# New Nitrogen Rate Guidelines for Corn Using a Regional Approach

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# Why a regional approach?

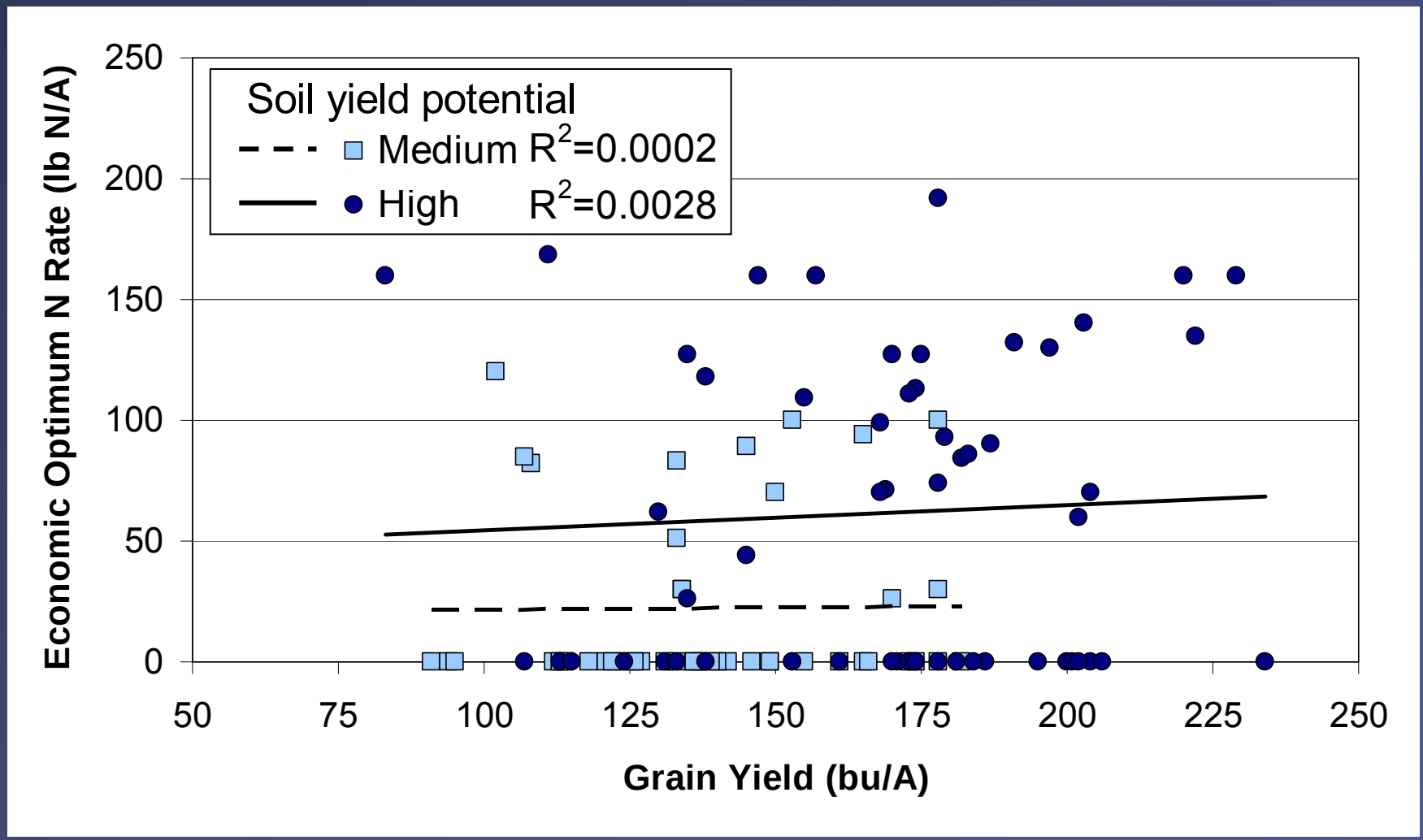
- Nutrient management may be based on a watershed approach (CSPs)
  - Watersheds may cross state boundaries
  - N recommendations for different states don't always match up
- Different states have different approaches to N recommendations
  - Can cause farmer confusion as to what is the right rate to apply
- Questions surrounding the adequacy of N rates at higher yield

# N Recommendation Comparison Prior to Fall 2005

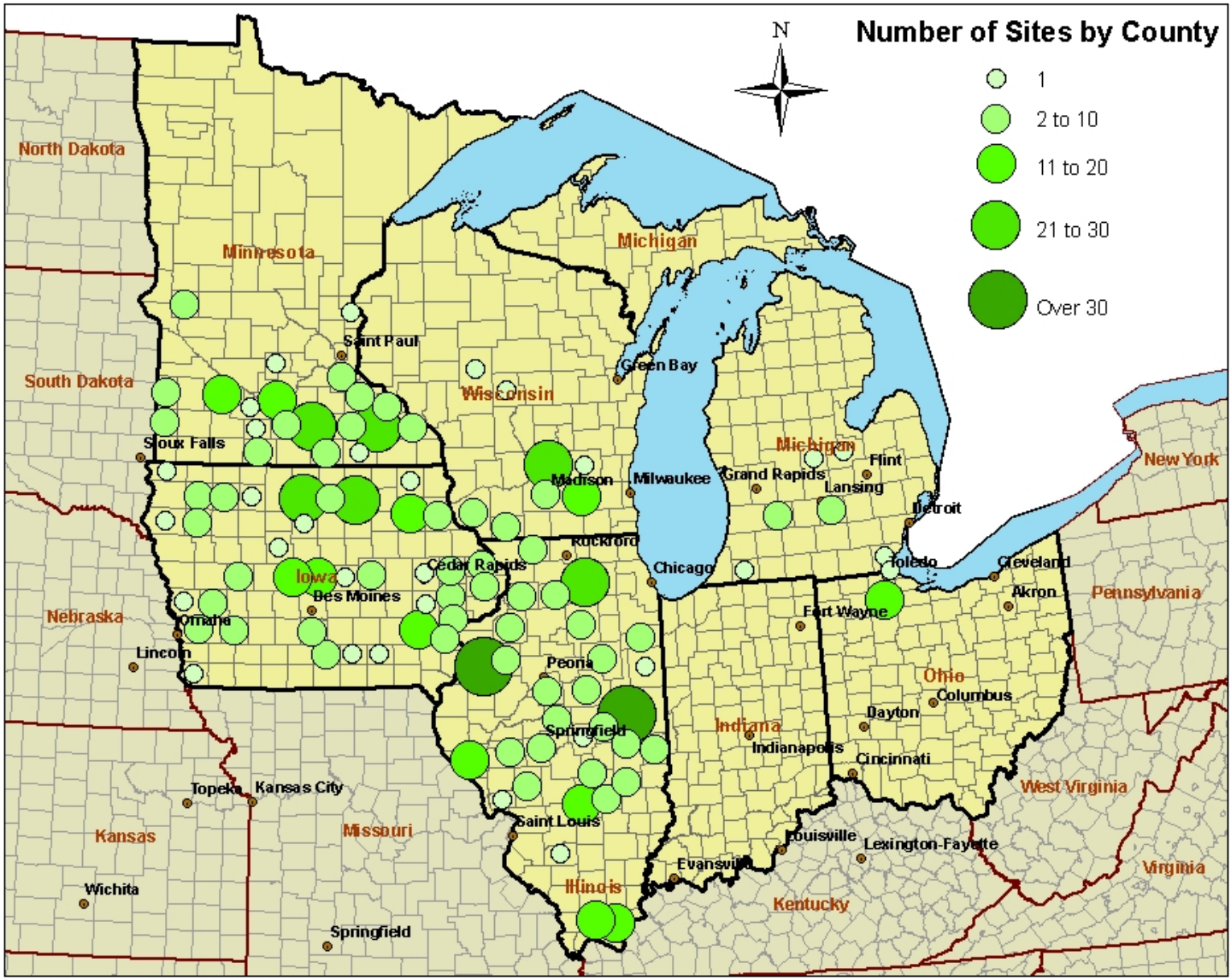
| Previous Crop: | Corn | | Soybean | |
|---|---|---|---|---|
| Yield Goal (bu/A): | 150 | 200 | 150 | 200 |
| | lb N/A | | | |
| IL | 180 | 240 | 140 | 200 |
| MI/IN/OH | 177 | 245 | 147 | 215 |
| MN | 160 | 200 | 120 | 160 |
| IA | 150-200 | | 100-150 | |
| WI | 160 | | 120 | |

Soil with 3.1% OM, considered high yield potential

# Relationship between optimum N rate and corn yield (101 WI sites; 1989-1999)



# Regional N Rate Database



# Foundation to the new approach

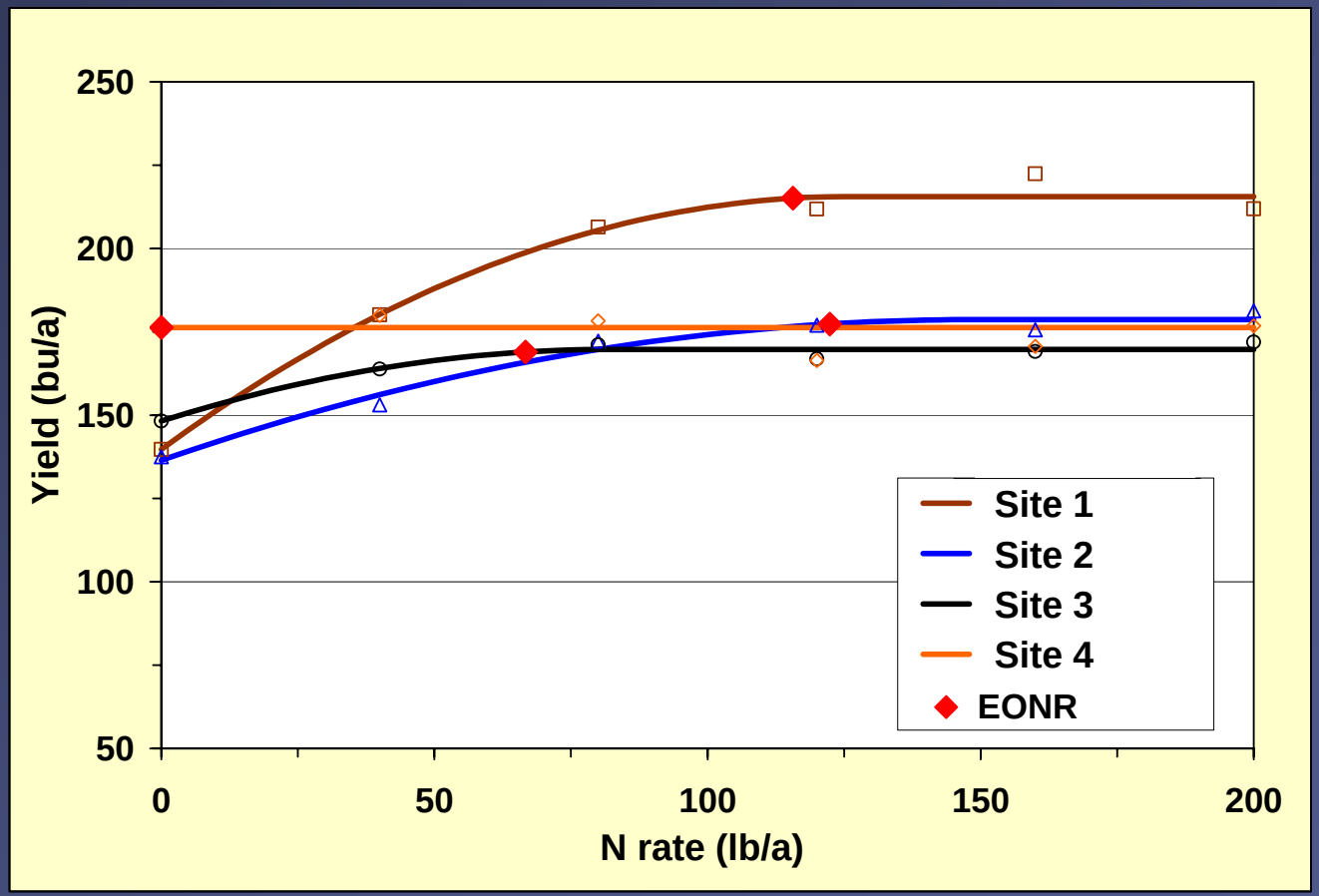
- Data analyzed the same way in each state
  - Still uses data from each state individually
  - Data from recent N response trials
    - 1983 to present
- Based on economics of N fertilization for profitable corn production
  - Maximum return to N (MRTN)

# Basics of MRTN

- 1st Compile data sets for corn yield response to N for various crop rotations and soil yield potentials
  - C-C, S-C
  - high/very high, medium/low yield potential soils; irrigated sands

# Basics of MRTN

- 2nd Calculate the response model for each site



# Basics of MRTN

- 3rd Calculate return to N for each site in data set
  - For every 1 lb N/a applied, calculate the yield increase over the yield obtained when

    0 lb N/a is applied
  - Multiply yield increase by price of corn and subtract the cost of N
  - Do this for N rates of 0 through 240 lb N/a

# Basics of MRTN

- 4th Calculate the average return to N at each N rate, using all of the data for a given crop rotation

| Site | Return to N at various N rates (lb/a) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 100 | 110 | 120 | 130 | 140 | 150 | 160 |
| | $/acre | | | | | | |
| 1 | 113.96 | 115.43 | 115.10 | 113.16 | 110.96 | 108.76 | 106.56 |
| 2 | 63.80 | 70.18 | 76.56 | 82.94 | 89.32 | 87.98 | 85.78 |
| 3 | 79.20 | 81.31 | 82.37 | 82.37 | 81.31 | 79.29 | 77.09 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| 39 | 94.60 | 98.98 | 102.43 | 104.96 | 106.57 | 107.25 | 107.01 |
| Average | 66.57 | 68.68 | 70.08 | 70.74 | 70.73 | 69.89 | 69.00 |

# Basics of MRTN

- 5th Find the N rate with the greatest average return to N, this is the MRTN

| Site | Return to N at various N rates (lb/a) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 100 | 110 | 120 | 130 | 140 | 150 | 160 |
| | $/acre | | | | | | |
| 1 | 113.96 | 115.43 | 115.10 | 113.16 | 110.96 | 108.76 | 106.56 |
| 2 | 63.80 | 70.18 | 76.56 | 82.94 | | 87.98 | 85.78 |
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| 39 | 94.60 | 98.98 | 102.43 | 104.96 | 106.57 | 107.25 | 107.01 |
| Average | 66.57 | 68.68 | 70.08 | 70.74 | 70.73 | 69.89 | 69.00 |

MRTN

# Basics of MRTN

- 6th Find the N rates with returns to N within $1/a of MRTN
  - This provides a range in N profitable N rates

| Site | Return to N at various N rates (lb/a) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 100 | 110 | 120 | 130 | 140 | 150 | 160 |
| | $/acre | | | | | | |
| 1 | 113.96 | 115.43 | 115.10 | 113.16 | 110.96 | 108.7 | 106.56 |
| 2 | 63.80 | 70.18 | 76.56 | 82.94 | | 87.98 | 85.78 |
| 3 | 79.20 | 81.31 | 82.37 | 82.37 | 81.31 | 79.29 | 77.09 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| 39 | 94.60 | 98.98 | 102.43 | 104.96 | 106.57 | 107.25 | 107.01 |
| Average | 66.57 | 68.68 | 70.08 | 70.74 | 70.73 | 69.89 | 69.00 |

MRTN

Low

High

# Comparison Across States
# Previous Crop = Corn

| State | Profitable N rates | | |
|---|---|---|---|
| | Low (-$1/a) | MRTN | High (-$1/a) |
| | lb N/a | | |
| IA | 155 | 175 | 195 |
| IL | 156 | 178 | 201 |
| MN | 124 | 139 | 154 |
| WI | 120 | 135 | 155 |

N to Corn price ratio of 0.10

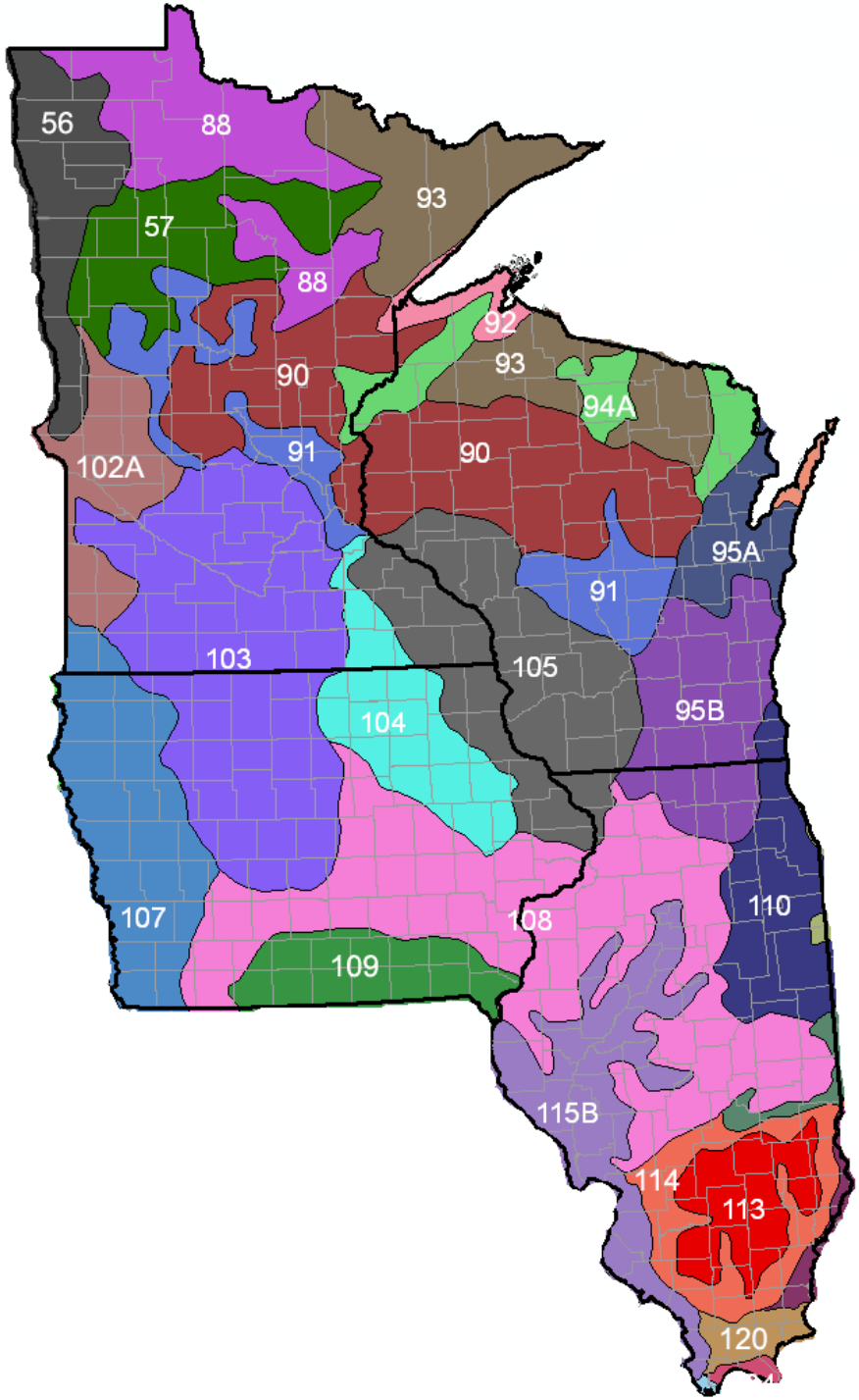
# Comparison Across States
# Previous Crop = Soybean

| State | Profitable N rates | | |
|---|---|---|---|
| | Low (-$1/a) | MRTN | High (-$1/a) |
| | lb N/a | | |
| IA | 109 | 126 | 144 |
| IL | 144 | 165 | 186 |
| MN | 89 | 104 | 120 |
| WI | 100 | 115 | 130 |

N to Corn price ratio of 0.10

# Why do we see some difference in MRTN between states?

- Soil
- Climate




## Legend

State Boundaries

County Boundaries

MLRA Boundaries

**mlra polygon color**

| | | |
|---|---|---|
| | 56 | Red River Valley of the North |
| | 57 | Northern Minnesota Gray Drift |
| | 88 | Northern Minnesota Glacial Lake Basins |
| | 90 | Central Wisconsin and Minnesota Thin Loess and Till |
| | 91 | Wisconsin and Minnesota Sandy Outwash |
| | 92 | Superior Lake Plain |
| | 93 | Superior Stony and Rocky Loamy Plains and Hills |
| | 94A | Northern Michigan and Wisconsin Sandy Drift |
| | 95A | Northeastern Wisconsin Drift Plain |
| | 95B | Southern Wisconsin and Northern Illinois Drift Plain |
| | 96 | Western MI and Northeastern Wisconsin Fruit Belt |
| | 102A | Rolling Till Prairie |
| | 103 | Central Iowa and Minnesota Till Prairies |
| | 104 | Eastern Iowa and Minnesota Till Prairies |
| | 105 | Northern Mississippi Valley Loess Hills |
| | 107 | Iowa and Missouri Deep Loess Hills |
| | 108 | Illinois and Iowa Deep Loess and Drift |
| | 109 | Iowa and Missouri Heavy Till Plain |
| | 110 | Northern Illinois and Indiana Heavy Till Plain |
| | 113 | Central Claypan Areas |
| | 114 | Southern Illinois and Indiana Thin Loess and Till Plain |
| | 115A | Central Mississippi Valley Wooded Slopes, Eastern |
| | 115B | Central Mississippi Valley Wooded Slopes, Western |
| | 120 | KY and IN Sandstone and Shale Hills and Valleys |

# Use of MRTN in Wisconsin

# N Rate Guidelines
## High/Very High Yield Potential Soils

| N:Corn Price Ratio | Previous Crop = Corn | | | Prev. Crop = Soybean | | |
|---|---|---|---|---|---|---|
| | low | **MRTN** | high | low | **MRTN** | high |
| $/lb:$/bu | ——— lb N/a ——— | | | ——— lb N/a ——— | | |
| 0.05 | 135 | **165** | 190 | 110 | **140** | 160 |
| 0.10 | 120 | **135** | 155 | 100 | **115** | 130 |
| 0.15 | 100 | **120** | 135 | 85 | **100** | 115 |
| 0.20 | 90 | **105** | 120 | 70 | **90** | 100 |

Current Rec. = 160 lb/a @ 0.06

Includes starter N

# N Rate Guidelines
## Medium/Low Yield Potential Soils

| N:Corn Price Ratio | Previous Crop = Corn | | | Prev. Crop = Soybean | | |
|---|---|---|---|---|---|---|
| | low | **MRTN** | high | low | **MRTN** | high |
| $/lb:$/bu | ——— lb N/a ——— | | | ——— lb N/a ——— | | |
| 0.05 | 90 | **110** | 135 | 75 | **90** | 110 |
| 0.10 | 80 | **100** | 110 | 45 | **60** | 70 |
| 0.15 | 70 | **85** | 100 | 40 | **50** | 60 |
| 0.20 | 60 | **75** | 90 | 35 | **45** | 55 |

Current Rec. = 120 lb/a @ 0.06

Includes starter N

# N Rate Guidelines
## Irrigated Sands

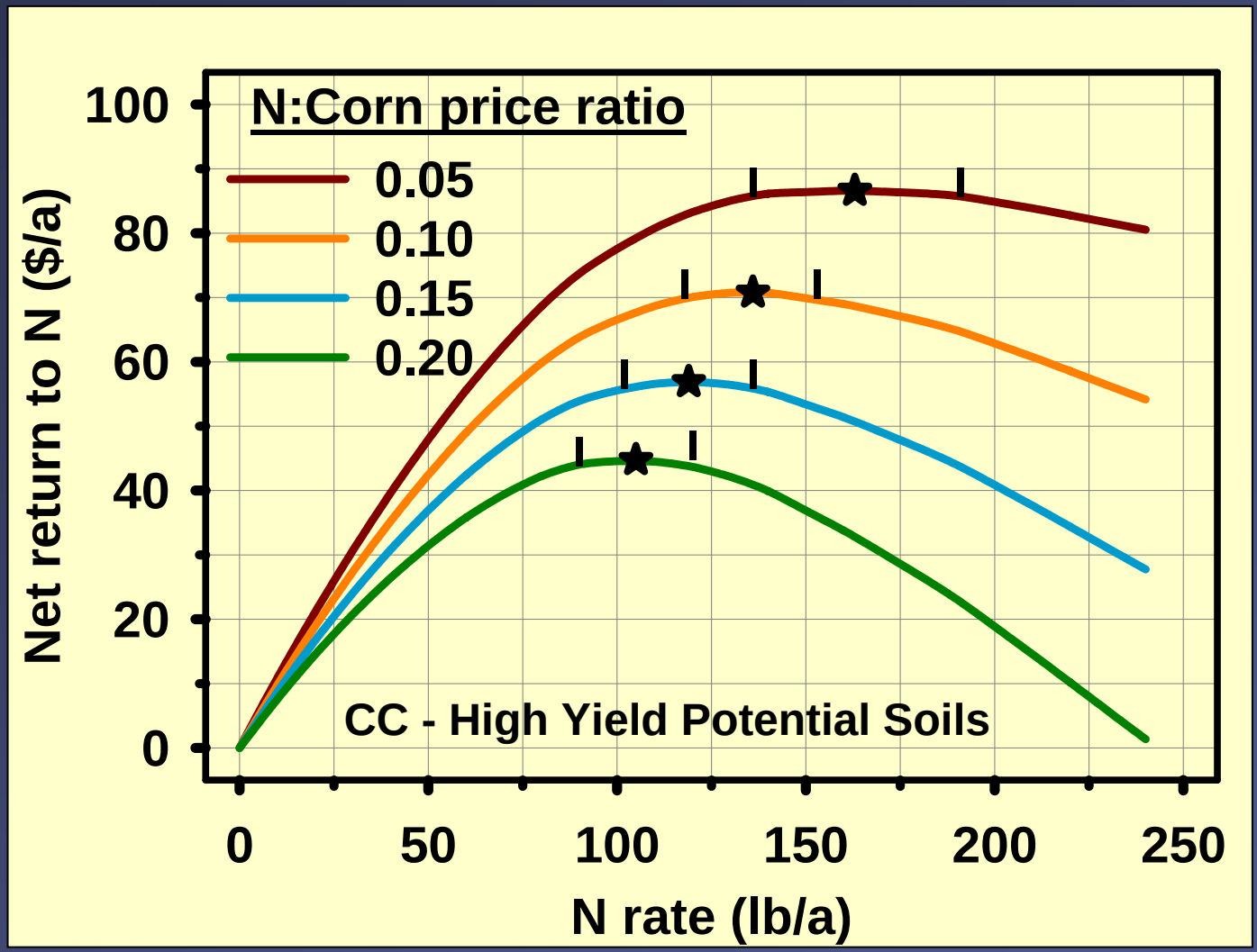
| N:Corn Price Ratio | PC = All crops except forage legumes & green manures | | |
|---|---|---|---|
| | low | **MRTN** | high |
| $/lb:$/bu | lb N/a | | |
| 0.05 | 200 | **215** | 230 |
| 0.10 | 190 | **205** | 220 |
| 0.15 | 180 | **195** | 210 |
| 0.20 | 175 | **190** | 200 |

Current Rec. = 200 lb/a @ 0.06

Includes starter N

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

# Profitable N Rates




- A range of N rates can produce profitable yields
- Economics clearly drives the profitable N rate

# Guidelines on determining which part of the MRTN range to use

| Situation | Portion of Range to Use | | |
|---|---|---|---|
| | low | mid | high |
| > 50 % residue cover at planting | | | ✓ |
| Corn follows a small grain | ✓ | ✓ | Use previous crop = soybean on your soil type |
| Non-irrigated sands, regardless of previous crop | ✓ | ✓ | Use previous crop = corn for med/low yield potential soils |

# Guidelines on determining which part of the MRTN range to use

| Situation | Portion of Range to Use | | |
|---|---|---|---|
| | low | mid | high |
| Irrigated sands with > 2.0 % organic matter | ✓ | | |
| Non-sandy soils with < 2.0 % organic matter | | | ✓ |
| Non-sandy soils with > 10.0 % organic matter | ✓ | | |

# Guidelines on determining which part of the MRTN range to use

| Situation | Portion of Range to Use | | |
|---|---|---|---|
| | low | mid | high |
| If you think there may be carry over (residual) N | ✓ | *OR* | ✓ & use PPNT |

- When corn follows a forage legume, green manure, or leguminous vegetable, use the table for corn following corn and take N credit
- NOTE: Starter N counts towards total N applied
- Consider using the lower end of the range to improve environmental quality

# N credits

- There is no longer a N credit for soybean
  - Use values listed in the tables
- Forage legume, leguminous vegetable, and green manure N credits remain the same
- Manure N credits remain the same

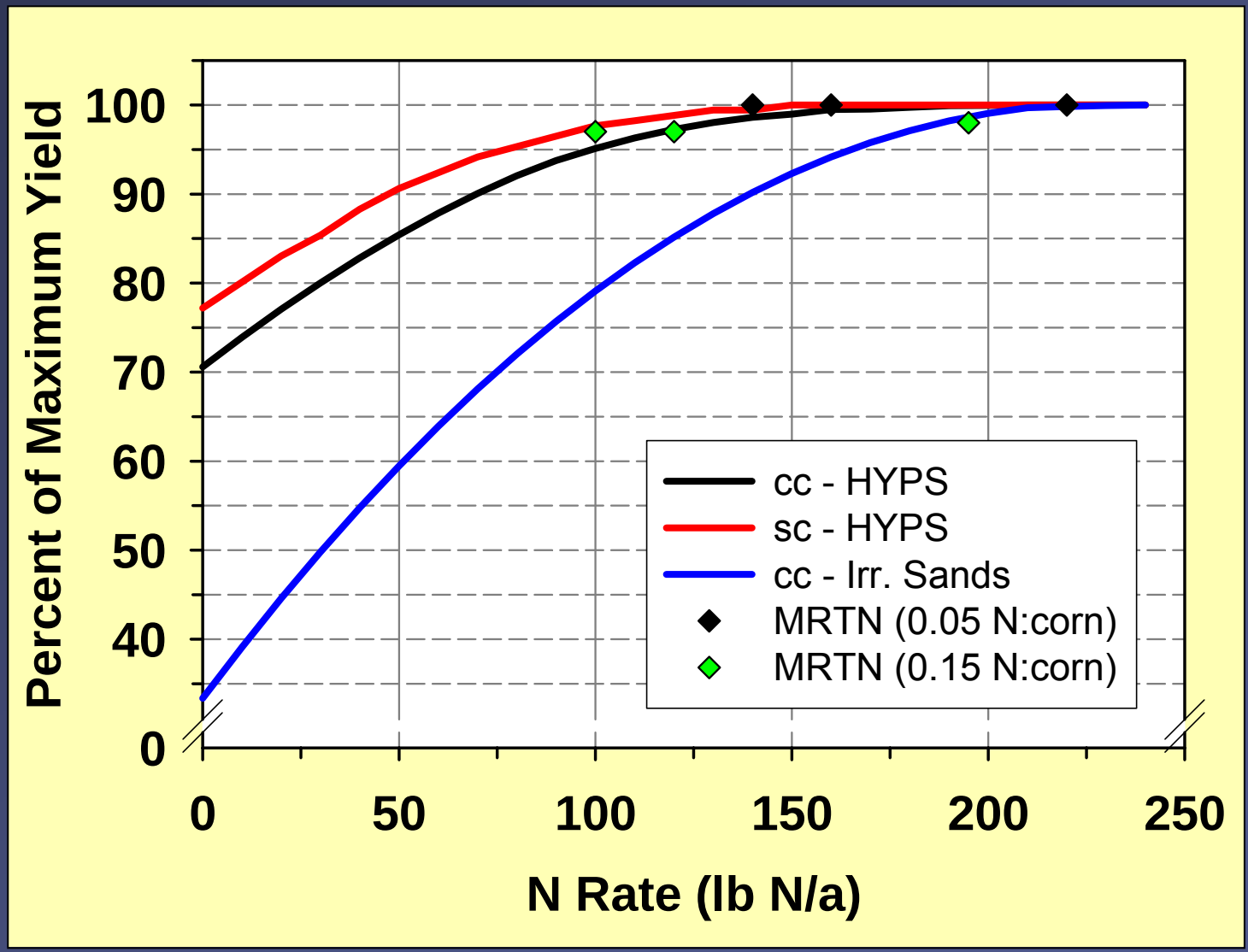
# N credits

- PSNT is used as a N credit
  - First determine target N rate, then subtract PSNT credit from the target N rate
  - Previously, PSNT values provided different target sidedress N rates
- PPNT is unchanged

| PSNT ppm | Yield Potential High N credit — lb N/a — | Med. |
|---|---|---|
| ≥ 21 | * | * |
| 18-20 | 100 | 80 |
| 15-17 | 60 | 80 |
| 13-14 | 35 | 40 |
| 11-12 | 10 | 40 |
| ≤ 10 | 0 | 0 |

* No additional N is needed

# How much yield will be lost by reducing N rates?



# Summary

- Based on field data
- Solidly based on economics
  - MRTN can be calculated for various corn and N prices to show the range in profitable N application
- Helps growers easily adjust N rates for varying price climates or management level
  - Provides grower flexibility

# Summary

- MRTN approach analyzes research data a little differently than previous method
  - But confirms our previous guidelines
- Provides ability to adjust for environmental costs and show profit losses when certain environmental quality criteria must be met
- Provide consistency in approaches to determining N rates across state borders