



# Corn Belt N Guidelines

John A. Lamb

University of Minnesota



# Outline

- Where have we been?
- Where are we now?
- Where are we going?

# UM N Recs--Trends

<u>N Rec. Factors</u>	<u>1971</u>	<u>1986</u>	<u>1999</u>
	---Lb N/acre---		
C-C, OM <sub>(H)</sub> , 160 bu.	200	170	150
Sb-C, OM <sub>(H)</sub> , 160 bu.	180	130	110
A-C, OM <sub>(L)</sub> , 145 bu.	100	80	0

# Factors Contributing to Reduction in N Rates

- Environmental Awareness/Issues
- N Credit Quantification
- More Calibration/Correlation Studies
  - Statistical modeling methods

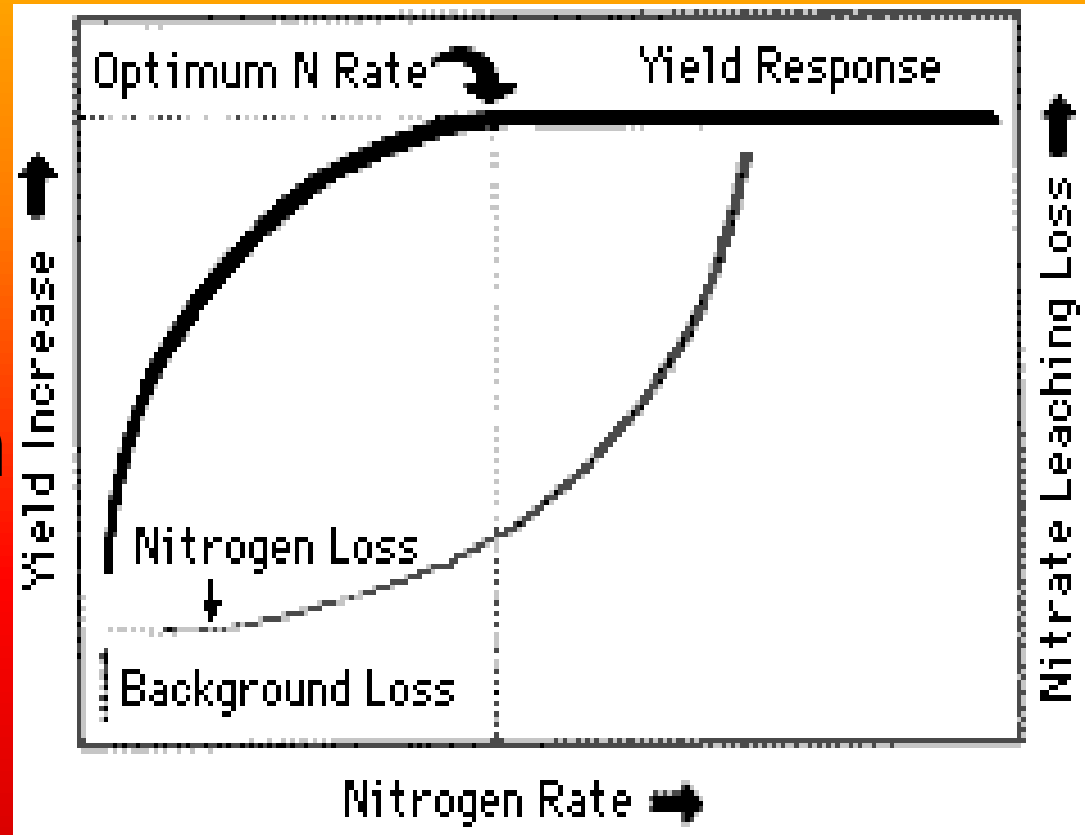
# UM N Rates-Corn, lb/a

<u>Previous Crop</u>	<u>Yield Goal, bu/acre</u>			
	<u>111-130</u>	<u>131-150</u>	<u>151-170</u>	<u>171-190</u>
A <sub>(g)</sub> -C	0	0	0	20
Sb-C	60	80	110	130
A <sub>(m)</sub> -C	15	45	75	95
C-C	100	120	150	170

Assumes >3%OM soils

# Crop Production and the Environment--Nitrogen

- Balance between yield and loss
- **Minimize** loss in each system



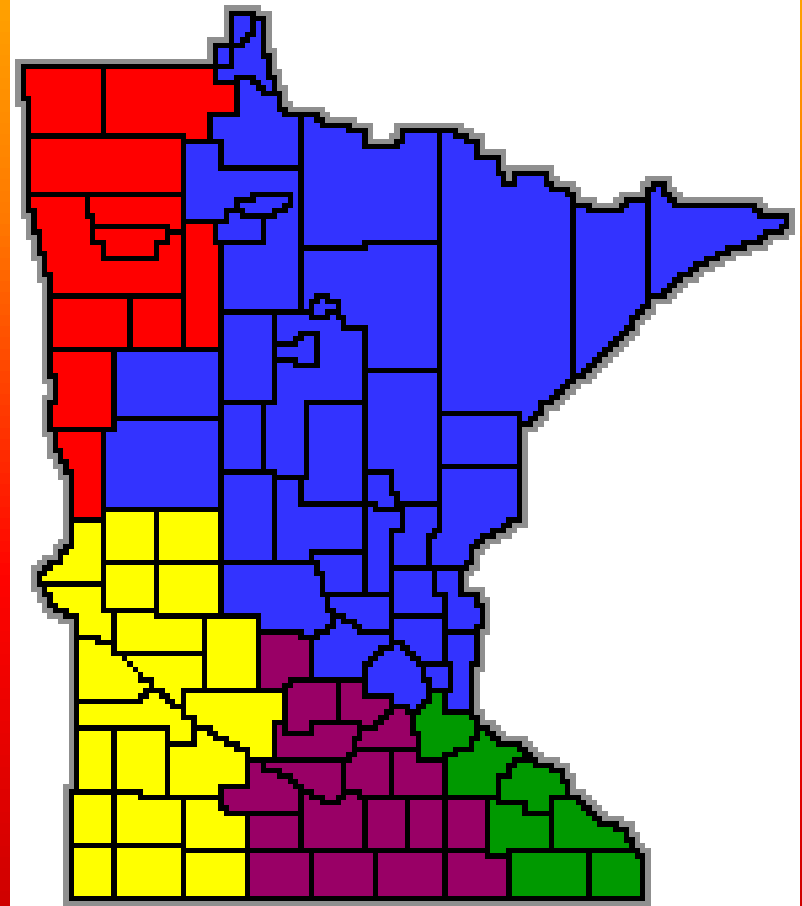
# Nitrogen Rate Recs.

- **Best Management Practices are followed**
- Manure and 2nd year alfalfa credits are properly credited

# Nitrogen BMPs

## Statewide/Regions/Special Situations

- Southeast
- South-central
- Southwest/West Central
- Northwest
- Central/East Central



What are we doing now?

“I’ll just cross the border and use a neighboring state’s N rate.”



What was going on around the North Central Region?

# Previous N Recommendations – Background

- Minnesota - - N rates are adjusted upward as yield goal increases.
- Some states - - N rate ranges are suggested depending on previous crop and production potential.
- Some states - - N rates are based on 1.2 lb fert. N per bushel produced (yield goal)  
Expl.  $180 \text{ bu/A} * 1.2 = 216 \text{ lb N/A}$   
minus N credits, i.e., 40 lb N for soybean

# Comparison of N Recs

165 bu/A, Sb-C, 3.5% OM

Minnesota	110 lb N/A
Wisconsin	120 lb N/A
Iowa	100-150 lb N/A
Illinois	170 lb N/A

# Comparison of N Recs

165 bu/A,  $A_{(m)}-\underline{C}$ , 3.5% OM

Minnesota

75 lb N/A

Wisconsin

40 lb N/A

Iowa

0-30 lb N/A

Illinois

160 lb N/A

# Is there a solution?

- North Central States developed N guidelines with similar philosophy.
- <http://extension.agron.iastate.edu/soilfertility/nrate.aspx>
- John Sawyer of ISU lead the group.
- Gyles Randall and George Rehm represented MN
- Gyles Randall and Jeff Vetsch has keep the MN database updated.

# Changes to N guidelines

- New N rate guidelines are:
  - NOT yield based
  - Based on previous crop, soil productivity potential and ratio of fertilizer N price to corn value.
  - Flexibility added
    - Attitude toward risk and water quality
    - Variable N rates within fields
    - Previous experiences
    - Local information

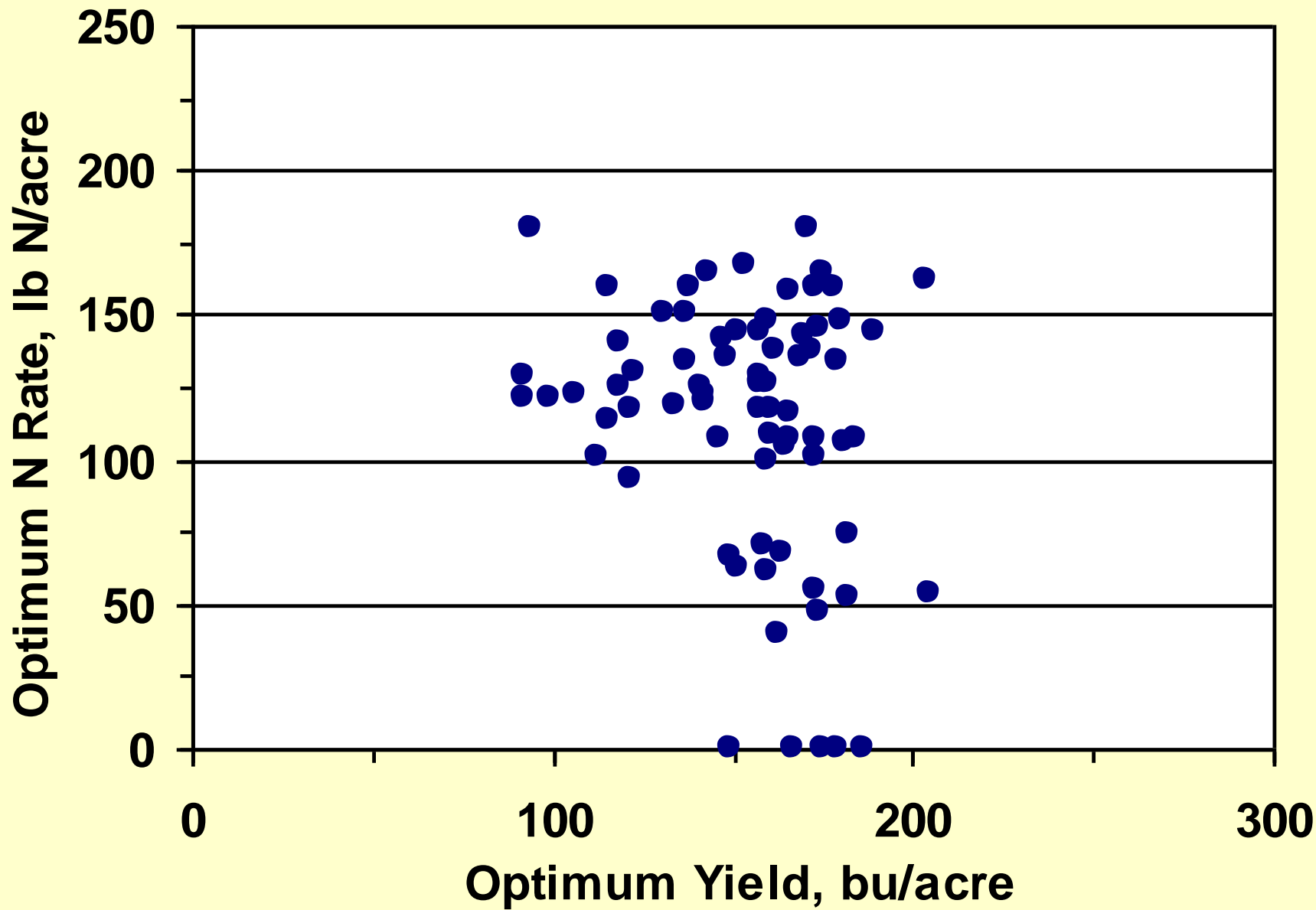
# Regional Database

- A seven state effort.
- Most of data collected from field experiments since 1993.
- Non-irrigated
- 3 to 4 replications
- 5 to 7 N rates
- High to very high yield potential (MN 97 %)

# Minnesota Data Base

Previous crop	Total	Responsive	Exp. Stn	On-farm
	----- number of sites -----			
C-C	73	68	33	35
Soybean-C	55	50	16	34
Alf.-C	14	7	7	0
Alf.-C-C	15	13	5	8
Sm grains-C	10	10	6	4
All	167	148	67	81

● MN - CC - Including NR Sites



# Corn N use efficiency

Yield group (bu/A)	Portion of yield from no N	NUE	Portion of yield from no N	NUE
	Soy/corn		Corn/corn	
	%	lb N/bu	%	lb N/bu
0-150	72	0.70	52	1.04
150-174	75	0.63	58	0.86
175-199	74	0.60	54	0.78
200+	74	0.53	79	0.69

# Factors Affecting N Rate Guidelines

- Soil productivity
- Fertilizer Price: Corn value ratio
- Grower attitude (water quality issues and risk)
- Grower experience
- Local information

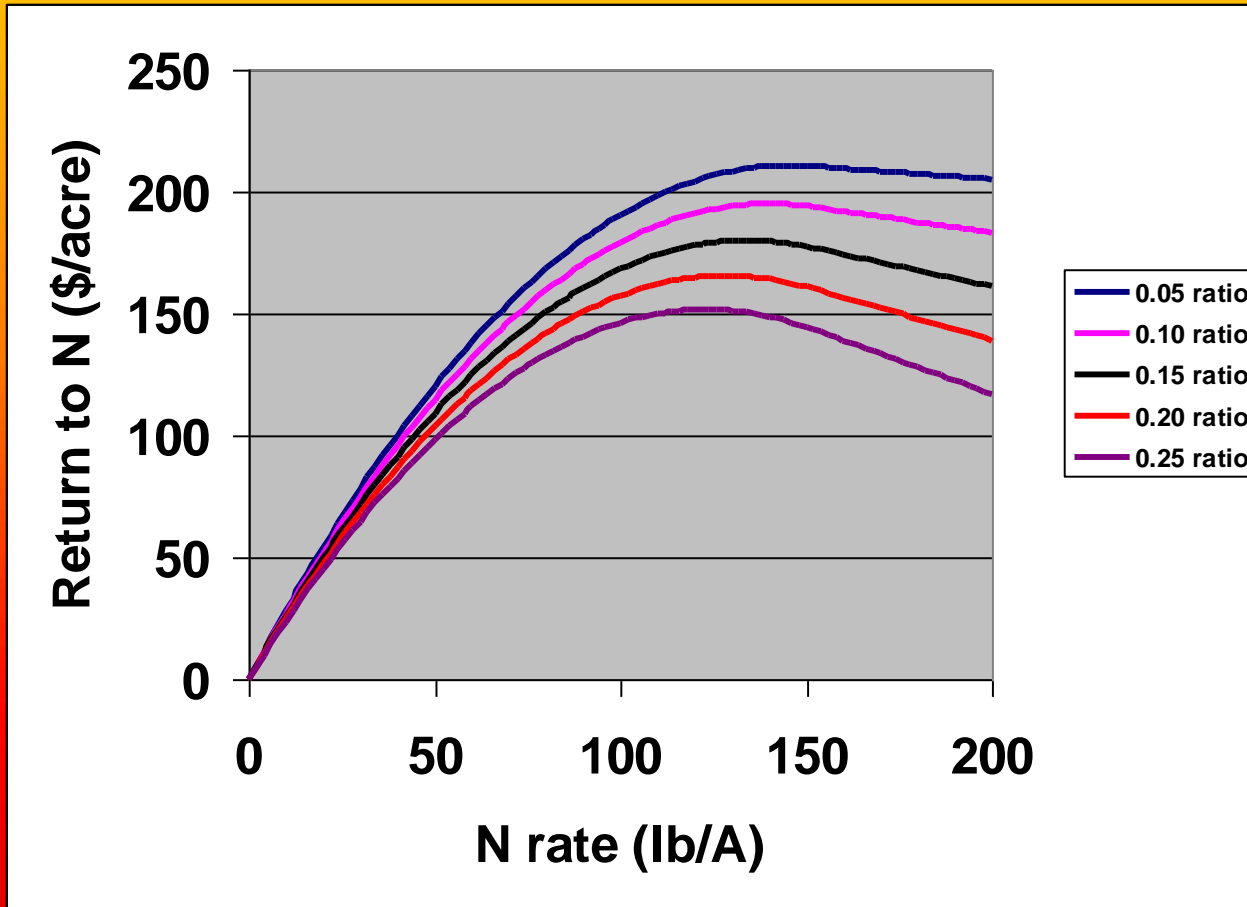
# Fertilizer N Price: Corn Value Ratios

- Because fertilizer N prices have escalated greatly in the last 5 years, various ratios of fertilizer price: corn value were examined
- Corn value was held at \$2.20
- N prices used were \$0.11, \$0.22, \$0.33, and \$0.44/lb
- Gives price: value ratios of 0.05, 0.10, 0.15, and 0.20

# Olmsted Co. Example Summary

Ratio	EONR	MRTN	- \$1	+ \$1
unitless	lb N/A	\$/A	lb N/A	
0.05	146	210.61	135	158
0.10	140	194.96	130	150
0.15	134	179.92	124	144
0.20	128	165.47	118	138
0.25	124	151.62	113	133

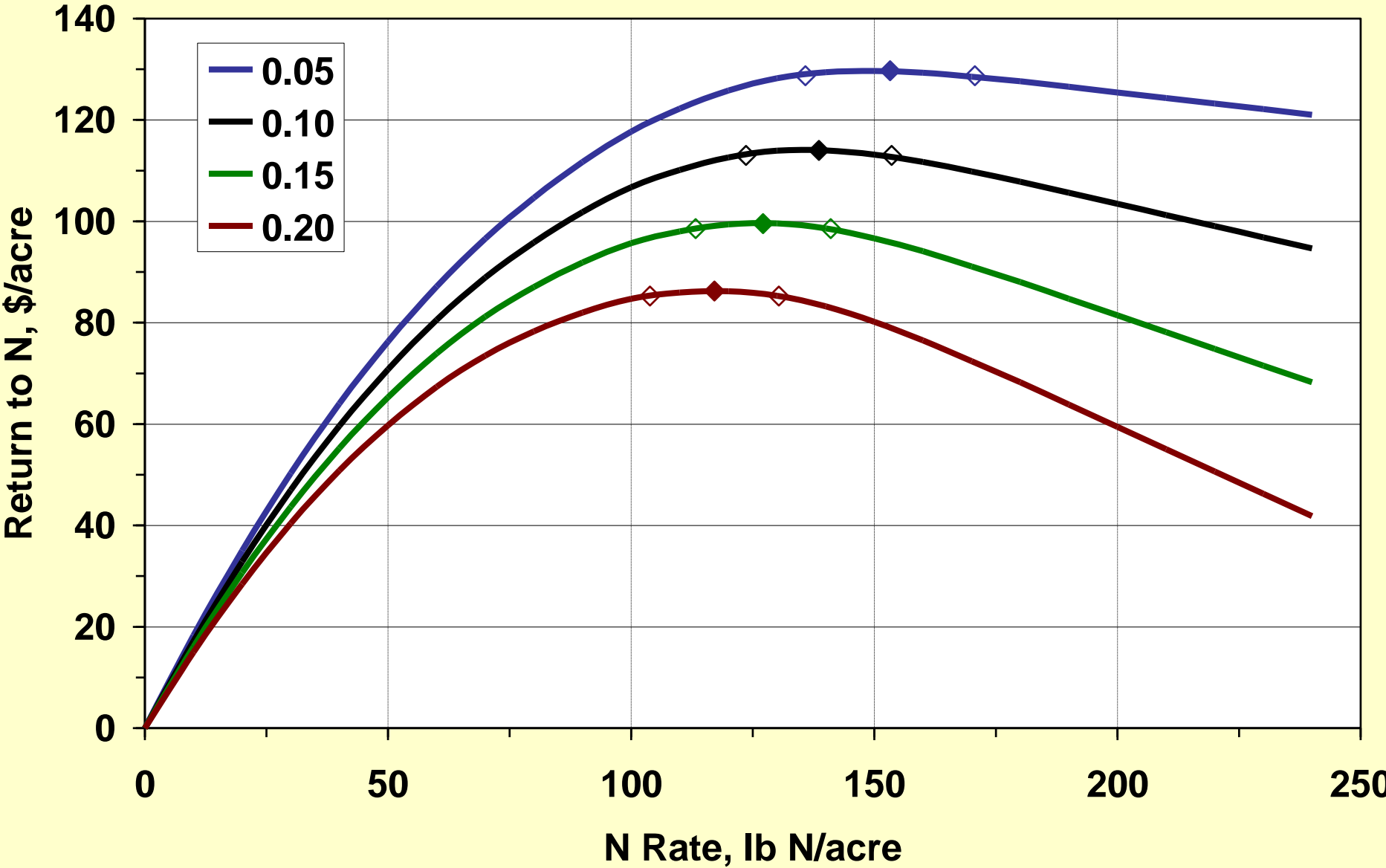
# Olmsted Co. Ex. MRTN



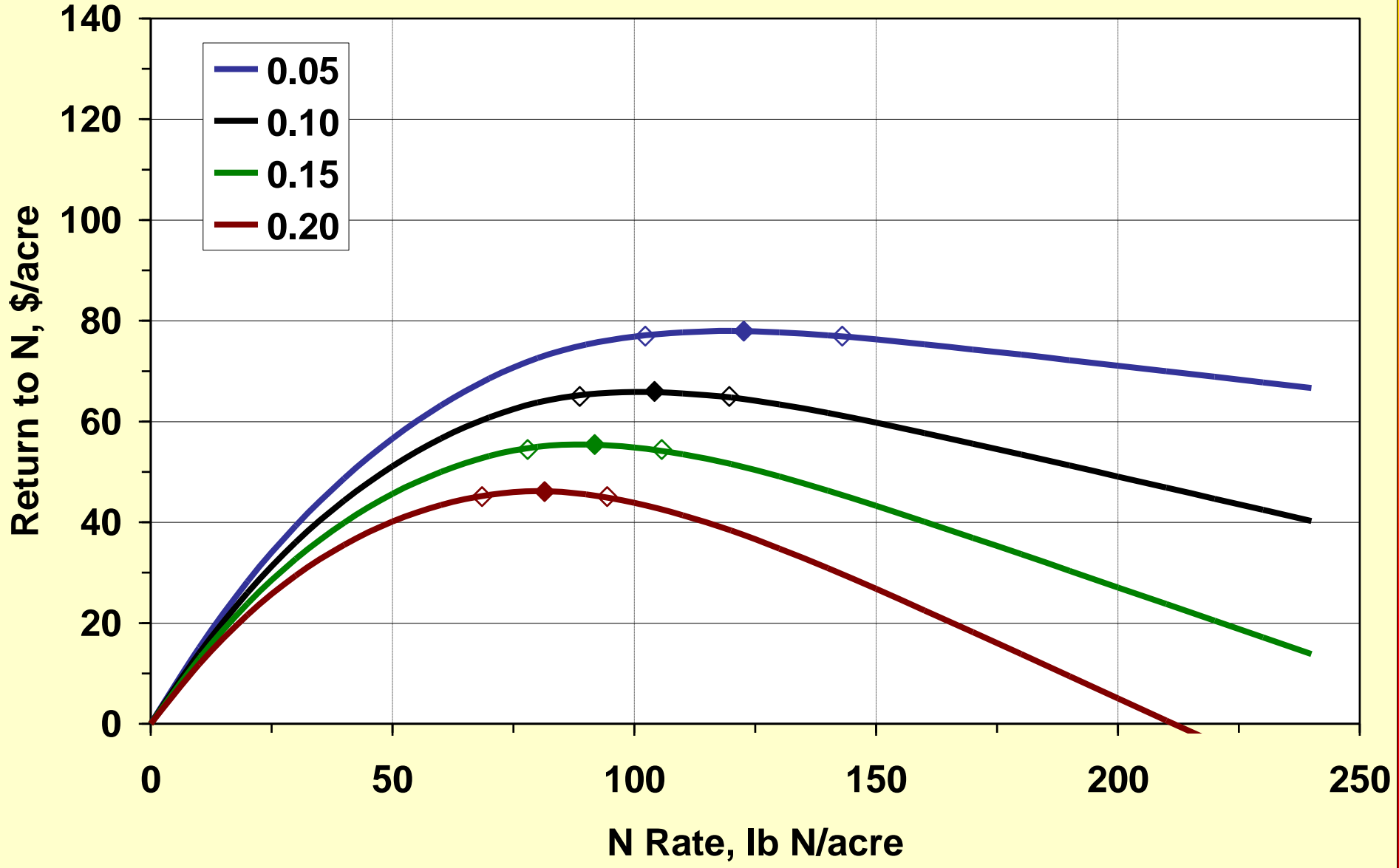
# Maximum Return to Nitrogen “MRTN”

- MRTN was calculated for each site using the a, b, c and plateau values from the response curve.
- Sites were separated into C-C and S-C cropping systems, and an average MRTN for each system was determined.
- N rate guidelines are based on these MRTN's for each fertilizer N price: corn value ratio.

# Minnesota - CC



# Minnesota - SC



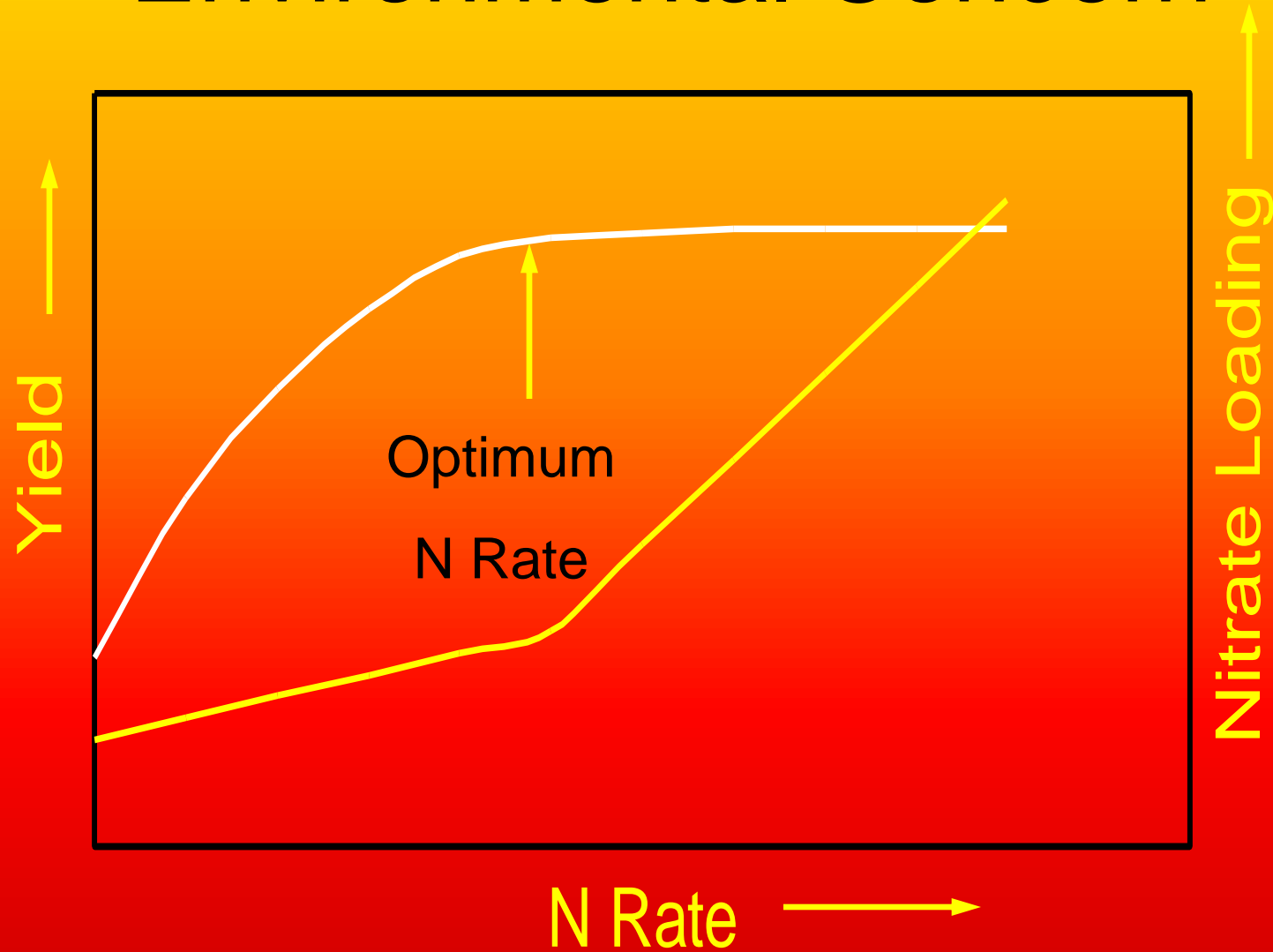
# N Guidelines

(high productivity)

N price/Crop value ratio	<u>Corn/corn</u>		<u>Corn/soybean</u>	
	MRTN	Flexible range	MRTN	Flexible range
unitless	----- pounds N per acre -----			
0.05	155	130 to 180	120	100 to 140
0.10	140	120 to 165	110	90 to 125
0.15	130	110 to 150	100	80 to 115
0.20	120	100 to 140	85	70 to 100

MRTN = maximum return to nitrogen.

# Environmental Concern



# What did we do to fill data holes?

- Example 2006 - 17 new sites
  - 2 in Sibley County
  - 2 in Chippewa County
  - 2 in Waseca County
  - 1 in Fillmore County
  - 1 in Fairmount County
  - 3 in Fergus Falls area – medium productivity area
  - 3 in Dawson area – medium productivity areas
  - 1 near Hastings – irrigated sand
  - 1 near Forreston – nonirrigated sand

# How are the guidelines working?

- On productive soils – well. Most misses are in advising too much N.
- Data base has been updated every year since 2006.
- Low yielding years were taken out in 2008.
- Area of concern are irrigated soils.

# Soil Texture

- Surface texture of soils under the irrigation tend to be silt loam to sandy.
- Underlain with gravel deposits
- The combination of these factors suggests that careful application of N is important.
  - Apply close to the time the plant needs it.
  - Split applications – half at planting – half when the corn is 6 to 12 inches tall.

# Irrigated Corn Sites

- High productivity soils
- Needed to confirm that the N guidelines work.
- One site in 2006 – George Rehm previous crop corn.
- Two sites in 2007
  - Near Hastings - sandy, previous crop potato with rye cover crop
  - Near Cannon Falls – silt loam surface, previous crop sweet corn

# Irrigated Corn Sites

- Three sites in 2008
  - Near Hastings – sandy, previous crop corn.
  - Near Cannon Falls – silt loam surface, previous crop, sweet corn.
  - Near Becker – sandy loam, previous crop rye.
- Three sites in 2009.
  - SE of Hastings – silt loam surface, previous crop soybean.
  - SW of Hastings – sandy, previous crop corn.
  - Becker – sandy loam, previous crop rye.

# 2006 - 2009 sites

- N rates 0, 30, 60, 90, 120, 150, and 180 lb N/A
- Urea split applied
  - At planting and at 6 to 12 inches in height.
  - Measured grain yield.

# Four year summary

- 2006 – 215 bu/A - 110 lb N/A\*
- 2007
  - 190 bu/A 146 lb N/A \*
  - 230 bu/A 160 lb N/A
- 2008
  - 289 bu/A 193 lb N/A plus 15 lb starter + 22 lb irrigation water.\*
  - 218 bu/A 162 lb N/A
  - 250 bu/A 240 lb N/A plus 3 lb starter + irri water\*

# Four year summary

- 2009
  - 223 bu/A 193 lb N/A plus 15 lb starter + ?? lb irrigation water.\*
  - 242 bu/A 148 lb N/A
  - 225 bu/A 221 lb N/A plus 3 lb starter + irri water\*

2008 and 2009 a problem? Results fit Wisconsin rate calculator for sands.

# So where are we going?

- Need to firm up the irrigated sandy soil recommendations.
- Confirm the N guidelines for RRV.
- Monitor the role of soil N
- Assess the effect of improved genetics and higher corn yield potential
- Monitor N use efficiency (NUE)

# So where are we going? (2)

- Develop and test new N BMPs.
  - Tried remote sensing
  - Tried in-season sensing
- Keep putting new data in the database to keep the guidelines current.

# Report Card

- Corn Guidelines
  - High productivity soils non-irrigated – A-
  - Irrigated silt loams - A-
  - Irrigated sands – D
- New guidelines for irrigated sands are coming!

# Summary

- Moved to a new guideline system.
  - Brings in economics
  - Uses similar philosophy in the North Central States.
  - Leaves room for adjustment for local conditions.
  - System is easily updated.

# Questions?

