional quality

(4) Evaluate and develop germplasm and cultivars that are resistant to iron deficiency chlorosis, soybean mosaic virus, bean pod mottle virus, phytophthora root rot, soybean cyst nematode, and sudden death syndrome (SDS).

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

Please see attached sheet. There is not sufficient room here to list all of our accomplishments.

**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 nearly 5.5 million acres of soybean in Nebraska, 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 companies and germplasm suppliers, who request information on our new soybean lines, as well as Nebraska Foundation Seed/Husker Genetics and NuPride/NCIA. 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 other universities, USDA programs, and companies through MTAs and license agreements for both direct commercialization and for use in their breeding programs. Results from our research are published in peer-reviewed journals.

**5. Did the NE soybean checkoff funding of your project, leverage additional State or Federal funding support? Please list sources and dollars approved.**

Applied for USDA NIFA CAP grant, pending.

Receive support for NCSRP and USB projects that we lead from Nebraska.

*Please email this completed form to the Agriculture Research Division (jmcMahon10@unl.edu) based on the reporting schedule given to you. If you have any questions, please call Jen McMahon at the ARD 2-7082.*

**Soy Breeding Year End Report Oct 2021 – This page needs to be included with the pdf file for the Soybean Breeding & Genetics Year End Report.**

**2. Major Findings**

- We grew over 42 increase plots for new lines that entered 2021 regional testing, 18 new variety purification blocks, and 4 new breeder seed increase blocks. The purification blocks and breeder seed increases are for advanced lines that remain at the top of regional test performance and will likely be released/commercialized as new soybean varieties. In addition, Foundation Seed/Husker Genetics is growing four other new lines in Foundation Seed production.
- Completed license agreements for two new soybean varieties to a new company we have not licensed to previously. The company is involved in creating new food products using soybean, and is interested in high-protein, high-yield soybeans.
- Shared more than 25 new soybean lines with superior yield, disease resistance, and seed composition traits with 9 companies during 2021. Four of those are new companies that have not obtained material from us previously.
- Shared more than 25 new soybean lines and 11 populations with superior yield and disease resistance traits with seven university and USDA programs for use in their breeding research and development efforts – includes Ohio State University, USDA-ARS, University of Illinois, Kansas State University, University of Tennessee, University of Minnesota, and University of Missouri.
- Provided 87 new, high-yielding advanced lines in our program for multi-location performance evaluation by one of the major US seed companies. Companies are using our conventional soybean varieties in their breeding programs to enhance yield and quality in their products, which impacts Nebraska producers and soybean farmers throughout the major soybean production areas in the US. This is their second year of wide area evaluations.
- Worked with another company who is interested in drought tolerance in soybean and other crops. We will complete a MTA during the first quarter of the FY22 project to share 12 of our soybean lines with superior yield, disease resistance, and seed composition for their evaluation and use in breeding and trait integration.
- Submitted 34 new high-yielding SCN resistant lines to the SCN Regional Tests for 2021
- Advanced 11 superior high-yield, SCN resistant lines in the 2021 SCN Regional Tests.
- Submitted 30 new high-yielding lines to the 2021 USDA Uniform Soybean Tests.
- Advanced 18 superior lines in the USDA Uniform Soybean Tests Northern States for 2021 tests.
- Results from the 2021 regional tests will be summarized after harvest is completed at all locations.
- Continued long-term research projects for increasing soybean seed protein concentration. I started these selection programs in 1988 and we now have soybeans that consistently produce seeds with 60% protein on a dry matter basis. One graduate student is completing his Ph.D. project to evaluate progress over cycles of selection for increased seed protein concentration in these populations, and characterize correlated changes that occurred with the significant increase in seed protein.
- Continue to identify important new traits and strategies for improving yield, quality, and stability to enhance profitability for Nebraska soybean farmers. You saw some of those things during your September field visit.

### 3. Impact

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### 4. Distribution of findings

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