

Nitrogen Rates



Field to Stream Partnership

The Root River Field to Stream Partnership (RRFSP) is a multi-organizational effort to evaluate agricultural practices and water quality at multiple scales and landscape settings. The strategic selection of these study watersheds allows the findings to be applied to similar areas across southeastern Minnesota.

On-Farm Nitrogen Rate and Timing

The relationship between corn yield, nitrogen rate and timing was studied over a seven-year period in southeast MN. Results across four different counties from 2015-2021 (24 site years) are summarized.

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What's the Best Nitrogen Rate?

- A total of twenty-four nitrogen (N) rate and timing experiments were conducted on corn fields in southeast Minnesota from 2015 through 2021.
- Ten treatments were replicated four times in a randomized, complete-block design. Seven of the ten treatments were N rates applied at planting and three treatments were split applied.
- On-farm studies were conducted near the city of Grand Meadow in Mower County, Harmony in Fillmore County, Utica in Winona County and Elgin in Wabasha County. Most plots were located and repeated on the same farm.
- The **Maximum Return To Nitrogen (MRTN)** is the nitrogen (N) rate that maximizes return on investment. The MRTN is a data driven, economically and environmentally sound method for making N rate decisions and is a recommended best management practice (BMP) when fertilizing corn in Minnesota.
- The University of Minnesota updated the corn nitrogen fertilizer guidelines in 2022 and are summarized in Table 1. Using the most common N price to corn price ratio of 0.10, the acceptable range of nitrogen to apply is **130-150 lb N/ac** when corn follows soybeans and **160-190 lb N/ac** when corn follows corn. Total nitrogen applied should include credits from other fertilizers containing nitrogen such as MAP, DAP, AMS, starter and nitrogen credits from alfalfa and manure.
- The Corn Nitrogen Rate Calculator can be used identify the most profitable N rates using different nitrogen and corn prices. <http://cnrc.agron.iastate.edu/>



Plot harvest near Grand Meadow in Mower County

University Nitrogen Rate Guidelines for Corn

Previous Crop	N Price/Corn Price Ratio	MRTN	Acceptable Range
-----lb N/acre-----			
Corn (71 sites)	0.075	190	170-205
	0.100	175	160-190
	0.125	165	150-175
	0.150	155	145-165
Soybeans (165 sites)	0.075	150	135-165
	0.100	140	130-150
	0.125	135	125-145
	0.150	130	120-140

Table 1. Nitrogen fertilizer rate recommendations for non-irrigated corn in Minnesota. The most common nitrogen price to corn price ratio, 0.10, is highlighted. A \$0.50 nitrogen price and \$5.00/bu corn price equates to a 0.10 ratio. Source Aug 2022: <https://extension.umn.edu/crop-specific-needs/fertilizing-corn-minnesota>.

Results

Corn following Soybean

- A total of 13 corn fields were studied over a seven-year period. Most fields were located on well drained silt loam soils in Fillmore, Winona and Wabasha counties. Two sites were located in Mower County on poorly drained soils that contained subsurface drainage tile and high organic matter.
- Figure 1 shows the best rate of nitrogen (N) to apply on sites with well drained soils was 129 lb N/ac with an exceptional corn yield of 249 bu/ac.
- Figure 2 shows the response at a poorly drained site located south of Grand Meadow (GM south). This farm typically responded to more preplant nitrogen and required over 70 lb N/ac more preplant N when compared to well drained sites. The best preplant nitrogen rate at GM south was 202 lb N/ac with a yield 229 bu/ac.
- The zero-rate check produced over 150 bu/ac corn yield in plots with well drained soils while the poorly drained GM south site typically produced 40 bu/ac less yield. This could indicate that less N was supplied by the soil through mineralization.
- Even with drain tile, a natural dense layer of glacial till located at depths below one foot at the GM south site creates anaerobic conditions which likely results in more frequent N loss through de-nitrification and less soil N contributions from mineralization. This dense subsoil could also be affecting corn rooting depth.

Corn following Corn

- A total of 11 different fields were studied. Fields were located in Fillmore, Winona and Wabasha Counties on well drained silt loam soils.
- Across all plots and years, the best preplant rate to apply was 175 lb N/ac with a yield of 223 bu/ac (Figure 3).

Split Applied Nitrogen

- When N was split applied, corn yields were significantly higher at 5 of the 24 sites (21%) when compared to fields that received all N at preplant.
- At the poorly drained Grand Meadow South site, split N application rates were occasionally more profitable and required less N.
- Starting in 2022, enhancements to this study will provide new and better insights to MRTN values for split applied N applications.

Residual Soil Nitrate (RSN)

- Figure 4 shows the relationship between RSN and nitrogen rates above or below the MRTN. RSN samples were collected to a depth of four feet after harvest. Elevated RSN can increase the risk for nitrate movement to groundwater and surface water.
- RSN rarely exceeded 60 lb N/ac when rates were applied near the MRTN (within ± 25 lb N/ac). When N rates were applied above the MRTN (right side of the vertical line), the amount of RSN increased rapidly.

Summary

- When averaged across similar sites, the MRTN was consistent with University N rate guidelines for sites with well drained soils, but typically underestimated preplant N needs for a poorly drained site in Mower County. Continuation of this study will provide valuable information for growers and crop advisors that is current and specific to southeast Minnesota.

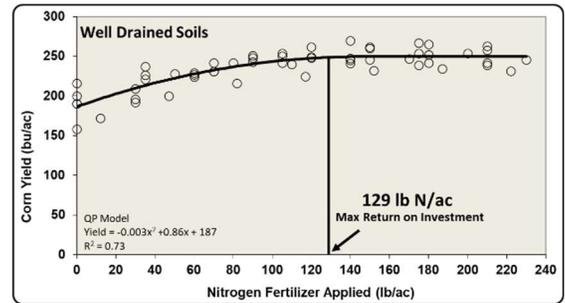


Figure 1. Corn following soybean yield as affected by nitrogen rate on well drained soils from 2015-2021 (8 site years).

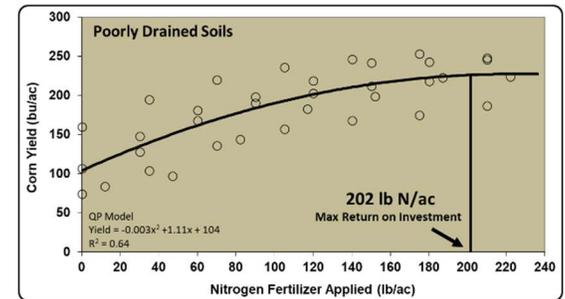


Figure 2. Corn following soybean yield as affected by nitrogen rate on a poorly drained site south of Grand Meadow (GM south) from 2017-2021 (5 site years).

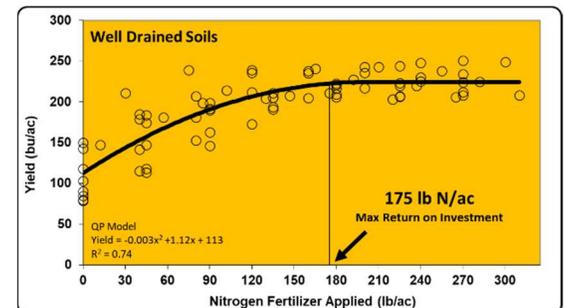


Figure 3. Corn following corn yield as affected by nitrogen rate on well drained soils from 2015-2021 (11 site years).

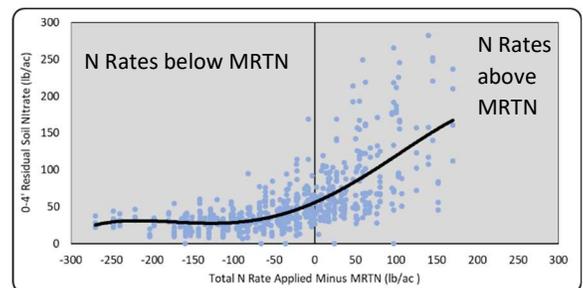


Figure 4. Relationship between residual soil nitrate and N rates above or below the MRTN from 2015-2021 (24 site years).



Root River Field to Stream Partnership



Minnesota Department of Agriculture
Minnesota Agricultural Water Resource Center
The Nature Conservancy

Mower SWCD
Fillmore SWCD
Root River SWCD