There are three objectives for this project including:

**1. Characterize mutants exhibiting shoot architecture phenotypes.**We are still working on the four mutants (Lps1, Christmas tree, short petiole and reduced branch angle) and characterizing transgenic plants for mutations in candidate genes and studying the phenotype of each mutant.

2. **Identify novel genes controlling shoot architecture in germplasm collections.**Three hundred and eighty-four accessions were grown in the field in 2016, 2017 and 2018 and shoot architecture phenotypes were obtained. We used a combination of high-throughput (e.g., drone-based imaging) and standard phenotyping approaches to score plants for height, petiole length, flowering time, growth habit, canopy closure, light penetration through the canopy, branch angle, branch number, node number, internode length, and plant shape.  We developed high-throughput imaging approaches for collecting branch angle, petiole length and leaf shape data. We are analyzing the shoot architecture data collected these field seasons. We have shown that branch angle and leaf shape is genetically related to canopy closure. We also developed automated high-throughput approaches to obtaining leaf area and branch angle data. In the future, this will save a considerable amount of time in collecting these data types. Two papers are being written that describe our results and a third describing the automated phenotyping approaches will be initiated soon. The lines used in this objective were also planted this year (2020) to obtain data in support of an National Science funding grant we were planning to submit.

**3. Examine shoot architecture in historical cultivars.**We planted 75 private and public cultivars that represent cultivars grown in Minnesota from the 1930s – present in the field in 2019. We phenotyped these cultivars for shoot architecture traits with high- and low-throughput approaches. Data analysis is ongoing. These lines were also planted in the field in 2020 for obtaining data for the funded USDA-NIFA federal grant.

The funding for this project laid the foundation for Aaron Lorenz (PI), Bob Stupar and myself to obtain a federal grant from the USDA-NIFA.  In addition, we are also using this project as leverage for a grant submission to the National Science Foundation.

Presentation:

Sreekanta, S. 2020. Developing new methods to measure traits impacting soybean shoot architecture. Plant and Animal Genome Conference Abstracts, San Diego, CA

**Achievements:**

There are multiple achievements associated with this project: (1) we showed phenotypically and genetically that branch angle and leaf area were associated with canopy closure; (2) we genetically map the location of numerous shoot architecture traits and have genetic markers associated with the traits; (3) we developed an understanding of soybean shoot architecture and how it pertains to canopy closure and light interception; (4) we developed automated systems to score branch angle and leaf area; (5) we have two papers in preparation; (6) we are developing an understanding of the phenotypic selection associated with shoot architecture that occured through 80 years of soybean breeding; and (7) we obtained a USDA-NIFA grant to continue and extend he work.

**Challenges:**

Measuring shoot architecture traits on almost 400 accessions per year (10 plants/accession = 4000 plants/yr) was a tremendous amount of work with regards to time and personnel. From harvest to the completion of data collection took us from 5-6 months with 4-5 people working on it. We have streamlined this process by developing more high-throughput automated data collection.