Approaches to N Recommendations in the North Central Region

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N Recommendations

- Two prevailing theories
  - Yield goal based
  - Non-yield goal based

N Recommendations

- Yield goal based
  - Illinois
    - lb N/A = (1.2 x YG) – N credits; soybean credit = 40 lb/A
  - Michigan/Indiana/Ohio
    - lb N/A = (1.36 x YG) - 27 – N credits; soybean credit = 30 lb/A
  - Minnesota

		Expected Yield (bu/A)				
PC	OM*	100-124	125-149	150-174	175-199	200+
		N to apply (lb N/A)				
Corn	Low	130	160	190	210	230
Corn	Med/High	100	130	160	180	200
Soybean	Low	90	120	150	170	190
Soybean	Med/High	60	90	120	140	160

* Low OM < 3.0%; Med/High OM ≥ 3.0% soybean credit = 40 lb/A

N Recommendations

- Not yield goal based
  - Iowa

PC	N rec. (lb N/A)
Corn	150 to 200
Soybean	100 to 150

  - Wisconsin

	--- Sands/loamy sands ---		---------- Other soils ----------	
OM	Irrigated	Non-irrigated	Low/Med YP	High/Very High YP
%	---------- lb N/A ----------			
< 2	200	120	150	180
2-9.9	160	110	120	160
10-20	120	100	90	120
> 20	80	80	80	80

(soybean credit = 40 lb N/A)

N Recommendation Comparison

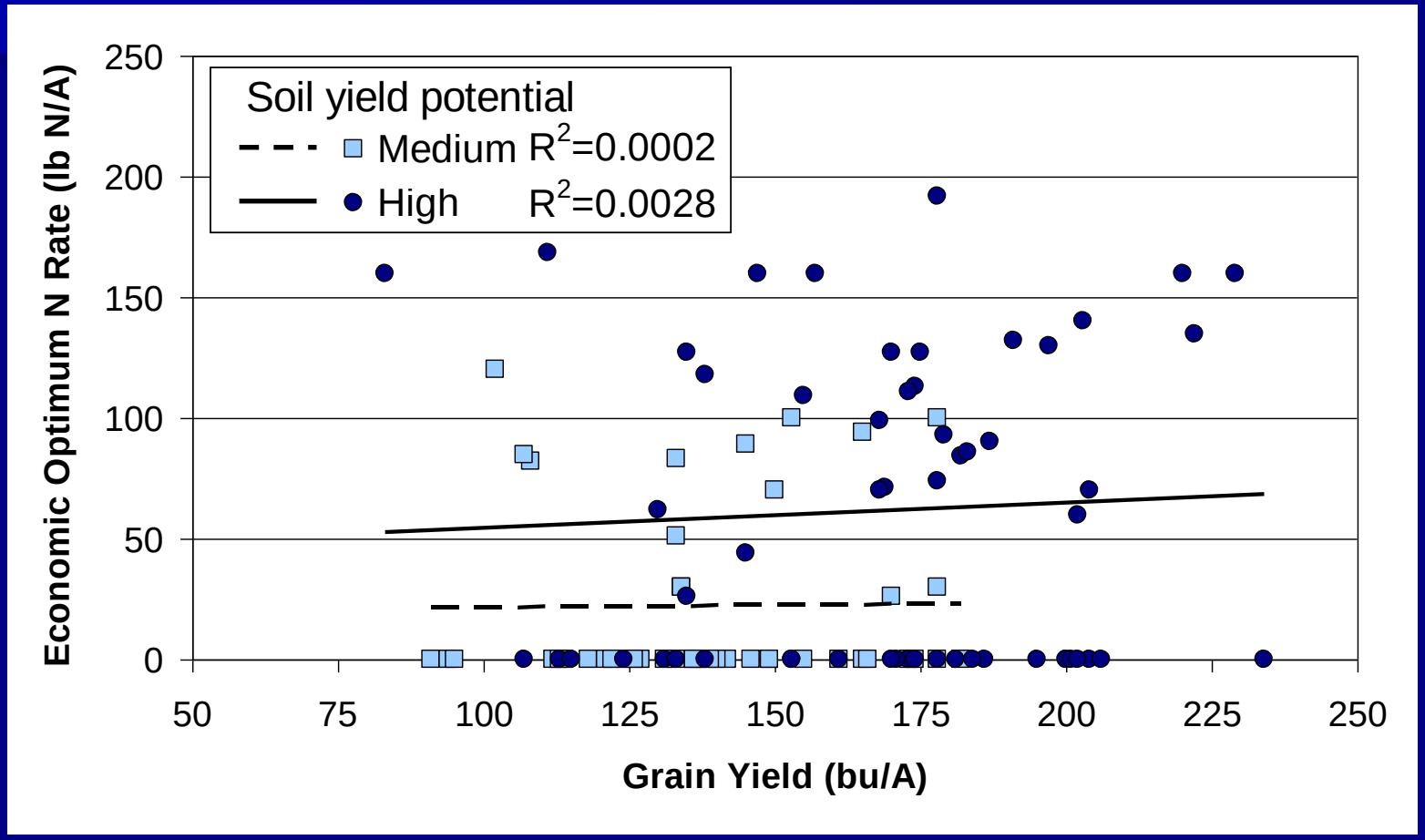
Previous Crop:	Corn		Soybean	
Yield Goal (bu/A):	150	200	150	200
	lb N/A			
IL	180	240	140	200
MI/IN/OH	177	245	147	215
MN	160	200	120	160
IA	150-200		100-150	
WI	160		120	

Soil with 3.1% OM, considered high yield potential

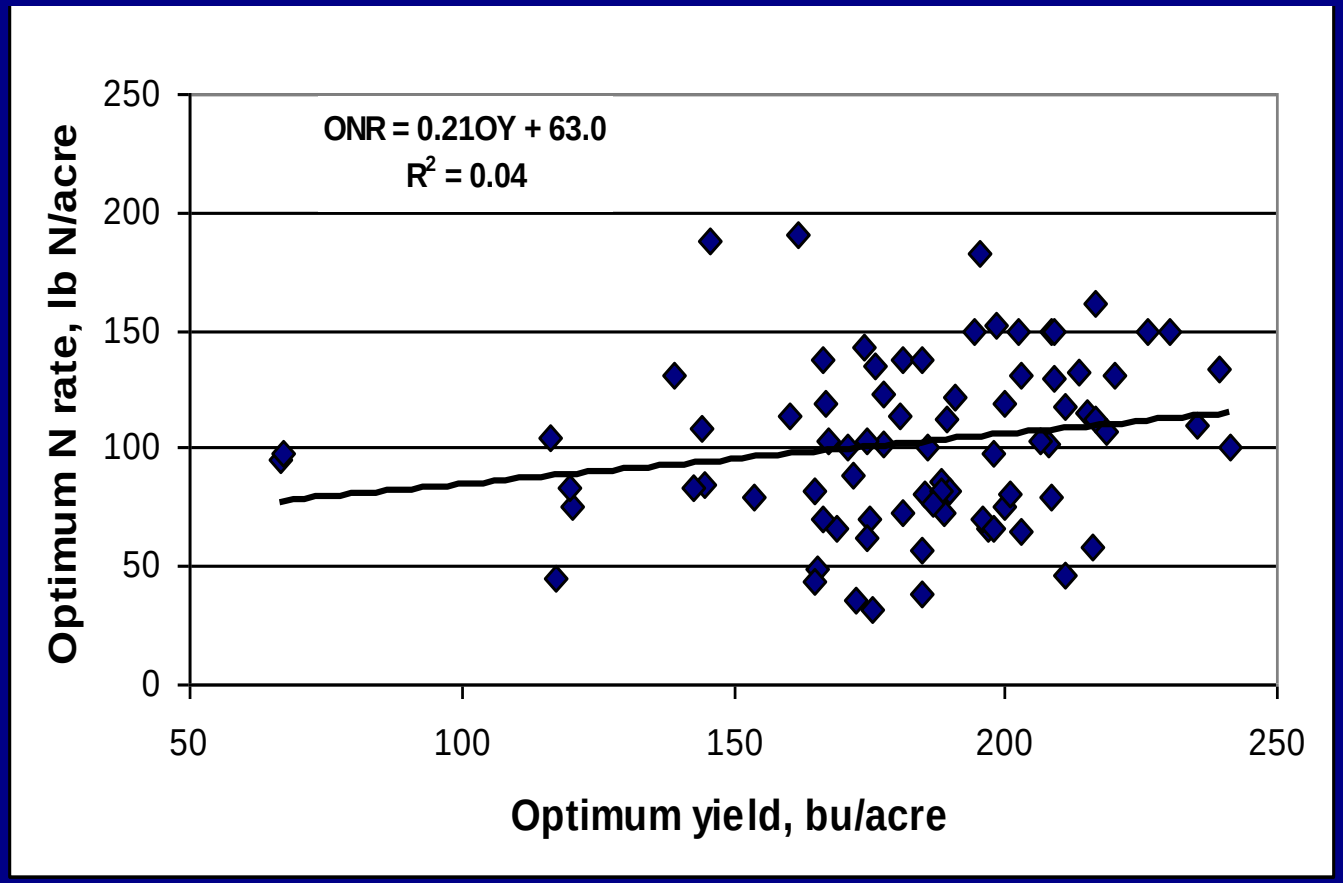
Are Yield Goal Based N Recommendations Valid ?

- If so, there will be a relationship between economic optimum N rate (EONR) and yield obtained at EONR

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

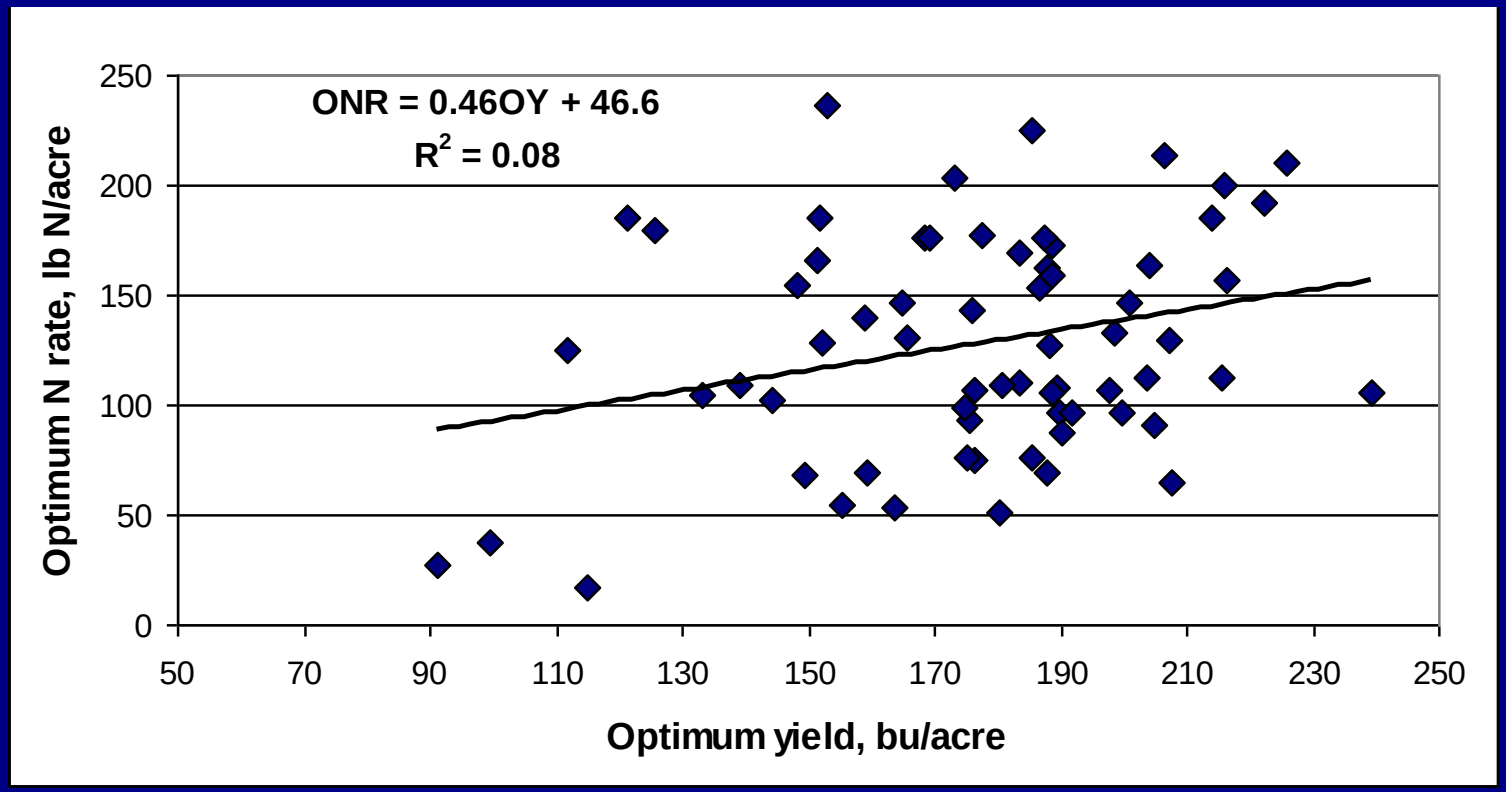


Relationship between optimum N rate and yield in IA (81 site years; pc = soybean)



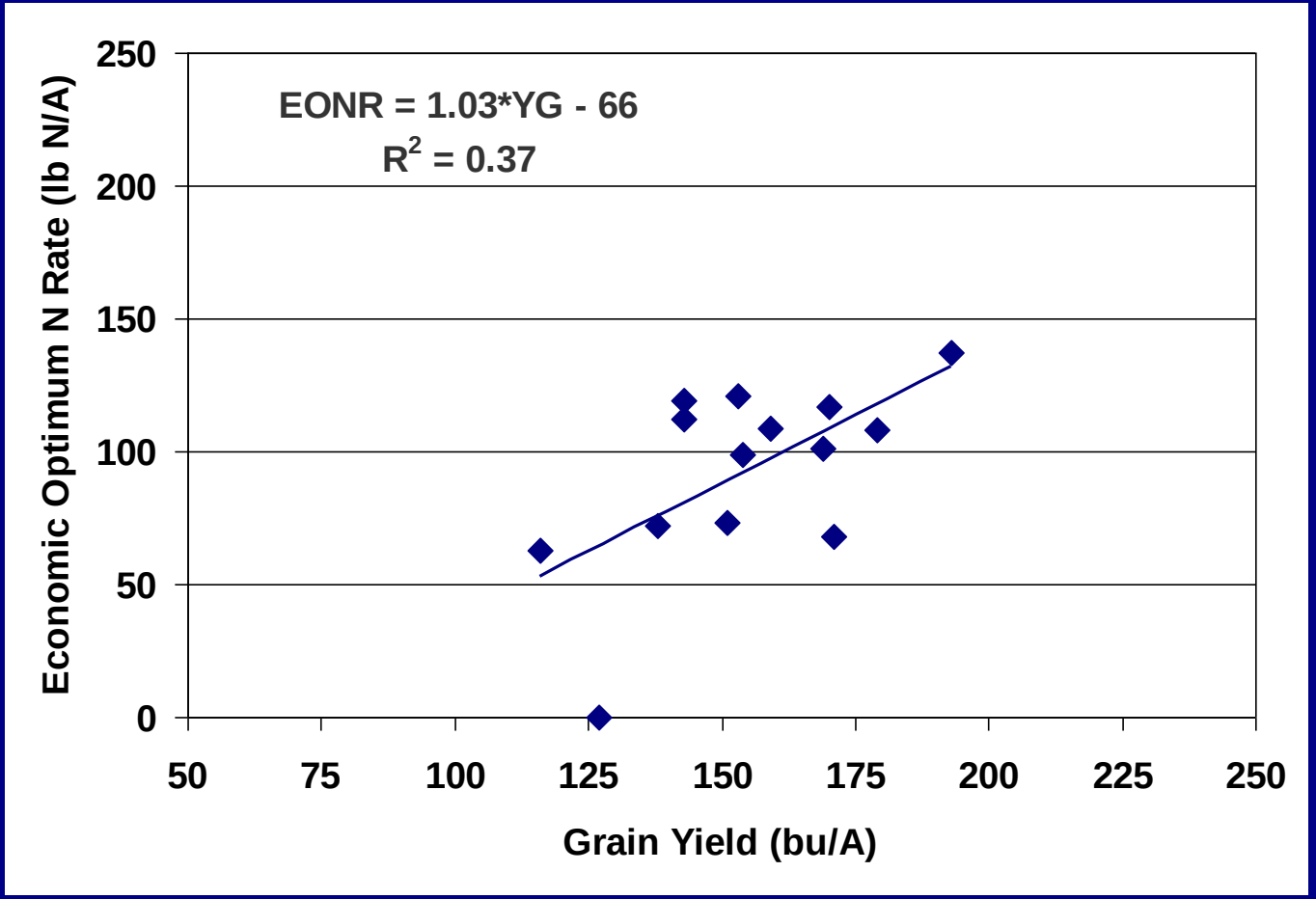
From Nafziger et al., 2004

Relationship between optimum N rate and yield in IL (72 site years; pc = soybean)



From Nafziger et al., 2004

Relationship between optimum N rate and yield in MI (14 site years; 2002-2003)



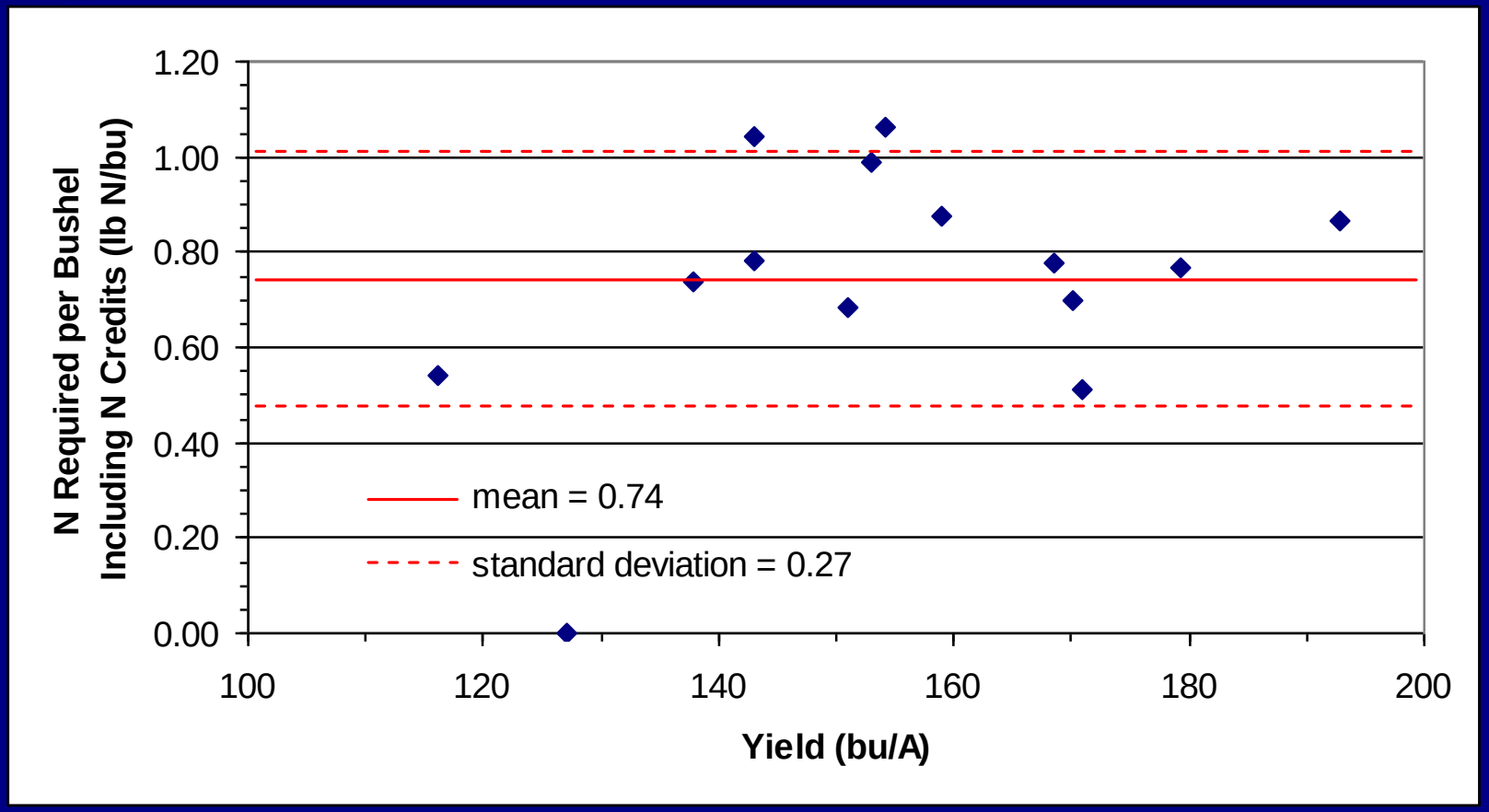
Relationship between optimum N rate and yield in MN

- Data across southern and south east MN show a poor/no relationship between yield and economic optimum N rate

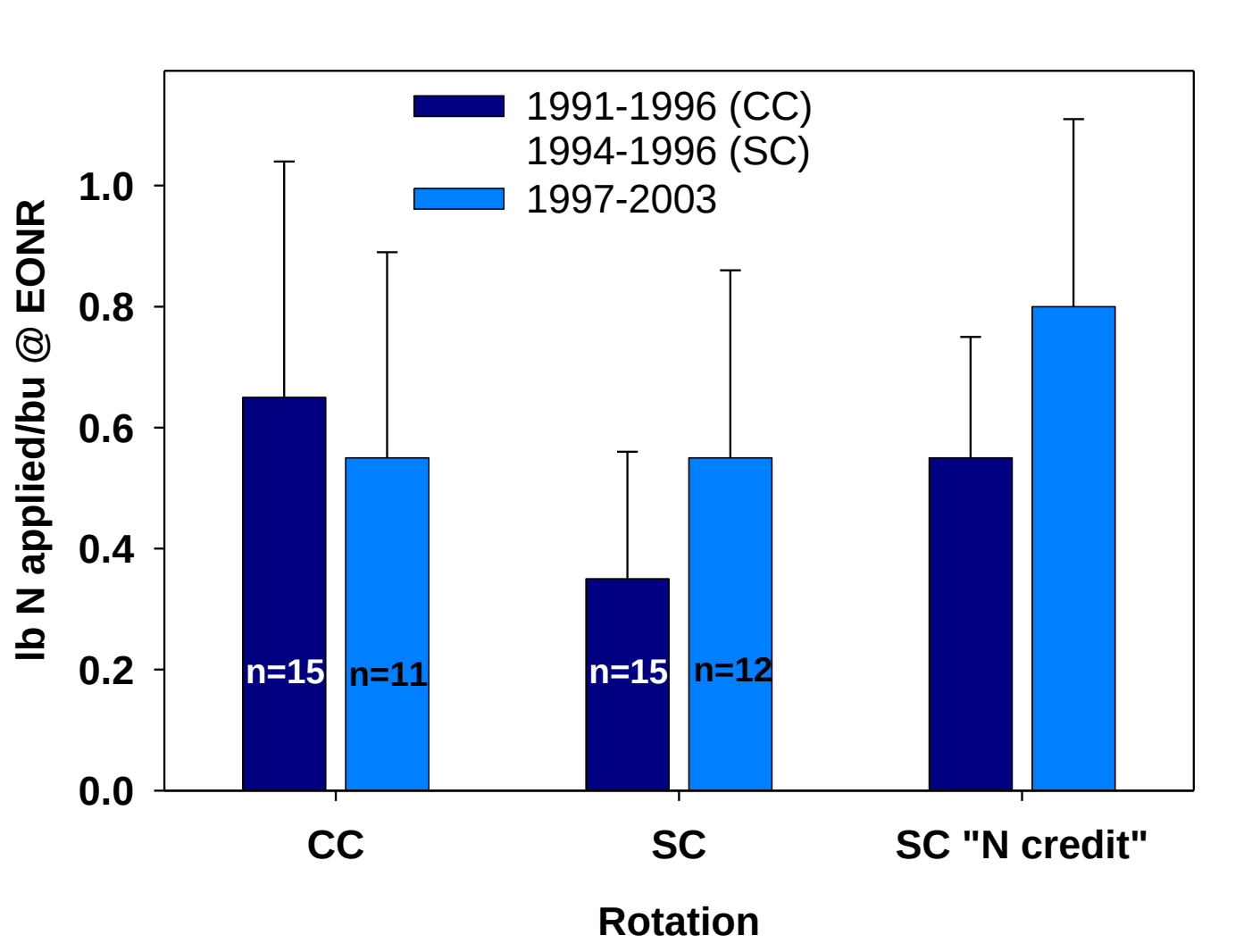
Are Yield Goal Based N Recommendations Valid ?

- If so, there will be a relationship between economic optimum N rate (EONR) and yield obtained at EONR
  - Relationship is poor
- If so, the pounds of N required per bushel would be relatively stable over time/across sites

N required per bushel in MI (2002-2003)



N required per bushel in WI with and without 40 lb N credit added to EONR



Are Yield Goal Based N Recommendations Valid ?

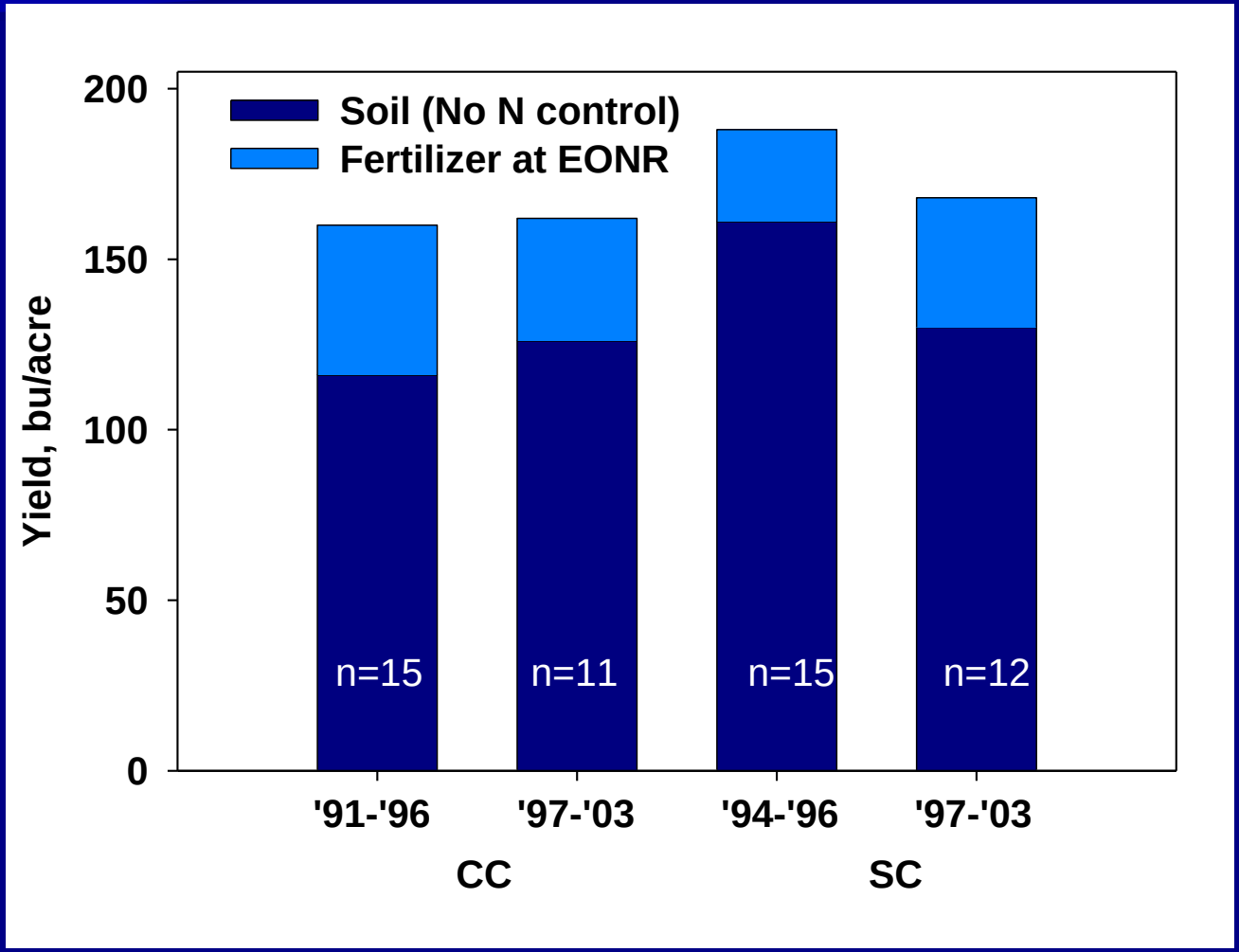
- If so, there will be a relationship between economic optimum N rate (EONR) and yield obtained at EONR
  - Relationship is poor
- If so, the pounds of N required per bushel would be relatively stable over time/across sites
  - N required per bushel is:
    - Highly variable
    - Much less than 1.2

Let's look at factors in Wisconsin's N recommendations

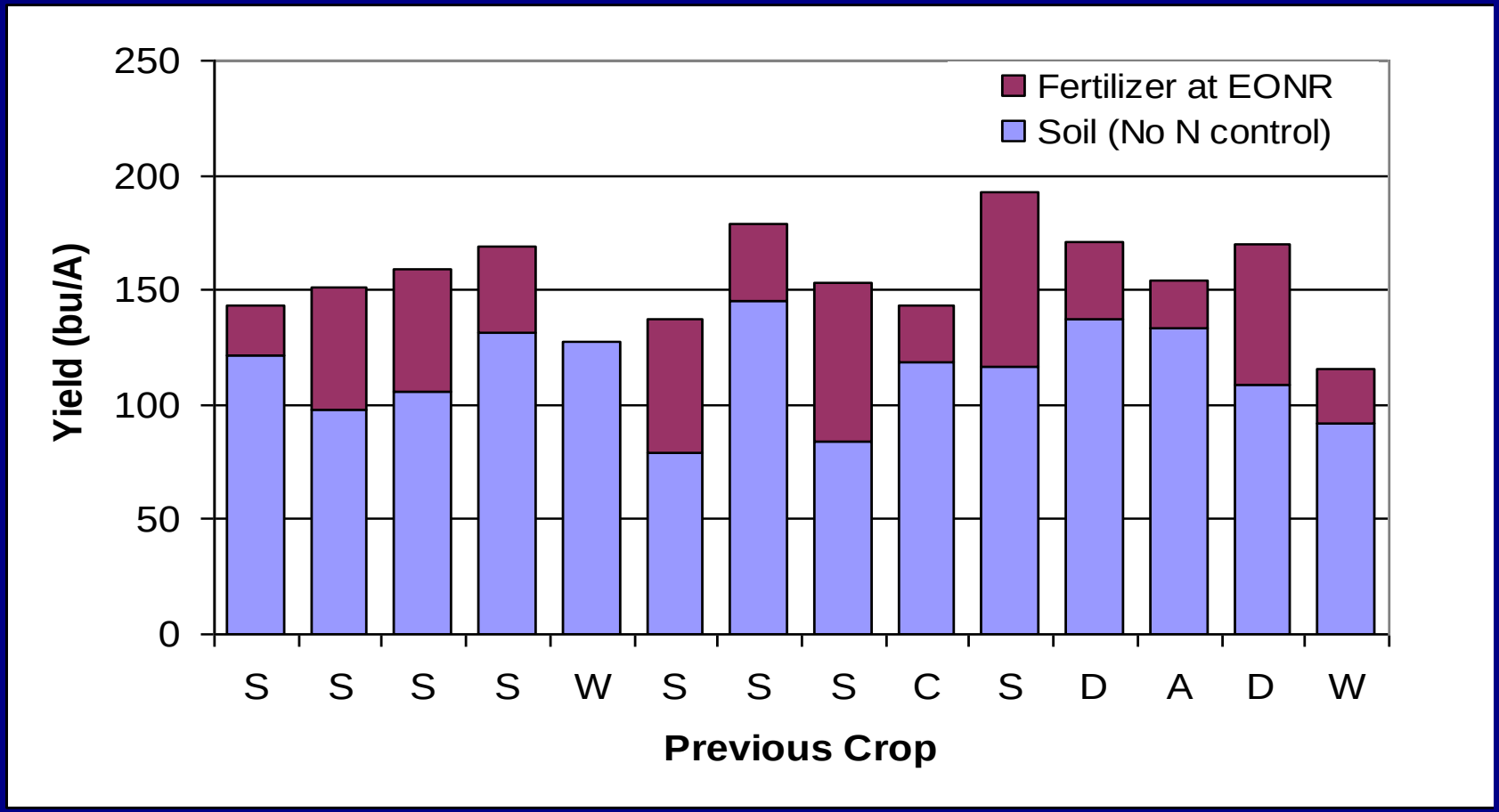
- Yield potential
  - Based on:
    - Drainage
    - Depth of root zone
    - Water holding capacity
    - Length of growing season
- Soil organic matter

How much N does soil supply?

Contribution of soil N and fertilizer N to yield in WI



Contribution of soil N and fertilizer N to yield in MI (2002-2003)

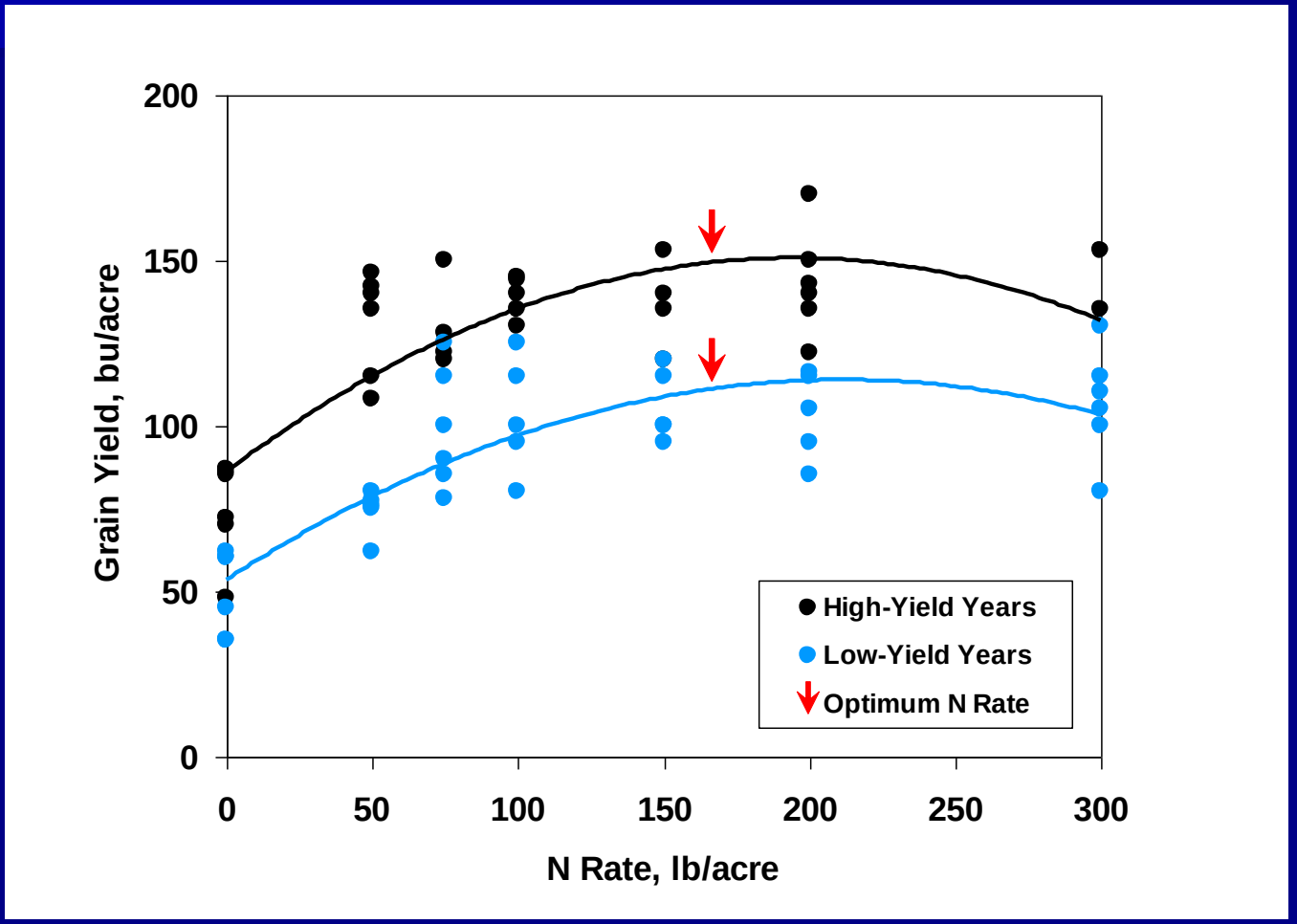


How much N does soil supply?

- A majority of N needed is supplied by the soil
  - WI: Soil N contributed 79% of total yield
    - 53 sites, 1991-2003, v. high/high YP sites
    - PC = corn and soybean
  - MI: Soil N contributed 74% of total yield
    - 14 sites, 2002-2003
    - PC = corn, wheat, soybean, dry bean, alfalfa
  - Varies with temperature and moisture
  - Acts as a buffer for climate variability

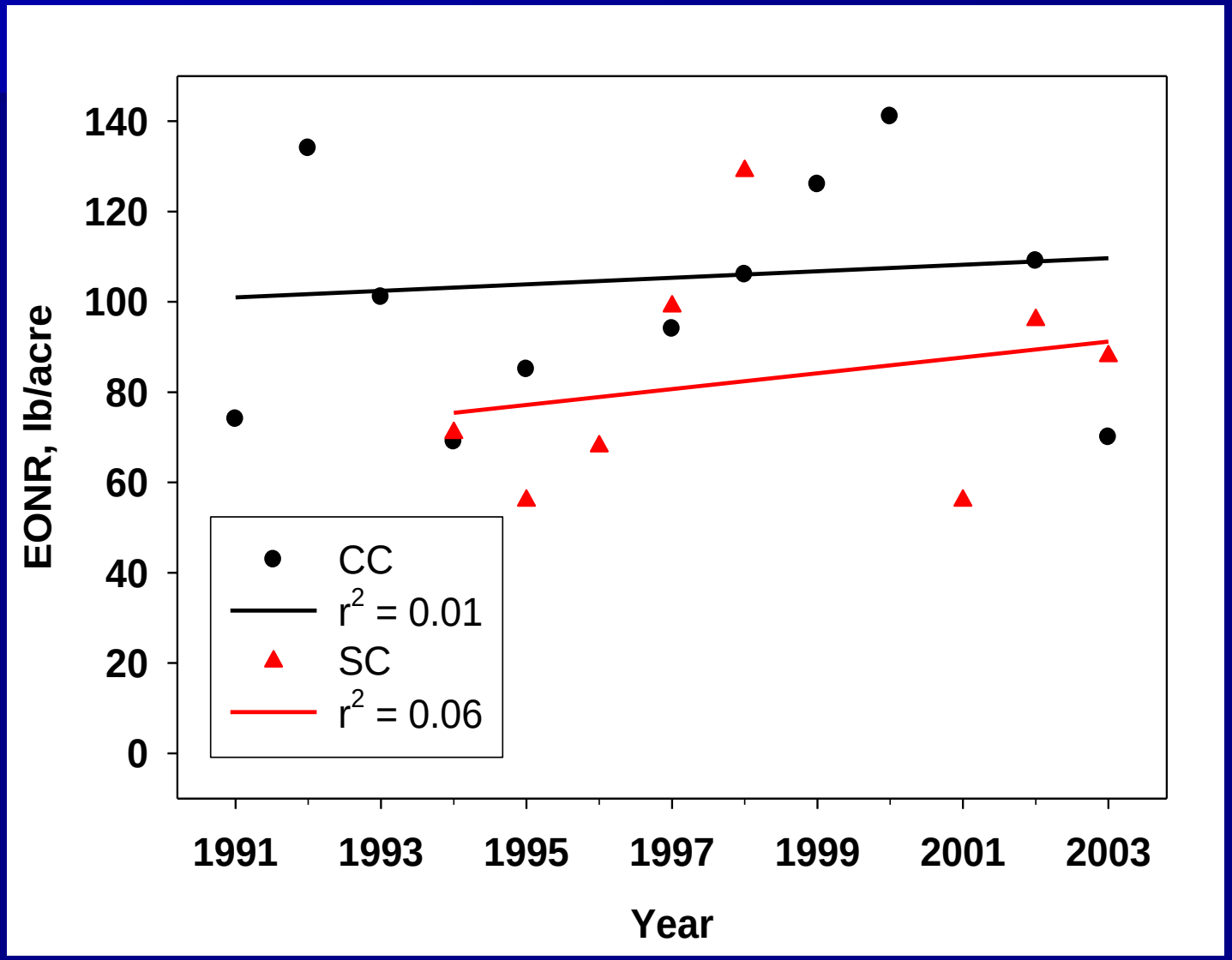
Stability of EONR over time

Optimum N rates for corn in high- & low-yielding years (1967-90), Lancaster, WI

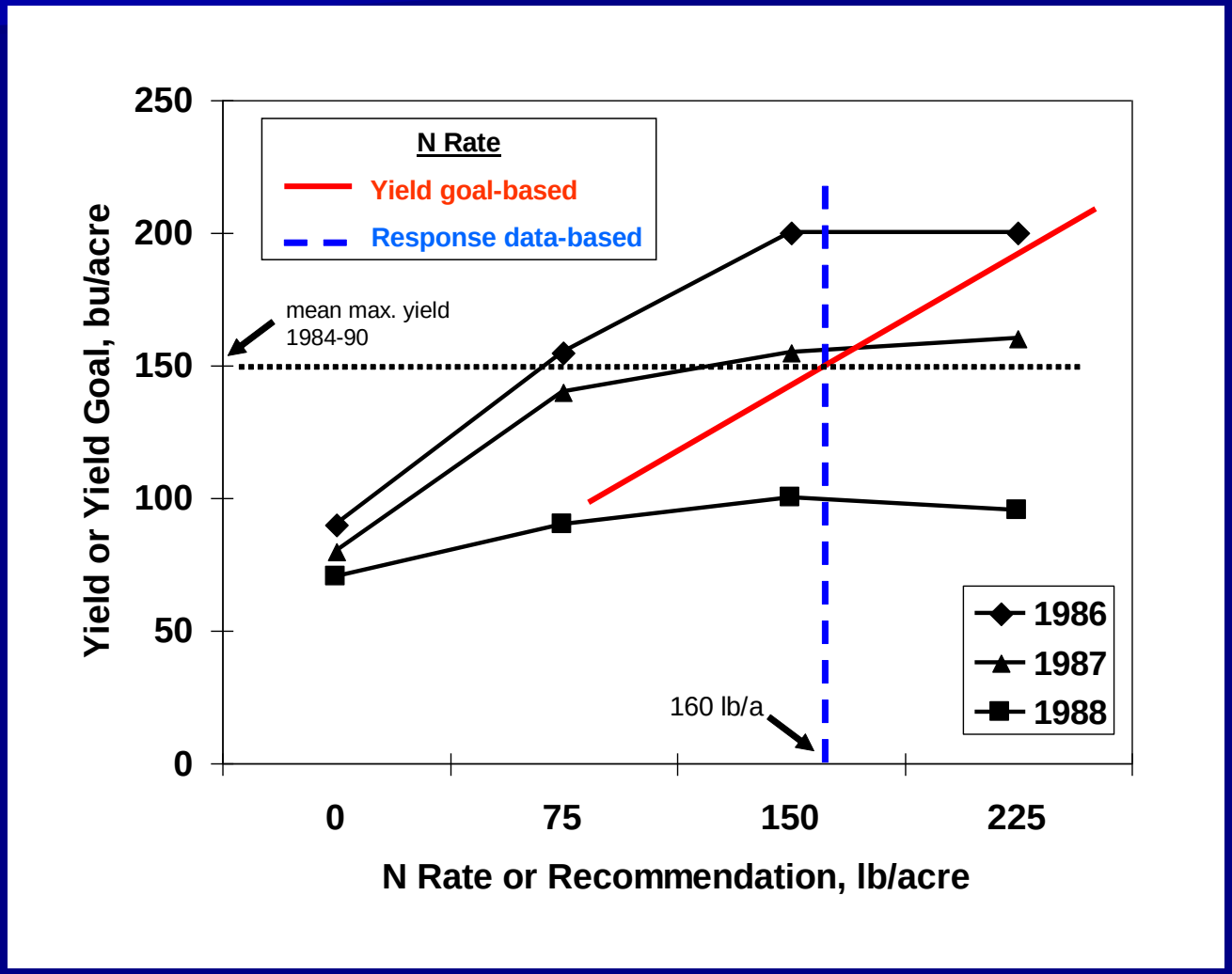


Economic optimum N rates calculated at corn:N price ratio of 13.3:1 (eg. $2.00:$0.15)

Annual average EONR for corn in WI



Comparison of corn yield response to N recommendations based on yield goal and soil-specific N response approaches, Arlington, WI



Profitability of Wisconsin's N recommendation system

Net economic return from fertilizer N for corn production on several WI soils

Soil	N rate	Yield increase from fertilizer N	Net economic return from fertilizer** Corn:N price ratios			
			8.33:1	10.0:1	13.3:1	16.7:1
	lb/acre	bu/acre	$/acre			
Plano	130	31.4	14.75	22.60	38.30	54.00
	160*	34.7	14.38	23.05	40.40	57.75
	190	36.5	12.13	21.25	39.50	57.75
Withee	90	24.3	11.88	17.95	30.10	42.25
	120*	27.5	11.38	18.25	32.00	45.75
	150	28.2	7.75	14.80	28.90	43.00
Meridian	90	21.7	8.63	14.05	24.90	35.75
	120*	25.2	8.50	14.80	27.40	40.00
	150	26.7	5.88	12.55	25.90	39.25
Plainfield	170	101.8	96.75	122.20	173.10	224.00
	200*	106.9	98.63	125.35	178.80	232.25
	230	108.1	95.63	122.65	176.70	230.75

* Recommended N rate prior to taking legume/manure N credits

** Value of yield increase due to N – cost of N – cost of application ($5/acre). All calculations were based on $0.15/lb N and $1.25, $1.50, $2.00, and $2.50 per bushel corn for 8.33:1, 10:1, 13.3:1, and 16.7:1 ratios, respectively.

Conclusions

- There is no relationship between yield goal and optimum N rate
  - Even in states that use yield goal to make N recommendations
  - Yield goal based recommendations do not follow curves of corn yield response to N
    - Results in over or under application of N at high and low yield goals, respectively
- Wisconsin's current method of N recommendations allows for profitability as well as environmental protection

So what's next?

- Regional N rate recommendations
- Discussions between WI, MN, IA, IL, IN, OH, MI
  - Pooling data sets to evaluate yield response over range of soils and climates
  - May evaluate probability of N sufficiency for given N rates
    - Producers could determine the level of risk with which they are comfortable and economic outlook