

North Dakota Soybean Council Midyear Report – FY 24

Project Title: State-wide evaluation of P rates required for Soybean in North Dakota

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Research Overview and Objectives:

There is a need for a reevaluation of phosphorus (P) recommendations in North Dakota. In general, soil test P values are lower in ND than other states, necessitating more careful P-management and potentially more frequent applications. Recent research showed increases in soybean yield with P-application in Minnesota on soils with moderate P-levels, but not in North Dakota. Therefore, current ND recommendations only recommend P-applications to soybean to fields with low or very low P-levels. This project seeks to reassess these recommendations with a coordinated statewide P-rate study in soybean. In addition, the fertilizer P rates recommended at low soil test P may be greater or less than what is profitable. There were 8 sites in 2023 throughout North Dakota (Figure 1 & Table 1). Each site had five P-rates applied. Soybean yield and soil test P were measured at all sites prior to fertilization and after harvest. The coordinated effort between researchers and Extension specialists at RECs is key for this project; a consistent protocol over 16 site-years across North Dakota will provide farmers with usable recommendations beyond a single region. This effort leverages the research infrastructure developed by NDSU in the RECs, and provides value to ND soybean farmers across the entire state. Additionally, a graduate student in Soil Science at NDSU is supported by this project – this student will integrate data between sites and will encourage a cohesive team.

The objective of the study is to establish meaningful phosphorus application rates for soybean across ND.

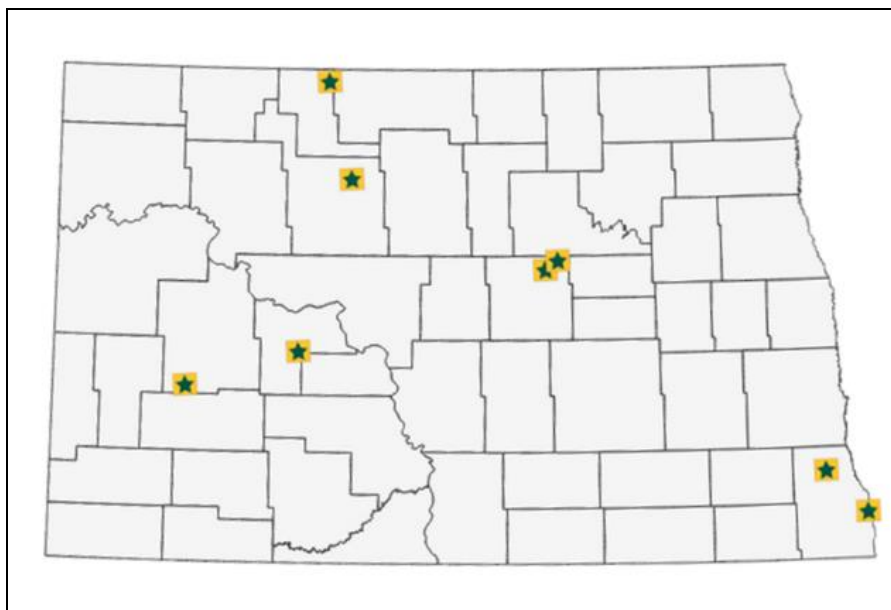


Figure 1. Map of 2023 soybean phosphorus trials sites.

Table 1. Townships and inherent soil properties (from Web Soil Survey) for each of the eight 2023 sites.

Township	Texture Class	Drainage Class
Fairmount, ND	clay loam	Somewhat poorly drained
Barney, ND	fine sandy loam	Somewhat poorly drained
Bremen, ND	loam	Somewhat poorly drained
Bremen, ND	loam	Well drained
Beulah, ND	clay loam	Moderately well drained
Dickinson, ND	loam	Well drained
Minot, ND	loam	Well drained
Mohall, ND	loam	Moderately well drained

Completed Work: Deliverables and/or Milestones.

All eight trials were established on low-P fields throughout the state. All trials have been harvested at the time of writing, but data processing and analysis is not complete.

This project supports an NDSU Soil Science M.S. student advised by Dr. Malone, who was hired in June of 2023 (Mr. Dayne Tallier). Mr. Tallier will compile results from all sites from 2023, as well as 2024 if funded.

In July 2023, Dr. Malone discussed this trial at the Dickinson REC Field Day, the first of many informal presentations on the project. Mr. Tallier brought a poster to ASA/CSSA/SSSA annual meeting in St Louis, MO as well as to the NDSU SNRS annual symposium with preliminary results from the SE sites.

Progress of Work and Results to Date:

Data from all locations will be analyzed together once all data is available. Preliminary results are shown here for the SE sites only.

Yield for both SE ND sites (Barney & Fairmount) did not show a significant response to P-rate (Figure 2), but the Fairmount yield did have a significant, positive relationship with spring soil test P (Figure 3, $p=0.004$, $R^2=0.36$). A second set of replications was implemented in Barney due to unexpected high spring P tests, but both trials were carried to yield. Integration of soil test P data into results will be crucial for testing fertilizer responses in future analysis.

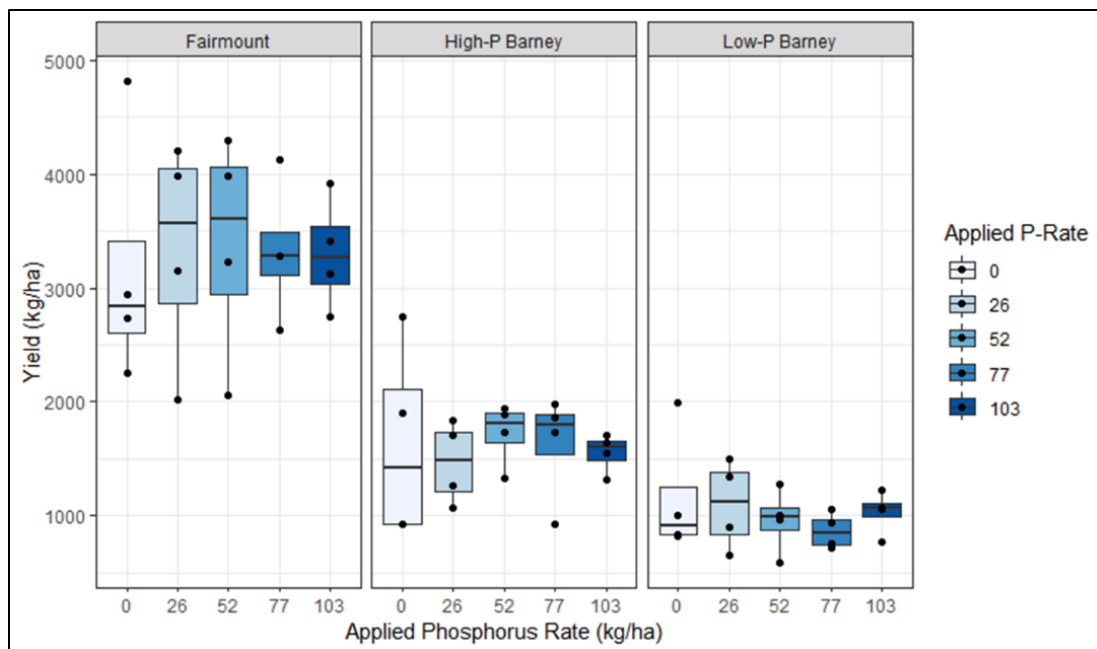


Figure 2. Boxplots of soybean yield at each of the SE ND sites by phosphorus rate.

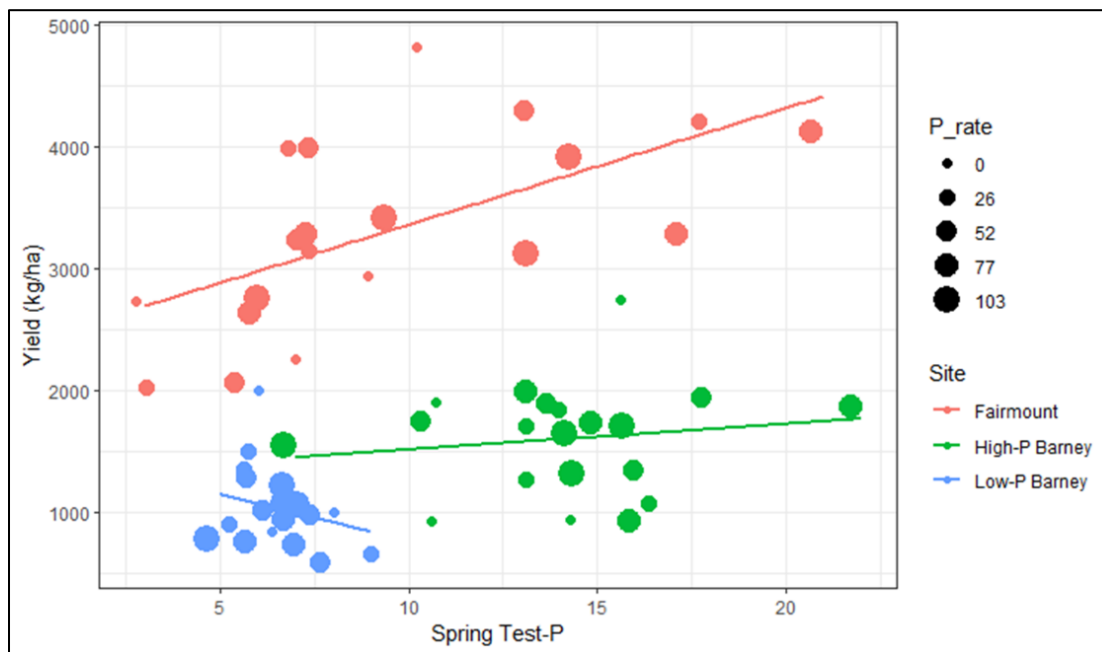


Figure 3. Scatterplot of Spring soil test phosphorus (Olsen method) and soybean yield in three SE ND trials. Point size corresponds to the P-rate, while color indicates trial location.

Work to be Completed:

Fall soil testing is still underway, as is processing yield data from all eight sites for 2023.

Deliverables of this research will include Extension presentations, both informal (plot demonstrations, field day conversations) and formal presentations or posters at academic conferences, an academic publication, and an Extension publication with updated P-fertilization recommendations. In order to support these recommendations, we have requested funding for a second year of field trials.

Other relevant information: potential barriers to achieving objectives, risk mitigation strategies, or breakthroughs.

Finding consistently low-P fields was more challenging than expected in 2023. This may be in part due to weaknesses in soil testing methods. We intend to archive the soil from these trials to assess soil-test options in the future. We are also looking at arbuscular mycorrhizal populations at select sites. No funding is currently being requested for these projects, but we wanted to emphasize the value of these trials beyond the current project.

Summary:

Improved recommendations are needed for phosphorus fertilization in soybean in North Dakota. We have made progress toward updating these recommendations in 2023 by conducting a statewide evaluation of P-rates on low-P fields. Data analysis is still underway, but two of eight sites did not respond to P-additions, although yield at one site was correlated with spring P levels. This research represents an important statewide collaboration, and supports a graduate student in Soil Science at NDSU. A second year of field trials and complete analysis on 2023 data will generate useful results for ND soybean growers.