# Minnesota Department of Agriculture
# Agricultural Fertilizer Research & Education Council

## Annual Project Report for 2023 Cropping Season (Year 4)

**PROJECT TITLE:** **Quantifying soil carbon, nitrogen, and phosphorus after subsurface drainage installation**

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**PROJECT NUMBER:** **CON000000102924**

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### Project Objectives

This project has three primary objectives:

1. *Quantify SOM depletion over two years in drained and undrained fields.*
2. *Measure nitrogen (N) losses via mineralization and nitrous oxide ($N_2O$) emissions over two years in drained and undrained fields.*
3. *Monitor total phosphorus (P) and plant-available P in the soil over two years in drained and undrained fields.*

### Plots Established

We collected data on four 15-acre plots (two drained and two undrained) were established in October 2019 at the University of Minnesota Northwest Research and Outreach Center (NWROC) in Crookston, MN (Figure 1). These plots were maintained throughout the 2020-2023 growing seasons.

Data collection took place throughout the growing season on the four drainage plots to support Objectives 1, 2, and 3. We met project goals for quarterly soil sampling, weekly greenhouse gas sampling, biweekly in-situ nitrate mineralization, and daily water sample collection.

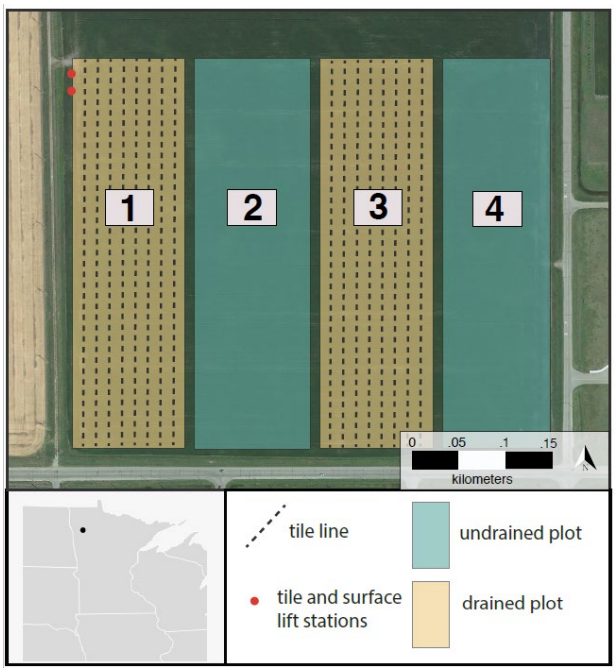


**Figure 1: Diagram of plot layout at NWROC**

## Measurements Collected

*Soil Sampling*

Spring soil sampling occurred pre-planting in April and fall soil sampling occurred post-harvest in October. We collected soil samples at 64 locations (16 locations per plot) to a depth of 90 cm.

*Water Sampling*

Daily water samples were collected from surface and subsurface drainage lift stations throughout the growing season (April through October). Water samples were processed and analyzed for nitrate, total nitrogen, dissolved phosphorus, and total phosphorus.

## Project Results

- We did not see any evidence to change fertility for drained fields during the first four years.
- We saw an immediate yield benefit from subsurface drainage in 2020. The next three years were drought, but we did not see any evidence that drainage "over-dried" the soil. Any detrimental effects from the soil due to drainage were seen only in 2021, the second year after drainage installation.
- Soybeans helped to "even out" any excess N from drought during Spring Wheat years.
- Minimal winter N loss was observed because the soil was frozen, and the drainage system is controlled with a lift station.

## Presentations of Project Results

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| 7. | "Do newly drained fields need revised fertility recommendations?"<br>Fertilizer Research Forum, Fort Worth, Texas<br>Audience: Fertilizer Industry Reps | 03/19/2024 |
| 6. | "Does tile drainage pay if you only get 20 inches of precipitation?"<br>Iowa Learning Farms Conservation Webinar Series, Virtual<br>Audience: Farmers, researchers, conservation practitioners | 03/06/2024 |
| 5. | "Tile drainage performance in a wheat-soybean rotation"<br>Norman County Ag Day, Ada, MN | 01/10/2024 |
| 4. | "Current Research Support for 4R Practices in Northwest Minnesota"<br>Soil Health Field Day, Breckenridge, MN | 08/15/2023 |
| 3. | "Subsurface Drainage Research in Northwest Minnesota"<br>Tri-State Drainage Research Forum, Crookston, MN | 07/20/2023 |
| 2. | "Research Update from Minnesota's Coolest Drainage Plots" and "Cover Cropping in Sugarbeet Systems"<br>Northwest Research & Outreach Center's Crops & Soils Field Day, Crookston, MN | 07/19/2023 |
| 1. | "Drainage Research in Northwest Minnesota,"<br>Norman County SWCD Bus Tour Crookston, MN | 07/18/2023 |