HOW DO SULFUR AND CEREAL RYE AFFECT EARLY CORN AND SOYBEAN GROWTH?

Kaylee Johnson[1], Aaron Sassman[2], Larousse Dorrissant[3], Dr. Richard Roth[4]

[1]Department of Mathematics and Statistics, Northern Arizona University

[2,3,4]Department of Agronomy, Iowa State University

Background

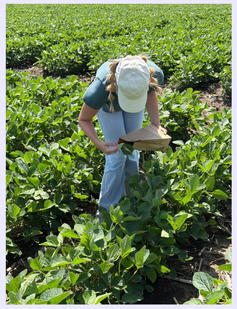
Sulfur deficiency is becoming a growing concern in Iowa soybean production because of declining atmospheric sulfur deposition and increased use of cereal rye cover crops. Current recommendations often assume that residual sulfur from corn is sufficient for soybeans, but these guidelines may not reflect modern production systems. This study evaluated how sulfur application rate and cereal rye affect early corn and soybean growth through replicated field trials across Iowa. Crops were grown with and without cereal rye, using sulfur rates (SR) from 0 to 50 lb S/acre, and biomass and plant population were measured. In soybeans, there were no statistically significant differences in biomass or plant population among cover-crop treatments or sulfur rates. Continued research across additional years and environments is needed to determine when sulfur applications are beneficial and to develop reliable, cost-effective recommendations for Iowa farmers.

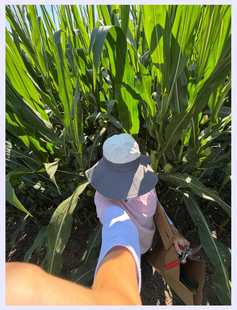
Objectives

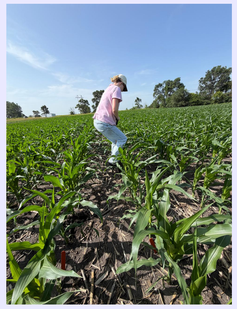
- Evaluate the accuracy of Iowa's current sulfur recommendations for soybeans.
- Determine whether cereal rye cover crops influence soybean response to sulfur.
- Identify sulfur application rates that optimize soybean growth and profitability.
- Develop Iowa-specific recommendations to improve sulfur management and return on investment.

Methods

- Conducted research at six Iowa State research farms and commercial farms across Iowa.
- Evaluated six sulfur rates (0, 10, 20, 30, 40, and 50 lbs S/acre).
- Compared cereal rye (CR) and no cereal rye (NCR) treatments.
- Collected soil, plant tissue, biomass, and plant population data.
- Used a randomized complete block split-plot design with four replications.
- Data were analyzed using ANOVA and regression models.







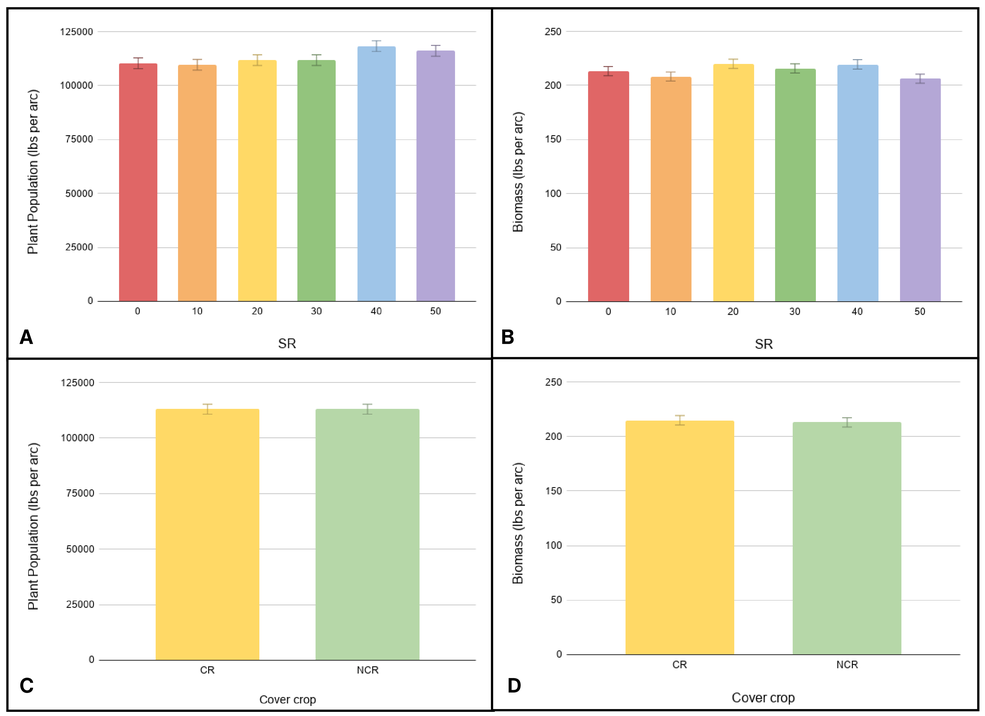


Figure 1: Soybean soil sample at V4, A)Plant population vs. SR, B) Biomass vs SR, C) Plant population vs Cover crop, D) Biomass vs Cover crop

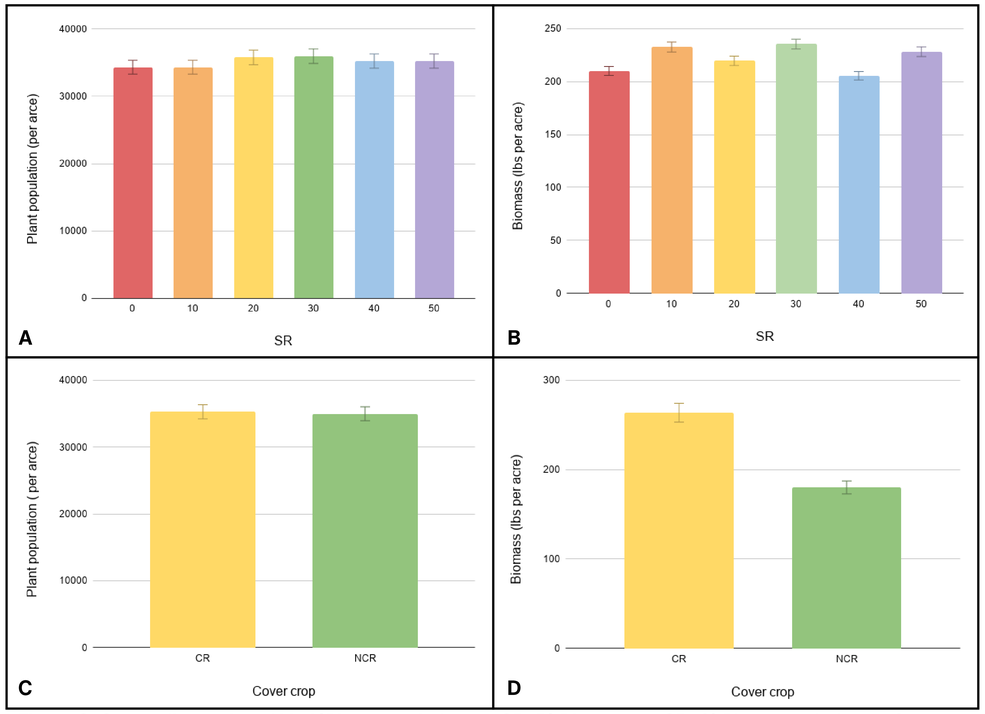


Figure 2: Corn soil sample at V4, A)Plant population vs. SR, B) Biomass vs SR, C) Plant population vs Cover crop, D) Biomass vs Cover crop

Classroom Applications

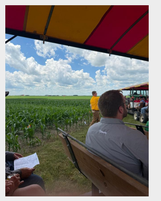
This research showed me how mathematics helps solve real-world problems. Farmers and researchers use data, statistics, and graphs to make decisions about crop management. I want students to see that math is more than textbook equations. In my classroom, students could analyze agricultural data, create graphs, calculate averages, and identify trends. They could also design mock farm investigations and use evidence to decide which practices produce the best results. These activities would strengthen data analysis, collaboration, and problem-solving skills while connecting math to STEM careers. My goal is to make mathematics engaging, hands-on, and meaningful by connecting it to the world around students.

Future Collarborations

Participating in this research taught me that successful projects rely on teamwork, communication, and trust. Even though I contributed to only one part of a larger project, I saw that every team member matters. Working with graduate students, visiting research sites, and meeting weekly with my mentor showed me the value of asking questions and learning from others. As a future mathematics teacher, I want to build that same collaborative environment in my classroom. Students should feel comfortable sharing ideas, helping one another, and learning through discussion. This experience also showed me the importance of relationships and partnerships. By connecting with universities, researchers, and agriculture professionals, I can provide students with real-world learning opportunities. Most importantly, I want students to understand that curiosity, persistence, and teamwork are essential parts of learning.

Results and Conclusions

- Our results showed different responses in soybeans and corn. In soybeans, cereal rye cover crops and sulfur application rates had little effect on biomass or plant population. Biomass was nearly the same between the cereal rye (CR) and no cereal rye (NCR) treatments, and plant populations remained very similar. Across the six sulfur rates, soybean biomass and plant population showed only small, inconsistent differences.
- Corn plant populations were also similar across cover crop treatments and sulfur application rates, averaging about 35,000 plants per acre. However, corn biomass was higher in the cereal rye treatment (about 260 lbs/acre) than in the no-cereal-rye treatment (about 180 lbs/acre). Corn biomass varied somewhat across sulfur rates, but there was no clear pattern of increasing biomass as sulfur rate increased.
- Overall, the results suggest that sulfur rate did not produce a consistent effect on early soybean or corn growth in this study. While cereal rye did not appear to affect soybean growth, it was associated with greater early corn biomass. Additional years and locations are needed before making broader recommendations because weather, soil type, and sulfur availability may influence crop response.



Acknowledgements

I want to express my sincere gratitude to Dr. Richard Roth, Larousse Dorissant, and Aaron Sassman for welcoming me into the Roth Lab and providing their mentorship throughout this summer. Their guidance, patience, and willingness to share their knowledge made this research experience both enjoyable and educational. I would also like to thank the members of the Roth Lab for their kindness, encouragement, and support. I am especially grateful to Eric Hall and Diana Oberender for organizing and leading the RET/REU program and for providing this incredible opportunity to participate in research while growing as a future educator. RegenPGC is supported by Agriculture and Food Research Initiative Competitive Grant No. 2021-68012-35923 from the USDA National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this website are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture. This Research is also supported by the Iowa Nutrient Research Center Grant number: Optimizing Sulfur Management in Iowa Soybeans: When, Where, and How Much?