

# Hoffmann NOPP Report

## Rock County

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

Other Collaborators:

Bill Stangel

Tom Hoffmann

Tom Novak

## Takeaways

- **Economic optimum nitrogen rate was 187 lb-N/ac in 2023 and 245 lb-N/ac in 2024.**
  - **Greater yield at EONR on 2024 site of 245 bu/ac compared to 215 bu/ac in 2023.**
- **Post-harvest residual soil nitrate increased as nitrogen rate increased in both years and both depths.**
  - **In the dry year of 2023, soil nitrate differed by 112 lb-N/ac between the lowest and highest nitrogen fertilizer rates.**



Extension

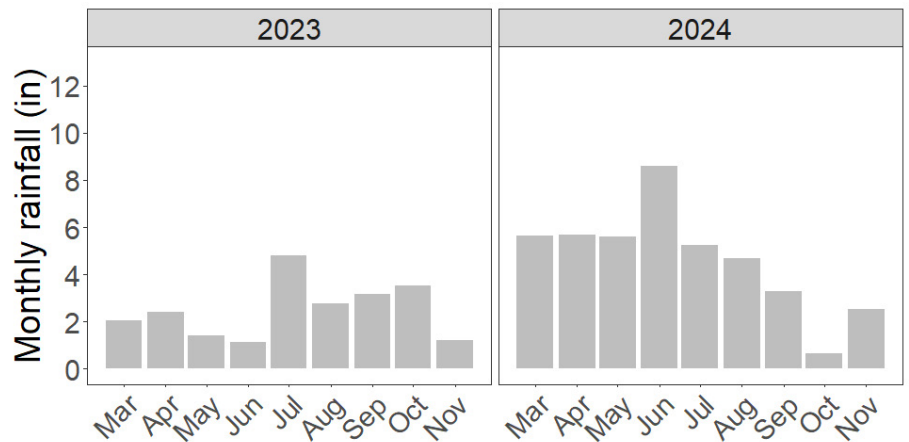
UNIVERSITY OF WISCONSIN-MADISON



## Nitrogen use efficiency for corn in the Rock River Basin

### Overview

The Upper Rock River Basin are dominated by dolomitic bedrock which are 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 Oconomowoc, WI. Data gathered from NOAA's National Centers for Environmental Information.

**Table 1.** Field history for 2023 and 2024.

Hoffmann	2023 KEU02	2024 HAR01
Soil series	Mahalasville	St. Charles
Soil texture	Silt loam	Silt loam
Soil drainage class	Very poorly drained	Moderately well drained
Years of previous 10 receiving manure	0	0
Years of previous 10 with cover crop	0	0
Years no-till	22	22
Irrigation	No	No
Drainage tile	Yes	No
Previous crop	Soybean	Soybean

# Methods

**2023:** DAP was fall applied prior to the trial at 27 lb-N/ac. The remainder of nitrogen fertilizer was applied at sidedress as 32% UAN to achieve final rates of 27, 67, 107, 147, 187, and 227 lb-N/ac.

**2024:** DAP was fall applied prior to the trial at 27 lb-N/ac. In spring, 45 lb-N/ac was applied across the whole trial area with pre-emergent herbicide. The remainder of nitrogen fertilizer was applied at sidedress as 32% UAN to achieve final rates of 72, 112, 152, 192, 232, 272 lb-N/ac.

The trial was a randomized complete block design with four replicates. Each year of the trial took place on a different field.

**Table 2.** Field management for each year of the trial. The trial took place on a different field in 2023 and 2024.

Hoffmann	2023 KEU02	2024 HAR01
Cover crop species	None	None
Manure	None	None
Corn variety	P0421Q	P0339Q
Corn planting date	5/5/23	4/24/24
N application date	5/30/23	5/31/24
N application method	Coulter inject	Coulter inject

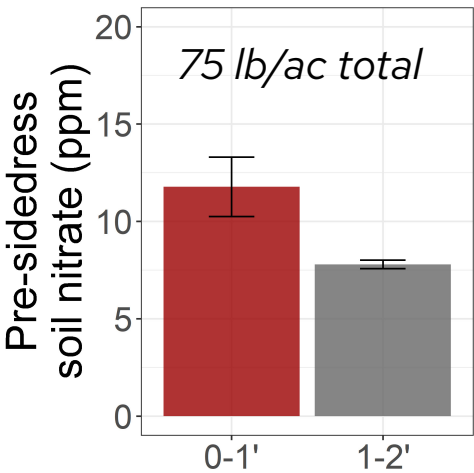
## Data Collection

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

# Spring soil results

**Table 3.** Routine soil analysis sampled at a depth of 0-6" prior to any nitrogen application. Routine soil sample not collected in 2024. Soil test interpretation categories for corn based on UW-Extension pub A2809.

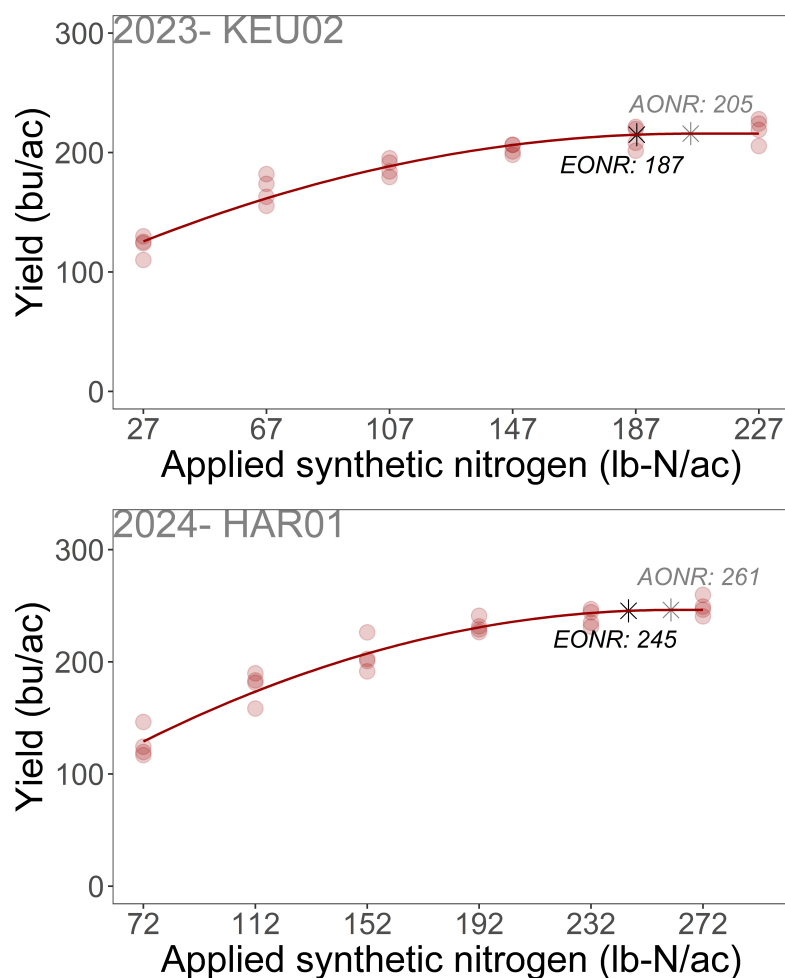
Hoffmann	pH	OM	P	K	Ca	Mg
		%	- - - - ppm - - - -			
2023- KEU02	5.8	3.4	52	126	1962	508
Interpretation category			Excessively high	Optimum	High	High



**Figure 3.** Pre-sidedress soil nitrate sampled prior to any nitrogen application in 2023. Spring soil nitrate not sampled in 2024.

- PSNT credit of 10 lb/ac calculated according to UW-Extension publication A2809 (Table 6.6).

# Yield results



**Figure 2.** 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 nitrogen:corn price ratio of 0.1 (\$0.50/lb-N, \$5/bu corn).

- In 2023 EONR for the field was 187 lb-N/ac with yield of 215 bu/ac and AONR was slightly higher at 205 lb-N/ac and yield of 216 bu/ac.
- In 2024 EONR on the field was 245 lb-N/ac with yield of 245 bu/ac and AONR was 261 lb-N/ac with yield of 246 bu/ac.

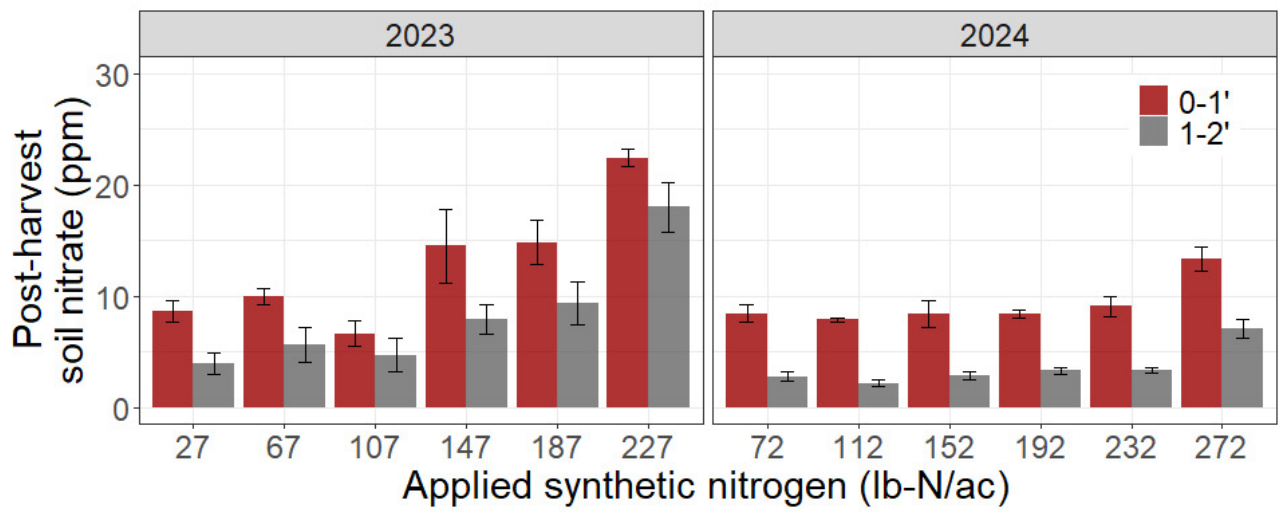
**Table 3.** Yield and marginal net return by site and applied nitrogen. Values within **column and year** with the same letter are not significantly different according to Fisher's LSD test at alpha = 0.1.

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

Hoffman	Applied synthetic nitrogen	Yield	Marginal net return*
	(lb-N/ac)	(bu/ac)	(\$/ac)
2023 KEU02	27	122 f	598
	67	169 e	809
	107	188 d	885
	147	203 c	941
	187	213 b	970
	227	219 a	982
2024 HAR01	72	127 e	598
	112	178 d	835
	152	205 c	950
	192	232 b	1064
	232	239 ab	1081
	272	249 a	1109

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

# Post-harvest soil results



**Figure 4.** 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)					
2023			2024		
Synthetic nitrogen (lb-N/ac)	0-1'	1-2'	Synthetic nitrogen (lb-N/ac)	0-1'	1-2'
27	34 c	16 c	72	34 b	11 b
67	40 c	23 c	112	31 b	9 b
107	26 c	19 c	152	34 b	11 b
147	58 b	32 b	192	34 b	13 b
187	59 b	38 b	232	36 b	13 b
227	90 a	72 a	272	53 a	28 a

**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 differed across N rate in 2023 across both depths.
- PHNT was greater at the highest N rate compared to all other rates at both depths in 2024.

## Conclusions

- In 2023, corn yield increased as nitrogen rate increased until it reached plateau at 205 lb-N/ac (AONR). Based on the curve of the yield response and a nitrogen:corn ratio of 0.1, EONR was 18 lb less at 187 lb-N/ac.
  - Fall applied DAP accounted for 27 lb-N/ac of the EONR, which may not have been available to the crop during the growing season. In addition, soil test phosphorus levels were excessively high, suggesting that the fall DAP application may not have provided agronomic value in this field.
  - Post-harvest soil nitrate was greater at the top three rates in both depths, indicating unused fertilizer N at those rates.
- In 2024, corn yield increased as nitrogen rate increased until it reached plateau at 261 lb-N/ac (AONR). Based on the curve of the yield response and a nitrogen:corn ratio of 0.1, EONR was 16 lb less at 245 lb-N/ac.
  - Greater AONR/EONR could be due to the first 72 lb-N/ac going on pre-emergence with a very wet spring. Much of the early applied N may not have been available to the crop later in the season.
  - Post-harvest soil nitrate was greater at the highest N rate in both depths, indicating excess nitrogen in the soil when applied beyond optimum rates.