

Nitrogen Application Rate Guidelines for Corn

Justification

While the yield response of corn to applied N has not changed, the economics of corn production have. Recently soil fertility specialists in Wisconsin, Minnesota, Iowa, and Illinois have agreed to use the same philosophy to develop N rate guidelines for corn (grain). The philosophy used is based on maximizing return to N fertilizer. The new N rate guidelines were developed as a means to provide growers guidance on how much they might adjust their N application rates and maintain or enhance profitability depending upon their individual farm situation. Research data collected in Wisconsin from research farms and grower fields over a period of 20 years was used to develop the guidelines.

Suggested N application rates for corn (grain) at different N:corn price ratios

Soil and Previous Crop	N:Corn Price Ratio (\$/lb N:\$/bu)							
	0.05		0.10		0.15		0.20	
	Rate ¹	Range ²	Rate ¹	Range ²	Rate ¹	Range ²	Rate ¹	Range ²
	lb N/a (Total to Apply) ³							
HIGH/V. HIGH YIELD POTENTIAL SOILS								
Corn, Forage legumes, Leguminous vegetables, Green manures ⁴	165	135-190	135	120-155	120	100-135	105	90-120
Soybean, Small grains ⁵	140	110-160	115	100-130	100	85-115	90	70-100
MEDIUM/LOW YIELD POTENTIAL SOILS								
Corn, Forage legumes, Leguminous vegetables, Green manures ⁴	120	100-140	105	90-120	95	85-110	90	80-100
Soybean, Small grains ⁵	90	75-110	60	45-70	50	40-60	45	35-55
IRRIGATED SANDS AND LOAMY SANDS								
All crops ⁴	215	200-230	205	190-220	195	180-210	190	175-200
NON-IRRIGATED SANDS AND LOAMY SANDS								
All crops ⁴	120	100-140	105	90-120	95	85-110	90	80-100

¹ Rate is the N rate that provides the maximum return to N (MRTN).

² Range is the range of profitable N rates that provide an economic return to N within \$1/a of the MRTN.

³ These rates are for total N applied including N in starter fertilizer and N used in herbicide applications.

⁴ Subtract N credits for forage legumes, leguminous vegetables, green manures, and animal manures. This includes 1st, 2nd, and 3rd year credits where applicable. Do not subtract N credits for leguminous vegetables on sand and loamy sand soils.

⁵ Subtract N credits for animal manures and 2nd year forage legumes.

Guidelines for choosing an appropriate N application rate for corn

1. If there is > 50% residue cover at planting, use the upper end of the range.
2. When corn follows small grains on medium and fine textured soils, the mid-to-low end of the profitable range is most appropriate.
3. If 100 % of the N will come from organic sources, use the top end of the range. In addition, up to 20 lb N/a in starter fertilizer may be applied in this situation.
4. For medium and fine textured soils with: < 2% organic matter, use the high end of the range; > 10 % organic matter, use the low end of the range.
5. For coarse textured soils with: < 2% organic matter, use the high end of the range; > 2 % organic matter, use the mid to low end of the range.
6. If a medium yield potential soil is irrigated, use the rates suggested for high yield potential soils.
7. If there is a likelihood of residual N (carry over N), then use the low end of the range or use the high end of the range and subtract preplant nitrate test (PPNT) credits.

Corn Silage

The relationship between silage yield and N application rate is similar to that for grain yield and N rate. Silage quality is not greatly influenced by N application rates over the range of N rates provided in the rate guidelines table. If growing silage for on-farm feed, usually growers want to maximize yield to minimize purchased feed. In this situation using a N rate in the mid to upper end of the 0.05 price ratio would be appropriate. If silage is being sold, and a producer would like to reduce N rates to improve profitability, then they should chose a N rate using a N:corn price ratio that reflects typical prices for N and grain.

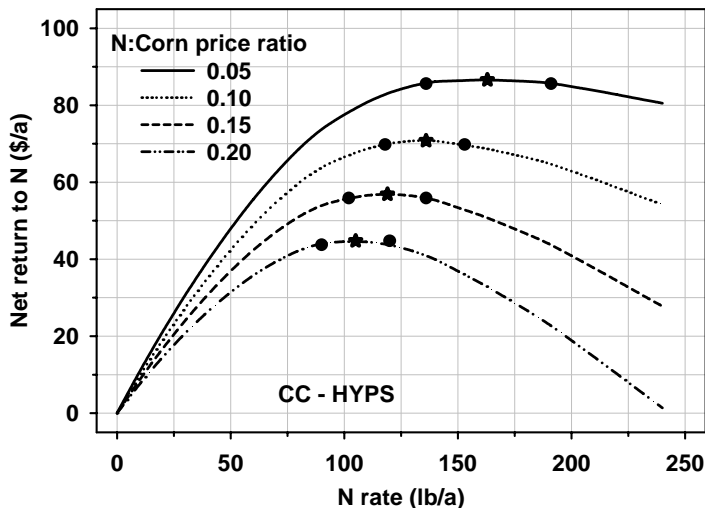
Valuing Grain and Manure N

Placing a value on fertilizer N is relatively easy in that the price of N is known at the time of purchase and application. The realistic value of grain will vary depending on where the grain is sold and how savvy a producer is in marketing the grain. Grain that will be used on farm as livestock feed should be valued at the price it would cost to purchase grain if feedstocks run short. The value of N in manure may vary between farms and between fields on farms depending upon the availability of land on which to spread manure. If a large enough land base is available to spread all manure, then the value of the N in manure could be considered to be equivalent to fertilizer N. This would mean that it would be more useful to spread the manure on as many acres as possible and reduce purchased N fertilizer, assuming poor or less than desirable N:corn price ratios. If the land base is limited, then spreading manure at a rate not to exceed the amount needed to maximize yield (top end of the profitability range for a N:corn price ratio of 0.05) would be appropriate. On some farms, there may be some fields that cannot receive manure and others that can. Thus, N application rates may be higher for fields receiving manure and lower for fields receiving fertilizer N.

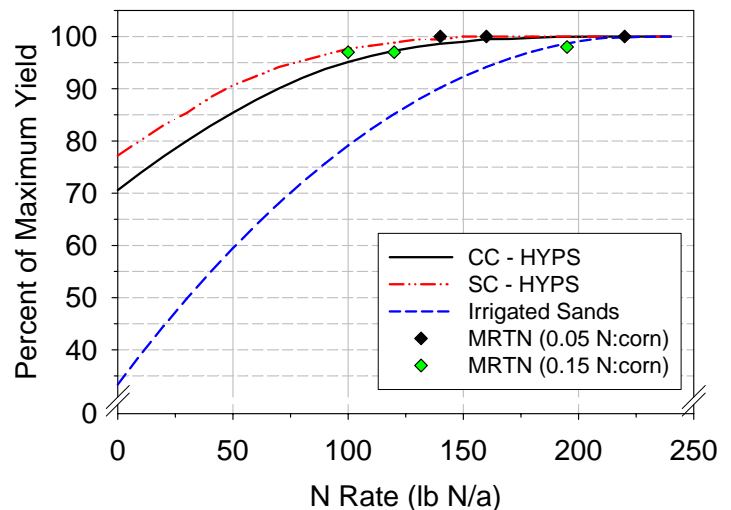
Price ratio of N:corn (ie. \$/lb N ÷ \$/bu corn)

Price of N [†] \$/lb N	Price of Corn (\$/bu corn)									
	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40	3.60
0.20	0.11	0.10	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06
0.22	0.12	0.11	0.10	0.09	0.08	0.08	0.07	0.07	0.06	0.06
0.24	0.13	0.12	0.11	0.10	0.09	0.09	0.08	0.08	0.07	0.07
0.26	0.14	0.13	0.12	0.11	0.10	0.09	0.09	0.08	0.08	0.07
0.28	0.16	0.14	0.13	0.12	0.11	0.10	0.09	0.09	0.08	0.08
0.30	0.17	0.15	0.14	0.13	0.12	0.11	0.10	0.09	0.09	0.08
0.32	0.18	0.16	0.15	0.13	0.12	0.11	0.11	0.10	0.09	0.09
0.34	0.19	0.17	0.15	0.14	0.13	0.12	0.11	0.11	0.10	0.09
0.36	0.20	0.18	0.16	0.15	0.14	0.13	0.12	0.11	0.11	0.10
0.38	0.21	0.19	0.17	0.16	0.15	0.14	0.13	0.12	0.11	0.11
0.40	0.22	0.20	0.18	0.17	0.15	0.14	0.13	0.13	0.12	0.11
0.42	0.23	0.21	0.19	0.18	0.16	0.15	0.14	0.13	0.12	0.12
0.44	0.24	0.22	0.20	0.18	0.17	0.16	0.15	0.14	0.13	0.12
0.46	0.26	0.23	0.21	0.19	0.18	0.16	0.15	0.14	0.14	0.13
0.48	0.27	0.24	0.22	0.20	0.18	0.17	0.16	0.15	0.14	0.13
0.50	0.28	0.25	0.23	0.21	0.19	0.18	0.17	0.16	0.15	0.14

[†] Price of N (\$/lb N) = [\$/ton fertilizer x (100 ÷ % N in fertilizer)] ÷ 2000



Profitable N rates for corn following corn on high/very high yield potential sites for N:corn price ratios of 0.05, 0.10, 0.15, and 0.20. Stars represent the maximum return to N (MRTN) and circles the low and high ends of the range of profitability (within \$1/a of MRTN) at each N:corn price ratio.



Percent of maximum yield obtained on average at each N rate for corn after corn (CC) and corn after soybean (SC) on high/very high yield potential soils (HYPS) and for all previous crops on irrigated sands with the exception of forage legumes and green manures. Diamonds represent the maximum return to N (MRTN) for each situation at price ratios of 0.05 and 0.15.

Legume N Credits

Crop	Medium/Fine textured soils		Sandy soils	
	> 8" of regrowth	< 8" of regrowth	> 8" of regrowth	< 8" of regrowth
	— lb N/a to credit —			
Alfalfa ¹				
Good stand (>4 plants/ft ²)	190	150	140	100
Fair stand (1.5-4 plants/ft ²)	160	120	110	70
Poor stand (<1.5 plants/ft ²)	130	90	80	40
Red Clover or Birdsfoot Trefoil	80 % of alfalfa credit for similar stands			
Vetch	160	90	110	40
Leguminous vegetables	20	—	—	—

Green Manures	lb N/a to credit ¹
Alfalfa	60-100
Sweet Clover	80-120
Red Clover	50-80

¹Use 40 lb N/a credit if < 6" growth before tillage

¹ Second year credit: in the second cropping year following a fair or good stand on medium and fine textures soils, take a 50 lb N/a credit

Manure N Credits

Approximate Available N Content 1 st year [2 nd year]					
Species, Type	N	N*	Species, Type	N	N*
Dairy			Swine		
Solid (lb/ton)	3 [1]	4 [1]	Solid (lb/ton)	7 [1]	9 [2]
Liquid (lb/1000gal)	7 [3]	10 [2]	Liquid (lb/1000gal)		
Beef			Indoor pit	25 [5]	33 [5]
Solid (lb/ton)	4 [1]	5 [1]	Outdoor pit	17 [3]	22 [4]
Liquid (lb/1000gal)	5 [2]	7 [2]	Farrow-nursery indoor pit	13 [2]	16 [3]
Poultry			Horse		
Solid (lb/ton)	20 [4]	24 [4]	Solid (lb/ton)	3 [1]	4 [1]
Liquid (lb/1000gal)	8 [2]	10 [1]			

* Manure incorporated with 3 days