

NEW MSU NITROGEN RECOMMENDATION FOR FIELD CORN

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Nitrogen (N) plays a significant role in the growth, development and yield of corn. From the mid-1900s until present time supplemental inputs of N through various N sources, especially legumes and manufactured N fertilizers, have contributed greatly to improvement in corn yields in Michigan. The first increments of N additions result in large increases in grain yield, but with each succeeding increment of N added the increase in grain yield becomes less until no further increase in yield occurs from additional N. The N recommendation for corn is based on this principle. Many field studies have been conducted over the years to establish the nature of the relationship between corn grain yield and N addition. For many years MSU's N recommendations for corn were provided in tabular form based on the yield potential of the soil. More N was recommended for soils with higher yield potentials. Studies indicated that, on average, 1.1 to 1.2 pounds N was required to produce 1 bushel of corn. In the 1970s the tabular information was used to create a linear N recommendation equation based on yield potential. This equation indicates that the amount of N required is related to the yield potential of the soil. However, the equation may give the mistaken impression that yield can be increased without limit by applying more N. This relation only applies within the bounds of the yield potential of the soil.

Corn yield response data collected over the last 10 years show that new corn hybrids are more effective in utilizing N for producing grain. One bushel of corn is being produced, on average, with 0.8 lb N. Summarization of corn yield response to N data in Michigan and other North Central corn producing states shows that the economic optimum N rate (EONR) is similar across a range of yield potentials. Many states have now adopted the maximum return to N (MRTN) approach to determine the appropriate amount of N to apply for corn. The cost of N increases linearly with rate whereas the increase in corn grain yield plateaus (Figure 1). Where the difference between the two lines is greatest is the MRTN nitrogen rate. The MRTN nitrogen rate is higher for corn after corn than for corn after soybeans, due to N benefit from the soybeans. The MRTN rate will also vary with the productivity or yield potential of the soil. The recommended amount of N varies with the N:corn price ratio. At an N: corn price ratio of 0.10 the MRTN for corn after soybean in Michigan and Minnesota is near 100 and 115 lbs N/a for medium/low productivity soils and high productivity soils, respectively. In Wisconsin the similar values are 60 and 115 lbs N/a. For corn following corn the N recommendations are near 135 and 150 for Michigan and Minnesota. For Wisconsin the recommendations are 105 for medium/low productivity soils and 135 for high productivity soils. The range of N recommendation for \pm \$1.00 of the MRTN is approximately \pm 15 lbs N/acre. As the N:corn price ratio increases the MRTN recommended N rate decreases.

Suggested N rates for corn grown in Michigan based on recent N response data and using the MRTN approach are given in Table 1. The more productive soils have soil conditions that are more favorable for root development and mineralization of N. Hence, higher yields can be attained in high productivity soils with only slightly more N fertilizer than in low to medium productive soils. These recommendations are significantly lower than previous N recommendations. Farmers may be hesitant to make a complete shift to

these recommendations, but rather moderate their N rates based on a better N efficiency of new corn hybrids (0.8 lbs N/bu than the previous 1.1). To test the new recommendations farmers should put in strips with the new N recommendation in comparison to their standard rate and compare yields and economic return. Research data indicates there is very good confidence the new recommendations will provide the best economic return on investment in nitrogen.

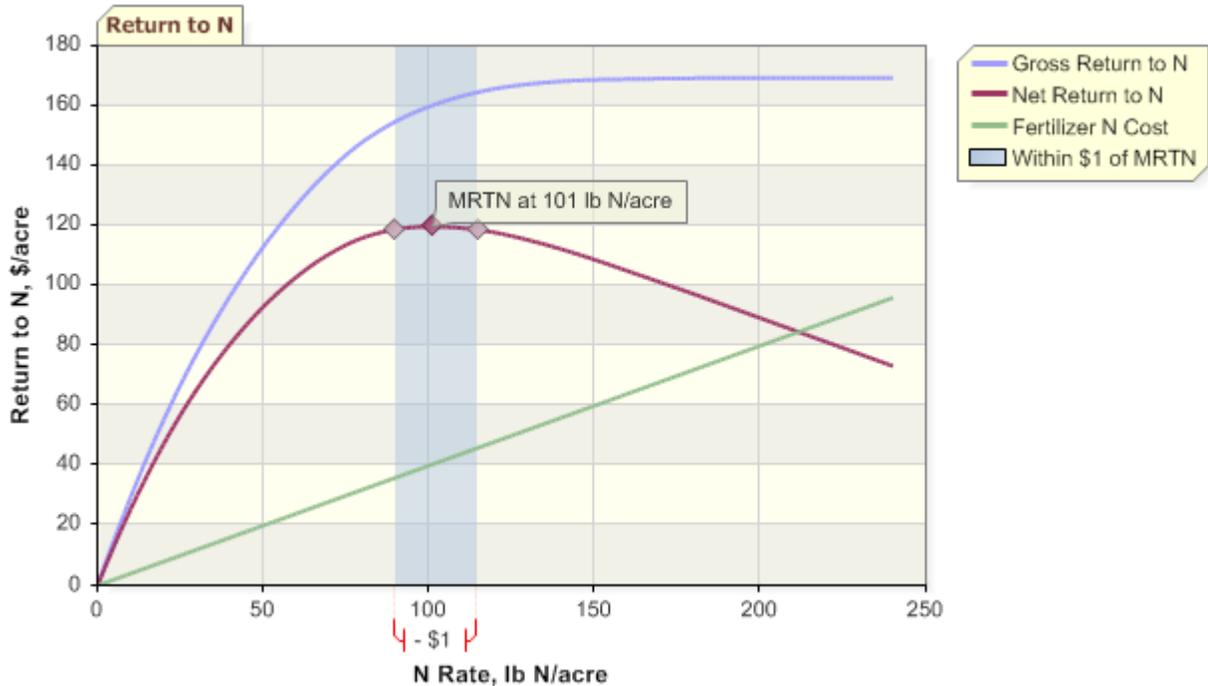


Figure 1. Illustration of maximum return to N (MRTN) concept. This example uses N priced at 40 cent/lb and corn at \$4.00 per bushel.

Table 1. Suggested N rates for corn grown in Michigan based on the MRTN approach. 2008.

Soil Productivity ¹	Previous Crop	N : Corn Price Ratio					
		0.10		0.15		0.20	
Suggested N Rate – lbs N/acre							
		Rate	Range²	Rate	Range²	Rate	Range²
Medium/low	Corn	130	115-145	120	105-135	110	95-125
High/Very High	Corn	150	135-165	135	120-150	120	105-135
Medium/low	Soybean	100	85-115	90	75-105	80	65- 95
High/Very High	Soybean	115	100-130	105	90-120	95	80-110

¹**Low:** Average Yield = < 120 bu/a; **Medium:** Average Yield = 121 to 150 bu/a
High: Average Yield = 151 to 180 bu/a; **Very High** = over 181 bu/a
where average yield is the 5 year running average (disregard unusual highs and lows)
²Range approximates ± \$1.00 of the Maximum Return To N (MRTN) rate.

ADAPTING TO THE NEW CORN N RECOMMENDATIONS

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The change from recommending nitrogen (N) based on expected yield to recommending N based on economic return is quite significant. To adapt to this change will take time and some on-farm N rate evaluation by farmers to become comfortable with these new recommendations. In making this change farmers may want to use the higher recommended amount in the “Maximum Return to N (MRTN)” range in Table 1. For example, if the 5 year running average year is 170 bushels per acre, the previous crop was corn and the N:corn price ratio is near 0.10 (\$0.50/ lb N and \$5.00/ bu corn), then the recommended N rate is 150 lbs N/acre. The upper range value is 165 lb N/acre. If soybean is the previous crop the upper range value is 130 lb N/acre.

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Medium/low	Corn	130	115-145	120	105-135	110	95-125
High/Very High	Corn	150	135-165	135	120-150	120	105-135
Medium/low	Soybean	100	85-115	90	75-105	80	65- 95
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¹**Low:** Average Yield = < 120 bu/a; **Medium:** Average Yield = 121 to 150 bu/a

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To determine the MRTN rate from Table 1 you need to know: 1) the productive capacity of the soil, 2) the previous crop, and 3) the N:corn price ratio. The N:corn price ratio is the cost of N (\$/lb) divided by the expected corn selling price (\$/bu). For example, if the price of N is \$0.50/lb (\$820/ton anhydrous ammonia) and corn is \$5.00/bu the N:corn price ratio is 0.10 (0.50/5). If the price of N is \$0.65/lb (\$600/ton urea) and corn is \$5.00/bu, then the N:corn price ratio is 0.13 (0.65/5).

If the previous crop is something other than corn or soybean use the recommendations associated with soybeans. Any crop other than corn as the previous crop will usually result in some N benefit similar to soybean. When the previous crop is alfalfa or clover then some additional N credit can be taken based on percent stand. For established alfalfa the additional N credit will be approximately equal to percent stand. For clovers the additional N credit will be about 0.5 x percent stand.