

# Hammer NOPP Report

## Dodge County

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

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## Takeaways

- **Economic optimum nitrogen rate was 164 lb-N/ac in 2023 and 192 lb-N/ac in 2024.**
- **Maximum yield of ~260 bu/ac in both years.**
- **Post-harvest residual soil nitrate increased as nitrogen rate increased, with greater residual soil N in 2023 (dry growing season) than 2024 (wet spring).**



Extension

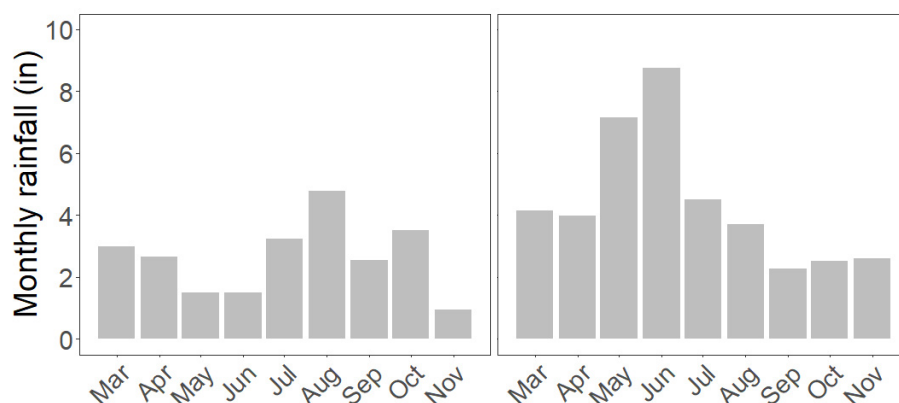
UNIVERSITY OF WISCONSIN-MADISON



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

### Overview

Farmed areas in Dodge County and the Upper Rock River Basin are dominated by dolomitic bedrock which are prone to groundwater pollution and have experienced high levels of groundwater nitrates. As a response, the goal of this study was 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 more than a dozen area growers conducting this trial.



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

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

Hammer	2023 Markhardt South	2024 Koerner North
Soil series	Plano	Plano
Soil texture	Silt loam	Silt loam
Soil drainage class	Well-drained	Well-drained
Years of previous 10 receiving manure	0	1
Years of previous 10 with cover crop	6	5
Years no-till	20+	20+
Irrigation	No	No
Drainage tile	No	No
Previous crop	Winter wheat	Winter wheat

Methods

Starter fertilizer was applied to all plots, containing 5 lb-N/ac. Nitrogen (32% UAN) was applied as a split application, with 40 lb-N/ac at plant to all plots besides 0 N. Remaining nitrogen was applied at sidedress to reach final rates of 6 nitrogen rates targeting 5, 45, 85, 125, 165, and 205 lbs N/acre. The 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 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. Baseline soil analysis sampled at a depth of 0-6". Trial area sampled in 2023 prior to corn planting. 2024 routine soil value composite of field sampled post harvest. 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).

Hammer	pH	OM	P	K	Ca	Mg
		%	- - - - ppm - - - -			
2023- Markhardt South	6.8	3.8	33 (EH)	150 (H)	1663 (H)	500 (O)
2024- Koerner North	6.3	3.6	35(EH)	148 (H)	1781 (H)	470 (O)

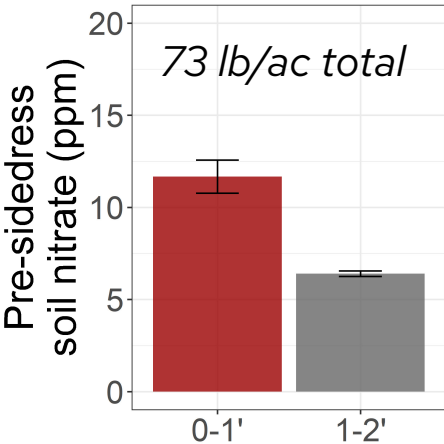


Figure 3. Pre-sidedress soil nitrate sampled prior to any nitrogen application in 2023. Spring soil nitrate not sampled in 2024.

Table 2. Trial management information in 2023 and 2024.

Hammer	2023 Markhardt South	2024 Koerner North
Cover crop species	Alfalfa, peas, oats	Crimson clover, alfalfa, radish, rye, annual ryegrass, peas
CC termination date	5/13/23	Mid-April
Spring CC height	6-8", great stand	<8", fair stand
CC planting	Drilled	30 lb/ac drilled
Manure	None	None
Corn variety	DKC48, P9955AM*	DKC102-28
Corn planting date	5/18/23	5/15/23
N application date	6/30/23	6/27/24
N application method	Stream (early) and Y-drop (sidedress)	Stream (early) and Y-drop (sidedress)

\*Hybrids planted with split-planter. Each plot had equal rows of both hybrids.

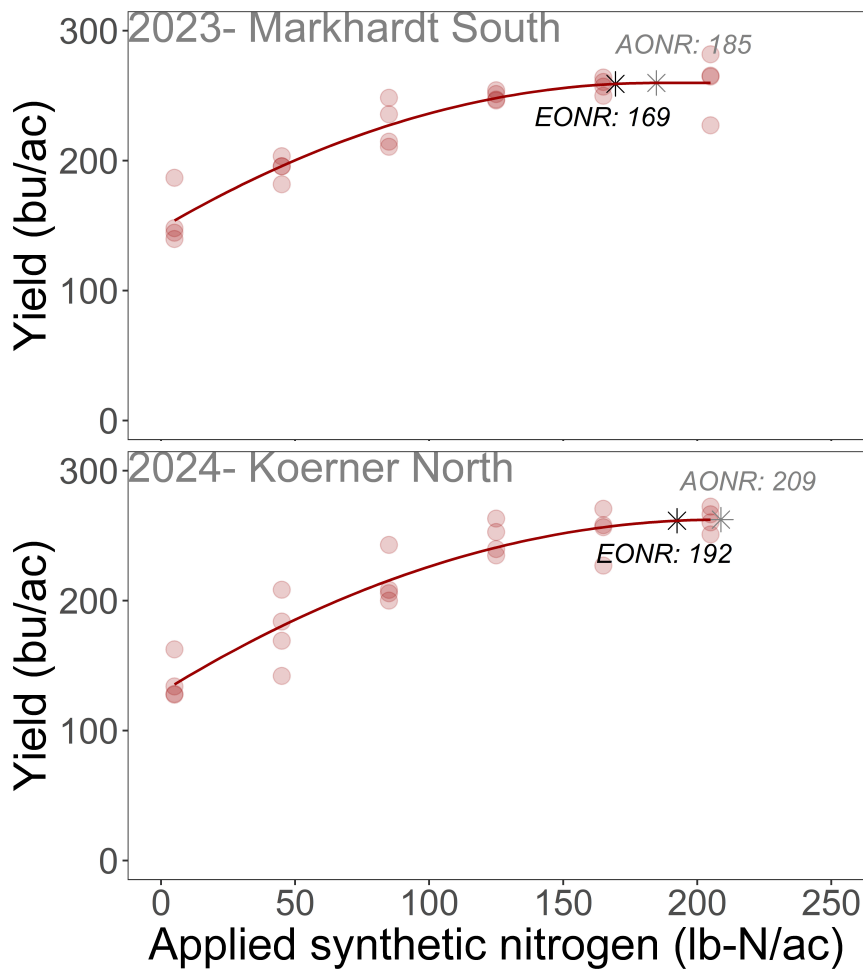
2023 cover



2024 cover



# 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 (\$0.40/lb-N, \$4/bu corn).

- In 2023 EONR for the field was 169 lb-N/ac and AONR was 185 lb-N/ac.
- In 2024 EONR on the field was 192 lb-N/ac and AONR was 209 lb-N/ac.

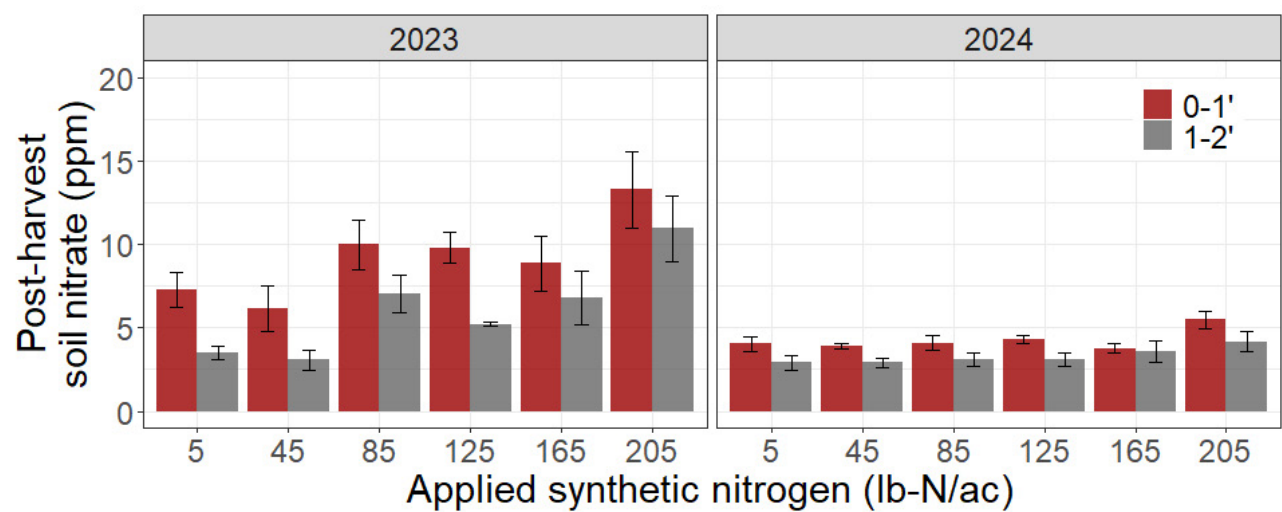
**Table 3.** Yield and marginal net return by site and applied nitrogen. Values within **column and year** with the same letter are not significantly different according to Fisher's LSD test at alpha = 0.1.

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

Hammer	Applied synthetic nitrogen	Yield	Marginal net return*
	(lb-N/ac)		(\$/ac)
2023 Markhardt South	5	155 d	774
	45	194 c	951
	85	227 b	1096
	125	250 a	1188
	165	258 a	1209
	205	260 a	1199
2024 Koerner North	5	138 d	688
	45	176 c	857
	85	214 b	1028
	125	248 a	1175
	165	253 a	1183
	205	262 a	1210

\*Marginal net return calculation based on nitrogen:corn price ratio of 0.1 (\$0.40/lb-N, \$4/bu corn).

# Post-harvest soil nitrate



**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).

Synthetic nitrogen (lb-N/ac)	Post-harvest soil nitrate (lb-N/ac)			
	2023		2024	
	0-1'	1-2'	0-1'	1-2'
5	29 b	14 c	16 b	12
45	25 b	12 c	16 b	12
85	40 ab	28 b	16 b	12
125	39 ab	21 bc	17 b	12
165	36 b	27 b	15 b	14
205	53 a	44 a	22 a	17

**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 0-1' in 2024.

## Conclusions

- In 2023, corn yield increased as nitrogen rate increased until it reached plateau at 185 lb-N/ac (AONR). Based on the curve of the yield response and a nitrogen:corn ratio of 0.1, EONR was only 16 lb less at 169 lb-N/ac.
  - 2023 post-harvest soil sampling indicated a difference in soil nitrate at both depths with soil nitrate increasing as N rate increases, indicative of the dry growing season.
- In 2024, corn yield increased as nitrogen rate increased until it reached plateau at 209 lb-N/ac (AONR). EONR was only 17 lb less at 192 lb-N/ac.
  - Greater post-harvest soil nitrate at highest N rate at 0-1' depth.
- Similar yield at AONR in both years with 260 bu/ac in 2023 and 262 bu/ac in 2024.
- Yield at optimum N rate above 5 year county average of 194 bu/ac.



Dodge County HSHW NOPP participants.