

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?

- We grew over 40 increase plots for new lines that entered 2020 regional testing, 16 new variety purification blocks, and 5 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 more than 40 soybean varieties to seven companies for commercialization so the results of our efforts can get directly to soybean farmers.
- Commercialized our first new LibertyLink® soybean varieties to an independent Nebraska-based seed company that will directly impact Nebraska producers with new varieties.
- Licensed 16 lines with superior yield, high protein, high oil, and improved balance of oil, protein and carbohydrates to a newer company interested in providing quality products for the growing food-grade and quality composition market.
- At least two other companies are focused on soybean seed composition for oil and/or meal traits and are using lines from our Nebraska Soybean Breeding program to help achieve their product development goals.
- 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.
- Cooperated with another company to evaluate 1,700 of our new lines in early development to provide us with other Midwest locations of data and them with earlier information on our new developments.
- Identified soybean lines and genotypes related to improved soybean water productivity (WP), or yield per unit of effective water received. This is important for Nebraska soybean producers in both irrigated and rainfed production systems. In irrigated production, we have potential for meaningful reductions in irrigation inputs to achieve similar yields and improve both profitability and sustainability for soybean farmers. In rainfed production systems, those soybean varieties that yield more per unit water received are going to be the most profitable in the long-run. This was part of the Ph.D. project of Shawn Jenkins, that involved multi-sensor field phenotyping and mapping soil properties in collaboration with colleagues in Biological Systems Engineering, as well as genotype information from Dr. David Hyten's Soybean Genomics Lab.
- We made crosses with the highest yielding lines with best WP lines to develop populations and lines for even greater water productivity, as well as improved seed composition traits and SCN and disease resistance traits.

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.

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

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.