

THE “FLAT OBJECTIVE” PROBLEM IN CROP PRODUCTION: IMPLICATIONS FOR NITROGEN MANAGEMENT

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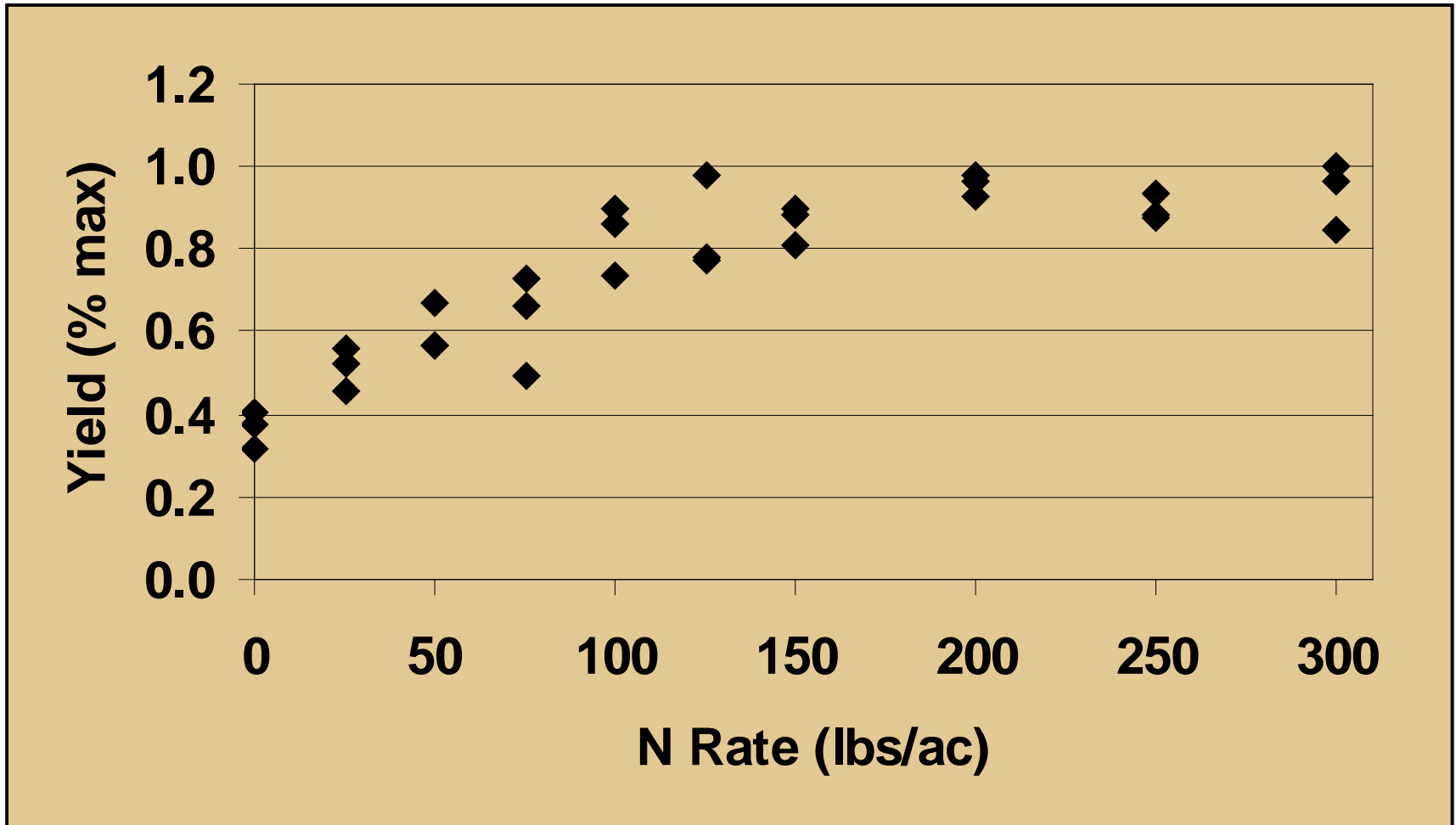
My Main Point

- Stylized facts
 1. Crop yield is non-responsive to the level of some inputs when they are at or near optimal levels
 2. Under use of these inputs is often obvious, but over use is invisible
 3. Crop yields vary substantially, even at optimal input levels, so it is difficult to determine why yields are high or low
- Implications
 - Farmers “instinctually” use higher input levels than mean yield models predict as optimal

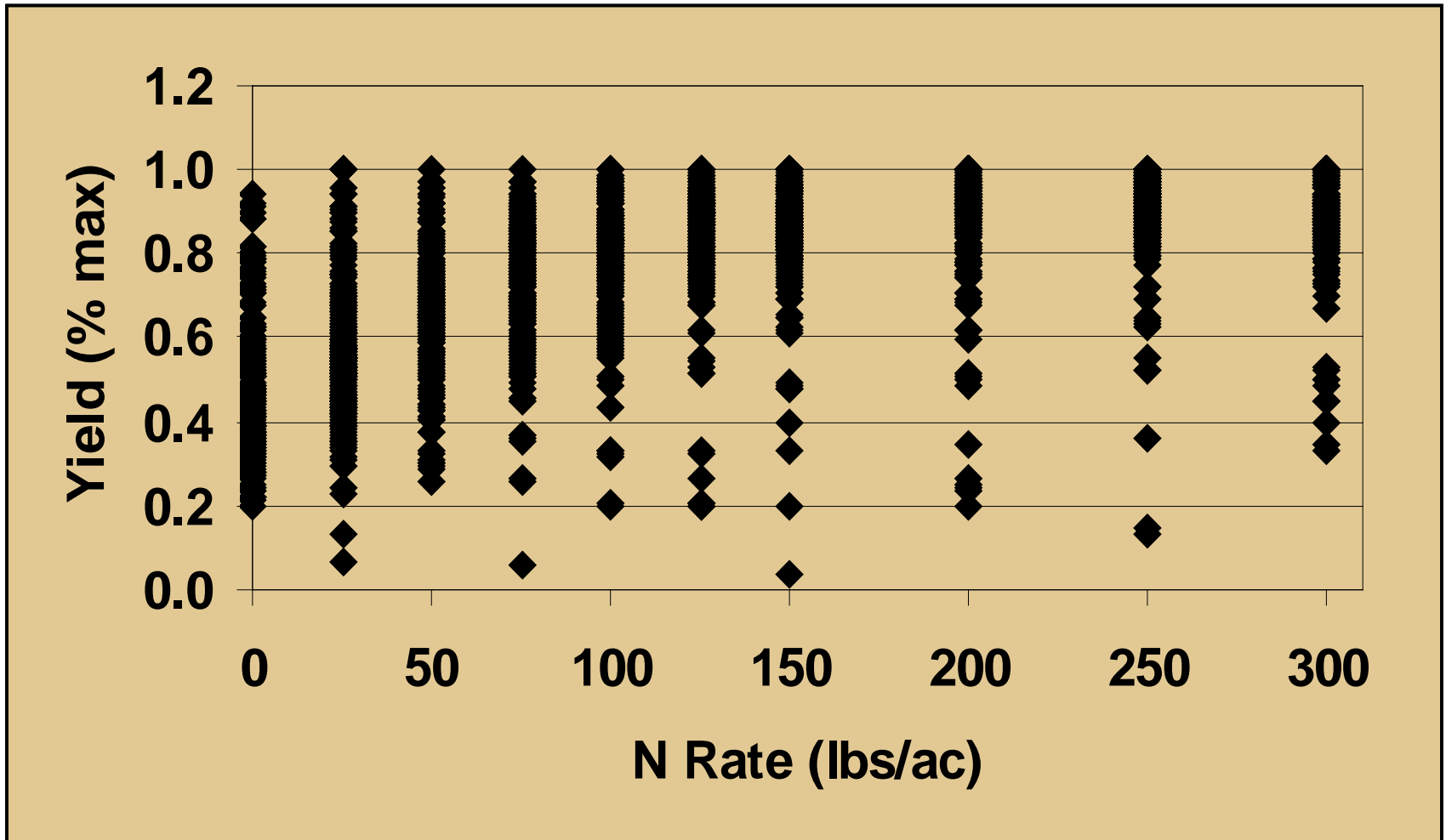
Mitchell (2004)

- Assembled data from experiments examining corn response to nitrogen
- Most from late 1980's and early 1990's
- Seven states (IA, IL, IN, MN, NE, PN, WI)
- Almost 6,000 individual observations
- Analyze to see if could statistically observe effect of nitrogen on yield when at high/near optimal nitrogen rates

One Site-Year from Iowa

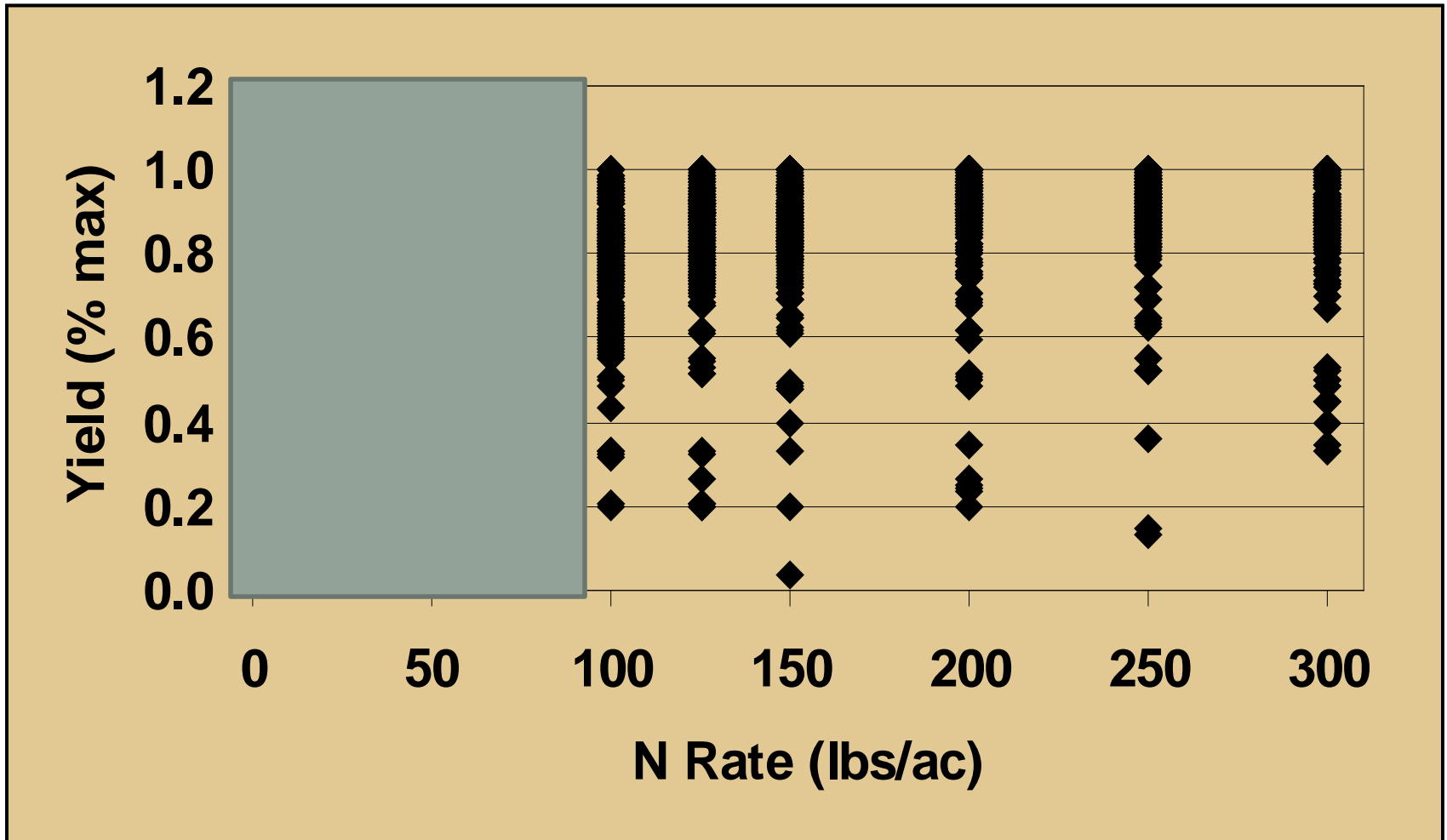


All Site Years from Iowa



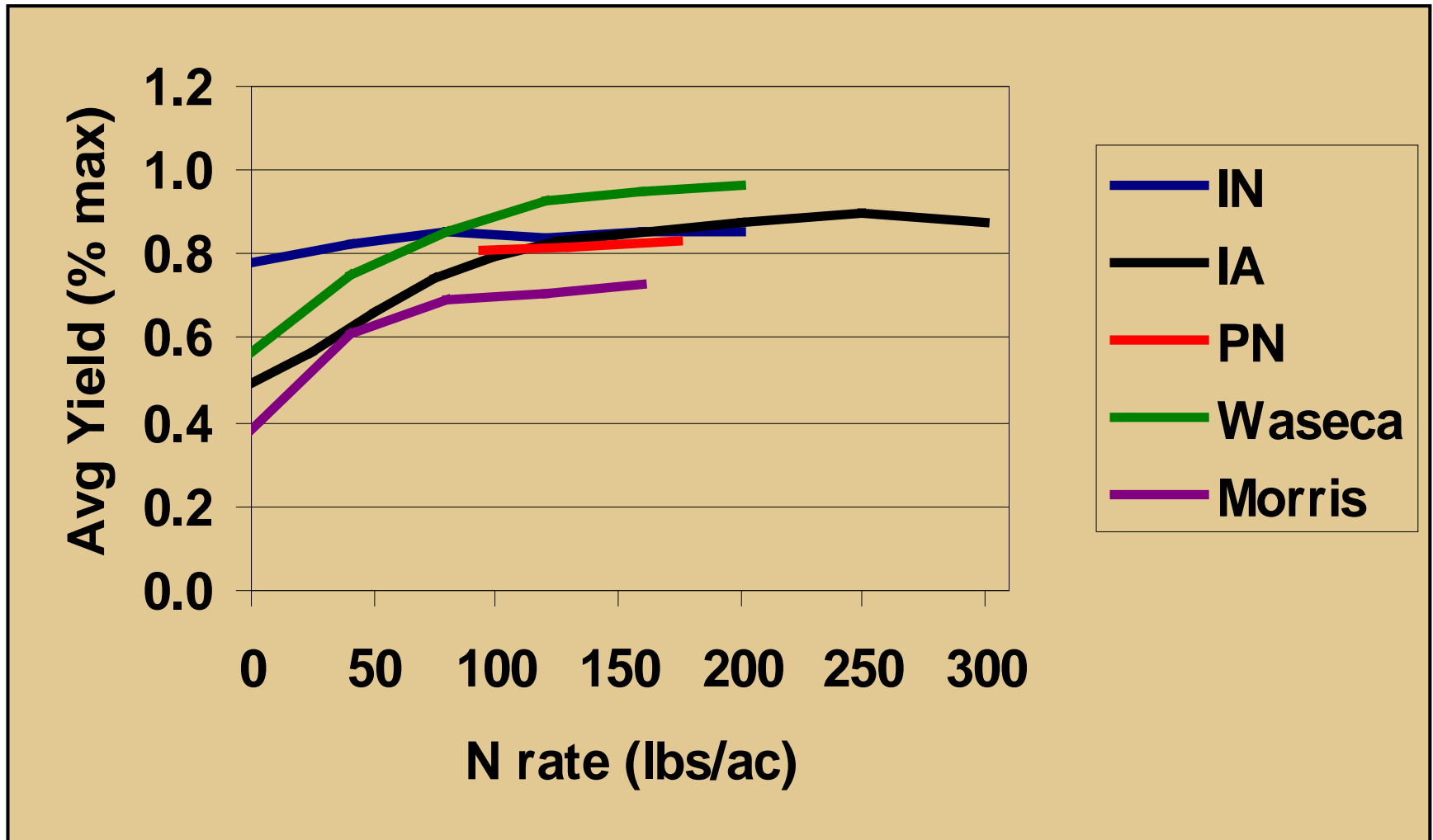
2,200 observations

All Site Years from Iowa

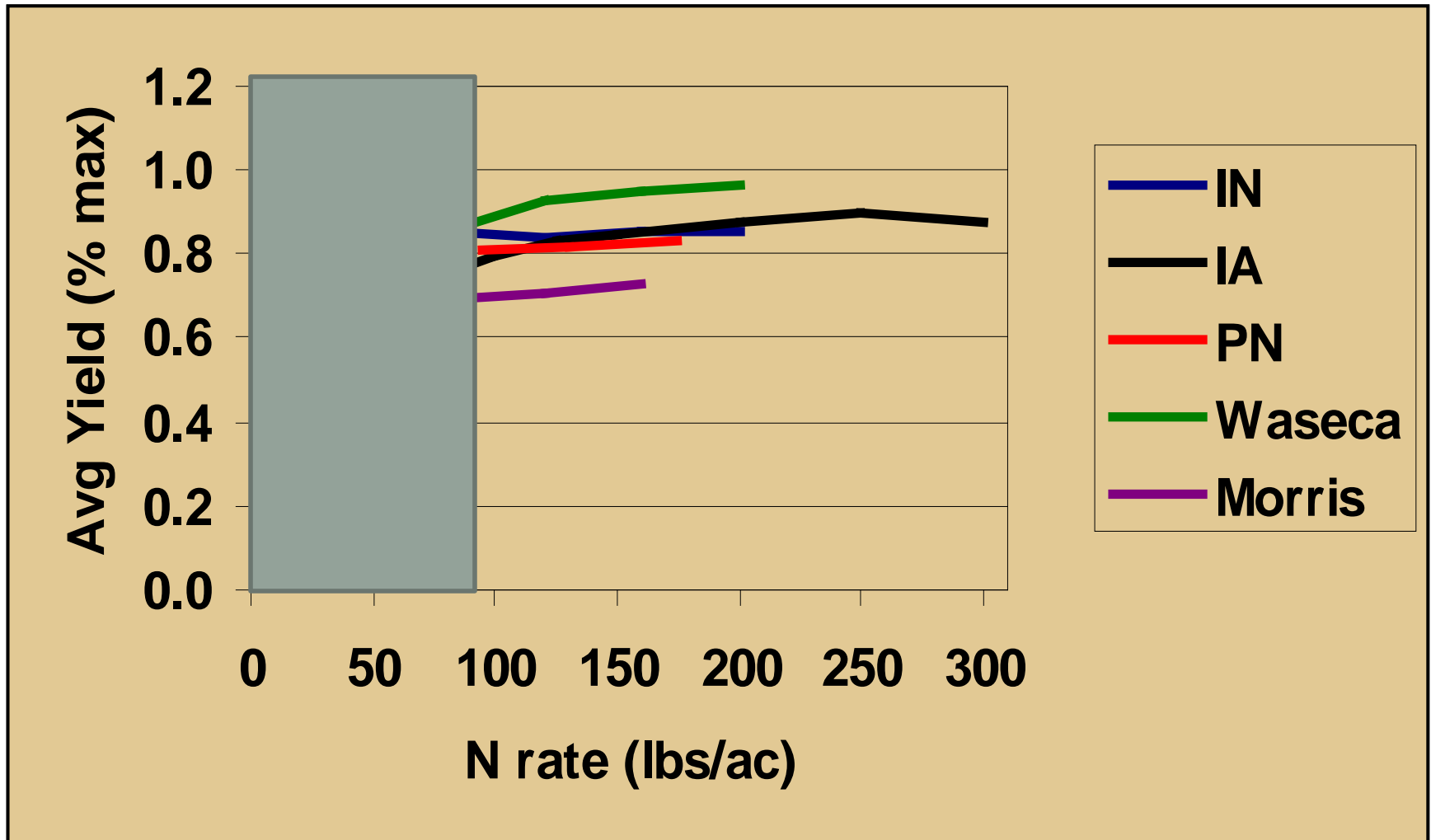


2,200 observations

Average Yield by N Rate



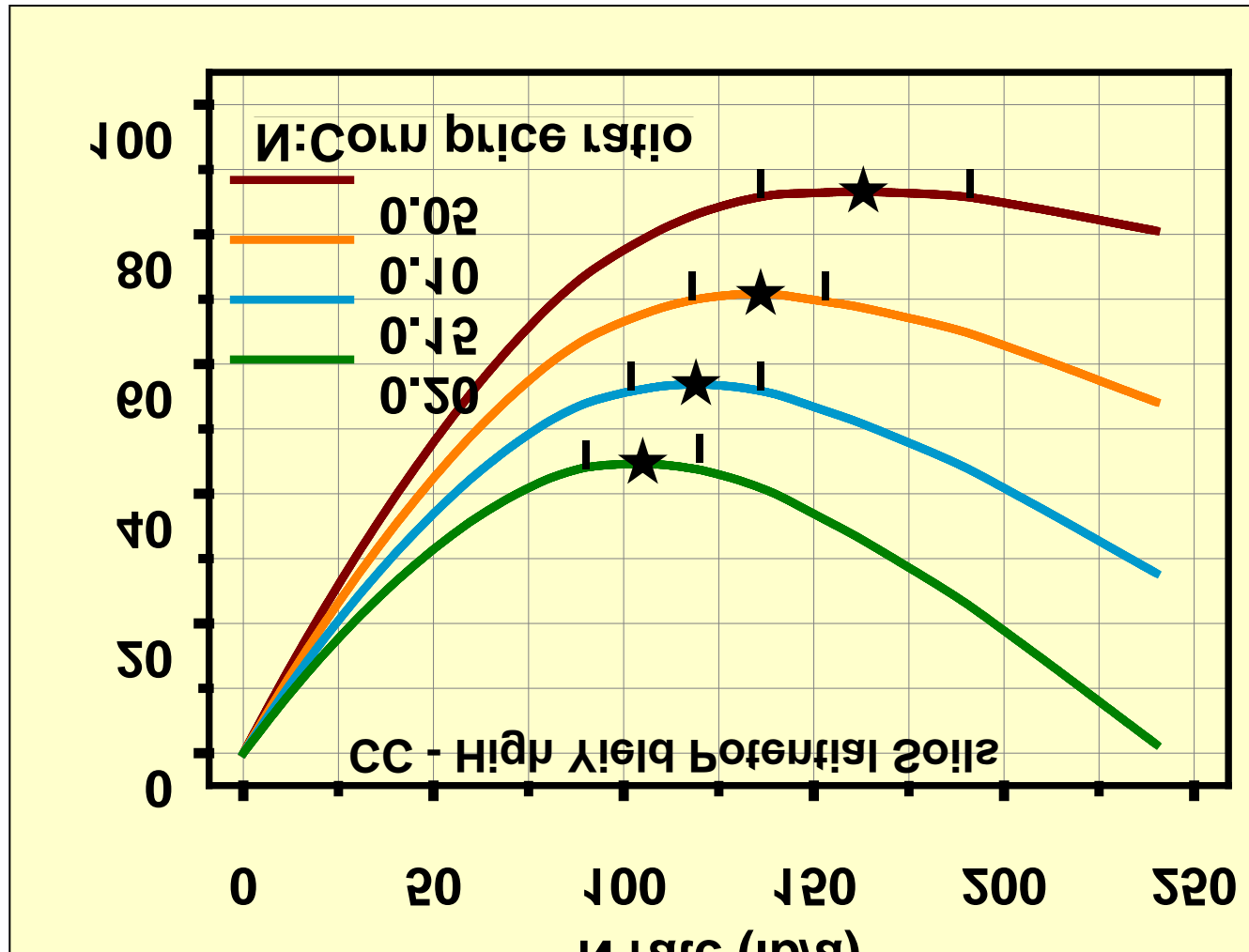
Average Yield by N Rate



Main Point

- Once N rates get above 85-100 lbs/ac, expected (average) corn yield very flat, but lots of variability around this average
- Makes identifying yield effects of nitrogen on corn statistically difficult/impossible
 - **Found no statistical difference in the N data I had**
- Change in yield with changing N rate hard to see with all the noise from other factors

Current WI Recommendations



Source: C. Laboski, UW Soil Science

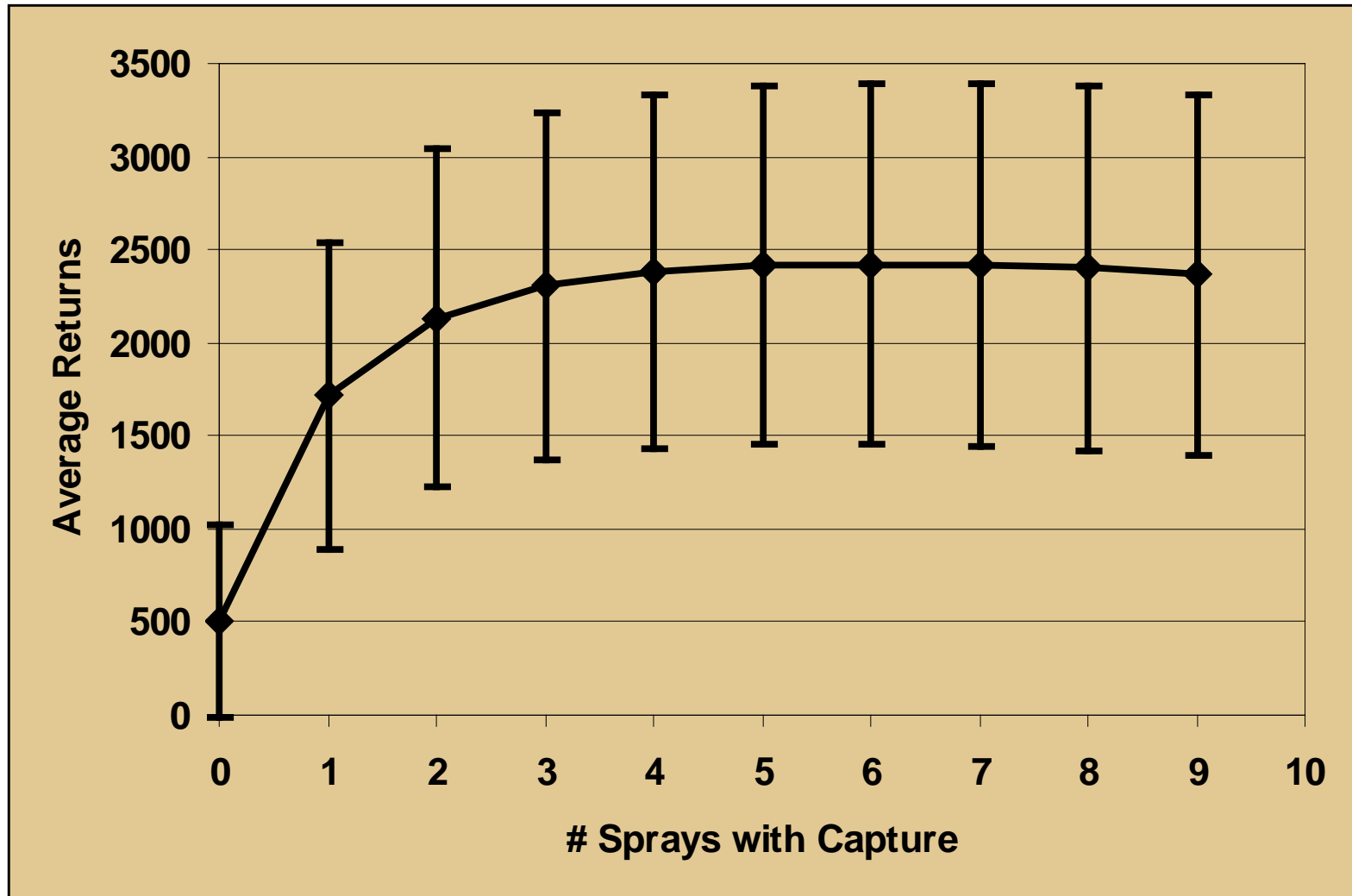
SOIL AND PREVIOUS CROP	———— N:Corn Price Ratio (\$/lb N:\$/bu) ————			
	0.05	0.10	0.15	0.20
	————— lb N/a (Total to Apply) —————			
HIGH/ V.HIGH YIELD POTENTIAL SOILS				
Corn, Forage legumes, Vegetable legumes, green manures	165 (135-190)	135 (120-155)	120 (100-135)	105 (90-120)
Soybean, Small grains	140 (110-160)	115 (100-130)	100 (85-115)	90 (70-100)
MEDIUM/LOW YIELD POTENTIAL SOILS				
Corn, Forage legumes, Vegetable legumes, green manures	110 (90-135)	100 (80-110)	85 (70-100)	75 (60-90)
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	110 (90-135)	100 (80-110)	85 (70-100)	75 (60-90)

Source: C. Laboski, UW Soil Science

What about other inputs?

- Economic analysis of fresh market sweet corn and the value of insecticide sprays for controlling European corn borer (ECB)
- Monte Carlo simulation model based on spray efficacy data (Mitchell et al. 2005)

Effect of Capture (bifenthrin) on Fresh Market Sweet Corn (mean with 95% error bars)



Implications of Flat Objective Function Combined with Noise in Ag Systems

- **Under use of inputs is often obvious**
 - See yellow crop, weeds, insects, blight, ...
- With a “flat objective function”
Over use of inputs often an invisible cost
- With all the “variability” in crop production,
How do you know if you put on too much
Fertilizer? Fungicide? Insecticide?
- Call this the “Flat Objective Problem”

So What Should We Do?

- Programs have not really changed in 80 years: public subsidization to encourage farmers to adopt practices correlated with generating positive public goods
 - Benefits of such approaches have saturated
- Create tools and institutions to help farmers “rationalize” their decisions, make them less “instinctual” choices
- Move away from models of the rational individualized farmers, put them into their social context
- Social networks, peer pressure, local knowledge
- Goal-appropriate and scale-appropriate research: cost effective monitoring to document changes, demonstration
- Incentivize them to improve their environment in ways they want to, for themselves, not for the “public”

Time for New and Creative Alternatives

- Watershed Teams or Cooperatives
- Conservation Tillage Clubs
- Management Intensive Grazing Pasture Walks
- Farmer-Led Sustainability Programs