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

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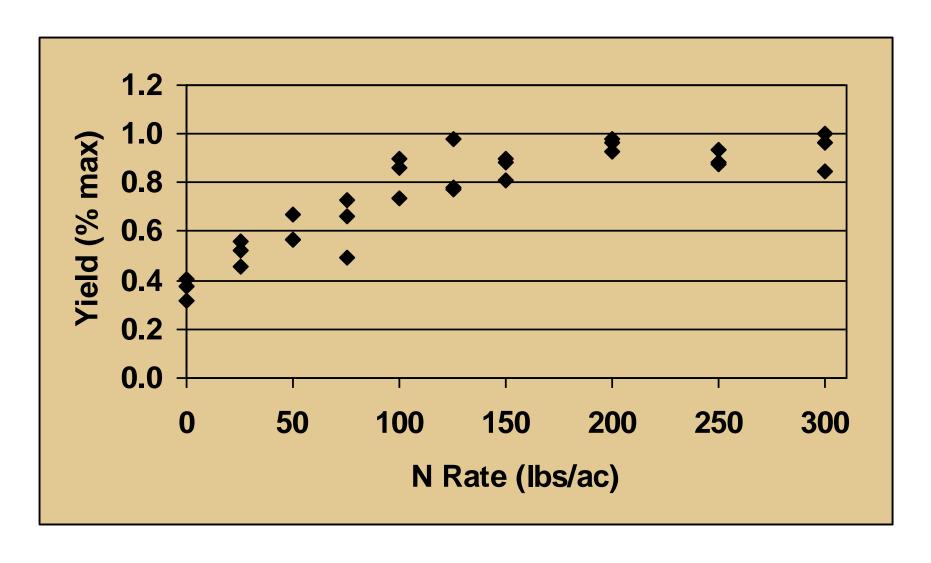
My Main Point

- Stylized facts
- 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
- 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

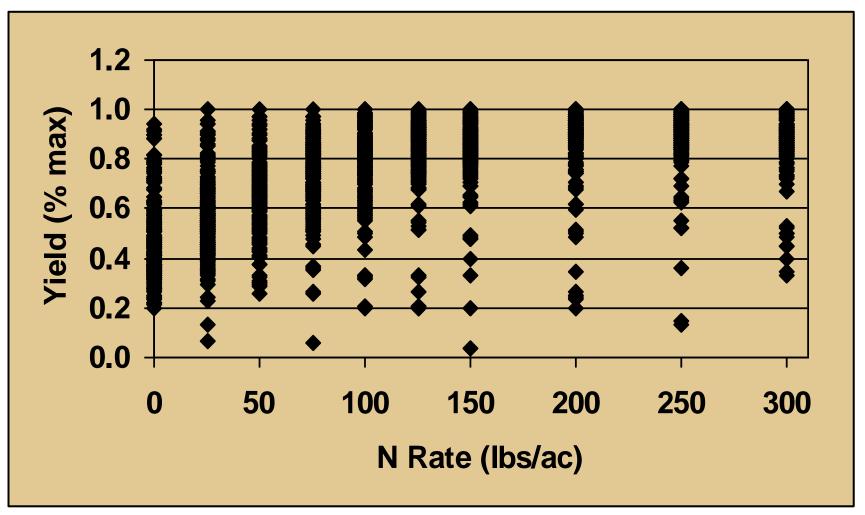
Mitchell (2004)

- 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

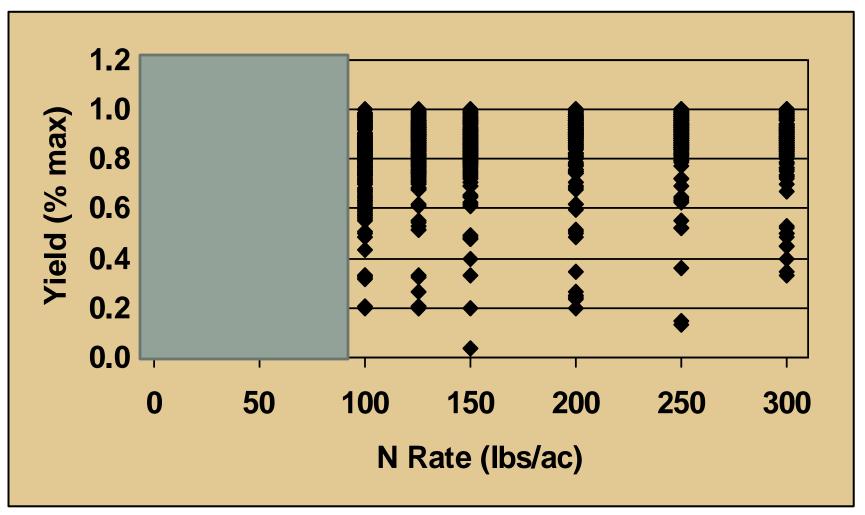


All Site Years from Iowa



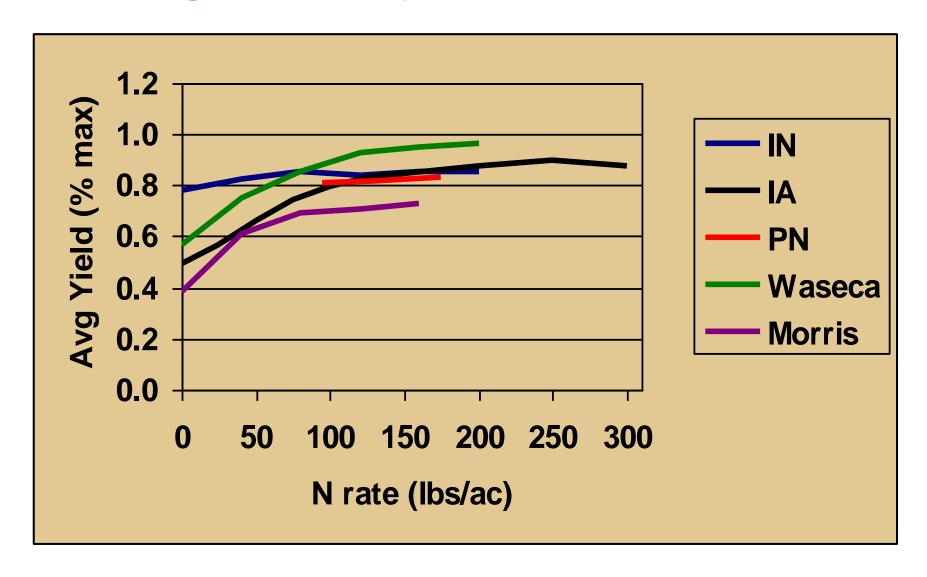
2,200 observations

All Site Years from Iowa

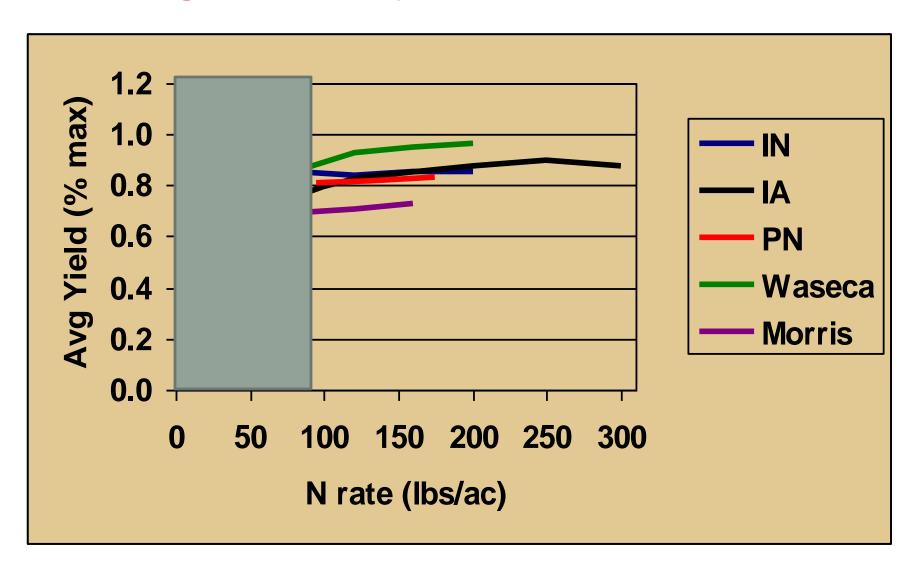


2,200 observations

Average Yield by N Rate



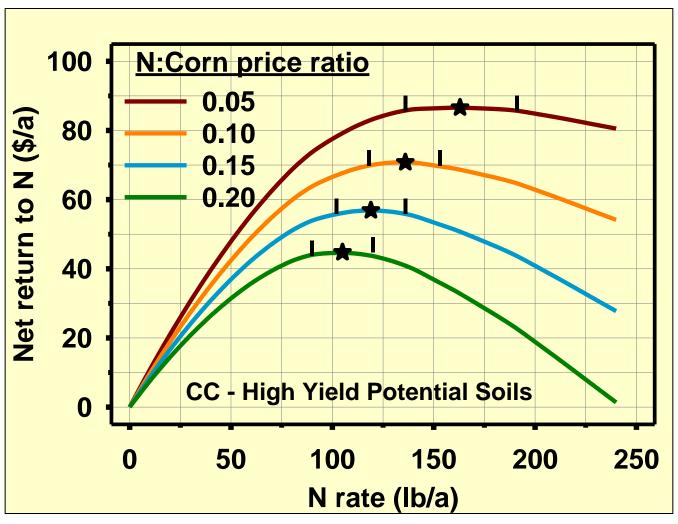
Average Yield by N Rate



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 my data
- 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

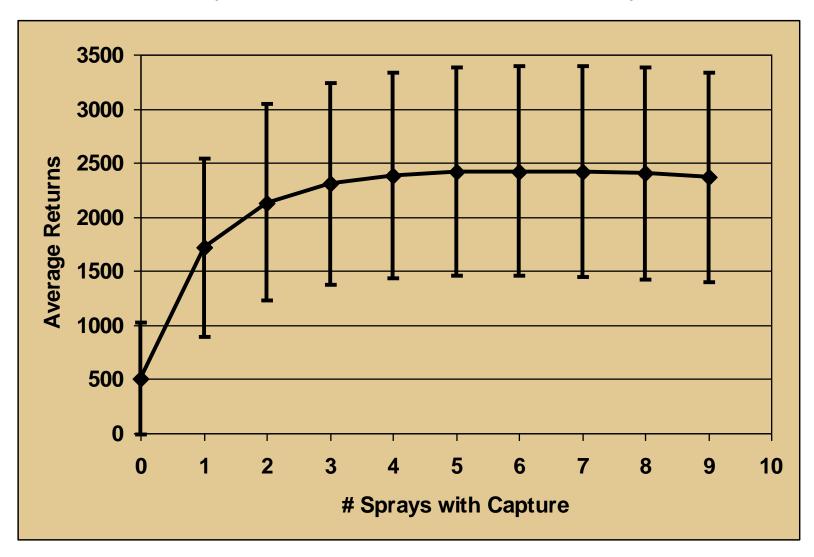
	N:Corn Price Ratio (\$/lb N:\$/bu)			
SOIL AND PREVIOUS CROP	0.05	0.10	0.15	0.20
	———— Ib N/a (Total to Apply) ———			
HIGH/ V.HIGH YIELD POTENTIAL SOILS				
Corn, Forage legumes, Vegetable legumes, green manures	165 (135-190)	135 (120-155)	120 (100-135)	105 (90-120)
Soybean, Small grains	140 (110-160)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

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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