Economic Nitrogen Fertilizer Rates for Corn in 2005

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If anticipating soybean rust isn't keeping you up at night, corn and fertilizer prices probably are. The corn to nitrogen price ratio is at an unprecedented low. Potash costs about 50% more than last year and supply may be limited. So if you have been thinking that the economics of corn production have been looking poorer than normal, you are right. The objective of this article is to provide you with information to help you make decisions regarding how much nitrogen fertilizer to apply this spring.

Often N rates are set for corn by using an equation like 1.2 x yield goal = lb N/a to apply. While this practice is currently employed by some people, UWEX does not recommend using this formula. Research in Wisconsin shows that for both medium and high yield potential soils there is no relationship between the yield obtained and the nitrogen needed to obtain that yield (Figure 1). Because of the lack of a relationship between yield and N rate, UWEX N recommendations for corn are instead based on soil texture, yield potential, and organic matter content. A soil's yield potential can be found in "Soil test recommendations for field, vegetable, and fruit crops" (UWEX Bulletin A2809). The recommendations are provided in Table 1 and UWEX Bulletin A2809.

The N recommendations were developed to maximize the economic return on the investment in N fertilizer. Thus, it must be remembered that applying N fertilizer to obtain maximum yield is not economical because of the very flat nature of the yield response curve to applied N near maximum yield (Figure 2). The N recommendations in Table 1 are based on historically typical corn:N price ratios (10:1 to 15:1, eg. $3.00/bu and $0.30/lb N to $3.00/bu and $0.20/lb N, respectively). Figure 3 shows that in the range of price ratios from 10:1 to 15:1, the economic optimum N rate for high/very high yield potential soils varies by about 10 lb N/a. Current corn:N price ratios are at an unprecedented low (6:1 to 7:1). As seen in Figure 3, the economic optimum N rate for our current price ratios is about 20 lb N/a less than when the ratio ranges from 10:1 to 15:1. The table contained within Figure 2 shows the economic optimum N rate at various corn:N price ratios along with the respective yield increase from N fertilization. As the corn:N price ratio is reduced from 16.7:1 to 6.7:1 the EONR drops from 156 to 129 lb N/a. The subsequent yield reduction over the same range in price ratios is 3 bu/a. This data highlights the fact that a relatively large quantity of N is needed to produce the last few bushels of yield and that in the current economic climate it is not cost effective to gain those last few bushels.

The economic optimum N rates for our current price ratios are less than the ratios recommended in Table 1. Generally N rates should be reduced by approximately 20 lb N/a for high/very high yield potential soils, 40 lb N/a for low/medium yield potential soils, and 10 lb N/a for irrigated sandy soils. A N rate calculator has been developed by Mike Rankin (Crop and Soils Agent in Fond du Lac Co.) using UW-Soil Science data that has been collected over the past 20

years. This calculator allows the user to input various prices of N fertilizer materials along with expected corn prices. The calculator then determines the economic optimum N rate for the most current corn and N prices. The calculator is an Excel file that can be downloaded from the following web site: http://www.uwex.edu/ces/crops/NComparison.htm. For those that do not have internet access, Table 2 provides the economic optimum N rates for various prices of N and corn for high/very high and low/medium yield potential soils along with irrigated sands.

Overall, if one were to calculate the actual differences in return from the fertilizer investment, reducing N rates to achieve current economic optimum will result in $1 to 4/a greater return for high/very high yield potential soils and irrigated sands and $4 to 6/a greater return for low/medium yield potential soils. Over application of N compared to UWEX recommendations in Table 1 and/or failing to properly credit manure and legume N credits can result in much larger reductions in return.

Many producers may not want to reduce N rates for fear of greatly reducing yield. However, it must be remembered that on non-sandy soils the soil can supply a considerable amount of N for crop growth. The amount of yield obtained with no N applied for high and medium yield potential soils is provided in Figure 4. On high yield potential soils, the soil supplied enough N to provide 75 % of total yield when no N was applied to corn following corn; when corn followed soybean, 82 % of total yield was obtain with no N applied. The difference in soil N's contribution to yield is reflective of the fact that more N was available to the corn crop when soybean was the previous crop. For medium yield potential soils, 84 % of total yield was obtained when no N was applied. Soil N contributed to a greater percentage of total yield on medium yield potential soils compared to high yield potential soils where corn followed corn. This is because corn yield is less responsive to N applications on medium yield potential soils compared to high yield potential soils. It must be noted that these data represent averages of individual locations where N applications prior to the study year were uniform over the plot area.

In summary, we are in a poor economic climate for corn production in 2005. Profitability can be increased by reducing N application rates as described. Fully accounting for N credits from manure and legumes will help improve profitability. For additional help in determining N application rates and credits, contact your county extension office. For more soils information, visit us on the internet at: http://www.soils.wisc.edu/extension/.

Table 1. Nitrogen recommendations for corn grain and silage from UWEX Bulletin A2809.

	----- Sands/loamy sands -----		---------- Other soils ----------	
OM[†]	Irrigated	Non-irrigated	Low/Medium YP[‡]	High/Very High YP
%	---------- lb N/a ----------			
< 2	200	120	150	180
2 – 9.9	160	110	120	160
10 – 20	120	100	90	120
> 20	80	80	80	80

[†] OM = organic matter

[‡] YP = yield potential

Notes: 1) Subtract legume and manure N credits. 2) Does not include up to 20 lb N/a in starter fertilizer. 3) If > 50 % residue after planting, increase rate by 30 lb N/a.

Table 2. Economic optimum N rates for various corn and N prices for high/very high and low/medium yield potential soils along with irrigated sands.

Price of corn	---------- Price of N ($/lb N) ----------								
($/bu)	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40
	---------- lb N/a to Apply ----------								
	High/Very High Yield Potential Soils								
1.80	150	150	140	140	130	130	130	120	120
1.90	150	150	140	140	140	130	130	130	120
2.00	150	150	150	140	140	140	130	130	130
2.10	160	150	150	150	140	140	140	130	130
2.20	160	150	150	150	140	140	140	140	130
2.30	160	160	150	150	150	140	140	140	140
2.40	160	160	150	150	150	150	140	140	140
	Low/Medium Yield Potential Soils								
1.80	90	90	90	80	80	70	70	70	60
1.90	100	90	90	90	80	80	70	70	70
2.00	100	100	90	90	80	80	80	70	70
2.10	100	100	90	90	90	80	80	80	70
2.20	100	100	100	90	90	90	80	80	80
2.30	100	100	100	100	90	90	90	80	80
2.40	110	100	100	100	90	90	90	90	80
	Irrigated Sandy Soils								
1.80	190	190	190	190	180	180	180	170	170
1.90	190	190	190	190	180	180	180	180	170
2.00	200	190	190	190	190	180	180	180	180
2.10	200	190	190	190	190	190	180	180	180
2.20	200	200	190	190	190	190	190	180	180
2.30	200	200	200	190	190	190	190	190	180
2.40	200	200	200	190	190	190	190	190	190

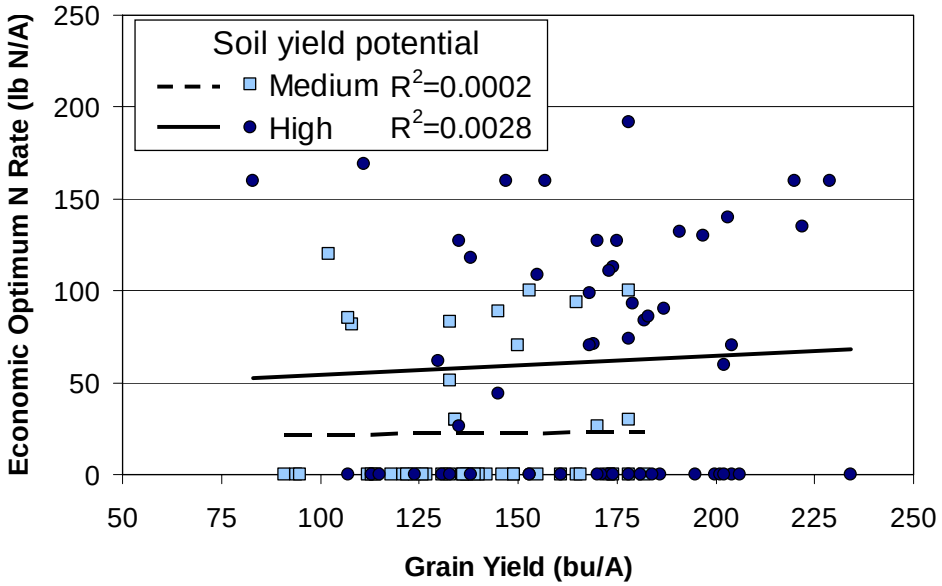

Figure 1. Relationship between economic optimum N rate (corn:N price ratio of 16.7:1) and corn grain yield for 101 sites throughout Wisconsin from 1989-1999.

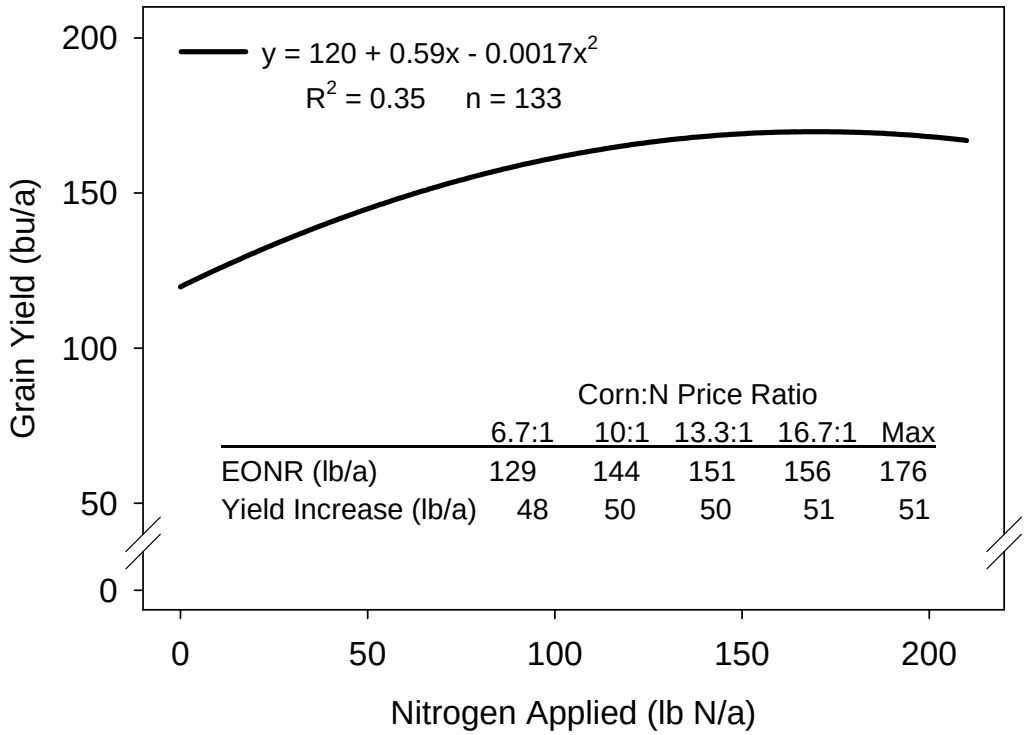

Figure 2. Yield response to N fertilizer for corn following corn on high yield potential southern silt loam soils from 1991 – 2003. Economic optimum N rates (EONR) were calculated for a variety to corn:N price ratios and related yield increases above a non-fertilized plot.

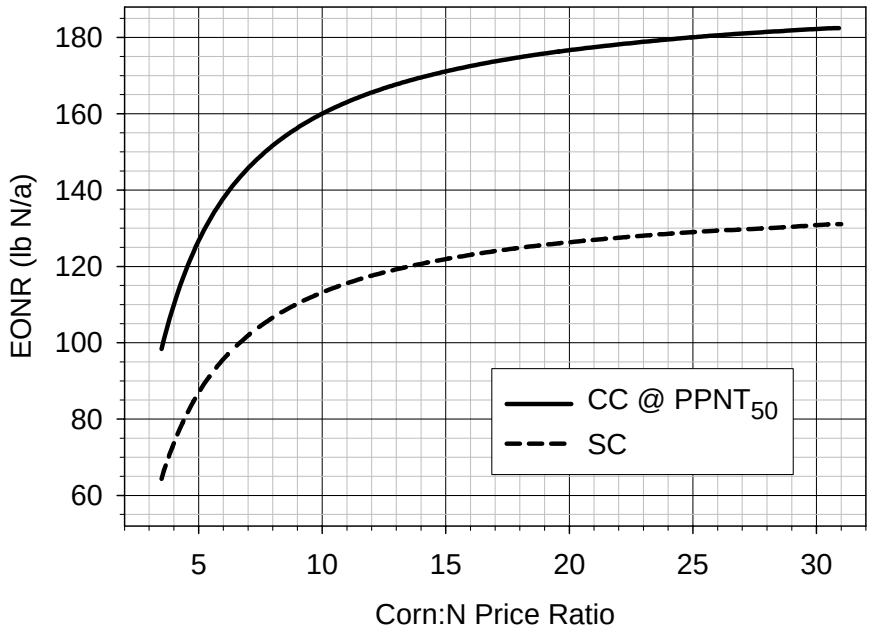

Figure 3. Relationship between corn:N price ratio and economic optimum N rate (EONR) for corn following corn (1991 – 2003) and corn following soybean (1994 – 2003) on high yield potential southern silt loam soils.

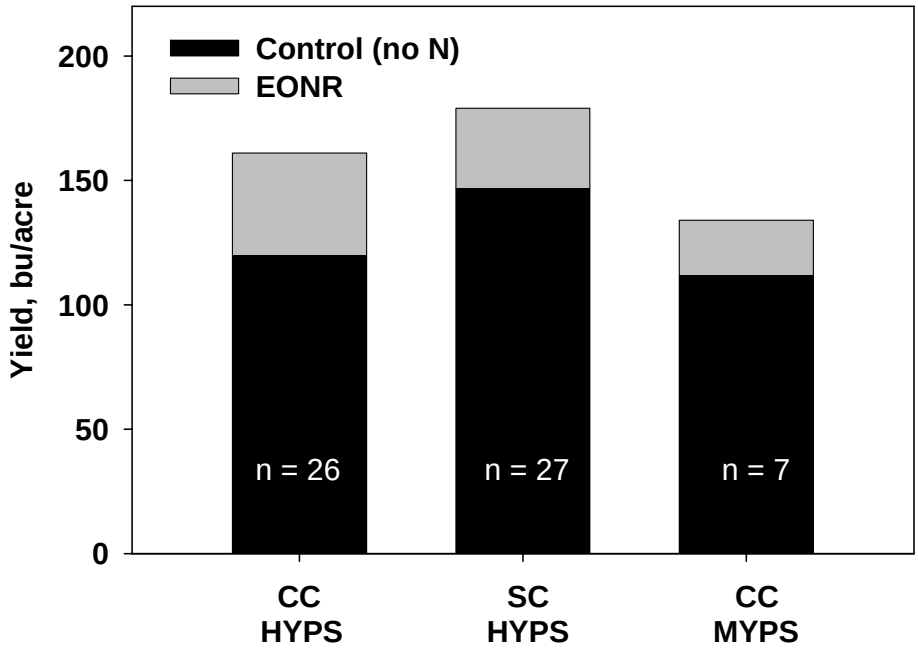

Figure 4. Yield obtained from soil (control, no N) and fertilizer N at the economic optimum N rate (EONR) for corn following corn (C-C) and corn following soybean (S-C) on high yield potential sites (HYPS) and corn following corn for medium yield potential sites (MYPS). Manure was not applied for at least five years prior to the experimental year at any location.