

Macheel NOPP Report

Dodge County

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

Other Collaborators:

Dale Macheel
Tom Novak
Phillips Crop Care
Bill Stangel

Takeaways

- Economic optimum nitrogen rate (EONR) was 169 lb-N/ac in 2023.**
- Greater post-harvest soil nitrate at highest N rate in 2023.**
- In 2024, yield never reached plateau.**
 - 131 bu/ac yield difference between 0 lb/ac and 200 lb/ac applied N.**



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.

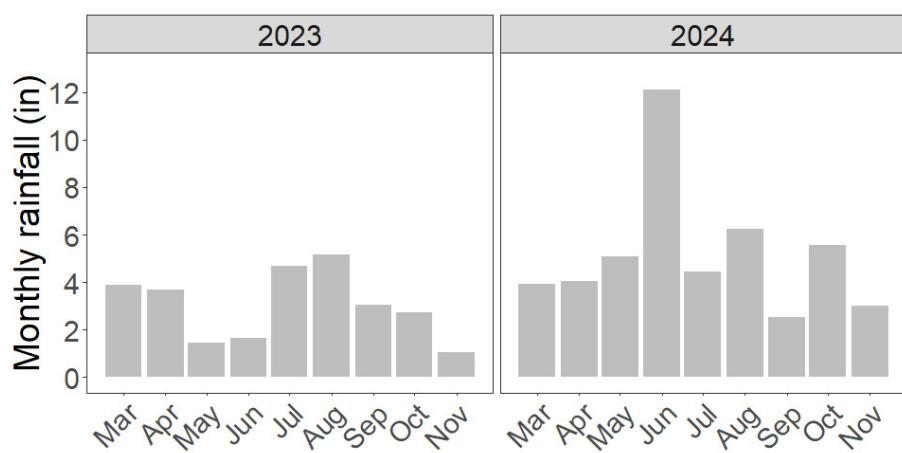


Figure 1. Monthly rainfall during the growing season in 2023 and 2024 with data from Beaver Dam, WI. Data gathered from NOAA's National Centers for Environmental Information.

Table 1. Field history for 2023 and 2024.

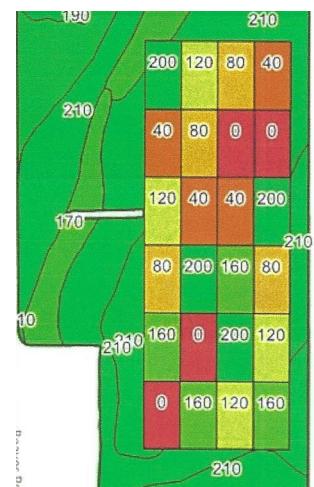
Macheel	2023 MOUL	2024 Jung Farm
Soil texture	Silt loam	Silt loam
Soil drainage class	Well drained	Moderately well drained
Years of previous 10 receiving manure	1	1
Years of previous 10 with cover crop	6	6
Years no-till	5	1
Irrigation	No	No
Drainage tile	No	Yes*
Previous crop	Corn	Soybean

***Field tiled in 2023. Field no till for 4 years prior to tiling. First growing season since tiling.**

Table 2. Trial management information for 2023 and 2024.

Macheel	2023 MOUL	2024 Jung Farm
Cover crop (CC)	Cereal rye	Cereal rye
CC seeding rate	70 lb/ac broadcast & incorporated	70 lb/ac broadcast & incorporated
Spring CC height	16"	16"
CC termination date	5/23/23	4/28/24
Corn variety	Jung 51sp513	RK720TRE
Corn planting date	5/20/23	4/24/24
N application date	6/23/23	6/11/24
N application method	Broadcast	Broadcast

Figure 2. Plot plan for 2024 site (Jung farm). Plots color coded by nitrogen rate.



Methods

In 2023, ~20 lb-N/ac was applied in the starter fertilizer to all plots. The remainder of nitrogen fertilizer was applied as a dry blend at sidedress to achieve final treatments of 21, 50, 89, 132, 175, and 289 lb N/ac.

In 2024, 40 lb N/ac was applied at-plant with starter to all plots except the 0 N treatment. The remainder of nitrogen fertilizer was applied as a dry blend at sidedress to achieve final treatments of 0, 40, 80, 120, 160, and 200 lb N/ac. 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". 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).

Site	pH	OM %	P	K ppm			Ca	Mg
				----- ppm -----				
MOUL	6.2	3.1	95 (EH)	224 (EH)	1692 (H)	456 (O)		
Jung Farm*	6.5	3.7	76 (EH)	158 (H)	-	-		

*Routine soil sampling was not conducted for the 'Jung' field in 2024, but data from the last time it was sampled (2021) have been included.

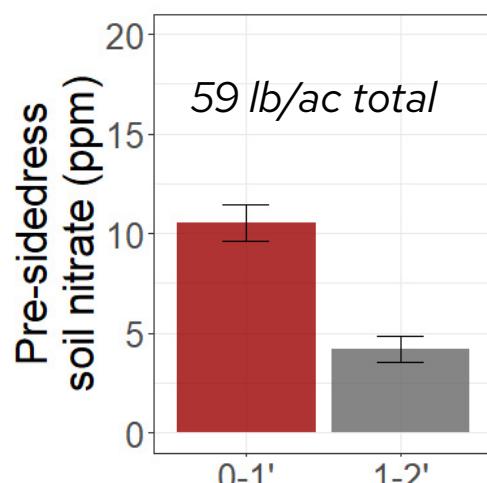


Figure 3. Pre-sidedress soil nitrate sampled prior to any nitrogen application in 2023. Spring soil nitrate not sampled in 2024.

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

Yield results

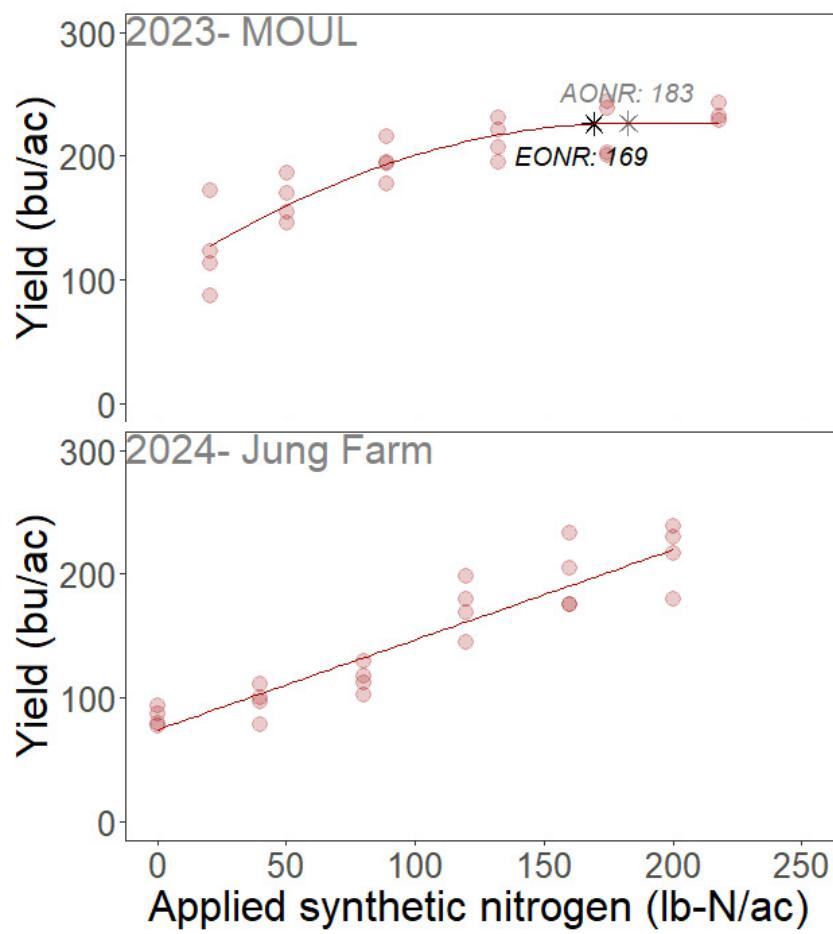


Figure 4. Corn yield (adjusted to 15.5% moisture) by applied synthetic nitrogen and field. Agronomic optimum nitrogen rate (AONR) is defined as the nitrogen rate that results in maximum yield, and economic optimum nitrogen rate (EONR) is the nitrogen rate that results in the maximum financial profit 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 169 and AONR was 183. Yield at EONR was 226 bu/ac.
- In 2024 corn yield increased as nitrogen rate increased without reaching a plateau, with maximum yield on the field of 216 bu/ac at 200 lb-N/ac.

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.

- **Significant difference** in yield across nitrogen rates in 2023 & 2024.
- In 2024, no significant difference between 0 and 40 lb-N/ac. The 40 lb-N/ac was applied at plant, so neither of these plots received N at sidedress.



Figure 5. Aerial image of site in 2024. Clear yellowing in low N plots.

Macheel	Applied synthetic nitrogen	Yield	Marginal net return*
	(lb-N/ac)	(bu/ac)	(\$/ac)
2023 MOUL	21	124 d	612
	50	164 c	796
	89	196 b	933
	132	214 ab	1002
	175	222 a	1021
	218	235 a	1064
2024 Jung	0	85 e	423
	40	97 e	465
	80	116 d	538
	120	173 c	806
	160	197 b	905
	200	216 a	980

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

Post-harvest soil results

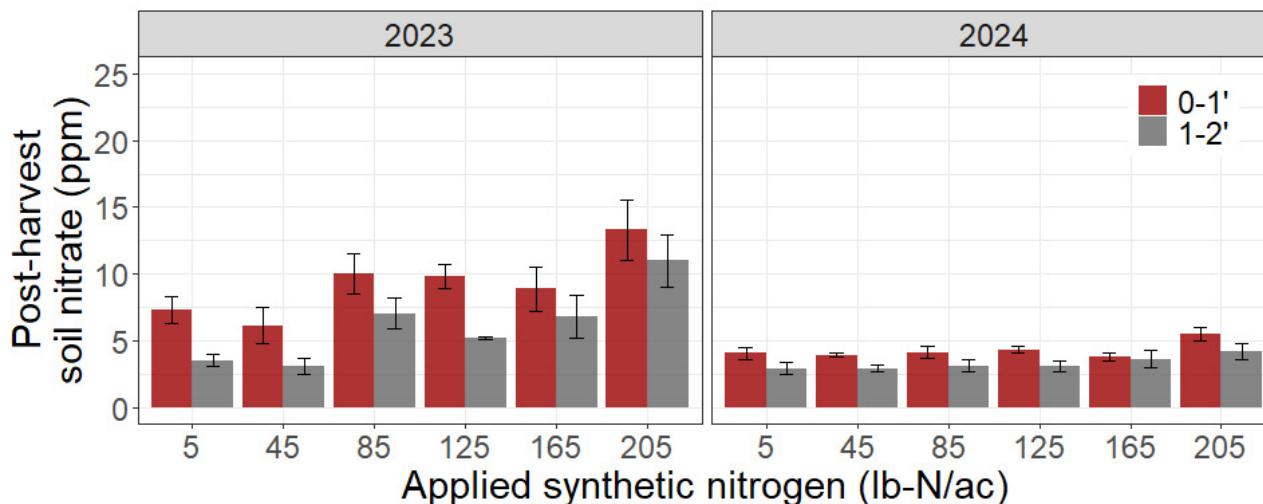


Figure 6. Post-harvest soil nitrate in ppm sampled at each nitrogen rate. In both years soil was sampled to a depth of 0-1' (red) and 1-2' (grey).

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'
21	35 b	14 c	0	11	6
50	38 b	15 c	40	12	4
89	39 b	15 c	80	10	6
132	36 b	19 bc	120	11	6
175	54 a	21 b	160	14	7
218	60 a	31 a	200	13	7

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 at both depths in 2023.
- PHNT did not differ across N rates in 2024.

Conclusions

- In 2023, corn yield increased as nitrogen rate increased until it reached plateau at 183 lb-N/ac (AONR). Based on the curve of the yield response and a nitrogen:corn ratio of 0.1, EONR was 14 lb less at 169 lb-N/ac.
 - Significantly greater post-harvest soil nitrate at highest N rate at both depths.
- In 2024, corn yield increased as N rate increased without reaching max yield within N applied. This was likely due to the very wet spring.
 - No significant difference between yield at 0 and 40 lb-N/ac. The 40 lb-N/ac was applied at plant, so neither of these plots received N at sidedress. This indicated N applied at plant may not have been available to the crop after heavy June rainfall.
 - Low amounts of post-harvest soil nitrate (<15 lb/ac) with no significant trend across N rates.
- Greater max yield in 2023 (235 bu/ac) than 2024 (216 bu/ac).
- Max yield in both years above 5 year county average of 194 bu/ac.