

Novak NOPP Report

Jefferson County

Data Collection Began: 2023
Data Collection Ended: 2024
Site Years: 2

Other Collaborators:

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Takeaways

- Economic optimum nitrogen rate was 205 lb-N/ac in 2023 with yield of 185 bu/ac.**
- Yield did not reach peak in 2024, likely due to above average spring rainfall.**
- Post-harvest soil nitrate consistent across N rate treatments with 35-40 lb/ac in both years.**



Extension

UNIVERSITY OF WISCONSIN-MADISON



Nitrogen use efficiency for corn in the Rock River Basin

Overview

The Upper Rock River Basin is characterized by Silurian dolomitic bedrock, making it prone to groundwater pollution. The Dodge County Farmers Healthy Soil Healthy Water producer-led group aimed to reduce nutrient losses and improve farmer profitability by conducting on-farm nitrogen rate trials paired with extensive soil sampling. This report focuses on one of thirteen sites in the area conducting this trial.

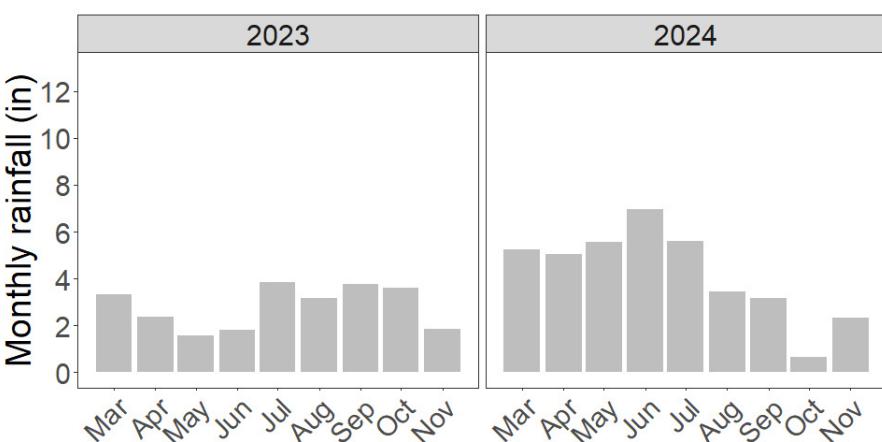


Figure 1. Monthly rainfall during the growing season in 2023 and 2024 with data from Sullivan, WI. Data gathered from NOAA's National Centers for Environmental Information.

Table 1. Field history for site in 2023 and 2024.

Novak	2023 H001ABC	2024 H004BCD
Soil series	Kidder	Sebewa
Soil texture	Sandy loam	Silt loam
Soil drainage class	Well drained	Poorly drained
Years of previous 10 receiving manure	0	0
Years of previous 10 with cover crop	10	7
Years no-till	27	0
Irrigation	No	No
Drainage tile	No	Yes
Previous crop	Soybean	Soybean

Methods

Corn was planted following rye termination in both years. A small amount of nitrogen (7 lb-N/ac) was applied as starter to the entire field in 2023. Nitrogen was applied as a split application in both years, with 40 lb-N/ac at plant to all plots besides 0 N. Remaining N was put out at sidedress as 32% UAN to achieve final rates of 7, 45, 86, 136, 181, and 227 lb N/ac in 2023 and 0, 40, 80, 120, 160, and 200 in 2024. Trial was a randomized complete block design with four replicates. Each year of the trial took place on a different field.

Data Collection

- Routine soil fertility samples (0-6")
- Pre-plant soil nitrate (0-1' and 1-2')
- Post-harvest soil nitrate (0-1' and 1-2')
- Yield collected via weigh wagon

Table 2. Field management for 2023 and 2024. The trial took place on a different field in 2023 and 2024.

Novak	2023 H001ABC	2024 H004BCD
Cover crop (CC)	Cereal rye	Cereal rye
CC seeding rate	40 lb/ac	40 lb/ac
CC height	6-8"	4-6"
Spring CC biomass	Not measured	100 lb-DM/ac
CC term. date	4/27/23	4/24/24
Manure	None	None
Corn variety	GH G95D32	P0075Q
Corn planting date	5/7/23	5/16/24
N application date	6/22/23	6/21/24
N application method	Y-drop	Y-drop

Spring soil results

Table 3. Routine soil analysis sampled at a depth of 0-6" prior to any nitrogen application. Soil test interpretation categories for corn based on UW-Extension pub A2809 (Very low=VL, Low=L, Optimum=O, High=H, Very high=VH, Excessively high=EH).

Novak	pH	OM %	P	K		
				----- ppm -----		
2023 - H001ABC	6.4	1.7	62 (EH)	124 (O)	1326 (H)	216 (O)
2024 - H004BCD	7.2	6.0	25 (H)	101 (O)		

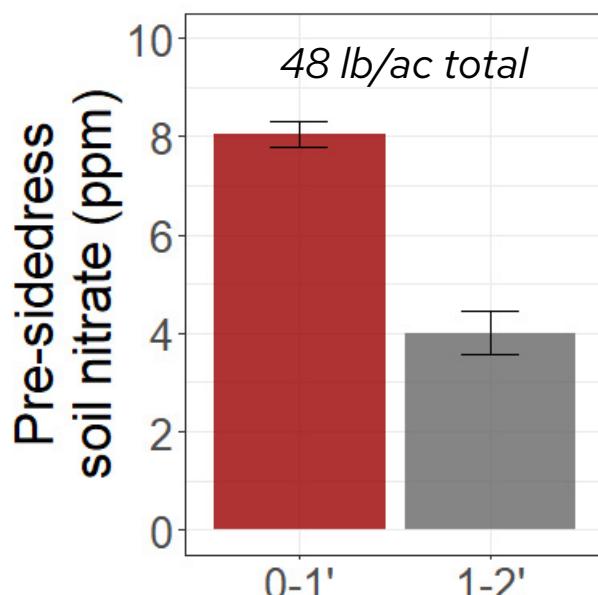


Figure 2. Pre-sidedress soil nitrate sampled prior to any nitrogen application in 2023. Spring soil nitrate not sampled in 2024.

- Soil test values indicate no additional N "credit" supplied to crop from soil N.

Yield results

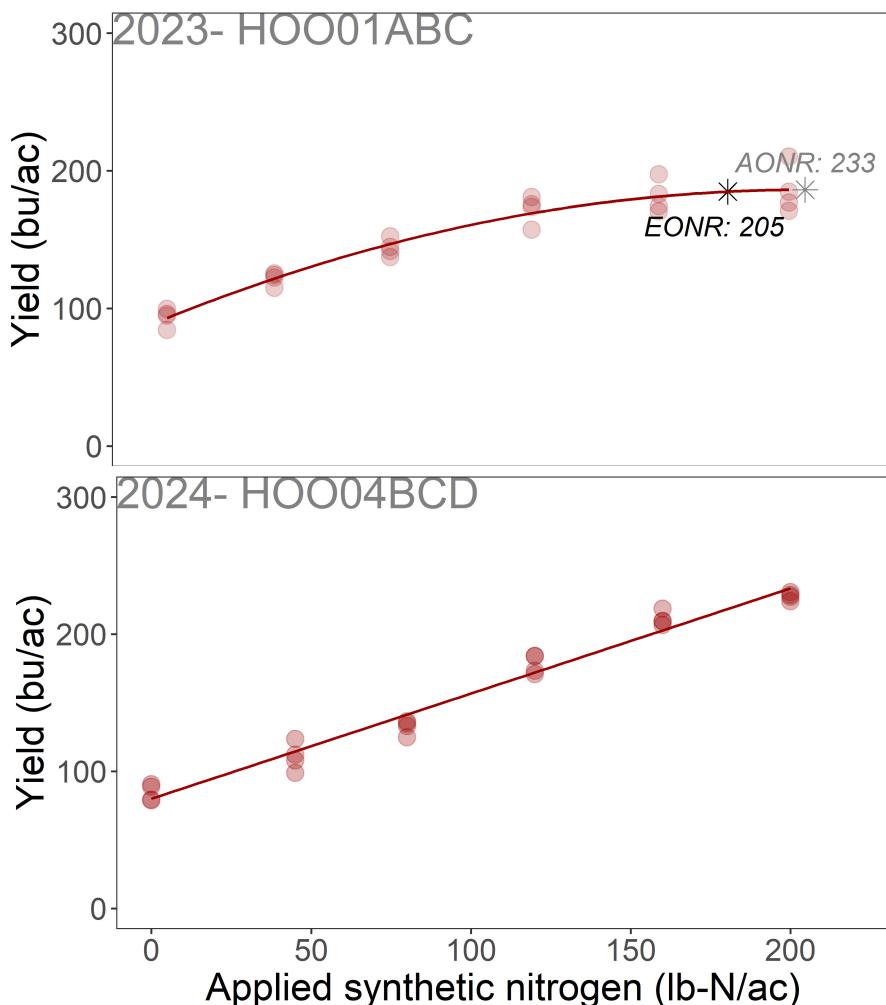


Figure 3. Corn yield (adjusted to 15.5% moisture) by applied synthetic nitrogen and field. Agronomic optimum nitrogen rate (AONR) is defined as the nitrogen rate that results in maximum yield, and economic optimum nitrogen rate (EONR) is the nitrogen rate that results in the maximum financial profit based on shape of yield response curve and corn:nitrogen price ratio of 0.1.

- In 2023 EONR for the field was 205 lb-N/ac with a yield of 185 bu/ac and AONR was 233 lb-N/ac with a yield of 186 bu/ac.
- In 2024 corn yield increased as nitrogen rate increased without reaching a plateau.

Table 4. Yield and marginal net return by site and applied nitrogen. Values within **column and year** with the same letter are not significantly different according to Fisher's LSD test at alpha = 0.1 (90% confidence).

- Significant difference in yield across nitrogen rates in 2023 & 2024.

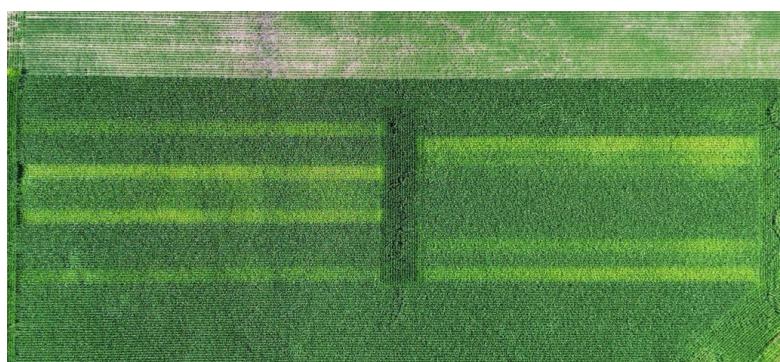


Figure 4. Aerial image of site from July 18, 2024, about a month after sidedress N application.

Novak	Applied synthetic nitrogen	Yield	Marginal net return*
	(lb-N/ac)	(bu/ac)	(\$/ac)
2023	7	94 e	465
	45	122 d	586
	86	144 c	677
	136	172 b	791
	181	181 a	816
	227	186 a	814
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2024	0	84 f	422
	45	111 e	531
	80	132 d	621
	120	178 c	830
	160	211 b	975
	200	228 a	1038

*Marginal net return calculation based on nitrogen:corn price ratio of 0.1 (\$0.50/lb-N, \$5/bu corn).

Post-harvest soil data

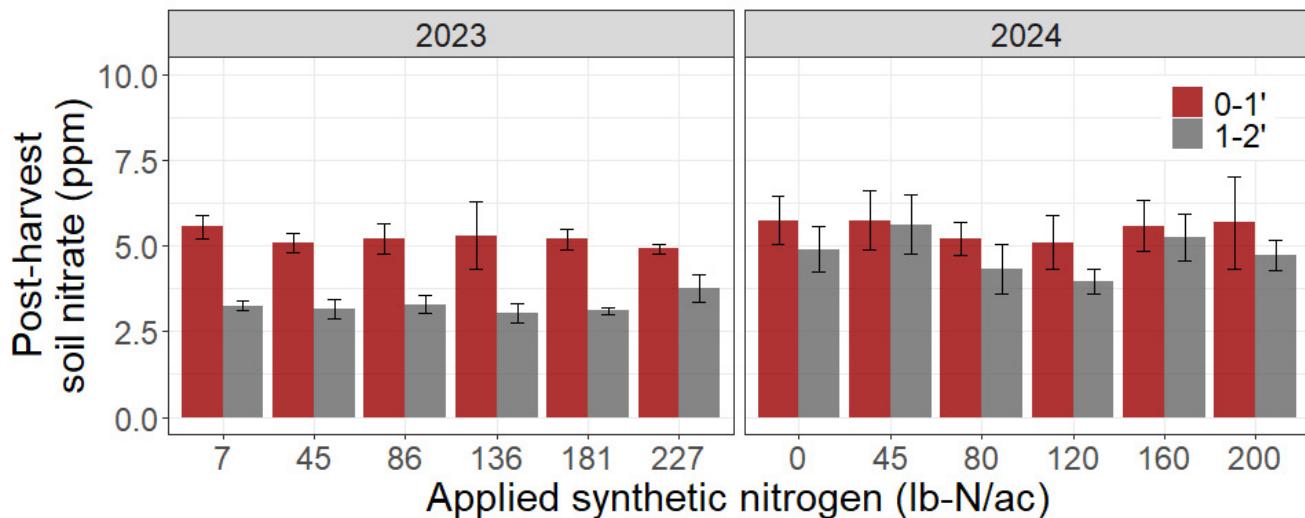


Figure 5. Post-harvest soil nitrate in ppm sampled at each nitrogen rate. In both years soil was sampled to a depth of 0-1' (red) and 1-2' (grey).

Post-harvest soil nitrate (lb-N/ac)

Synthetic nitrogen (lb-N/ac)	2023		2024		
	0-1'	1-2'	Synthetic nitrogen (lb-N/ac)	0-1'	1-2'
7	22	13	0	23	20 ab
45	20	13	45	23	23 a
86	21	13	80	23	17 ab
136	21	12	120	22	16 b
181	21	12	160	21	21 ab
227	20	15	200	20	19 ab

Table 5. Post-harvest soil nitrate in lb-N/ac by year and depth. Values within column with the same letter are not significantly different according to Fisher's LSD test at alpha = 0.1.

- PHNT did not differ across N rate 2023.
- PHNT differed across N rates in 2024 at 1-2', but this difference was small (7 lb/ac).

Conclusions

- In 2023, corn yield increased as nitrogen rate increased until it reached plateau at 233 lb-N/ac (AONR). Based on the curve of the yield response and a nitrogen:corn ratio of 0.1, EONR was only 28 lb less at 205 lb-N/ac.
- In 2024, the yield followed a quadratic model, increasing with higher N rates and not reaching a peak within N applied. This could be due to heavy spring rainfall following N application.
- Even with differing yield response between sites, in both years post-harvest soil nitrate consistent across N rate around 35-40 lb/ac, indicating similar remaining unused N across treatments.



Dodge County HSHW NOPP participants.

