



# MinnesotaCorn

## RESEARCH & PROMOTION COUNCIL

### PROGRESS REPORT

PROJECT TITLE: Mitigating Cold and Warm Season Nitrogen Losses from Corn Systems

PROJECT NUMBER: 6135-24DD

REPORTING PERIOD: April 1 to June 30, 2024

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1.) PROJECT ACTIVITIES COMPLETED DURING THE REPORTING PERIOD. (*Describe project progress specific to goals, objectives, and deliverables identified in the project workplan.*)

This report summarizes key findings from our mesocosm soil heating experiments.

The impact of soil warming on N<sub>2</sub>O emissions from corn systems utilizing an enhanced efficiency fertilizer (EEF) has been tested over three complete growing seasons. From the six mesocosms, three experimental pairs were randomly selected. In this experiment, the treatment imposed was the heating of the mesocosm topsoil to an elevated temperature of 2°C relative to the control mesocosms.

The heating treatment was accomplished by burying electric heating cables in the soil, and programming them to heat the soil column until the average temperature at a depth of 5 cm (measured by four thermocouple temperature sensors) reached the desired value. The cables were buried in a coil at a depth of 10 cm with 20 cm spacing between them. Four thermocouple temperature sensors were each buried at a depth of 5 cm in the middle of 4 quadrants of the column. Two soil moisture/temperature sensors were buried at depths of 10 cm and 25 cm respectively. Finally, a non-steady state flux chamber was installed in the center of each mesocosm to measure N<sub>2</sub>O emissions from the soil.

2.) IDENTIFY ANY SIGNIFICANT FINDINGS AND RESULTS OF THE PROJECT TO DATE.

In our first growing season experiment, the average cumulative N<sub>2</sub>O emissions for the heated mesocosms was 5.75 kg N ha<sup>-1</sup> while the average for the unheated mesocosms was 3.82 kg N ha<sup>-1</sup>. In the second experiment the average cumulative N<sub>2</sub>O emissions for the heated mesocosms was 7.5 kg N ha<sup>-1</sup> vs 3.0 kg N ha<sup>-1</sup>. In the third growing season experiment the average cumulative N<sub>2</sub>O emissions for the heated mesocosms was 6.0 kg N ha<sup>-1</sup> vs 10.0 kg N ha<sup>-1</sup>. In two of three growing seasons, soil heating of 2°C significantly enhanced N<sub>2</sub>O emissions from EEF treatments. It is unclear why the third growing season experiment showed substantially lower emissions. We hypothesize the soil heating lowered the soil water content (water filled pore space), which had a strongly negative influence on N<sub>2</sub>O emissions. We are currently examining this hypothesis.

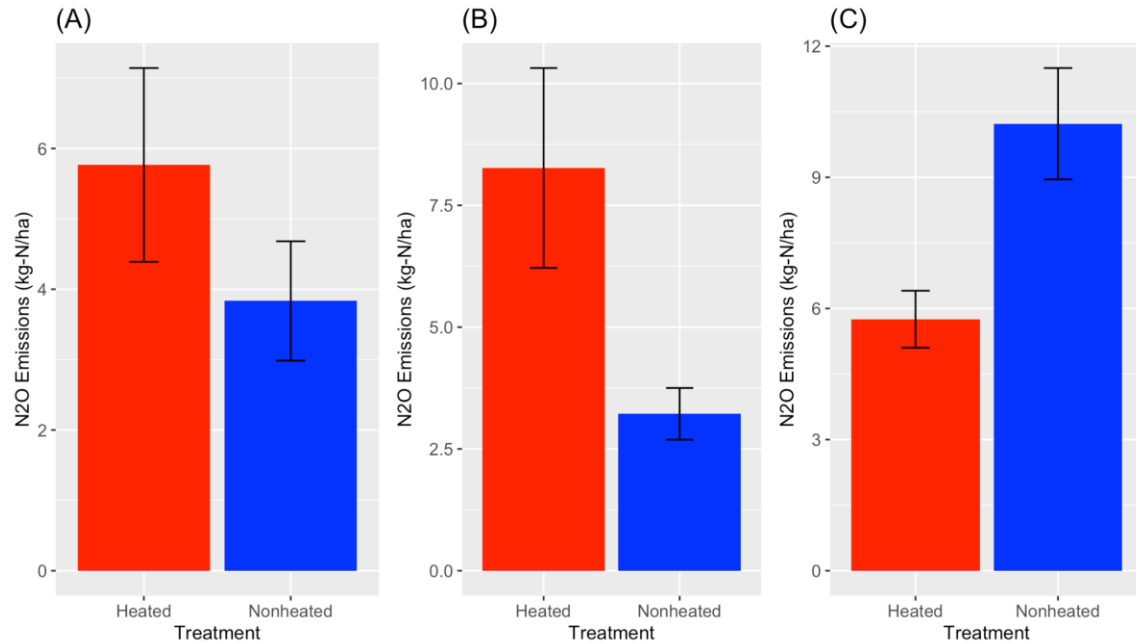


Figure 1. Average nitrous oxide emissions ( $\text{kg N ha}^{-1}$ ) from SuperU over each season (A) season 2, (B) season 3, (C) and season 4 based on treatment (Heated and Nonheated) with standard error bars.

3.) CHALLENGES ENCOUNTERED. (*Describe any challenges that you encountered related to project progress specific to goals, objectives, and deliverables identified in the project workplan.*)

4.) FINANCIAL INFORMATION (*Describe any budget challenges and provide specific reasons for deviations from the projected project spending.*)

5.) EDUCATION AND OUTREACH ACTIVITIES. (*Describe any conferences, workshops, field days, etc attended, number of contacts at each event, and/or publications developed to disseminate project results.*)

Our MS student (Michelle Bohnen) and Research Scientist (Sam Strack) are gaining hands-on experience working in the mesocosm facility. They are gaining new knowledge regarding the biogeochemical cycling of nitrogen and improving our understanding of how climate change can impact reactive nitrogen losses from cropping systems. We provided a tour of the Mesocosm facility for the annual meeting held by the University of Minnesota AI-Climate Institute. Scientists from the University of Minnesota, Cornell University, and Colorado State University participated.