



MinnesotaCorn

RESEARCH & PROMOTION COUNCIL

2024 FINAL REPORT (project ongoing)

PROJECT TITLE: Reduced Tillage and Cover Cropping in Corn-Soybean Rotation Across Varied Irrigation Regimes: Assessing Water Use Efficiency, Nitrate Leaching, and Crop Yield

PROJECT NUMBER: 6120-24DD

PRINCIPAL INVESTIGATOR AND CO-INVESTIGATOR(S): Vasudha Sharma

ABSTRACT

This multi-year project aims to evaluate the impact of conservation practices—reduced tillage and cover cropping—on crop yield, water use efficiency, and nitrate leaching in corn-soybean rotations under different irrigation regimes in coarse-textured soils of Minnesota. The primary activities in 2024 focused on project planning, field layout development, and preparation for data collection starting in the 2025 growing season. A graduate student was hired, and cereal rye was planted as a winter cover crop across the designated plots. This foundational year ensured that infrastructure, field design, and logistics were in place for rigorous implementation in the coming years. Although no experimental data were collected in 2024, this preparatory work was essential for the successful execution of the full project.

INTRODUCTION

Agricultural production in the Upper Midwest, particularly Minnesota, is increasingly challenged by erratic weather patterns linked to climate change. Farmers in the region are grappling with alternating cycles of excessive rainfall and prolonged drought, which complicate irrigation planning, reduce crop yields, and exacerbate environmental concerns such as nitrate leaching into groundwater. These issues are especially pronounced in irrigated sandy soils, which are prevalent in central Minnesota and have limited water and nutrient retention capacities.

Traditional tillage systems, while effective in some aspects of crop production, can degrade soil structure, reduce organic matter, and increase susceptibility to both drought stress and nutrient leaching. Similarly, the lack of cover cropping leaves soil exposed to erosion and nutrient loss during non-growing seasons. There is a growing recognition that conservation practices—specifically reduced or no-tillage combined with cover cropping—can mitigate these risks by improving soil health, enhancing water retention, and stabilizing nutrient cycling.

Despite their promise, the performance of these conservation strategies under varying irrigation regimes in sandy soils remains understudied. This gap in knowledge limits the ability of local producers and agricultural advisors to make data-informed decisions about adopting such practices, particularly in irrigated systems where water use efficiency and nutrient management are critical to regulatory compliance and economic viability.

The present study aims to fill this knowledge gap by evaluating how tillage and cover cropping practices influence water use, nitrate leaching, and crop yield under four irrigation regimes: optimum, water-stressed, over-irrigated and rainfed conditions. The project is being conducted at the Sand Plain Research

Farm (SPRF) in Becker, MN, a region representative of coarse-textured, irrigated agricultural systems. The research will provide actionable insights into how conservation practices perform under climate variability scenarios, ultimately helping farmers optimize production while protecting water quality.

Although 2024 was primarily a preparatory year, the planning and groundwork conducted during this time were essential to ensure a rigorous and scientifically sound study design. This included plot establishment, cover crop planting, student hiring, and coordination with collaborators to align research methods and timelines. With this foundation in place, the project is positioned to deliver robust results in the upcoming growing seasons.

OBJECTIVE AND GOAL STATEMENTS

- Determine the effect of tillage and cover cropping under varying water regimes on crop water use and yields.
- Assess nitrate leaching under these conservation practices.
- Promote local adoption of conservation practices via outreach and demonstrations.

MATERIALS AND METHODS

In 2024, the foundational phase of the experiment was carried out at the Sand Plain Research Farm (SPRF), Becker, MN. Specific actions included:

- Hiring of a graduate student to lead data collection and analysis starting in 2025.
- Design and establishment of 128 field plots (4 reps \times 2 crops \times 16 treatment combinations) for corn-soybean rotation trials. See figure 1 for plot plan.
- Planting of cereal rye in fall 2024 as the initial cover crop to be terminated in spring 2025.
- Coordination with collaborators and planning logistics for soil moisture monitoring, nitrate leaching assessments, and irrigation scheduling based on PR2 sensors and suction cup lysimeters starting in 2025.

RESULTS AND DISCUSSION

No data were collected in 2024, as this year was dedicated to site preparation, logistical planning, and securing personnel and supplies. The rye establishment was successful and will serve as the first step toward evaluating cover cropping effects in 2025. Plot demarcation and tillage treatment planning were finalized to allow for immediate implementation in spring 2025.

CONCLUSIONS

The first year of the project served as a vital foundation-building phase. While no field data were collected, all infrastructure and personnel are in place for successful implementation starting in 2025. This proactive planning is expected to ensure high-quality data collection and impactful results in subsequent years.

EDUCATION, OUTREACH, AND PUBLICATIONS

- No educational or outreach activities occurred in 2024 due to the preparatory nature of the work. Planned activities for 2025 include:
- Hosting the first field day at SPRF.



Figure 1. Plot layout with irrigation, tillage, and cover crop treatments at Becker, MN.