

Profitable Nitrogen Rates for Corn

Under Current Crop and Fertilizer Prices



High nitrogen (N) prices are not about to scare corn out of Manitoba. High corn prices and good residual soil N levels should keep corn a profitable component of the rotation in 2022. But let's consider what N rates are economically appropriate with today's fertilizer costs.

Firstly, soil residual N levels were generally high to very high following many droughted crops in 2021 (Figure 1). In normal years, soils typically have 25-40 lb. N/ac. Growers who have soil tested will be able to account for such a credit by reducing their 2022 fertilizer application rates accordingly. But not all areas suffered drought and poor yields, and in those areas, residual N will be closer to normal levels, as planned N rates should be.

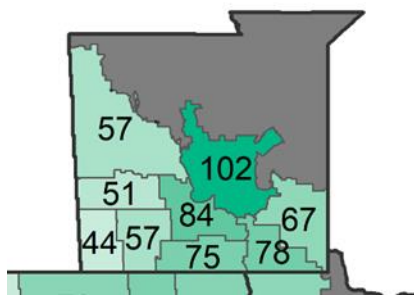


Figure 1. Median residual nitrogen values (lb nitrate-N/ac in 0-24") following wheat in Manitoba in 2021. From AgVise Laboratories¹

But what impact does the very high N price have on rates, and is it offset by good corn prices? And what if dry conditions persist? Fortunately, we have accumulated a body of research we can lean on for some ideas.

Manitoba Corn Growers supported my study of N rates at 10 sites through 2016-17, which included seasons with either good precipitation or well-recharged soils (Heard, 2017²). University of Manitoba researchers conducted studies at 17 sites between 2018-19 under generally dry conditions (Flaten and Gardiner 2020³).

It was invaluable to have these studies carried out across a range of precipitation and soil moisture conditions, because lack of moisture reduces nitrogen use efficiency and uptake by the plant. Under dry conditions there is less mineralization of soil organic matter. With less soil water, there is less mass flow movement of nitrate-N to the root. So under dry conditions, yields will be less, but more N is actually required for each bushel produced.

This is shown in table 1, which summarizes data according to higher and lower achieved yields in moist and dry years. Corn yields in the drier years were less, but the amount required per bu at the optimum rate were higher.

Yet the amounts per acre were strikingly similar across yield levels and moisture conditions, ranging between 150-190 lb. N/ac.

Table 1. Nitrogen requirement to achieve the economically optimum yield for higher and lower potential yields.

Yields achieved at sites	Moist sites (2016-17)	Dry sites (2108-19)
	Lb N/bu produced	
High (>130 bu/ac)	0.95 (7 sites)	1.1-1.4 (11 sites)
Lower (<130 bu/ac)	1.2 (3 sites)	1.5-2.1 (7 sites)
Economically optimum N rate in lb N/ac (soil N & fertilizer)	150-180	150-190

This data was produced well before such current extremes in crop and fertilizer prices. Have economically optimum rates changed?

When the data across moisture sites are combined (since one really does not know in advance if they will have a dry or moist year), a general yield function can be produced to compare the impact of various N costs and crop prices, based on higher and lower yield potential sites (Figure 2). Such responses can then be used to calculate the most economic N rates, or MERN (Table 2). These response curves are actually quite similar in shape, and the economically-optimum N rates are within 10-15 lb. N/ac despite a 50 bu/ac yield gap.

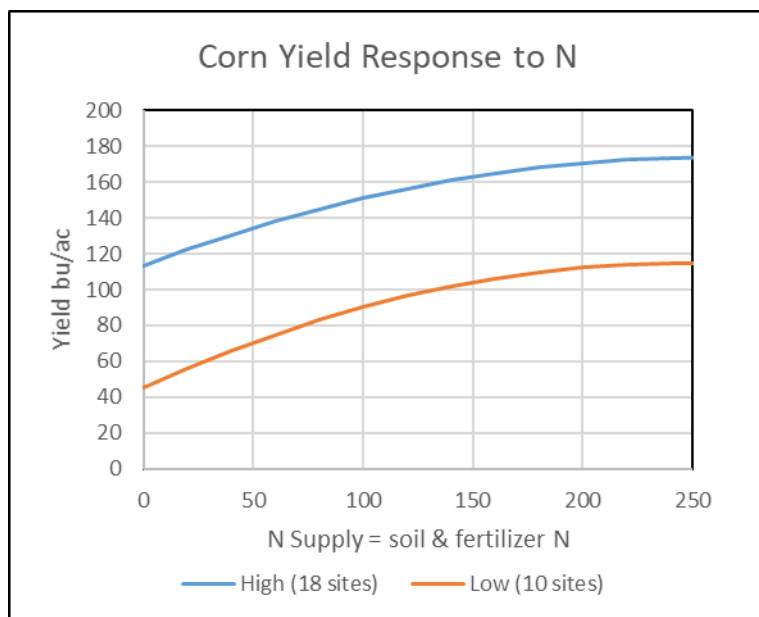


Figure 2. Corn yield response to N supply (lb soil and fertilizer N/ac) at higher and lower yielding sites.

Table 2. Most economic nitrogen rate (MERN) for high and low yield potential sites, across a wide range of N costs and crop prices.

N cost per lb N	Corn price \$/bu					
	\$6.00	\$8.00	\$10.00	\$6.00	\$8.00	\$10.00
	High Yield (>130 bu/ac) potential			Lower yield (<130 bu/ac) potential		
	Total N supply lb N/ac (soil nitrate plus fertilizer)					
\$0.40	210	230	240	210	215	220
\$0.60	205	220	225	195	205	210
\$0.80	185	205	215	180	195	205
\$1.00	165	190	205	165	185	195
\$1.20	150	175	190	155	175	185
\$1.40	130	165	180	140	165	180

Values in the above table are for comparative purposes, based on what one anticipates their N costs and crop prices will be. The value is the N supply that maximizes return, but in fact a +/-10 lb N/ac from these values provides within \$1/ac of this same return. Remember to subtract your soil test N from these values!

Now one may ask what constitutes a high versus lower yielding site. This may be soil productivity, limitations of drainage, salinity, erosion or poor crop husbandry. Poor crop husbandry means delayed seeding, inappropriate plant populations, soil compaction and delayed weed control, which were some factors associated with lower yields at my research sites.

There are many cases of exceptional crop husbandry and very high nutrient efficiency by Manitoba farmers. I have measured efficiencies of 0.84 lb N supply/bu in high yielding corn grower fields. This was achieved with reduced tillage, some N at seeding followed by the remainder at side-dressing.

So Manitoba farmers will likely reduce N rates for corn in 2022, primarily due to high residual N levels, rather than high N costs. However, higher fertilizer prices do mean that growers have more risk, in order to pursue high potential returns. Good field husbandry is always important, especially early weed control, to optimize nitrogen use efficiency.

References

¹AgVise Laboratories. <https://www.agvise.com/wp-content/uploads/2021/11/agvise-soil-test-summary-canada-2021.pdf>

²Heard, J. 2017. Nitrogen for MB corn: rates and splits. <https://mbcropalliance.ca/assets/uploads/images/2017-corn-N-poster.pdf>

³Don Flaten and Lanny Gardiner 2020. Optimum Nitrogen Fertilizer Management Strategies for Modern Corn Hybrids in Manitoba Final Project Report to the Manitoba Corn Growers Association



Contact Us

This article was developed by a Manitoba Agriculture Soil Fertility Specialist.

For more information, contact the department:

- Online www.manitoba.ca/agriculture
- Email crops@gov.mb.ca
- Phone 1-844-769-6224