Progress report

Title: Unlocking the linkage between breeding and production research for N fixation, protein, and yields.

Biological Nitrogen Fixation (BNF) may be the most important economic and environmental process affecting soybean production in the US. We know surprisingly little about the amounts of N fixed by US soybeans. In addition, breeding for improvement in N fixation with new soybean varieties can also help to reserve the decline in the protein content from the last decades. As growers produce more soybeans in the 70- and 80-bushels range, or the environment becomes more stressful, improving N fixation will help to sustain protein content while increasing yields.

Objectives:
This research aims to 1) to identify potential limitations of nutrient status, mainly nitrogen on yields, 2) to develop strategies to improve protein content, and 3) to improve new soybean varieties with high rates of N fixation for increasing yield. A study conducted by our team already demonstrated that soybeans yields are deaccelerating relative to corn yields. Thus, this research becomes critical to understand the tradeoff between yield and protein and help to move forward not only the productivity of this crop but its sustainability over time. At the end, this project will provide new insights for increasing soybean yields, improve seed quality, reduce environmental impacts and sustainability, and provide greater returns to US farmers.

Procedures:

A field study was established leading two the use of two genotypes (two nodulated, and two non-nodulated varieties) and with different fertilizer N rates. Fertilizer application will be at sowing time or right after emergence. N source will be urea (46%), N rates equivalent to 0, 100, 200 and 300 lbs N/acre, respectively.

A photo of non-nodulated and a nodulated soybean variety grown under field conditions.

Photo. Non-nodulated (left) and nodulated (right) soybean varieties.

In-season weather and initial soil information from the study is included here.

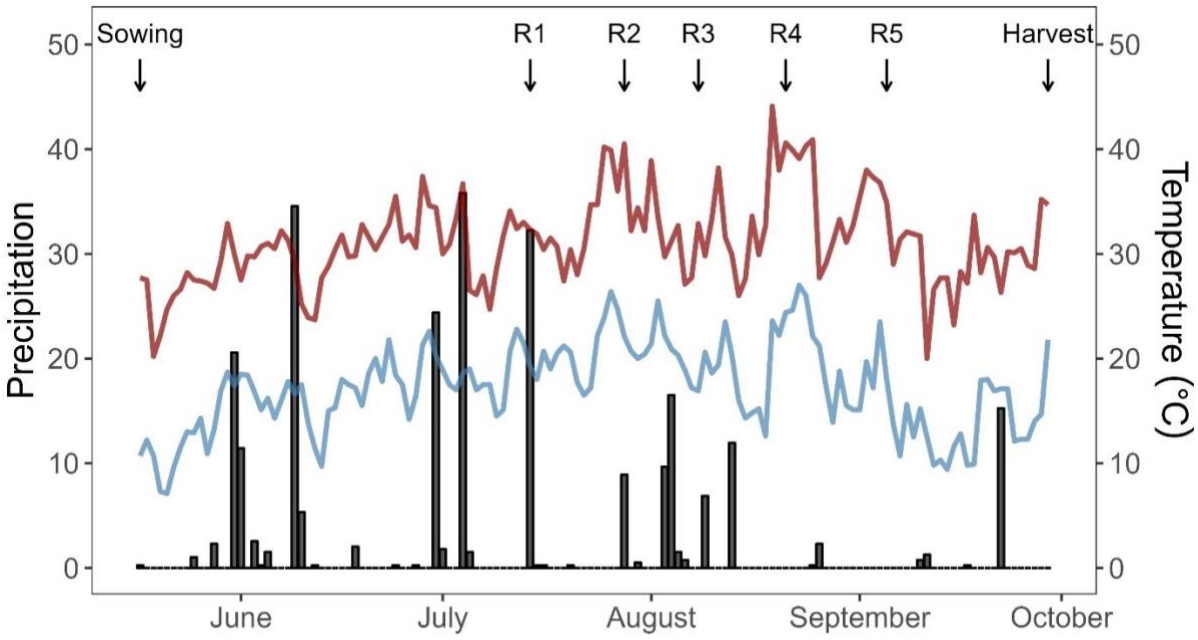

Figure. In-season weather characterization: maximum (red) and minimum (blue) temperatures, and precipitation (black bars). Sampling times, sowing, and harvest are illustrated

Table 1 Experiment soil characterization.

pH	OM (%)	NO3-N(ppm)	P (ppm)	K (ppm)	NH4-N (ppm)	Ca (ppm)	Mg (ppm)	(Na (ppm)	CEC	S (ppm)	Sand (%)	Silt (%)	Clay (%)
8.0	1.8	12.5	44	197	14	2640	66	12	14	12	27	60	13

The analysis of the yield data demonstrates that the non-nodulated (non-nod) soybean varieties are very responsive to the application of N fertilizer, with yields increasing in both varieties as the N fertilizer rates went up to 300 lbs N/acre (see below figure, lower panels). For the nodulated soybean varieties (nod), no response to increases in fertilizer N rates were documented (see below figure, upper panels).

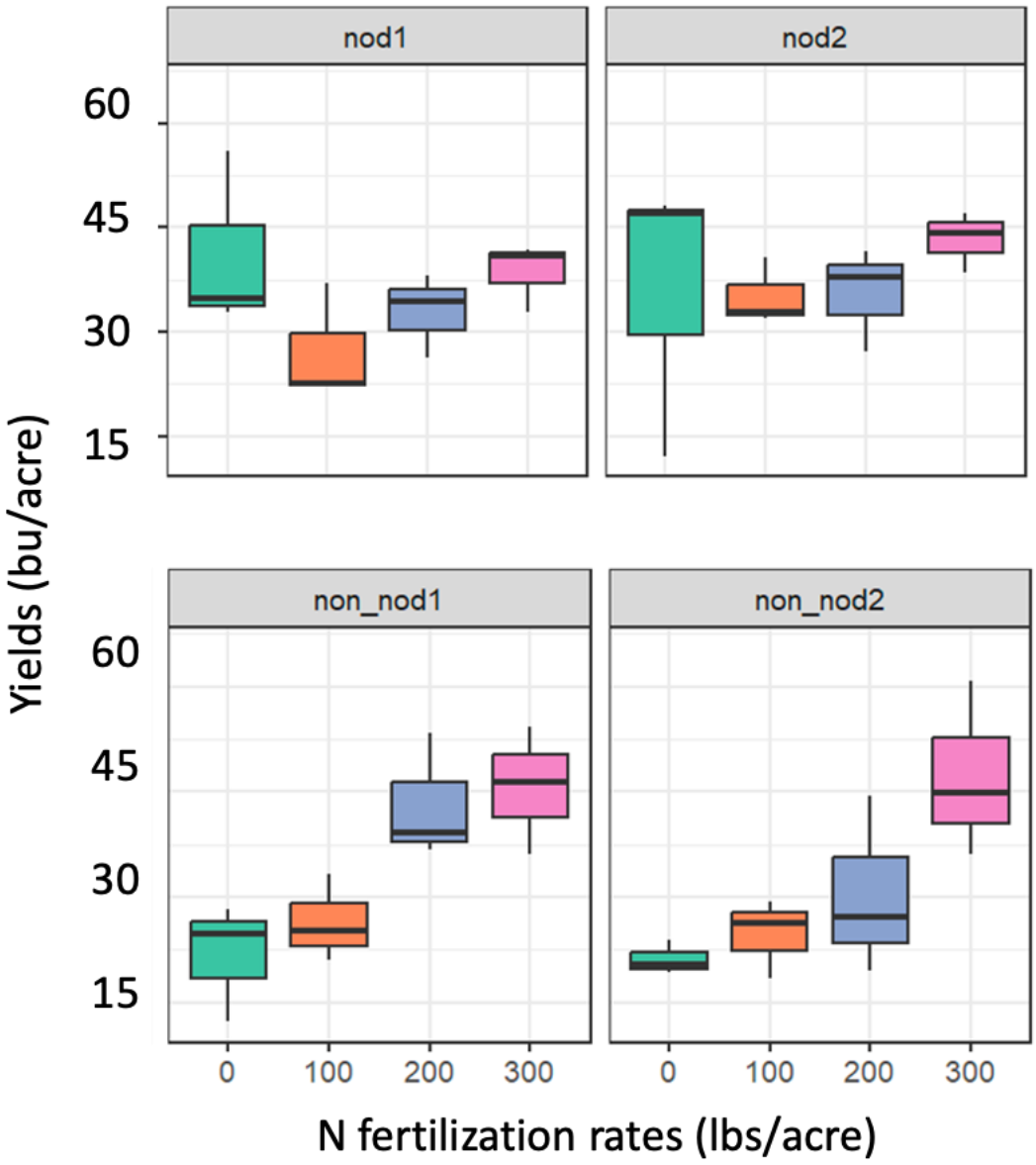

Figure. Soybean yields (bu/acre) for nodulated varieties (nod1 and nod2) and non-nodulated varieties (non_nod1 and non_nod2) on their response under different nitrogen fertilizer rates (lbs/acre), ranging from 0 to 300 lbs N/acre (0, 100, 200, and 300).

All plant data is currently evaluated – information on plant N concentration and development of a potential new in-season N screening tool are essential components of this project.

Preparation of a final publication will be an output of this project and extension bulletin will be derived from this document.