

## Nebraska Soybean Board

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



11/5/2018

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:** #1721 Integrating high throughput field phenomics into Nebraska Soybean Breeding

**Principal Investigator:** Yufeng Ge

**Year of Multi Year:** 3 of 3 (For example: Year 1 of 3, Year 2 of 2)

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

The focus of the research project was to collect field-based high throughput phenotyping data of soybean plots from various experiments in UNL soybean breeding program. A second focus was to develop and apply new data (image) analysis algorithms to analyze these phenotype data and integrate them into more advanced genotype-phenotype analysis or genomic selection.

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

The major findings are that crop traits such as canopy height, canopy temperature, and ground coverage can be effectively and accurately measured with the phenocart system. We used the color indices for the plot-level RGB images and showed that they can be used to score soybean iron deficiency chlorosis effectively. We also showed that soybean canopy temperature coupled with co-measured air temperature could be related to water use of different soybean lines. Further analyses are investigated to extract more relevant phenotyping data from these high-throughput, sensor based measurements which can be integrated into the soybean breeding program for selection.

**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.**

This project researches on non-destructive, rapid, and objective tools and systems to collect plant phenotyping data from soybean field plots. Examples are plot height, canopy temperature, reflectance spectra, and RGB images. We used these measurements as proxies for important morphological and physiological traits that are targets for breeding program and crop improvement. The research has the promise to enable more powerful phenotype-genotype analysis to shorten breeding cycles for soybean yield and quality improvement, thus benefit the Nebraska and U.S Soybean growers.

**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.**

Bai, G., Jenkins, S., Yuan, W., Graef, G.L., Ge, Y., 2018. Field-based scoring of soybean iron deficiency chlorosis using RGB imaging and statistical learning. *Frontiers in Plant Science* 9, 1002.

Bai, G., Ge, Y., Scoby, D., Leavitt, B., Stoerger, V., Norbert, Kirchgessner, Irmak, S., Graef, G., Schnable, J., Awada, T., 2018. NU-Spidercam: A large-scale, cable-driven, integrated sensing and robotic system for precision phenotyping, remote sensing, and agronomic research. *Computers and Electronics in Agriculture*. Under Review.

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

Tom Clemente, Yufeng Ge, James Schnable, Jinliang Yang. RII Track-2 FEC: Functional analysis of nitrogen responsive networks in sorghum. HudsonAlpha (primary sponsor: NSF). \$1,337,633.

James Schnable, Yufeng Ge, Yeyin Shi. Genomes to Fields (G2F) - Predicting Final Yield Performance in Variable Environments Through Consecutive Phenotyping Measurements Across the Growing Season. Nebraska Corn Board. \$51,054.

George Graef, David Hyten, Yufeng Ge. Increasing the Rate of Genetic Gain for Yield in Soybean Breeding Programs. Ohio State University (primary sponsor: North Central Soybean Research Program). \$282,668.

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