Performance of new corn N rate guidelines

Carrie A.M. Laboski, Larry G. Bundy, & Todd W. Andraski

Dept. of Soil Science
University of Wisconsin-Madison

Corn N rate guidelines - MRTN

- Introduced in winter 2005/2006
- In response to high N costs & low corn price
- Based on results of numerous N response experiments
- Goal: Maximize economic return on N fertilizer

Info. needed to use MRTN

- Soil yield potential
- Previous crop
- N:corn price ratio
  - $/lb N ÷ $/bu corn

Soil and Previous Crop	N:Corn Price Ratio ($/lb N:$/bu)			
	0.05	0.10	0.15	0.20
	lb N/a (Total to Apply)			
High/ V.High Yield Potential Soils				
Corn, Forage legumes, Vegetable legumes, green manures	165 (135-190)	135 (120-155)	120 (100-135)	105 (90-120)
Soybean, Small grains	140 (110-160)	115 (100-130)	100 (85-115)	90 (70-100)
Medium/Low Yield Potential Soils				
Corn, Forage legumes, Vegetable legumes, green manures	120 (100-140)	105 (90-120)	95 (85-110)	90 (80-100)
Soybean, Small grains	90 (75-110)	60 (45-70)	50 (40-60)	45 (35-55)
Irrigated Sands & Loamy Sands				
All crops	215 (200-230)	205 (190-220)	195 (180-210)	190 (175-200)
Non-Irrigated Sands & Loamy Sands				
All crops	120 (100-140)	105 (90-120)	95 (85-110)	90 (80-100)

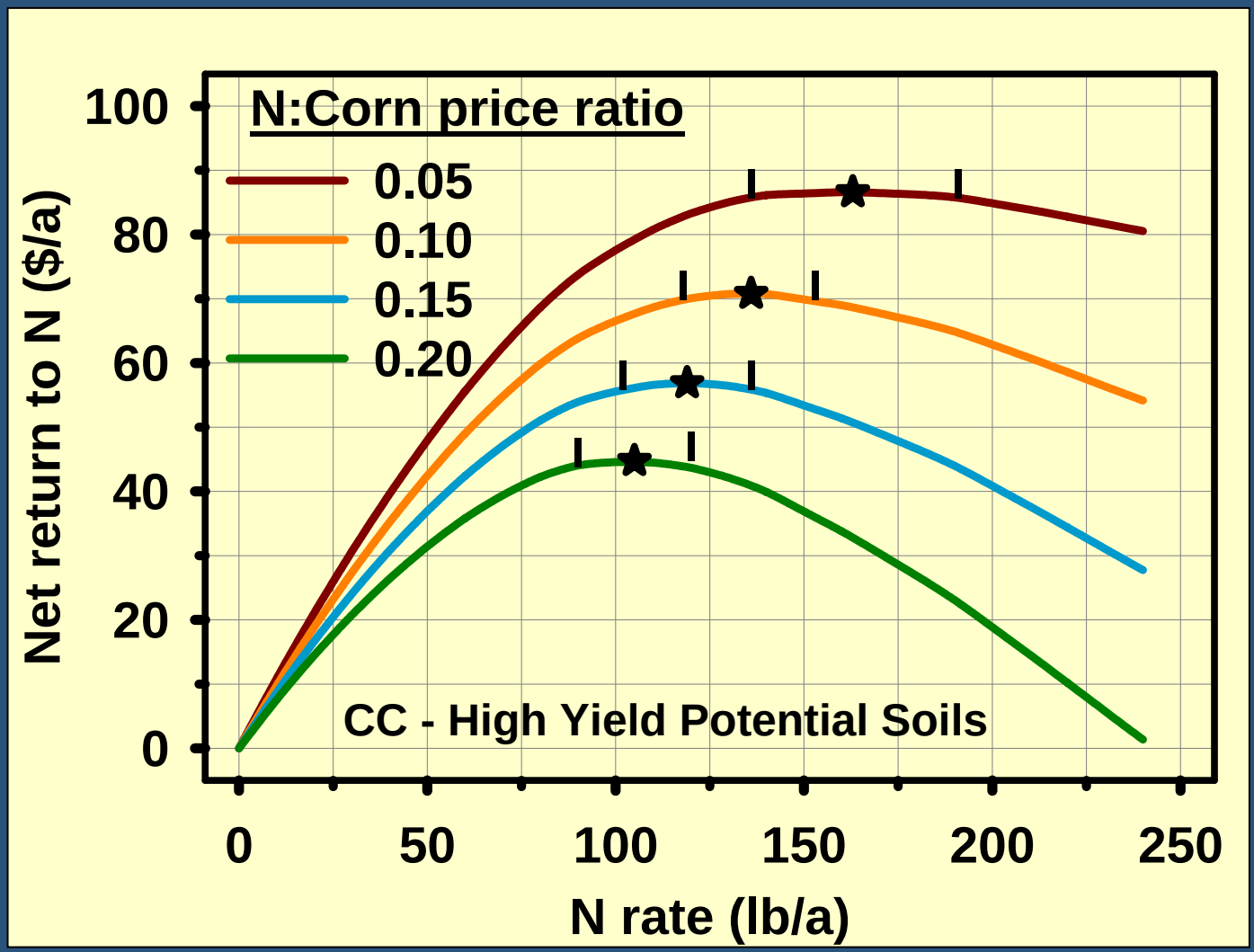
Some guidelines for using ranges

Situation	Portion of Range to Use		
	low	mid	high
> 50 % residue cover at planting			✓
Previous crop is small grain on medium/fine textured soils	✓	✓	
100 % of N is from organic sources			✓
	Plus up to 20 lb N/a in starter fertilizer may be applied		
If there is a likelihood of residual N (carryover N)	✓		
	Or use PPNT		

Some guidelines for using ranges

Situation	Portion of Range to Use		
	low	mid	high
Medium & fine-textured soils with < 2.0 % OM			✓
Medium & fine-textured soils with > 10.0 % OM	✓		
Course-textured soils with < 2.0 % OM			✓
Course-textured soils with > 2.0 % OM	✓	✓	

Profitable N Rates

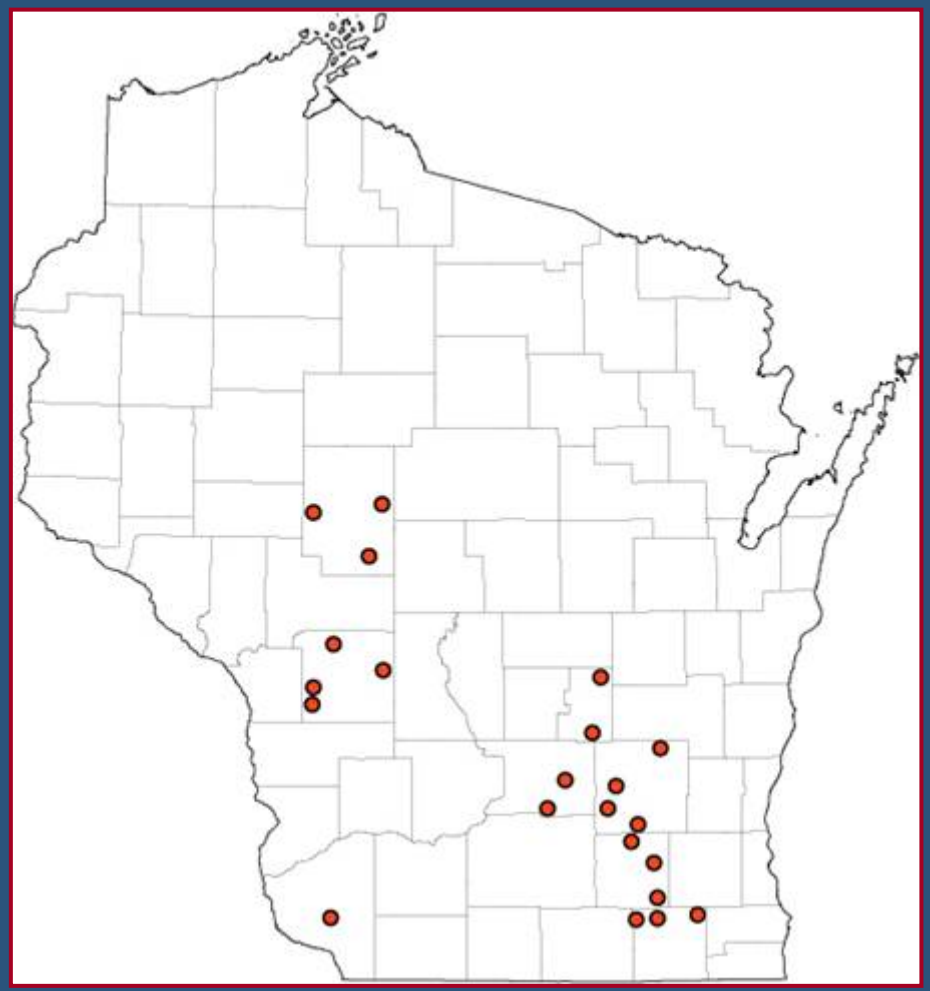


- A range of N rates can produce profitable yields
- Economics clearly drives the profitable N rate

Early 2006 much interest in MRTN, but reluctance to use on all acres

- Objective:
  - Establish plots on grower fields throughout the state
    - Demonstrate how MRTN performs
    - Collect more data to add to the database

22 Locations



- Range of soil yield potentials
- Previous crop:
  - Soybean at 13 sites
  - Corn at 9 sites
- N rates:
  - 0, 40, 80, 120, 160 lb N/a
    - and 200 lb N/a for HYPS
  - Small amount of starter N at some sites included in total N application
- Replications: at least 3

Photo: Bill Halfman, Monroe Co.

Data analysis

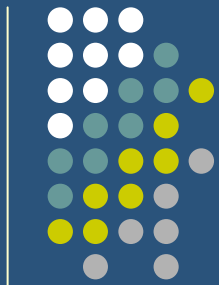
- Grain yield response to N was fit to an equation for each site
- Economic optimum N rate (EONR) calculated at N:corn price ratios of 0.05, 0.10, 0.15
- Yield and economics of using the MRTN N rate was calculated using equations
  - Compared to EONR

Corn: $3.00/bu
N: $0.15, 0.30, 0.45/lb

MRTN v. EONR
(Example: 0.05 N:corn price ratio)

Site ID	MRTN rate guidelines		Observed EONR		Difference (MRTN – EONR)		
	N rate	Yield	N rate	Yield	N rate	Yield	Econ.
	lb N/a	bu/a	lb N/a	bu/a	lb N/a	bu/a	$/a
1	160	173	129	173	31	0	-4.65
4	160	165	161	165	-1	0	0.15
22	165	156	180	157	-15	-1	0.75
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Average MRTN under applied (n=9)					-16	-2	-3.40
Average MRTN over applied (n=13)					44	0	-6.62

MRTN v. EONR Comparison
Average for all sites



N:Corn	MRTN: Under Applied				MRTN: Over Applied			
	n	N Rate	Yield	Return	n	N Rate	Yield	Return
		lb N/a	bu/a	$/a		lb N/a	bu/a	$/a
0.05	9	-16	-2	-3.40	13	44	0	-6.62

MRTN v. EONR Comparison
Average for all sites

N:Corn	MRTN: Under Applied				MRTN: Over Applied			
	n	N Rate	Yield	Return	n	N Rate	Yield	Return
		lb N/a	bu/a	$/a		lb N/a	bu/a	$/a
0.05	9	-16	-2	-3.40	13	44	0	-6.62
0.10	11	-28	-5.5	-8.24	11	38	0.9	-8.81

MRTN v. EONR Comparison
Average for all sites

N:Corn	MRTN: Under Applied				MRTN: Over Applied			
	n	N Rate	Yield	Return	n	N Rate	Yield	Return
		lb N/a	bu/a	$/a		lb N/a	bu/a	$/a
0.05	9	-16	-2	-3.40	13	44	0	-6.62
0.10	11	-28	-5.5	-8.24	11	38	0.9	-8.81
0.15	12	-32	-8.3	-10.20	10	31	1.1	-10.56

Under and over application $ losses are balanced

How often does MRTN range encompass EONR?

N:corn price ratio	EONR less than MRTN range	EONR in MRTN range	EONR greater than MRTN range
	%		
0.05	36	36	28
0.10	32	18	50
0.15	32	23	45

Over applied

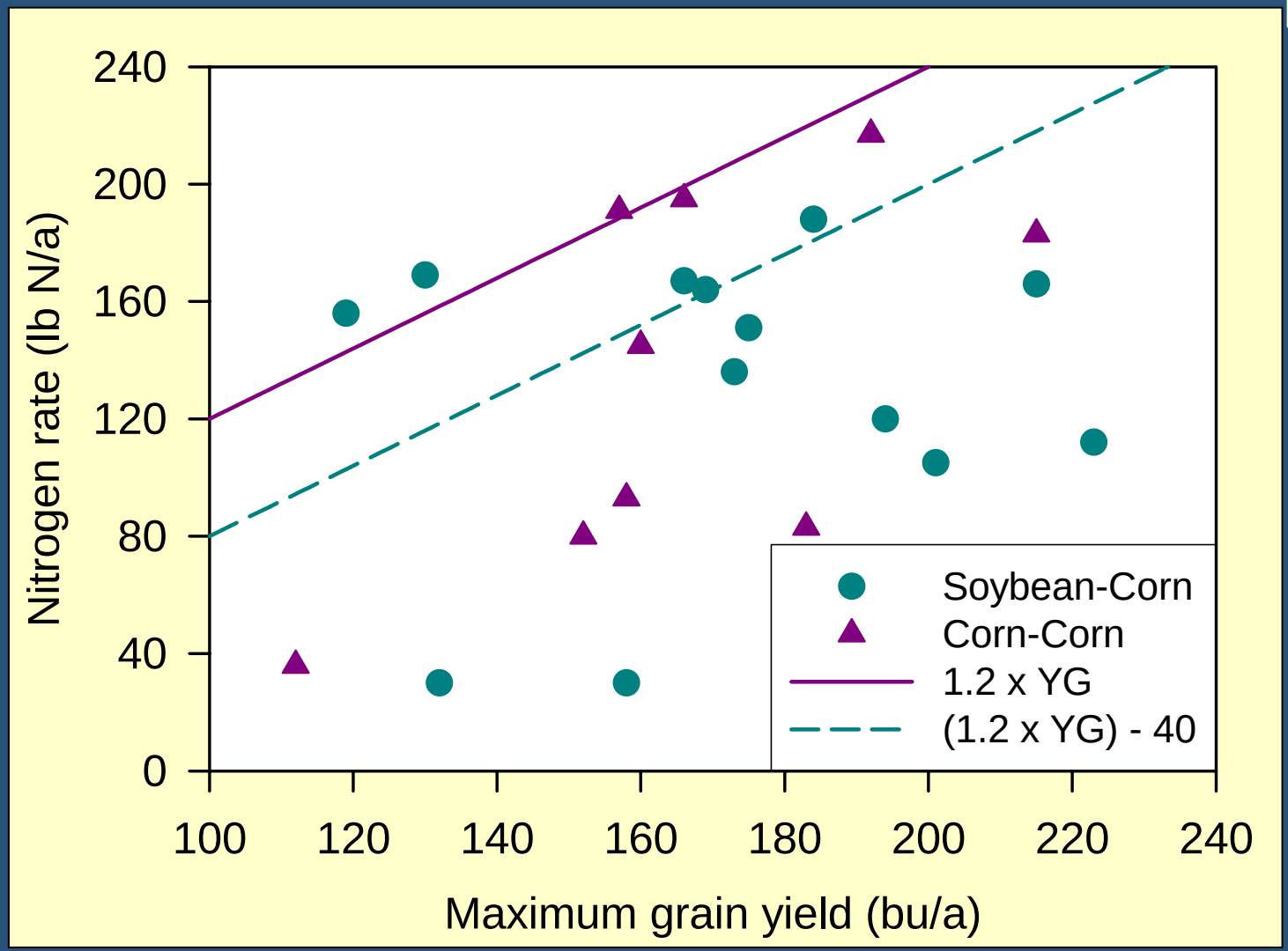
Under applied

Yield loss with MRTN

	N:Corn Price ratio		
	0.05	0.10	0.15
	% Relative Yield		
Mean	99	98	97
Stdev	0.80	2.39	3.64
Maximum	100	100	100
Minimum	97	93	89
Median	100	99	97

Relative yield is the yield calculated using the MRTN rate for a given price ratio divided by the max. yield achieved at the site

Can the yield goal method predict the amount of N needed?



Conclusions

- Data is representative of range of responses that occur on WI farms
- Remember data from just one year
  - On each field variation from year to year
  - Until we can accurately predict soil N mineralization, it will be difficult to determine exactly the amount of N needed each year

Conclusions

- Power of MRTN is the averaging of data from multiple locations over multiple years
  - A robust estimate of profitability by balancing economic losses from under and over application

Acknowledgements

- UW-Extension Staff
- Cooperating farmers
- UW-Extension Nutrient Management Team
- UW Nonpoint Pollution Demonstration Project