Commercial Nitrogen Fertilizer Management.

A bushel of corn contains approximately 0.8 lbs of nitrogen (N), thus a 200-bushel corn crop removes about 160 pounds of N from the field[1]. For those corn acres not receiving manure applications it is necessary to apply commercial nitrogen to meet the nitrogen demand of the planted crop. Until recently the guideline in Illinois was to apply 1.2 pounds of nitrogen per bushel of expected yield. Recent research has indicated that modern hybrids grown in Illinois Soils may not need as much N as previous recommendations have suggested.

The new approach recommended in the most current version of the Illinois agronomy handbook takes into consideration the value of Corn and the return to investment of additional N fertilizer. The Maximum Return to N (MRTN) is the point in which the yield increase for adding additional N just pays for the N added. Further Reading regarding the MRTN approach can be found in the Managing Nitrogen Section of the Illinois Agronomy Handbook.

The MRTN approach was a result of collaborative efforts between several Midwestern universities. Iowa State University hosts a website where N rate guidelines can be calculated using this approach. The website can be found at:

http://extension.agron.iastate.edu/soilfertility/nrate.aspx

The Illinois Agronomy Handbook describes the output of the MRTN Corn Nitrogen Rate Calculator as a guideline to N application rate. These guidelines are intended to be used as a decision aid rather than a fixed recommendation. However Illinois Agronomy Handbook strongly recommends that the new method be used for calculating N rates and that the Yield based N recommendations system no longer be used.

The N rate calculator was designed based on current N and corn prices. If N prices drop and corn prices rise so that the ratio drops to 0.05 or less (cost of N/Price of Corn), calculated N rates could be very high. The N rate calculator has built in limits and will not calculate N rates above 240 lbs per acre. In order to reach this limit corn would have to be $8 per bushel and N would have to cost less than 25 cents per pound.

It is recommended that when using manure, sewage sludge, or other N sources that usually cost less per pound of N than commercial fertilizers that a conservative approach to assigning value to those products be used. One such approach is to price the pounds of crop-available N the same as would be for a pound of N from a commercial fertilizer source. Available N from manure sources can vary and it is recommended that actual manure analysis be used to determine N available.

[1] Illinois Agronomy Handbook, 24th Edition.

How to Use the Calculator[2]

- Choose if you want to calculate for one set of prices or multiple prices (price ratio of N and corn).
- Choose which state you are interested in, or the region of a state or the soil yield potential grouping.
- Choose the rotation, either corn following soybean or corn following corn.
- Check if you want to include non N responsive sites (sites that had no yield increase to N application).
- Choose the N fertilizer product and price, and corn grain price. If you use the multiple price ratio option, then you can choose four prices for N and corn grain (four ratios). The prices for N and corn have default values already entered. You may enter either the product cost ($/ton) or unit cost ($/lb N).
- Hit the calculate button to run the calculations. This will take you to the results section. If you choose N or corn prices that are too high or low, you may get an error message in the results section. If that happens, please try another set of prices.

State Information

- **Illinois Geographic Region –** Sites for Illinois are grouped by geographic location in the state: North, Central, and South. Northern Illinois runs from the Wisconsin border and includes those counties through which Interstate Route 80 runs. Southern Illinois includes the counties through which Interstate Route 70 runs, and the southern parts of counties (Shelby, Montgomery, Macoupin) north of those where soils have lower organic matter. Central Illinois is the area in between, and might also be considered to include southern portions of large counties (Henry, Bureau, LaSalle) through which I-80 runs. When in doubt in "border" areas, assign higher organic-matter soils to the northern of two areas and lower OM soils to the more southern area.

[2] Taken from the Nitrogen Rate Calculator Website (http://extension.agron.iastate.edu/soilfertility/nrate.aspx)

Definitions

- **EONR –** Economic optimum N rate, the point where the last increment of N returns a yield increase large enough to pay for the additional N.
- **MRTN –** Maximum return to N, the N rate where the economic net return to N application is maximized.
- **Maximum Yield –**The yield where application of more N does not result in yield increase.
- **Net Return –** The value of corn grain produced minus the N fertilization cost.
- **Price Ratio –** The ratio of N fertilizer price to corn grain price ($/lb:$/bu).
- **Site –** The land area occupied by a N rate trial, either replicated small plots in a specific field area or replicated field-length strips.
- **Site N Responsiveness –** The corn grain yield increase with N application, non-responsive indicates no yield increase with N application while high response indicates large yield increase from N application.
- **Gross (Yield) Return –** The value of corn grain increase due to N application.

Calculated Values

The results of calculations are provided in a table and in up to four graphs. Also, the chosen input information that went into the calculations is displayed.

Displayed Input Information

- State.
- The number of N rate trials (sites) that fit the chosen criteria and used in the calculations.
- The rotation.
- An indication if non-responsive sites are included in the calculations.
- The N fertilizer and corn grain prices, and the price ratio(s).

Tables

Table 2. Example of results table using MRTN website

N Price ($/lb N):	**$0.34**	**$0.43**	**$0.52**	**$0.61**
Corn Price ($/bu):	**$4.50**	**$4.50**	**$4.50**	**$4.50**
Price Ratio:	**0.08**	**0.1**	**0.12**	**0.14**
RTN Rate (lb N/acre):	**180**	**170**	**161**	**154**
Profitable N Rate Range (lb N/acre):	165 - 196	156 - 185	148 - 175	141 - 166
Net Return to N at MRTN Rate ($/acre):	$301.01	$285.30	$270.43	$256.29
Percent of Maximum Yield at MRTN Rate:	99%	98%	98%	98%
UAN (28% N) at MRTN Rate (lb product/acre):	643	607	575	550
UAN (28% N) Cost at MRTN Rate ($/acre):	$61.20	$73.10	$83.72	$93.94

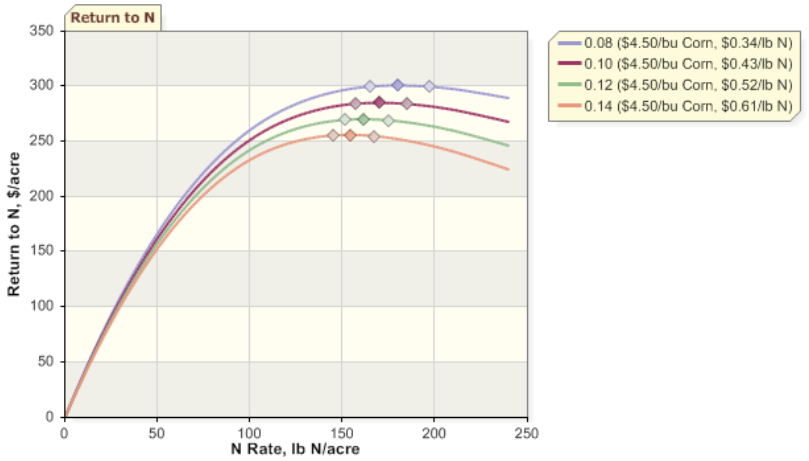
- **MRTN Rate (lb N/acre)**, is the N rate at the MRTN. For the data set, rotation, and price ratio(s), the MRTN rate would be the suggested rate to apply for maximizing net return to N application.
- **Profitable N Rate Range (lb N/acre)**, is the N rate values at a $1/acre net return range (LOW and HIGH) around the MRTN. An N rate within this range around the MRTN would provide similar expected economic return and could be considered the profitable N rate range.
- **Net return to N at MRTN Rate ($/acre)**, is the economic net return at the MRTN rate.
- **Percent of maximum yield** is the proportion of yield that might be produced at the MRTN rate and LOW/HIGH N rate range compared to the yield at the maximum response to N. It is not economical to attempt to apply N at a rate that would result in maximum yield or meet the N requirements of all sites (100% maximum yield), including the few most responsive sites. An economic rate will always result in less than 100% of maximum yield, that is, the MRTN rate will result in yield less than maximum. How far less than maximum depends on the price ratio of N and corn grain. For producers that are willing to tolerate more risk in their corn production system, then N application toward the LOW rate will have on average lower N input cost, but more frequently may supply N below maximum economic response. For producers with greater aversion to risk in their corn production system, then N application toward the HIGH rate will more frequently supply N that is at least adequate to meet corn N needs, but have on average greater N input cost and more frequently be above maximum economic response.

- **Nitrogen Product at MRTN Rate (lb product/acre)**, is the amount of product at the MRTN rate.
- **Nitrogen Product Cost at MRTN Rate ($/acre)**, is the cost of N at the MRTN rate.

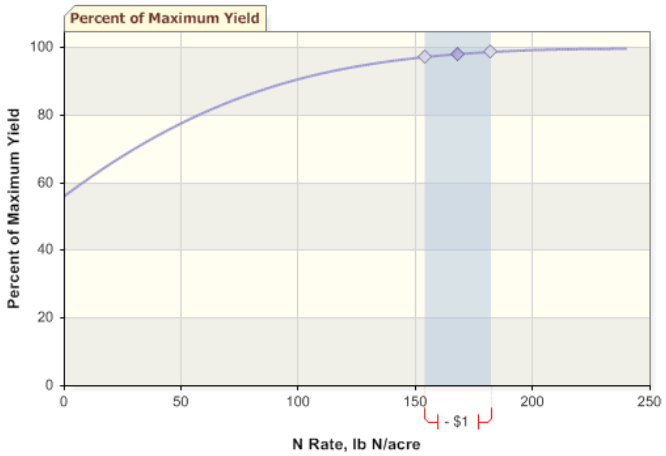
Charts

Four graphs are available for viewing. Each presents a different component of the economic rate calculations, and compliment results shown in the table.

- **Return to N.** This graph shows the two components for calculating net return across N rates; the gross return from yield increase and the fertilizer cost. The net economic return to N is the difference between these two values at each N rate. The point of maximum net return (MRTN, solid symbol) and the profitable N rate range (shaded symbol) within $1/acre of the maximum is shown on the graph. The N rate at the MRTN provides the greatest economic return to N application for the dataset, prices, and rotation chosen and would be the suggested N application rate. If multiple price ratios are chosen, then only net return to N is shown for each ratio.

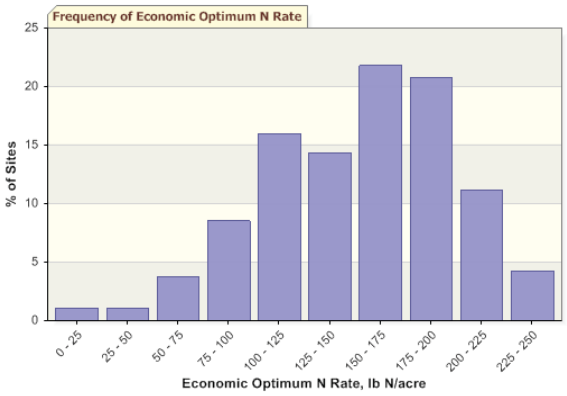


- **Percent of maximum yield.** This graph shows the percent of maximum yield across N rates for all sites in the dataset and rotation chosen. The N rate at the MRTN and the profitable N rate range (LOW - HIGH) within $1/acre of the MRTN are shown. As N rates move toward the LOW end of the range, the risk of having inadequate N increases and percent of maximum yield decreases, while as N rates move toward the HIGH end of

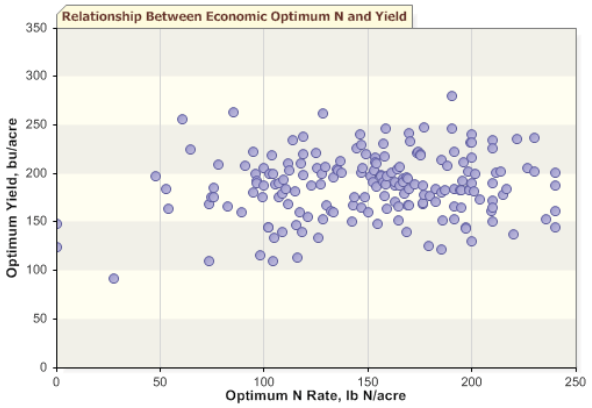


the range the risk of having inadequate N decreases and percent of maximum yield increases. The greater the N cost relative to corn grain price (the larger the price ratio), the lower the economic rate, the farther the MRTN rate moves down the N response curve, and the more yield will be below the maximum yield. This graph helps with decisions regarding choice of N rate in regard to risk management. Reducing risk of insufficient N (that is, using a higher N rate) does result in greater N input cost, which in the long run could reduce economic return to N use. If multiple price ratios are chosen, then the percent of maximum yield is shown for each ratio.

- **EONR Frequency.** This graph shows the frequency distribution, in 25 lb N increments, of the EONR for each site in the dataset and rotation chosen. The higher the bar for a N rate increment the more times sites had an EONR in that increment. Typically N trial datasets have a range of EONR values, with the most frequent range of EONR's being around the MRTN value. If multiple price ratios are chosen, then the frequency of EONR is shown for each ratio.



- **EONR vs. Yield.** This graph shows the relationship between the site EONR and yield at the EONR for each site in the dataset and rotation chosen. The number of symbols will match the number of sites in the dataset. You can scroll the cursor over the symbol to see the state, county, and manure history for that site. If multiple price ratios are chosen, then the graph will display the results for the first ratio.



Several scenarios have been run using the Nitrogen Rate calculator. These scenarios are provided in order to guide nitrogen applications on areas where manure is not applied. The following table is a summary of those scenarios.

Table 1. Summary of scenarios calculated using the MRTN rate calculation website.
All scenarios were calculated using a corn value of $4.50 per bushel

Crop Rotation	Fertilizer Type	Cost Per Ton
Corn following Soybeans	Anhydrous Ammonia (82%)	550-1000
Continuous Corn	Anhydrous Ammonia (82%)	550-1000
Corn following Soybeans	UAN (28%)	190-342
Continuous Corn	UAN (28%)	190-342

Producers are encouraged to use the online version of the Nitrogen Rate Calculator to fine tune Nitrogen Application Rates.

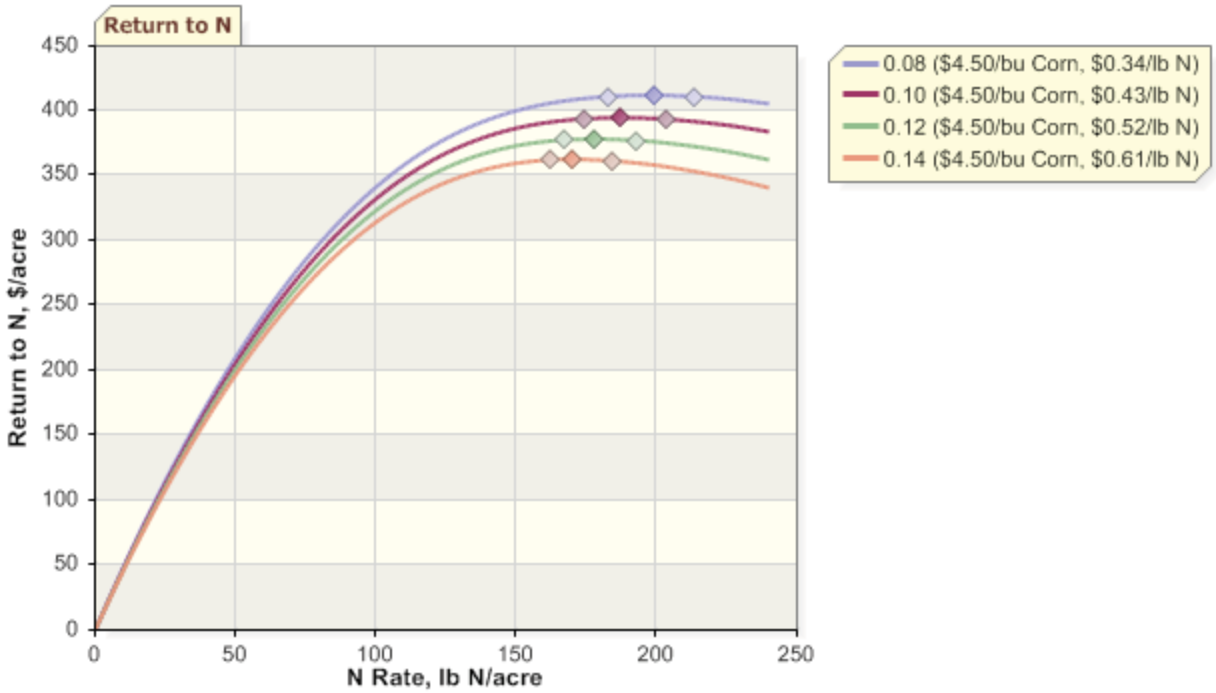
Corn Nitrogen Rate Calculator

Finding the Maximum Return To N and Most Profitable N Rate

A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

State: Illinois - Central
Number of sites: 93
Rotation: Corn Following Corn
Non-Responsive Sites Not Included

Anhydrous Ammonia (82% N) Cost per Ton	**$550**	**$700**	**$850**	**$1000**
N Price ($/lb N):	**$0.34**	**$0.43**	**$0.52**	**$0.61**
Corn Price ($/bu):	**$4.50**	**$4.50**	**$4.50**	**$4.50**
Price Ratio:	**0.08**	**0.10**	**0.12**	**0.14**
RTN Rate (lb N/acre):	**199**	**187**	**178**	**170**
Profitable N Rate Range (lb N/acre):	183 - 213	173 - 203	165 - 192	158 - 183
Net Return to N at MRTN Rate ($/acre):	$412.24	$394.87	$378.44	$362.79
Percent of Maximum Yield at MRTN Rate:	99%	99%	98%	98%
Anhydrous Ammonia (82% N) at MRTN Rate (lb product/acre):	243	228	217	207
Anhydrous Ammonia (82% N) Cost at MRTN Rate ($/acre):	$67.66	$80.41	$92.56	$103.70



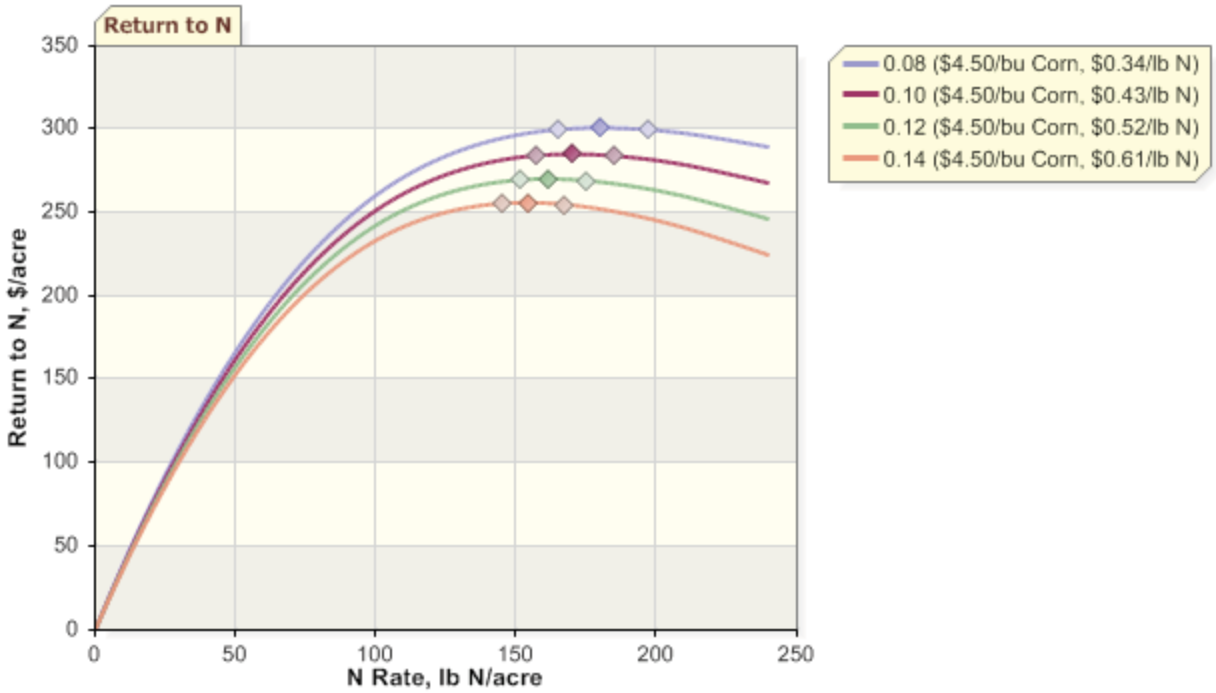
Corn Nitrogen Rate Calculator

Finding the Maximum Return To N and Most Profitable N Rate

A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

State: Illinois - Central
Number of sites: 188
Rotation: Corn Following Soybean
Non-Responsive Sites Not Included

Anhydrous Ammonia (82% N) Cost per Ton	**$550**	**$700**	**$850**	**$1000**
N Price ($/lb N):	**$0.34**	**$0.43**	**$0.52**	**$0.61**
Corn Price ($/bu):	**$4.50**	**$4.50**	**$4.50**	**$4.50**
Price Ratio:	**0.08**	**0.10**	**0.12**	**0.14**
RTN Rate (lb N/acre):	**180**	**170**	**161**	**154**
Profitable N Rate Range (lb N/acre):	165 - 196	156 - 185	148 - 175	141 - 166
Net Return to N at MRTN Rate ($/acre):	$301.01	$285.30	$270.43	$256.29
Percent of Maximum Yield at MRTN Rate:	99%	98%	98%	98%
Anhydrous Ammonia (82% N) at MRTN Rate (lb product/acre):	220	207	196	188
Anhydrous Ammonia (82% N) Cost at MRTN Rate ($/acre):	$61.20	$73.10	$83.72	$93.94



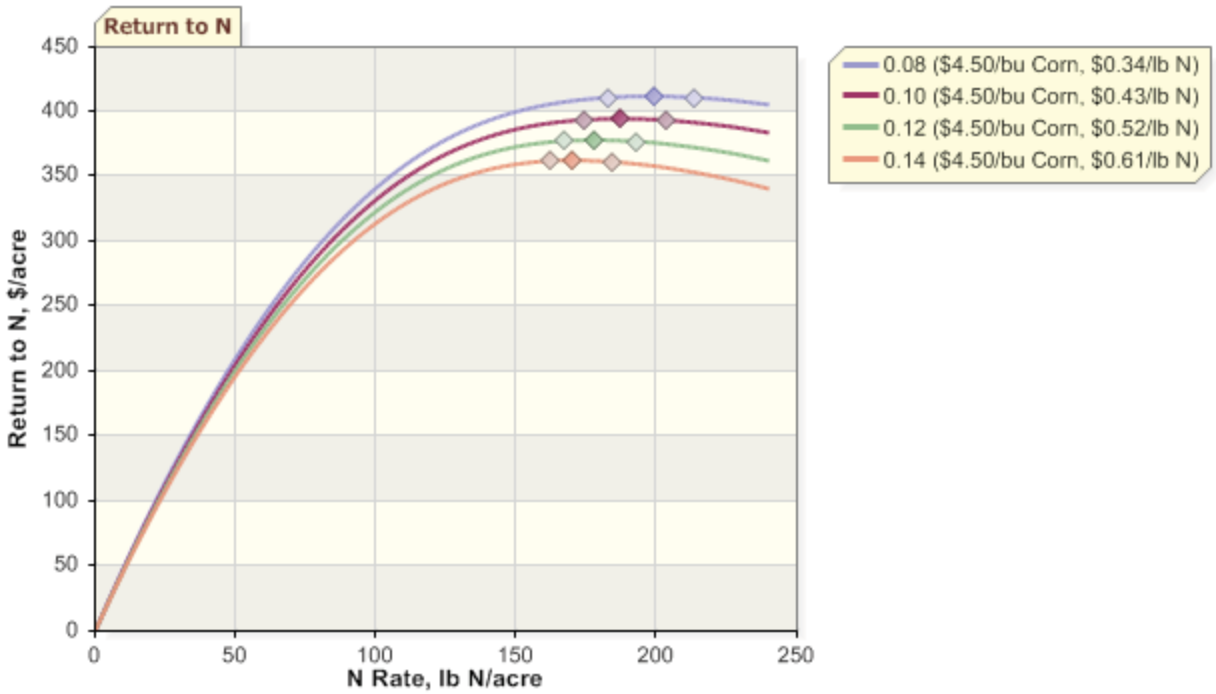
Corn Nitrogen Rate Calculator

Finding the Maximum Return To N and Most Profitable N Rate

A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

State: Illinois - Central
Number of sites: 93
Rotation: Corn Following Corn
Non-Responsive Sites Not Included

UAN (28%) Cost per Ton	**$190**	**$241**	**$291**	**$342**
N Price ($/lb N):	**$0.34**	**$0.43**	**$0.52**	**$0.61**
Corn Price ($/bu):	**$4.50**	**$4.50**	**$4.50**	**$4.50**
Price Ratio:	**0.08**	**0.10**	**0.12**	**0.14**
RTN Rate (lb N/acre):	**199**	**187**	**178**	**170**
Profitable N Rate Range (lb N/acre):	183 - 213	173 - 203	165 - 192	158 - 183
Net Return to N at MRTN Rate ($/acre):	$412.24	$394.87	$378.44	$362.79
Percent of Maximum Yield at MRTN Rate:	99%	99%	98%	98%
UAN (28% N) at MRTN Rate (lb product/acre):	711	668	636	607
UAN (28% N) Cost at MRTN Rate ($/acre):	$67.66	$80.41	$92.56	$103.70



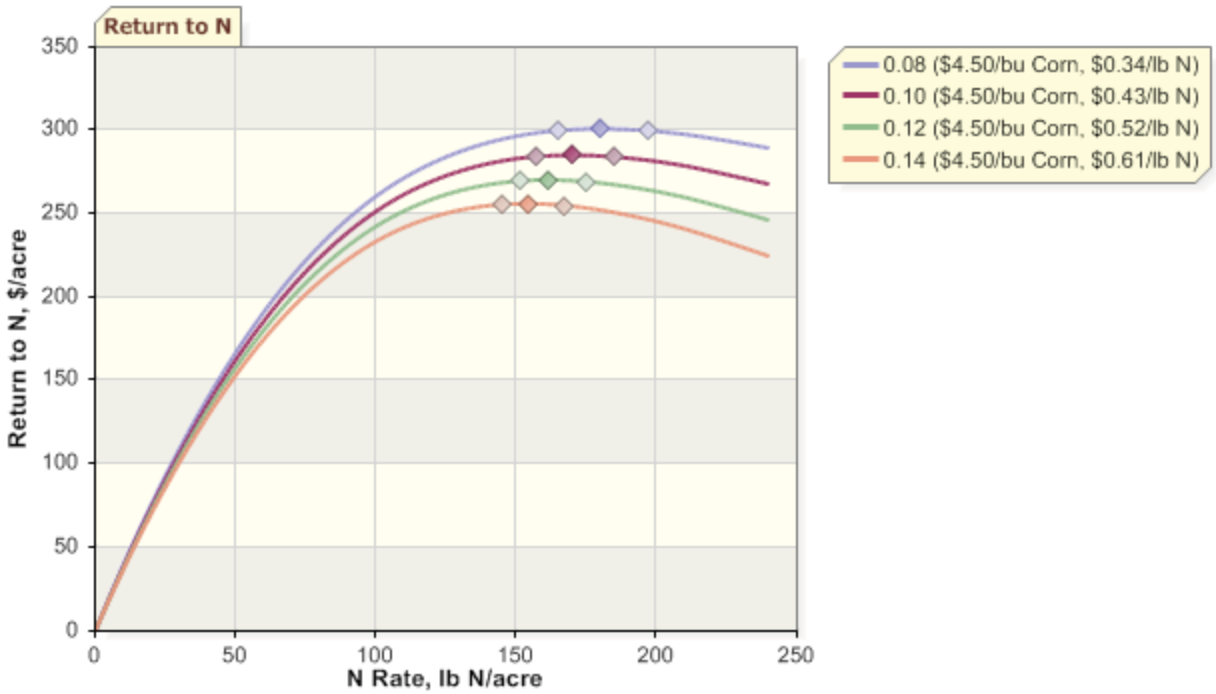
Corn Nitrogen Rate Calculator

Finding the Maximum Return To N and Most Profitable N Rate

A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

State: Illinois - Central
Number of sites: 188
Rotation: Corn Following Soybean
Non-Responsive Sites Not Included

UAN (28%) Cost per Ton	**$190**	**$241**	**$291**	**$342**
N Price ($/lb N):	**$0.34**	**$0.43**	**$0.52**	**$0.61**
Corn Price ($/bu):	**$4.50**	**$4.50**	**$4.50**	**$4.50**
Price Ratio:	**0.08**	**0.10**	**0.12**	**0.14**
RTN Rate (lb N/acre):	**180**	**170**	**161**	**154**
Profitable N Rate Range (lb N/acre):	165 - 196	156 - 185	148 - 175	141 - 166
Net Return to N at MRTN Rate ($/acre):	$301.01	$285.30	$270.43	$256.29
Percent of Maximum Yield at MRTN Rate:	99%	98%	98%	98%
UAN (28% N) at MRTN Rate (lb product/acre):	643	607	575	550
UAN (28% N) Cost at MRTN Rate ($/acre):	$61.20	$73.10	$83.72	$93.94



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Agronomy Extension

Corn Nitrogen Rate Calculator

Finding the Maximum Return To N and Most Profitable N Rate

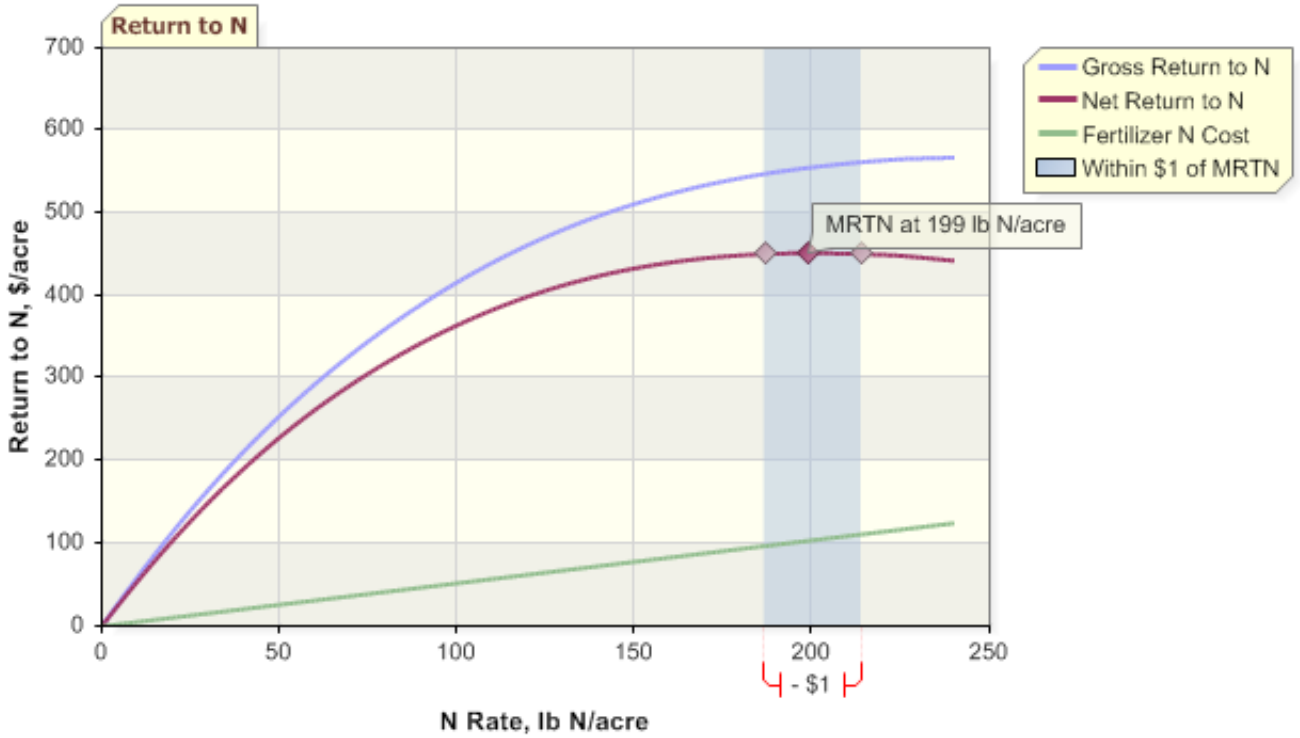
A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

State: Illinois - South
Number of sites: 47
Rotation: Corn Following Corn
Non-Responsive Sites Not Included

Nitrogen Price ($/lb): 0.52
Corn Price ($/bu): 6.50
Price Ratio: 0.08

MRTN Rate (lb N/acre):	**199**
Profitable N Rate Range (lb N/acre):	187 - 214
Net Return to N at MRTN Rate ($/acre):	$451.62
Percent of Maximum Yield at MRTN Rate:	99%
Anhydrous Ammonia (82% N) at MRTN Rate (lb product/acre):	243
Anhydrous Ammonia (82% N) Cost at MRTN Rate ($/acre):	$103.48

Most profitable N rate is at the maximum return to N (MRTN).
Profitable N rate range provides economic return within $1/acre of the MRTN.



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Corn Nitrogen Rate Calculator

Finding the Maximum Return To N and Most Profitable N Rate

A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

State: Illinois - South
Number of sites: 115
Rotation: Corn Following Soybean
Non-Responsive Sites Not Included

Nitrogen Price ($/lb): 0.52
Corn Price ($/bu): 6.50
Price Ratio: 0.08

MRTN Rate (lb N/acre):	**182**
Profitable N Rate Range (lb N/acre):	169 - 197
Net Return to N at MRTN Rate ($/acre):	$408.22
Percent of Maximum Yield at MRTN Rate:	99%
Anhydrous Ammonia (82% N) at MRTN Rate (lb product/acre):	222
Anhydrous Ammonia (82% N) Cost at MRTN Rate ($/acre):	$94.64

Most profitable N rate is at the maximum return to N (MRTN).
Profitable N rate range provides economic return within $1/acre of the MRTN.