



MinnesotaCorn

RESEARCH & PROMOTION COUNCIL

PROGRESS REPORT

PROJECT TITLE: Dialing in the Most Corn-Profitable and Environmentally Responsible Nitrogen Rate

PROJECT NUMBER: Award CON000000096855; Project 00098087

REPORTING PERIOD: January to March 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.*)

The objectives of this study are to conduct a comprehensive study measuring the effect of various nitrogen rates on: 1) corn grain-yield, 2) economic return, 3) nitrogen use efficiency of corn, 4) nitrate leaching load in tile-drained fields, 5) nitrous oxide emissions, and 6) ammonia volatilization. An additional objective is to translate the information generated through this study into usable knowledge that can benefit Minnesota corn growers and society (including data for the MRTN calculator and generation of data to inform other models or tools that may become available).

Below is a list of activities done during the quarter:

January:

- Interacted with participants at the Minnesota AgExpo and discussed the project
- Processing and analyzing plant, soil, gas, and water samples
- Calibrating flow meters for drainage pits to be reinstalled this spring
- Review data for outliers and begun analyzing the data

February:

- Presented a poster highlighting research findings at the 2024 CFANS research symposium
- All supplies were ordered for the upcoming field season
- Worked on cleaning and analyzing the data

March:

- Checked the N₂O analyzer to ensure proper functioning in preparation for the growing season
- Started to prepare ammonia traps for the summer (cutting out containers, gluing on parafilm bottoms, and cleaning and preparing the foam traps in the lab)
- Worked on analyzing the data and interpreting results

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

Grain yield data was already reported during the last quarter. Figure one is presented here simply for continuity.

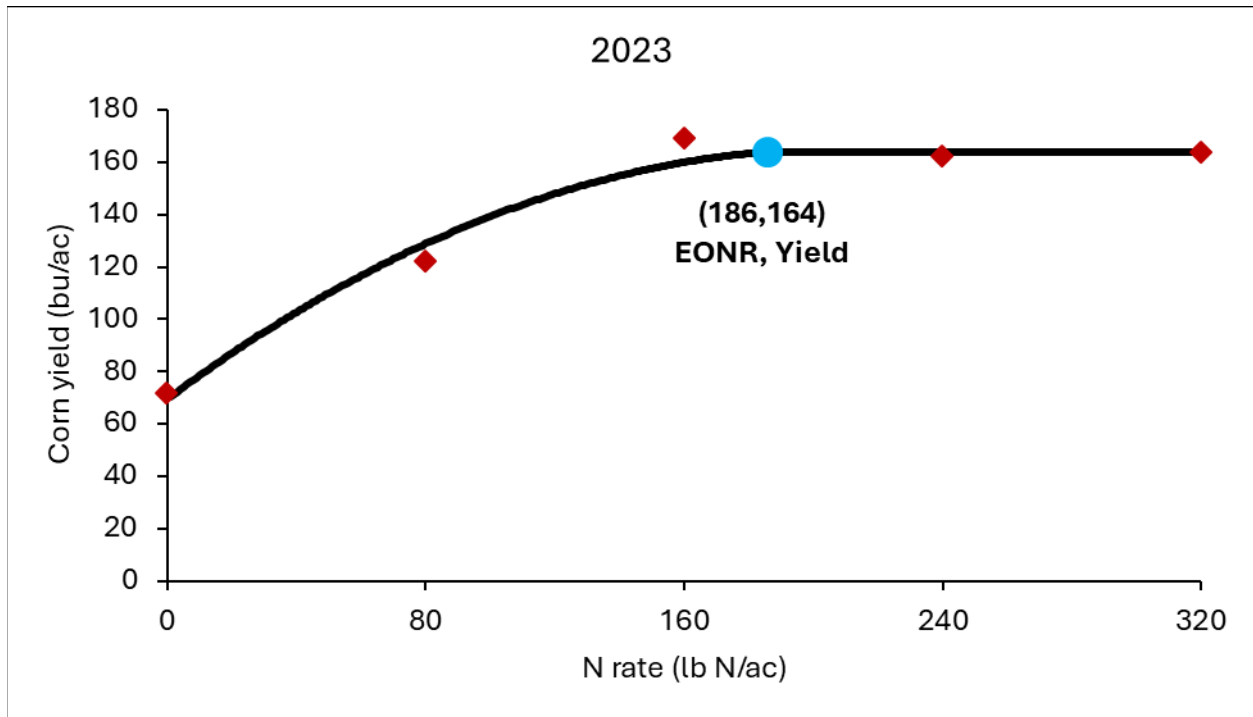


Figure 1. Corn yield response to nitrogen rate in 2023.

This year, as in previous years, there was a positive grain yield response to nitrogen rate. The fact that grain yields were higher than in previous years shows that overall growing season-conditions were better than the previous two seasons. The economic optimum N rate (EONR) was 186 lbs/ac and the yield at the EONR is 164 bu/ac (Fig. 1). We had more precipitation in 2023 than the previous two growing seasons, but the distribution of precipitation was not ideal. There was lack of moisture during important periods in crop development, which likely resulted in yield potential reduction for the crop. We also had excess precipitation during times of the season that resulted in increased N loss by leaching and denitrification but less loss than previous years from volatilization (Table 1). The fact that we needed additional nitrogen than in the previous years to reach the optimum yield likely reflects greater nitrogen losses relative to the previous growing seasons. We observed an increase N loss with increasing N rates for nitrate leaching and nitrous oxide emissions, but not for ammonia volatilization.

Table 1. Cumulative NO₃-N load, flow weighted NO₃-N concentration, cumulative N₂O-N emissions, cumulative NH₃ emissions, and grain yield for 2023. Within columns, means followed by the same letter are not significantly different (P<0.10).

Treatment	Cumulative Nitrate-N Load	Average Flow Weighted Nitrate-N	Cumulative N ₂ O Emissions	Cumulative 56 day NH ₃ Emissions	Grain Yield
lbs ac ⁻¹	lbs ac ⁻¹	mg L ⁻¹	lbs ac ⁻¹	lbs ac ⁻¹	bu ac ⁻¹
0	11.2B	3.5C	0.30B	0.22A	72C
80	17.8B	6.3BC	0.48AB	0.18A	122B
160	57.3AB	11.6AB	0.71AB	0.20A	169A
240	51.8AB	15.4A	2.07AB	0.27A	162A
320	82.4A	17.0A	2.45A	0.21A	164A

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

The season was better than the previous two growing seasons, but still moisture limitation during critical crop development stages created challenges.

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

None to report

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.)*

Some of the results from this research site were presented during the Minnesota AgExpo and shared through mass-media interviews including the Brownfield News and MN Ag-Expo podcast on corn grower research projects

Zac Aanerud presented findings from the project at the 2024 CFANS College-wide Research Symposium.

Fabian Fernandez presented findings from this project at the 9th International Nitrogen Conference in New Delhi, India in February 2024.

Fabian Fernandez was invited to present findings from this project at the World Summit of Environmental Science and Engineering in Porto, Portugal in April 2024.

In addition to these formal presentations, I have discussed the results of this study with extension educators who are using this information in their education programs, thus multiplying the benefits of the information generated in this project.