Nitrogen Recommendations for Optimizing Economic Return and Water Quality

Iowa Watershed Academy

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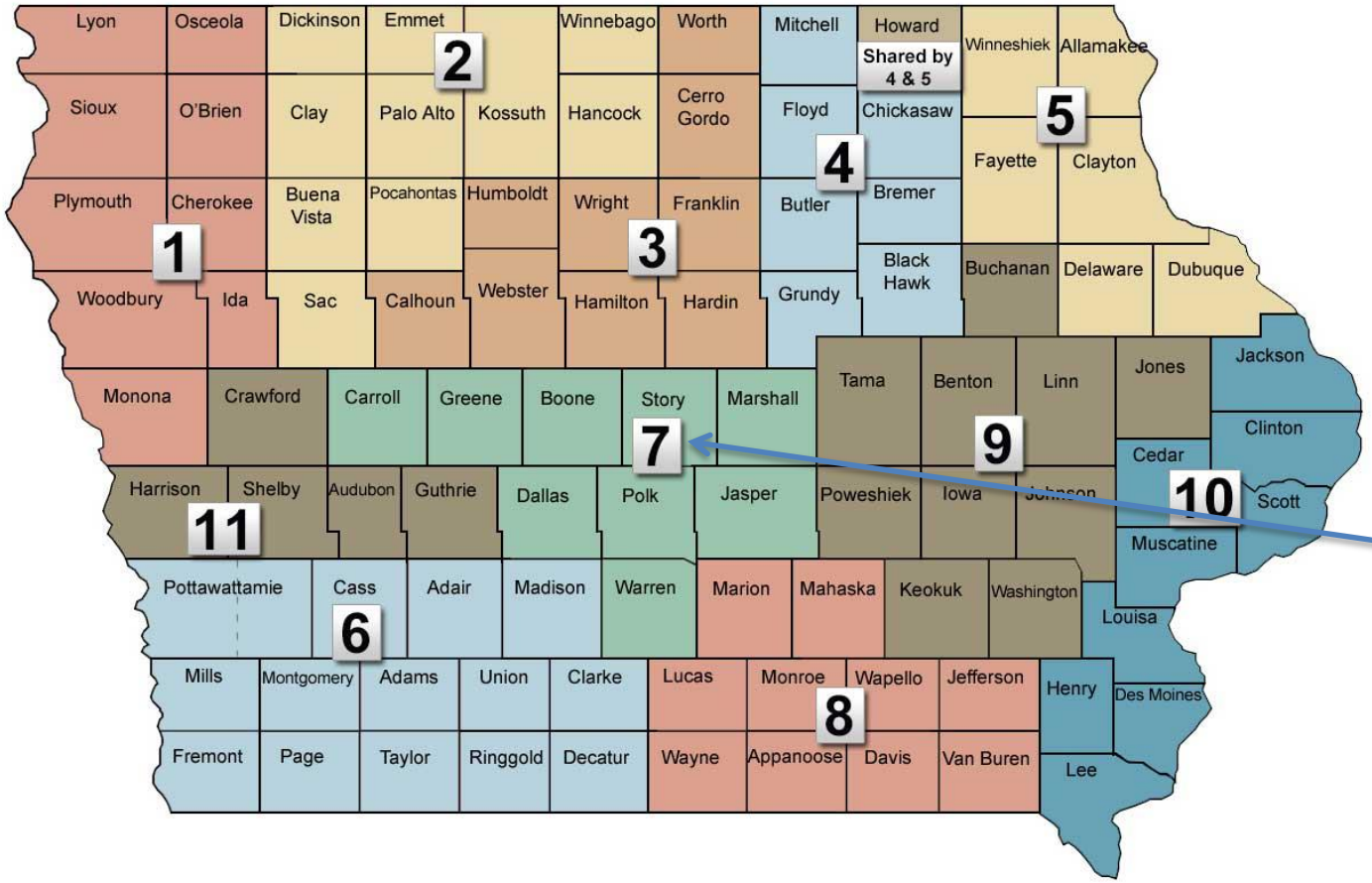
Extension Field Agronomist



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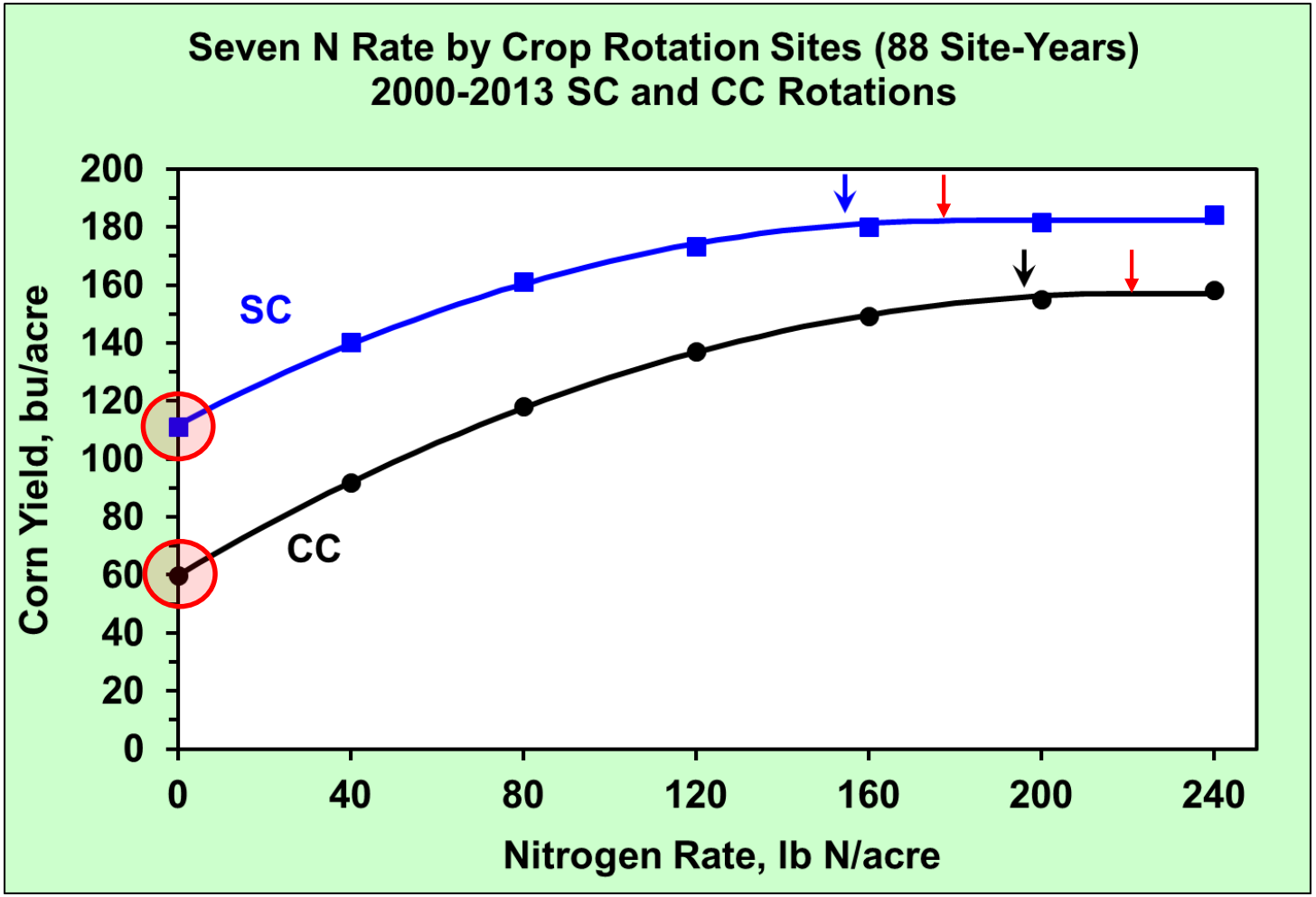
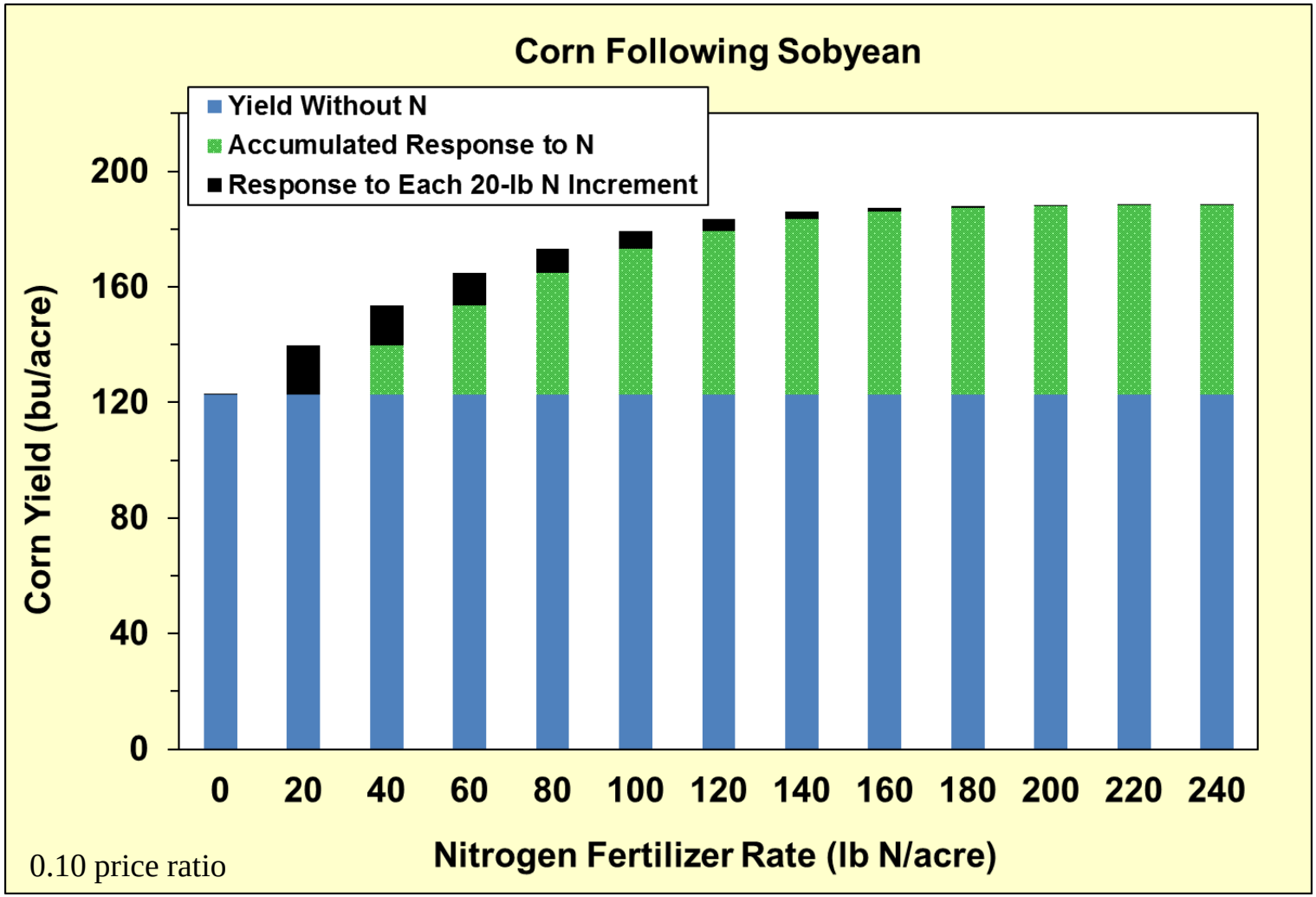
Today

Ask your questions as you have them

Nitrogen Application Needed For Acceptable Corn Yields



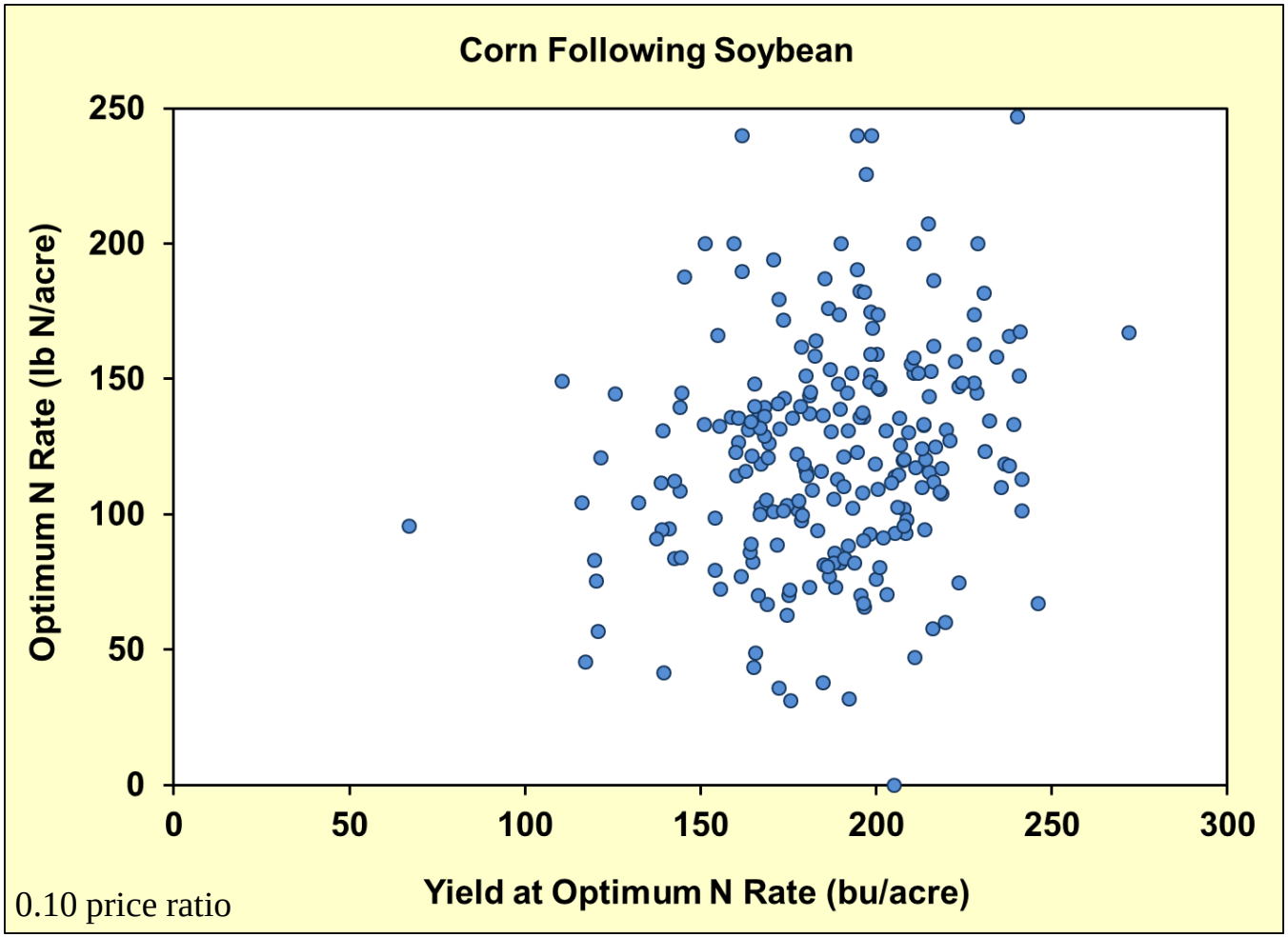
Diminishing Return to N Application



Why the Maximum Return To Nitrogen (MRTN) was Developed

- Diverse N rate guideline systems across states in the Midwest USA
- Cross-state programs
- Volatile N fertilizer and corn prices
- Lack of optimum N rate relationship with yield
  - Yield-based N rates greater than economic optimum with high yields **and** too low rates on lower OM, less productive “southern area” soils

Yield Level Does Not Relate to Optimum N Rate



MRTN Development **Timeline**

- Discussions in 2004
- Initial N response trial database completion in 2005
- Web based Corn N Rate Calculator (CNRC) in 2005
- Regional extension publication in 2006
  - PM 2015

Corn Nitrogen Rate Calculator

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

MRTN Development **Timeline**

May, 2016

Corn Nitrogen Rate Calculator

New URL

http://cnrc.agron.iastate.edu/

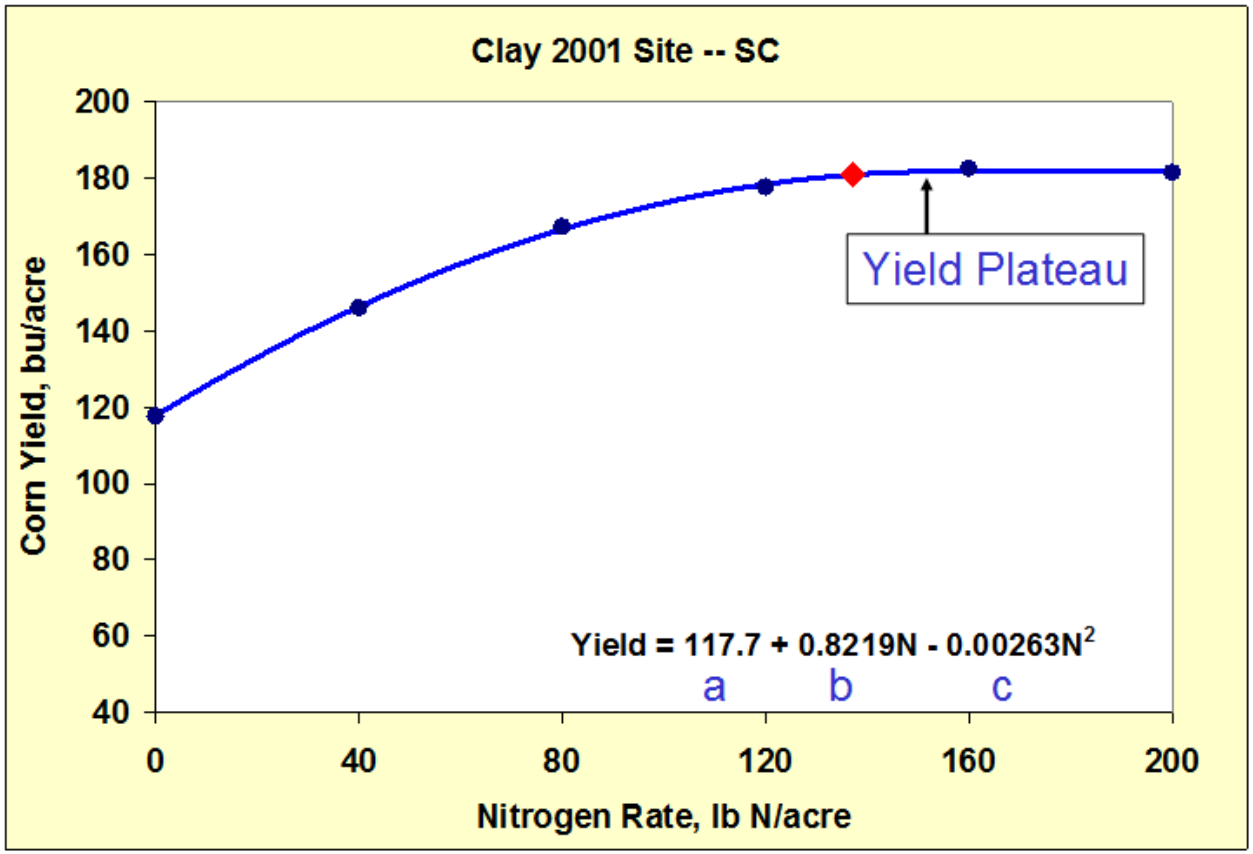
MRTN/CNRC - Database Driven Approach
Direct Use of "BIG DATA"

- Corn response data from research-based N rate trials
  - Well over 1,500 trials ≈ 36,000 research plots
- Analytical/predictive method to determine economic response **and** most profitable N rates directly from **research** trials

Current Data → N Rate Guidelines

Steps in MRTN Computation

- Corn N rate response trial example



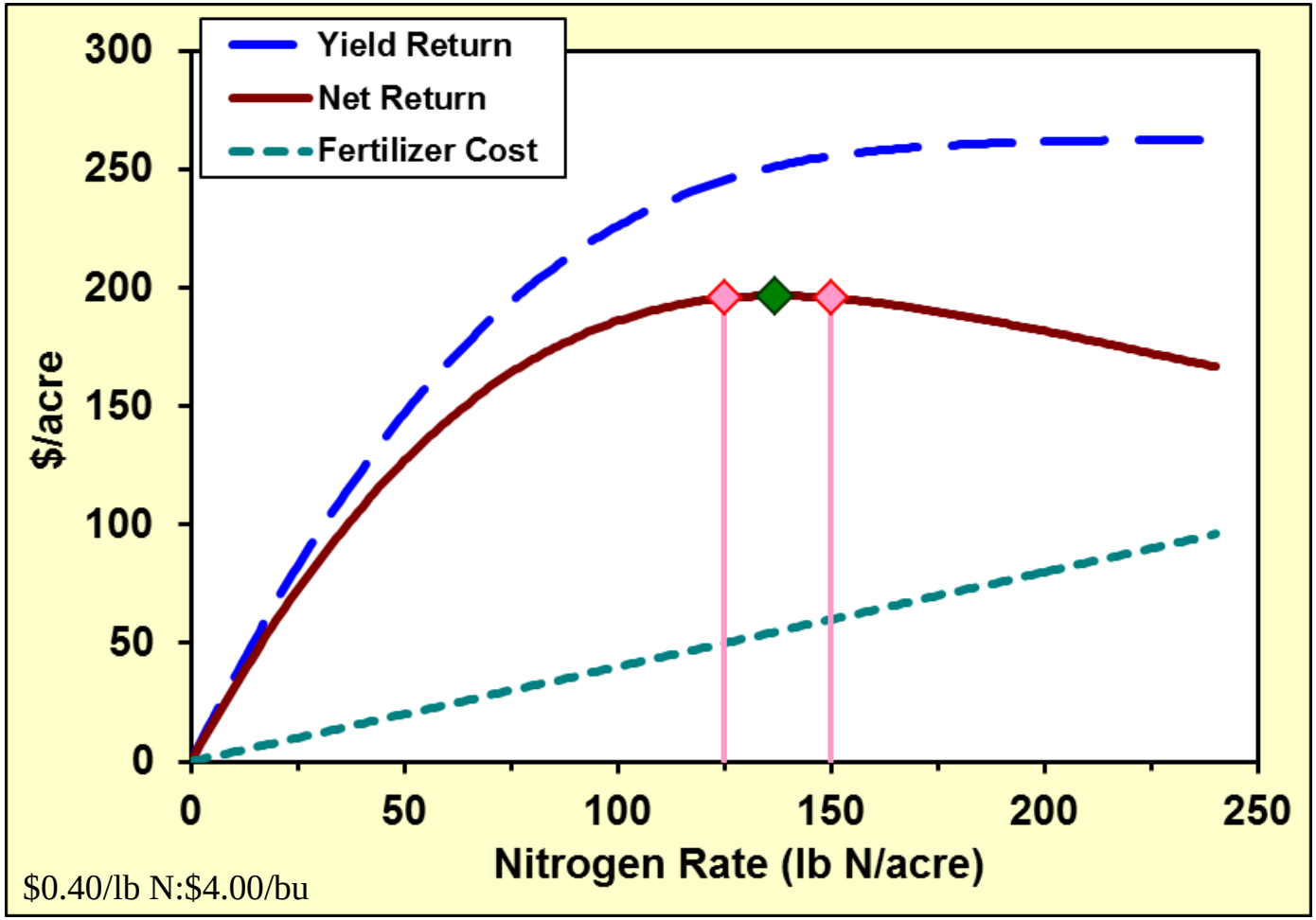
Steps in MRTN Computation

- 1. Collect N response trial site data
- 2. Observe shape of N response data
- 3. Fit regression equation to each trial data
- 4. Compile database of site response equations for CC and SC

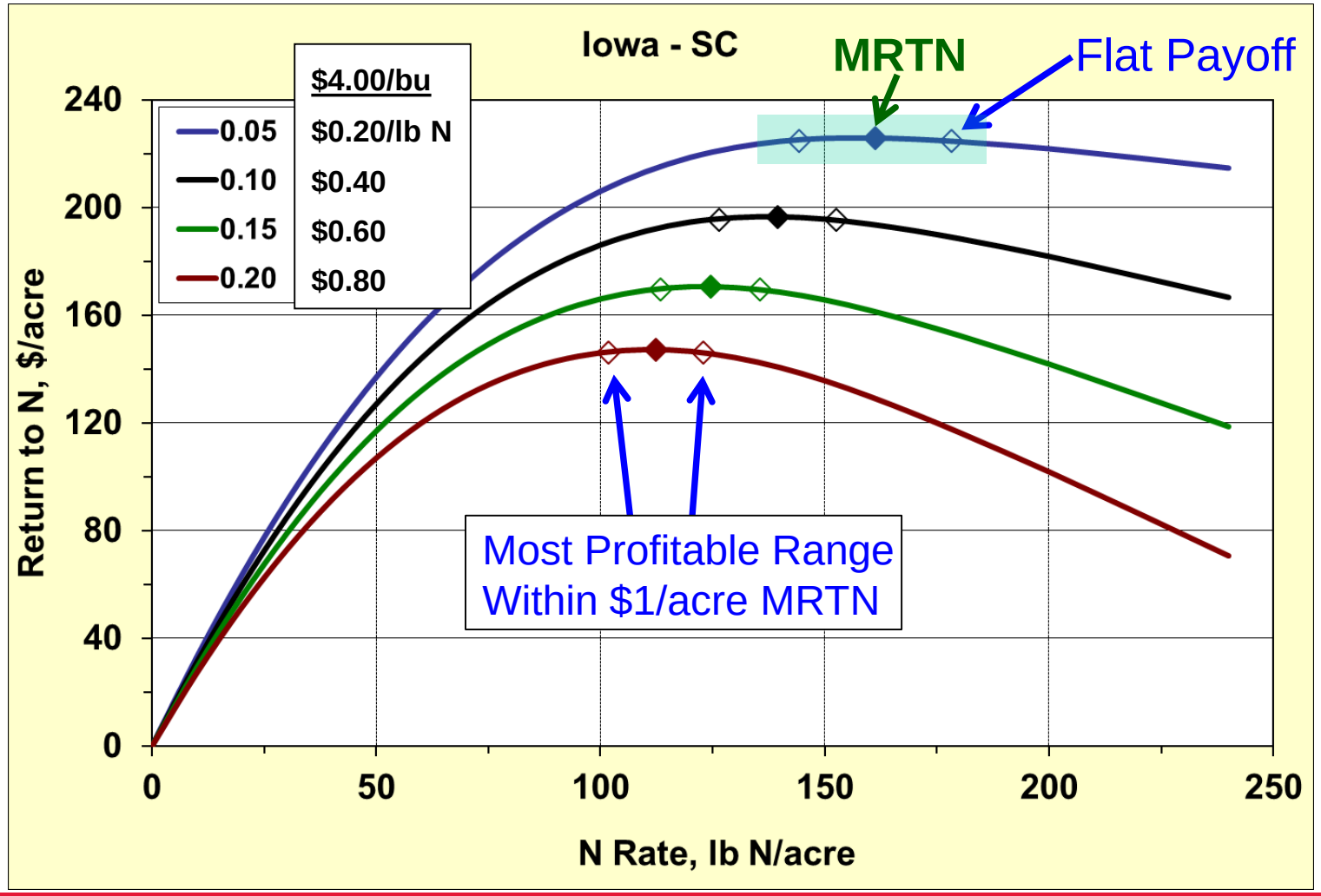
Steps in MRTN/CNRC Computation

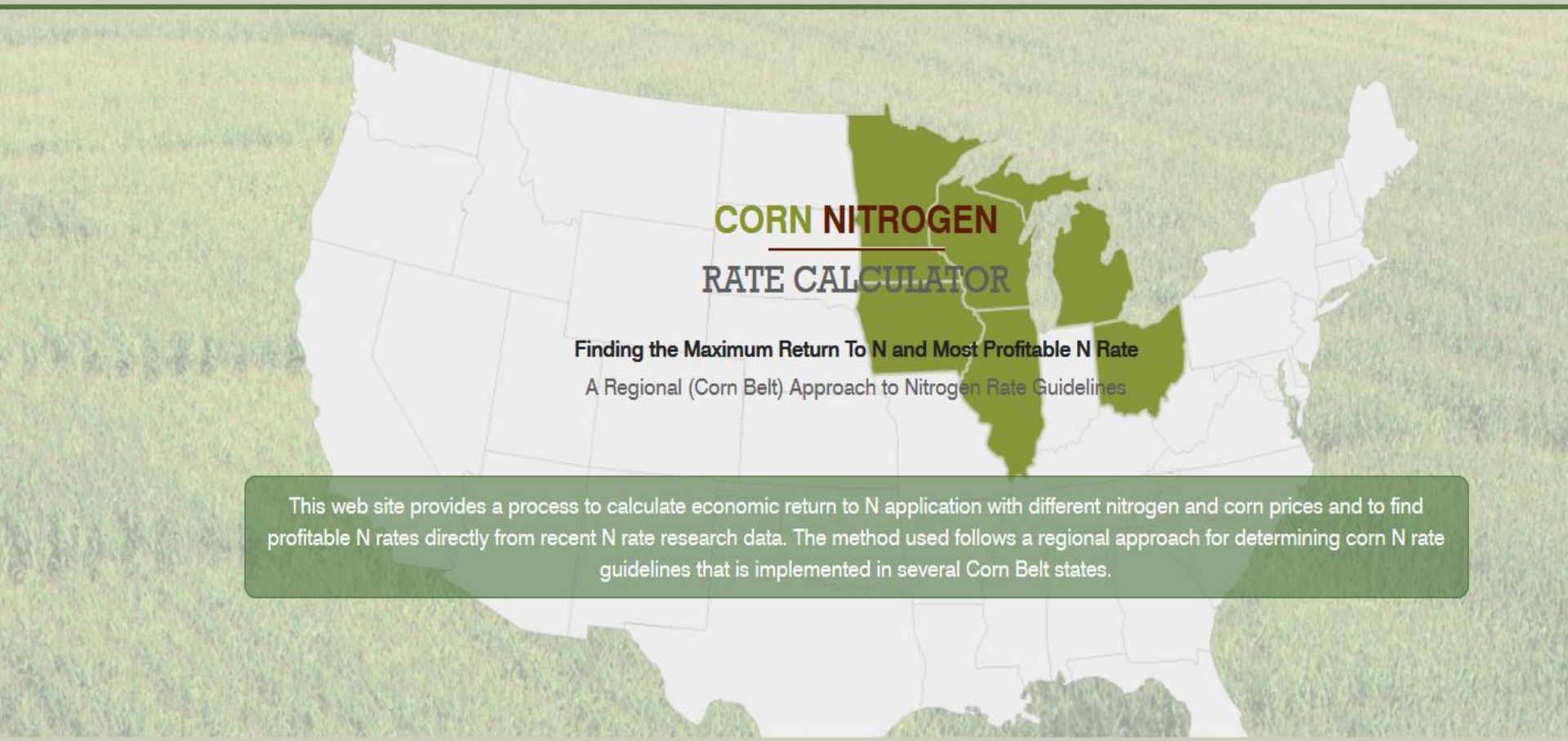
- 5. Calculate by 1-lb N rate increments: gross yield return, fertilizer cost, net return to N (RTN)
- 6. For user specified dataset (CC, SC, state, or substate), N and corn prices -- average across the RTN for selected response trials
- 7. The N rate with largest average RTN is the MRTN rate, with the most profitable range being the N rates within $1.00/acre of the maximum RTN

Net Return Determines MRTN Rate and Profitable Range



Effect of Prices on MRTN and Most Profitable N Rate Range





CORN NITROGEN RATE CALCULATOR

Finding the Maximum Return To N and Most Profitable N Rate

A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

This web site provides a process to calculate economic return to N application with different nitrogen and corn prices and to find profitable N rates directly from recent N rate research data. The method used follows a regional approach for determining corn N rate guidelines that is implemented in several Corn Belt states.

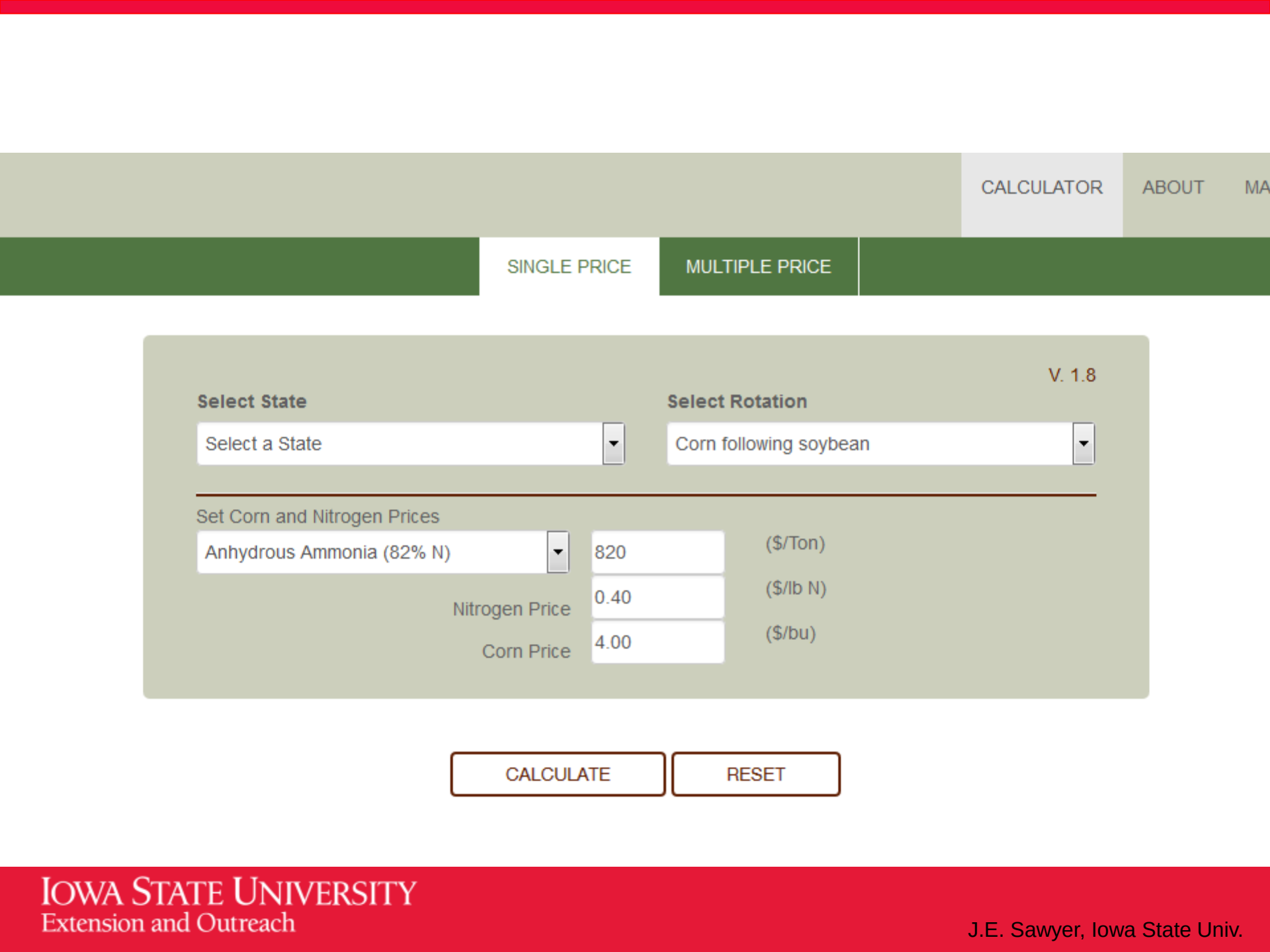
START HERE

Choose how you want to calculate N rates, using one set of prices or using mulitple prices.

SINGLE PRICE

MULTIPLE PRICE

In association with these Universities


CALCULATOR
ABOUT
MA
SINGLE PRICE
MULTIPLE PRICE
V. 1.8
Select State
Select a State
Select Rotation
Corn following soybean
Set Corn and Nitrogen Prices
Anhydrous Ammonia (82% N)
820
($/Ton)
0.40
($/lb N)
Nitrogen Price
4.00
($/bu)
Corn Price
CALCULATE
RESET

SINGLE PRICE
MULTIPLE PRICE
V. 1.8
Select State
Iowa
Select Rotation
Corn following soybean
Select Region
Main
Set Corn and Nitrogen Prices
Anhydrous Ammonia (82% N)
672
($/Ton)
Nitrogen Price
0.41
($/lb N)
Corn Price
3.60
($/bu)
CALCULATE
RESET

Rates and Charts

Options

CHART SIZE

- ○ Small
- ◉ Medium
- ○ Large

DISPLAY CHARTS

- ☑ Return to N
- ☐ % of Max Yield
- ☐ EONR Frequency
- ☐ EONR vs. Yield

HELP

Definitions

Calculated Values

RECALCULATE

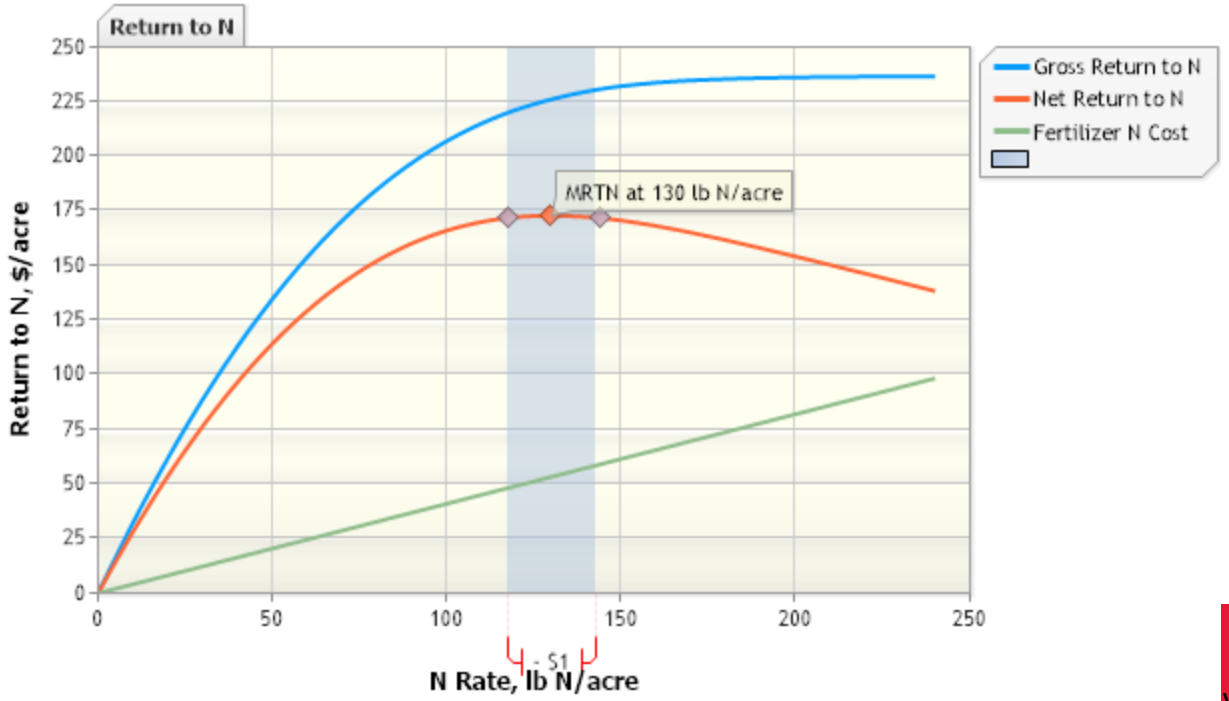
RETURN TO INPUT

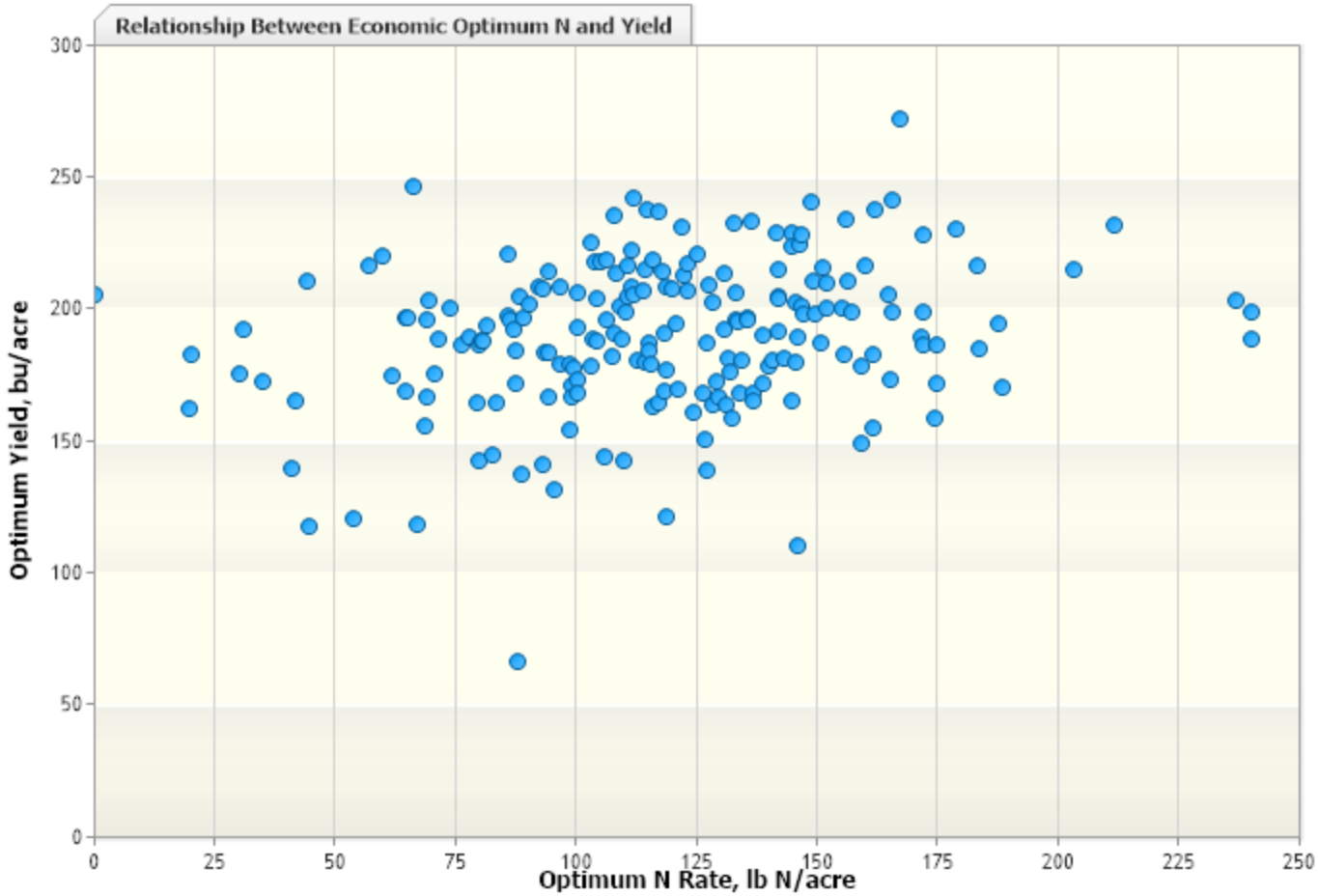
State: Iowa

Number of sites: 204

Rotation: Corn Following Soybean

Nitrogen Price ($/lb):	0.41
Corn Price ($/bu):	3.60
Price Ratio:	0.11
MRTN Rate (lb N/acre):	130
Profitable N Rate Range (lb N/acre):	117 - 143
Net Return to N at MRTN Rate ($/acre):	$172.86
Percent of Maximum Yield at MRTN Rate:	98%
Anhydrous Ammonia (82% N) at MRTN Rate (lb product/acre):	158
Anhydrous Ammonia (82% N) Cost at MRTN Rate ($/acre):	$53.30

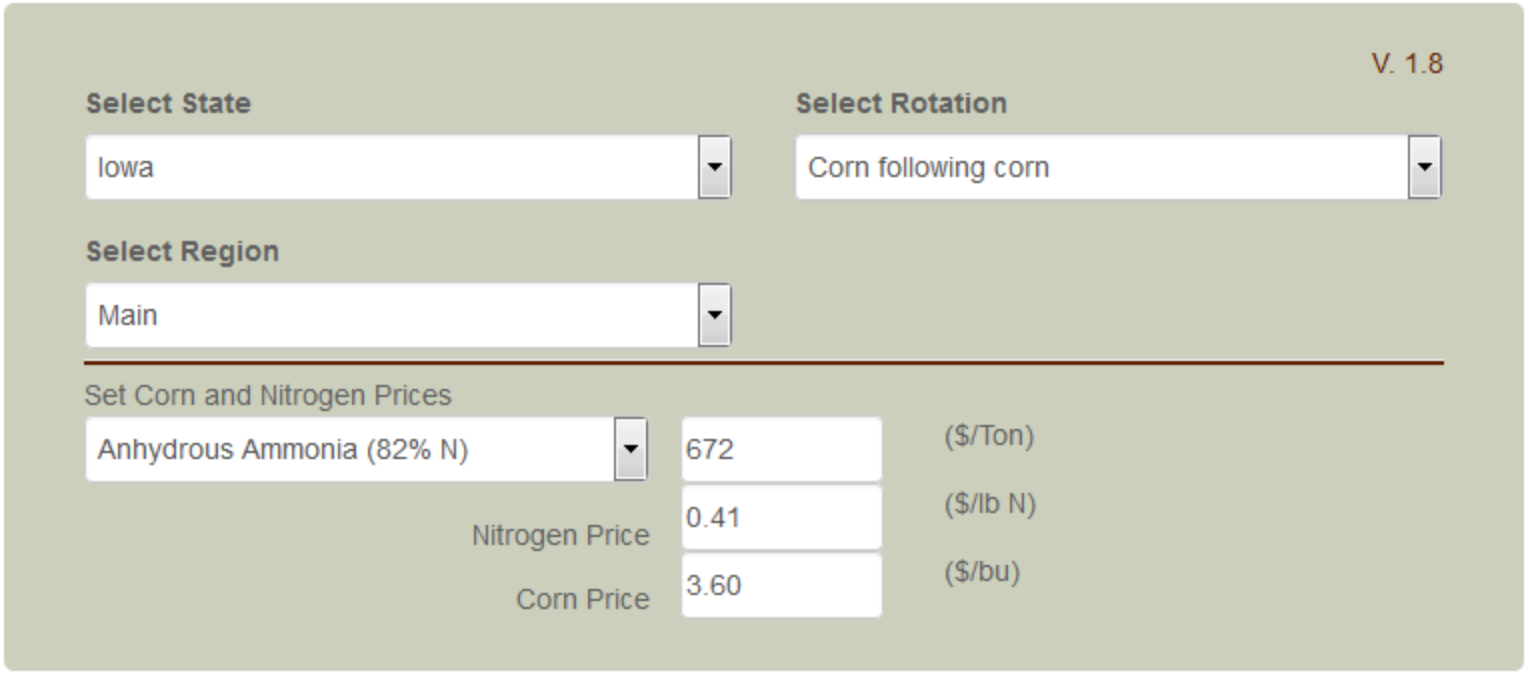



Relationship Between Economic Optimum N and Yield
Optimum Yield, bu/acre
300
250
200
150
100
50
0
0
25
50
75
100
125
150
175
200
225
250
Optimum N Rate, lb N/acre

Corn Nitrogen Rate Calculator

Regular – SC, CC

Multiple – SC, CC


V. 1.8
Select State
Iowa
Select Rotation
Corn following corn
Select Region
Main
Set Corn and Nitrogen Prices
Anhydrous Ammonia (82% N)
672
($/Ton)
0.41
($/lb N)
Nitrogen Price
3.60
($/bu)
Corn Price
CALCULATE
RESET

Rates and Charts

Options

CHART SIZE

- ○ Small
- ◉ Medium
- ○ Large

DISPLAY CHARTS

- ☑ Return to N
- ☐ % of Max Yield
- ☐ EONR Frequency
- ☐ EONR vs. Yield

HELP

Definitions

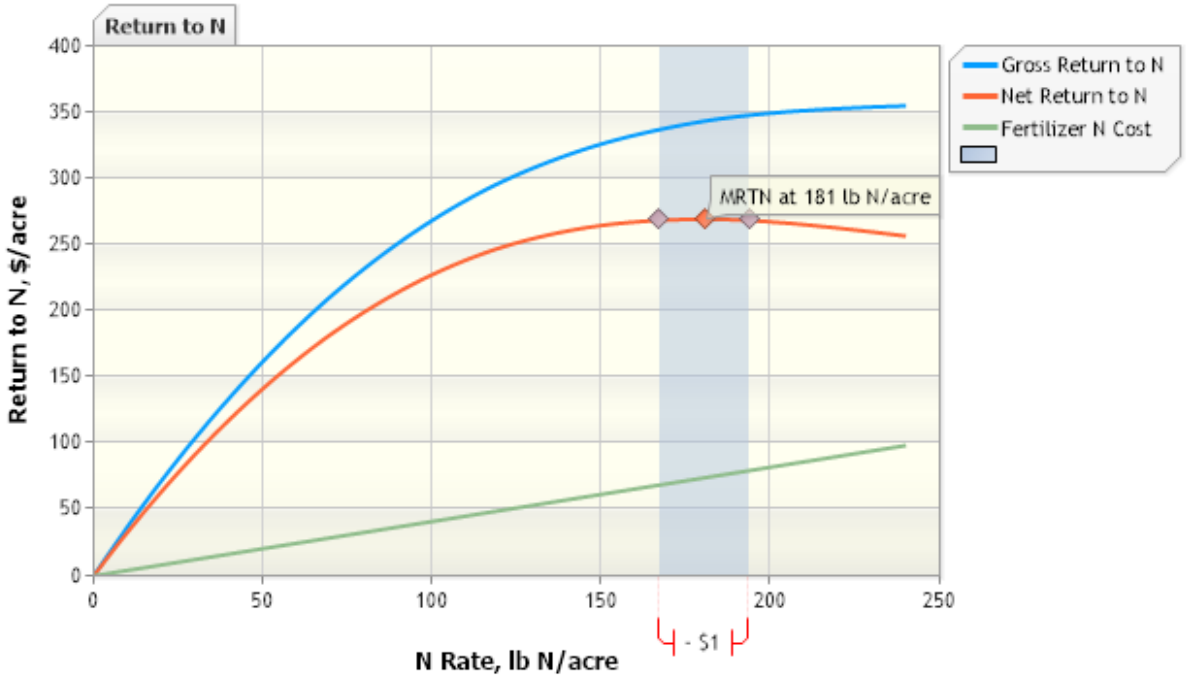
Calculated Values

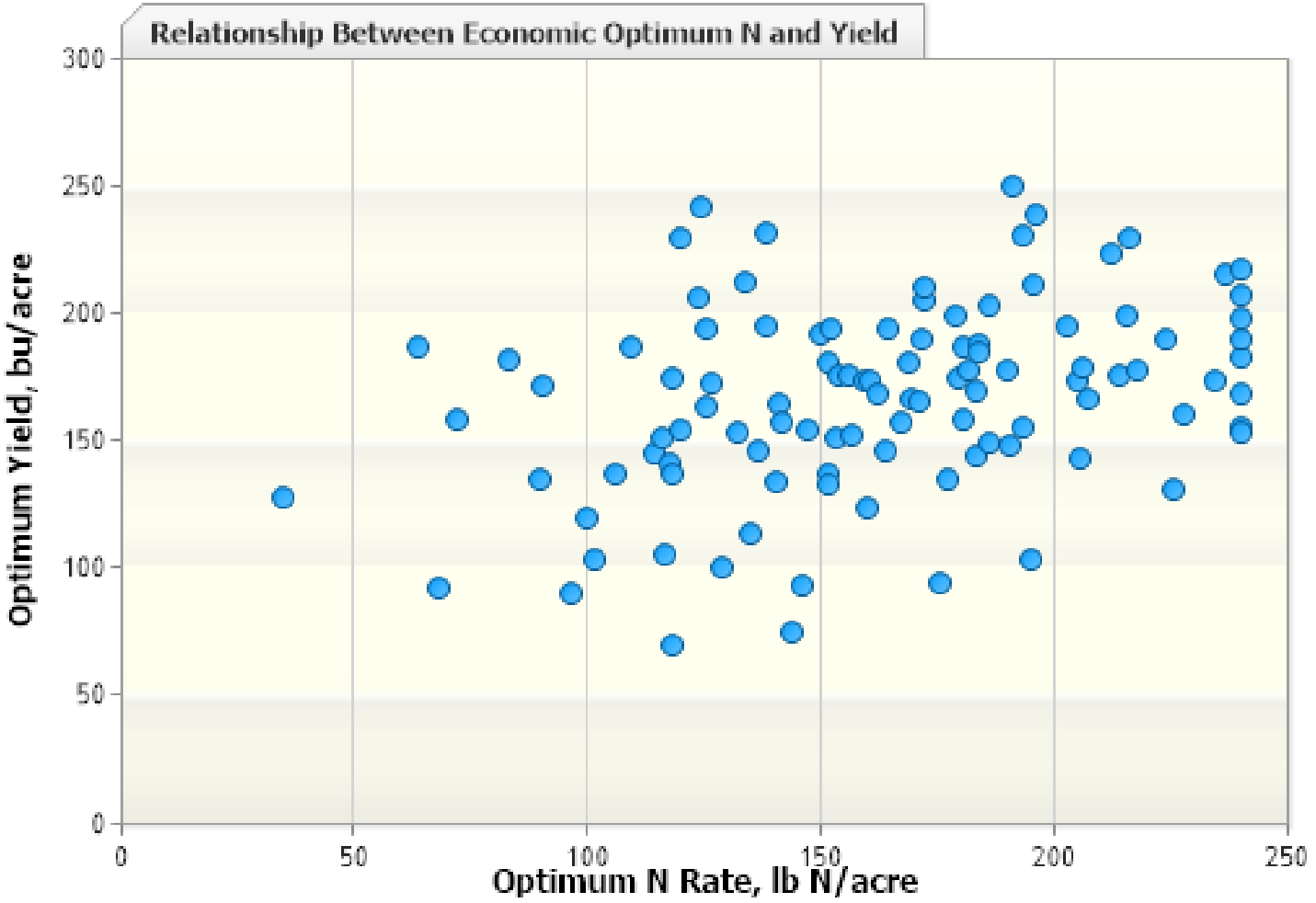
RECALCULATE

RETURN TO INPUT

State: Iowa
Number of sites: 105
Rotation: Corn Following Corn

Nitrogen Price ($/lb):	0.41
Corn Price ($/bu):	3.60
Price Ratio:	0.11
MRTN Rate (lb N/acre):	181
Profitable N Rate Range (lb N/acre):	166 - 193
Net Return to N at MRTN Rate ($/acre):	$269.28
Percent of Maximum Yield at MRTN Rate:	98%
Anhydrous Ammonia (82% N) at MRTN Rate (lb product/acre):	220
Anhydrous Ammonia (82% N) Cost at MRTN Rate ($/acre):	$74.21




Relationship Between Economic Optimum N and Yield
Optimum Yield, bu/acre
300
250
200
150
100
50
0
0
50
100
150
200
250
Optimum N Rate, lb N/acre

V. 1.8

Select State

Select a State

Select Rotation

Corn following soybean

Set Corn and Nitrogen Prices

Anhydrous Ammonia (82% N)

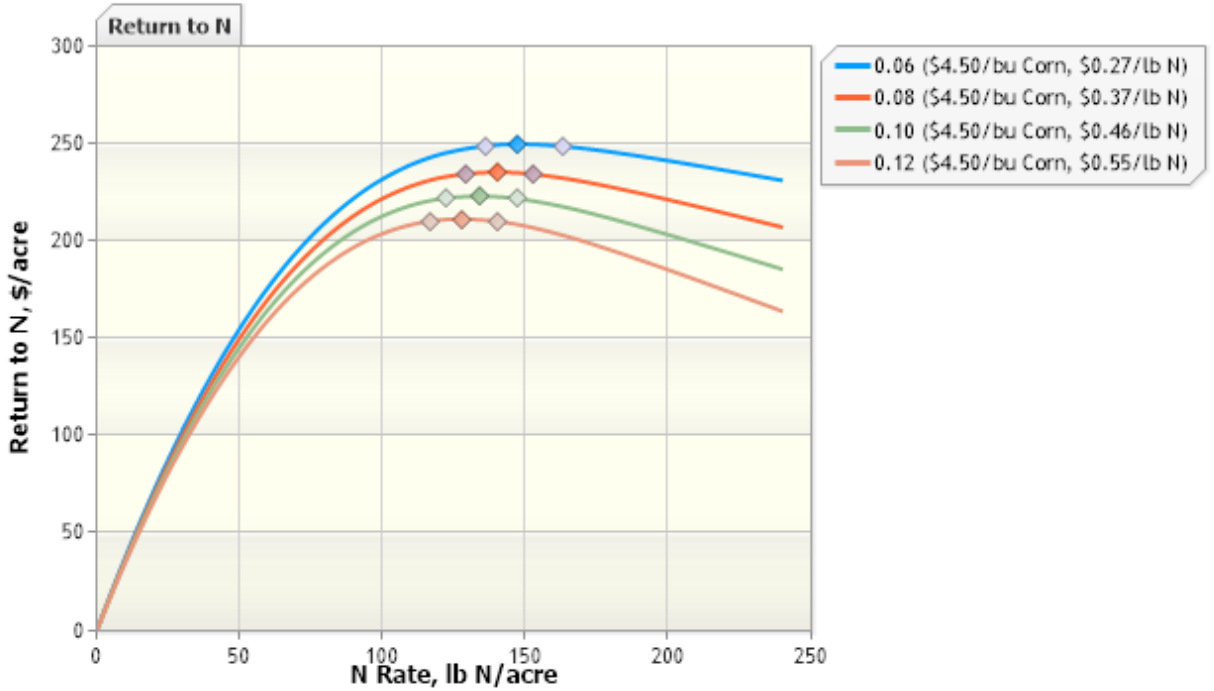
	450	600	750	900	($/Ton)
Nitrogen Price	0.27	0.37	0.46	0.55	($/lb N)
Corn Price	4.50	4.50	4.50	4.50	($/bu)

CALCULATE RESET

Rates and Charts

State: Iowa
Region: Main
Number of sites: 204
Rotation: Corn Following Soybean

N Price ($/lb N):	$0.27	$0.37	$0.46	$0.55
Corn Price ($/bu):	$4.50	$4.50	$4.50	$4.50
Price Ratio:	0.06	0.08	0.10	0.12
MRTN Rate (lb N/acre):	147	140	134	128
Profitable N Rate Range (lb N/acre):	135 - 162	128 - 152	121 - 146	116 - 139
Net Return to N at MRTN Rate ($/acre):	$249.76	$235.34	$222.98	$211.23
Percent of Maximum Yield at MRTN Rate:	99%	99%	99%	98%
Anhydrous Ammonia (82% N) at MRTN Rate (lb product/acre):	$179.27	$170.73	$163.41	$156.10
Anhydrous Ammonia (82% N) Cost at MRTN Rate ($/acre):	$39.69	$51.80	$61.64	$70.40

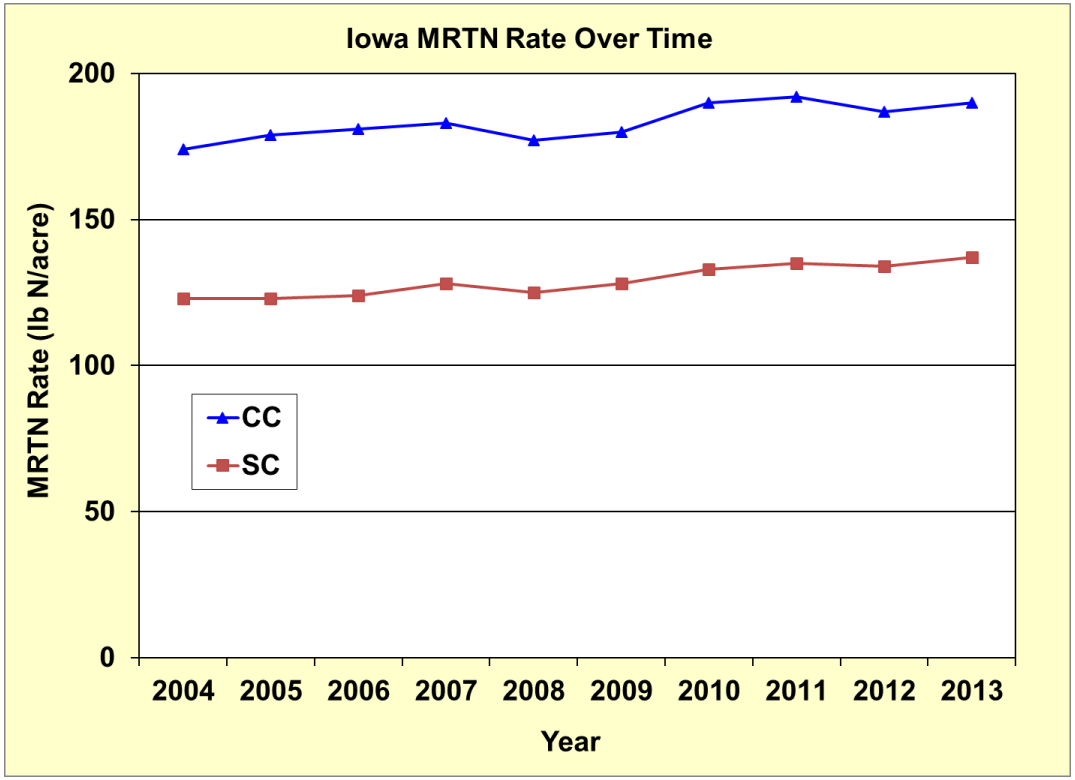


Strengths of MRTN Approach

- Straightforward computation
- **Based on N rate response trials**
- **Based on economic profitability**
  - **Not derived from yield level, but actual yield response which pays for the N applied**
- Directly provides CC and SC rate guidelines
  - **No reliance on inconsistent "soybean credit"**

Strengths of MRTN Approach

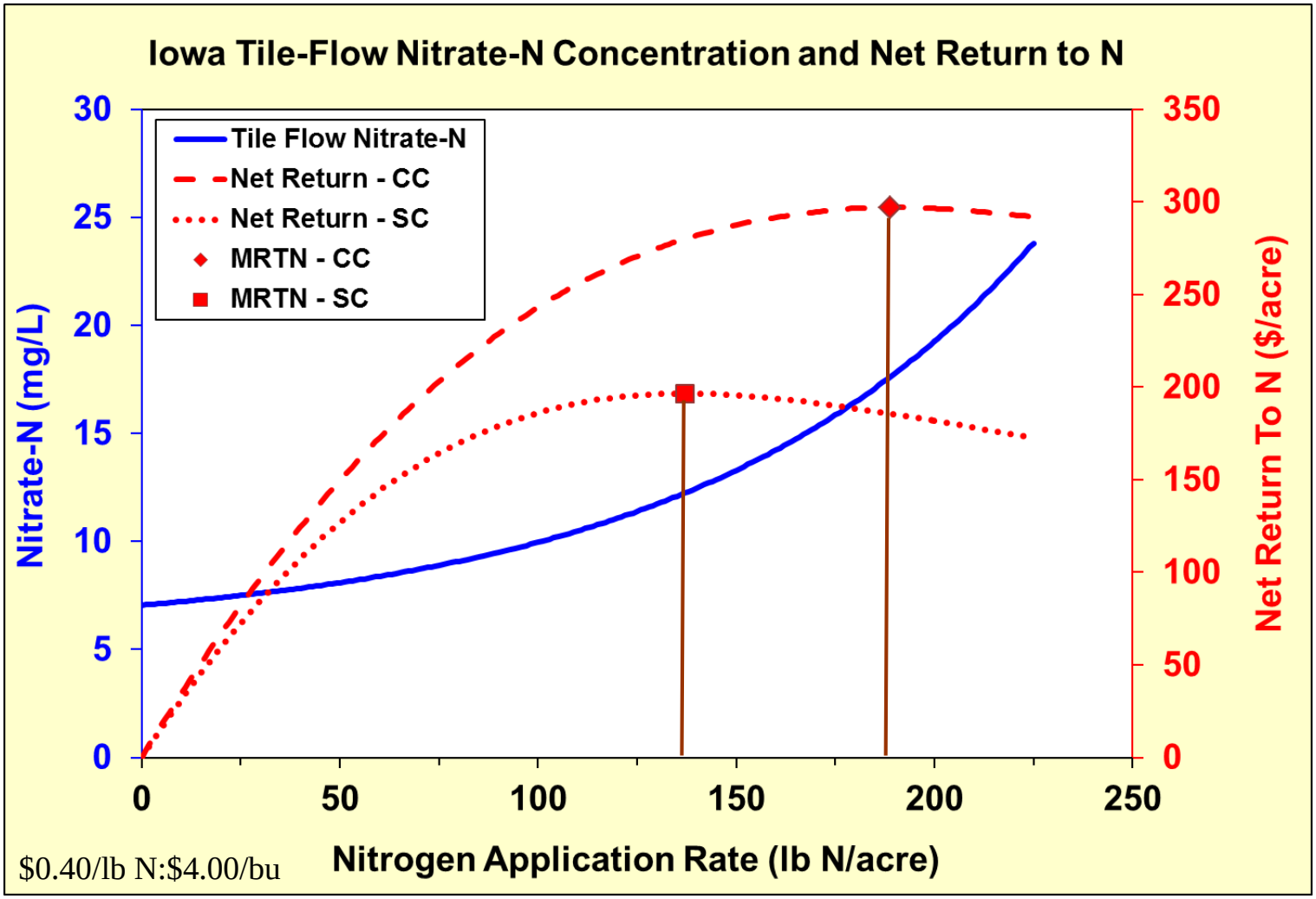
- Easy to add new response trials
  - Keeps rate guidelines current with production practices and climatic conditions



Strengths of MRTN Approach

- Provides opportunity for **user input and N rate adjustment**
  - Rotation
  - Fertilizer and corn price
  - Profitable N rate range
    - LOW ↔ MRTN ↔ HIGH
      - Farmer experience and attitude toward risk
      - Capitol allocation
      - Water and air quality
      - Local research information
      - Seasonal expectation

Nitrate-N Loss in Tile Drainage



Nitrogen Is Needed for Corn Production
Rate Management is a Challenge

- Corn has a high N demand
- Need N fertilization for profitable production
- Rate based on economic return to N
- Crops are grown in an open soil system
  - Nitrogen losses to leaching and denitrification
- Need to maintain soil N and C resource
- Precipitation amount/timing can change N response and fertilization need

N rate Calculator

http://cnrc.agron.iastate.edu/

Now, let's use it.

http://cnrc.agron.iastate.edu/