How Do We Continue to Grow Quality Potatoes With Skyrocketing Input Costs?

UW Extension & WPVGA Grower Conference

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The Issue

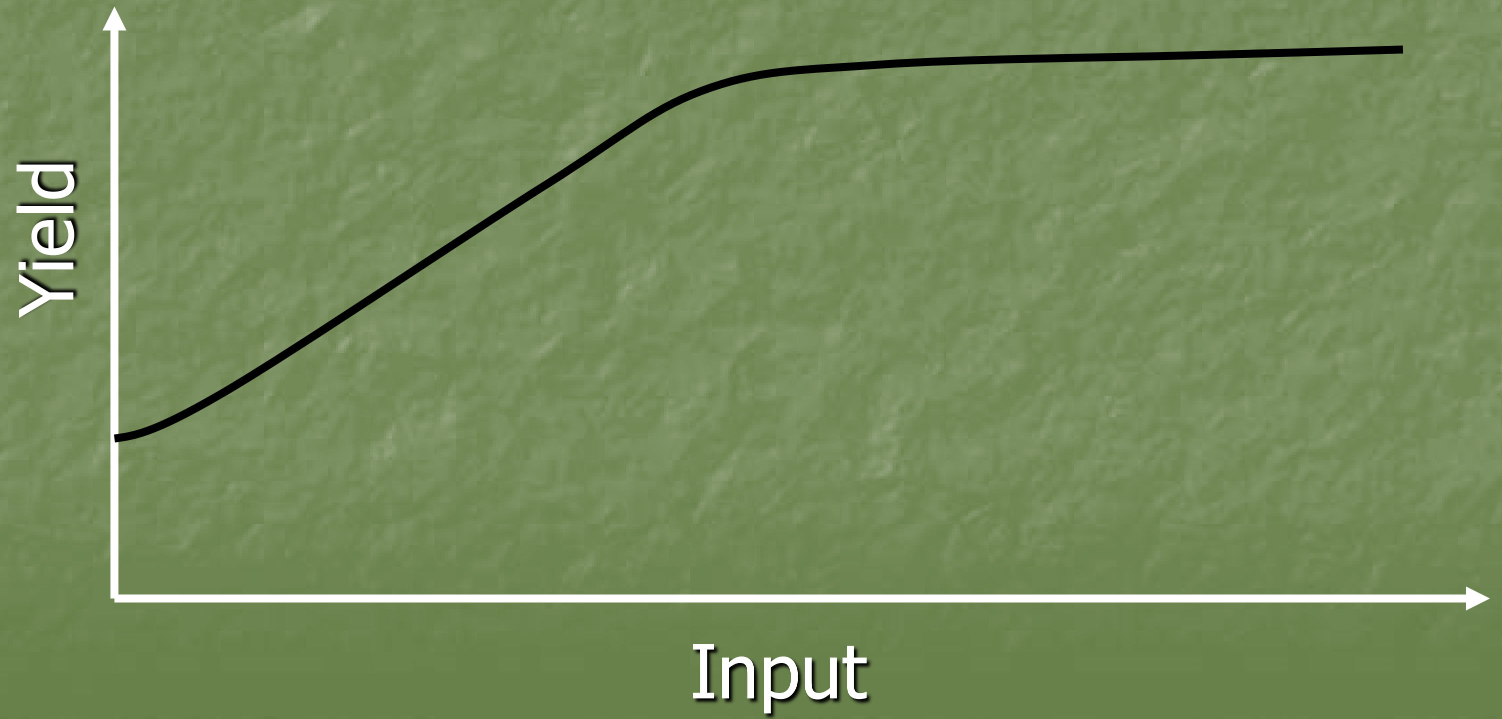
- For a variety of reasons, many input costs have increased dramatically in recent years, and potato prices haven’t fully compensated
  - Nutrients, pesticides, transportation, labor, etc.
- How can we remain profitable?
- One simple answer:
  - Use less inputs without reducing output
  - In other words: Be more efficient—How?

Overview of Talk

- Present the “Flat Objective Problem”
  - What is it? (Give Examples)
  - What does it mean? (Discuss Implications)
- Lessons from “Technical Efficiency”
  - Describe economic efficiency analyses of potato and crop farmers
  - What kinds of farmers are more efficient?
  - What practices do more efficient farmers use?

Flat Objective Problem

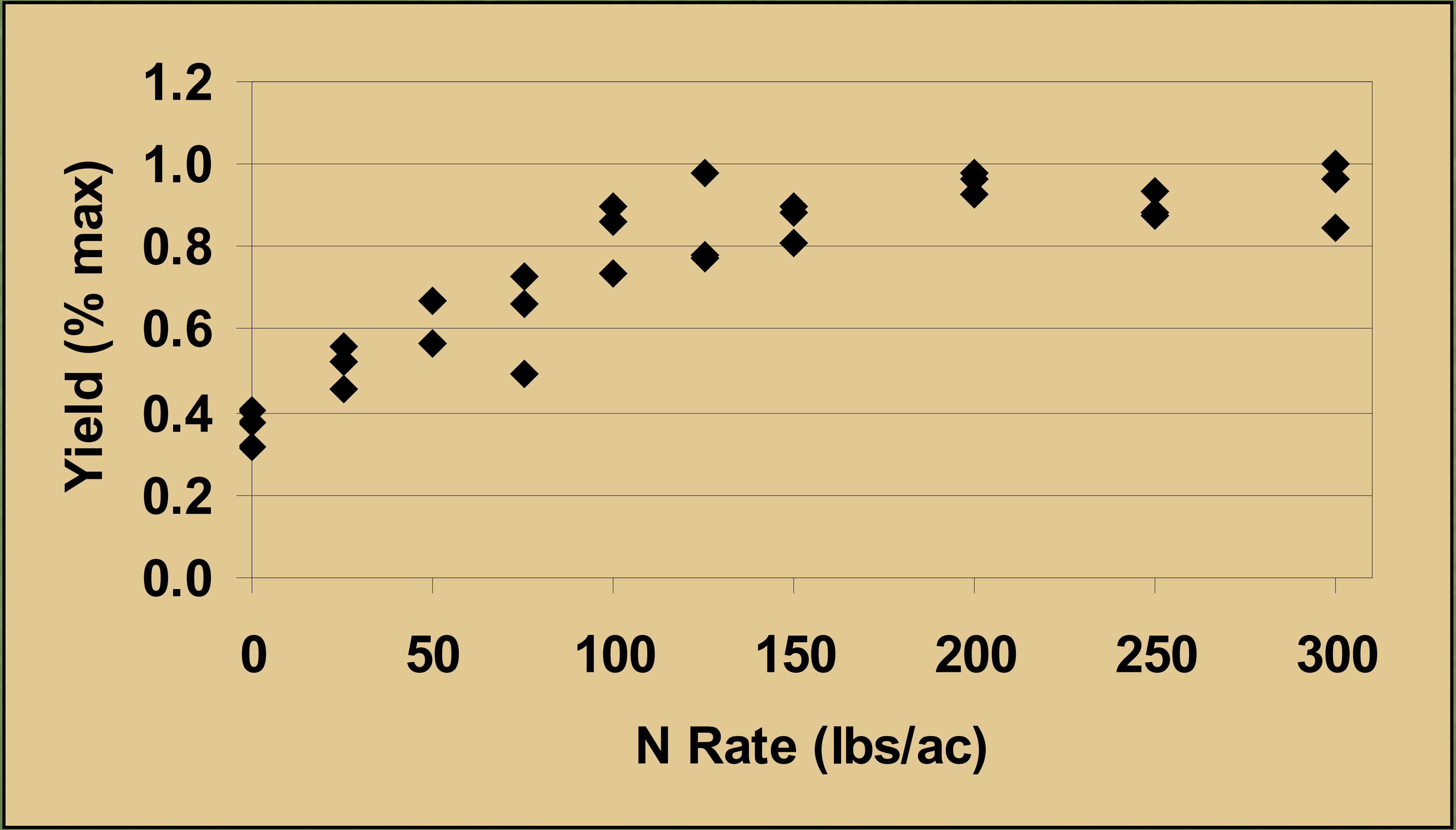
- For many crop production processes, yield becomes relatively unresponsive to inputs when they are used at near optimal levels



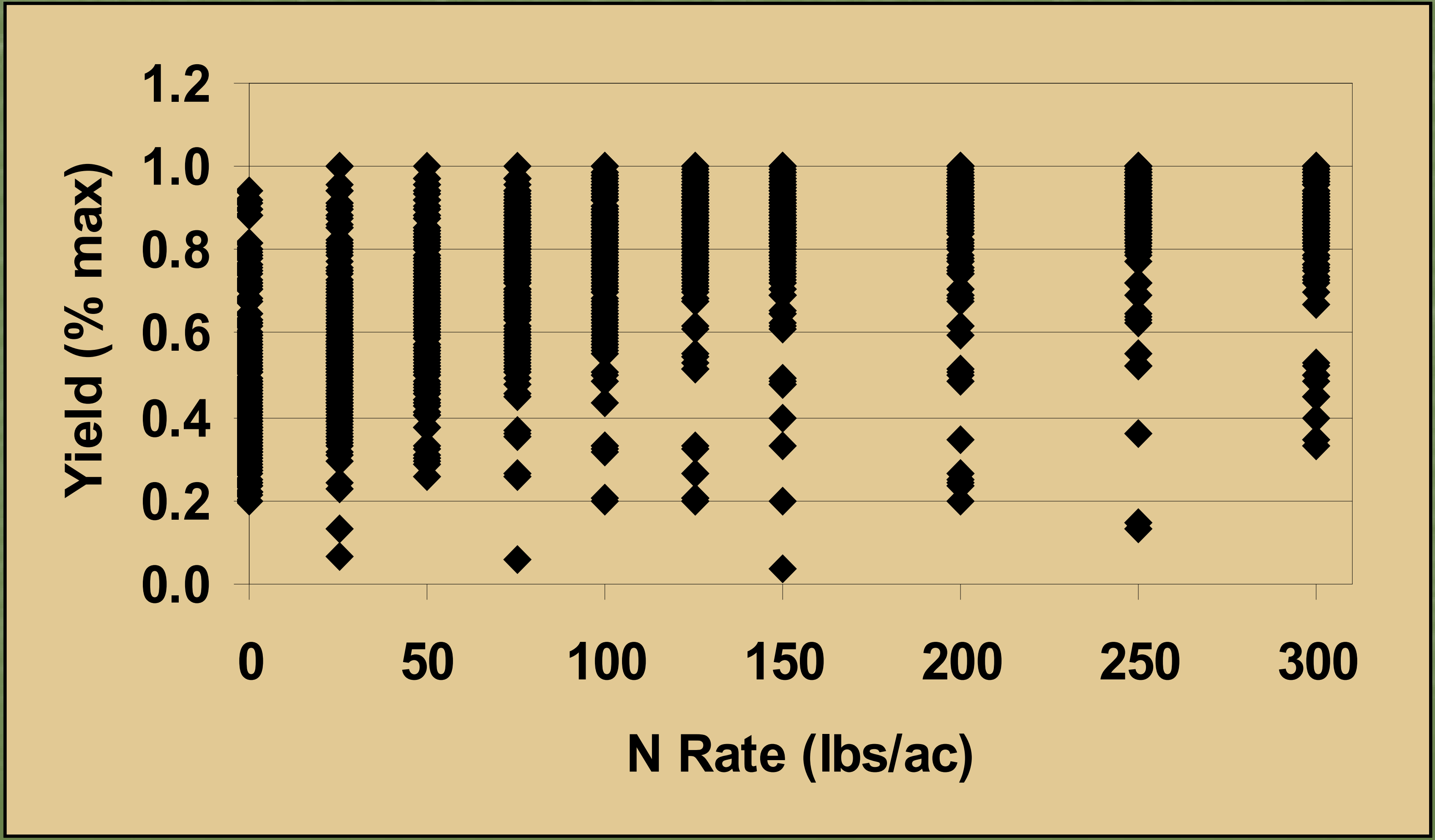
Mitchell (2004)

- 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
- Analysis to see if could statistically observe effect of nitrogen on yield when at high/near optimal nitrogen rates

One Site-Year from Iowa

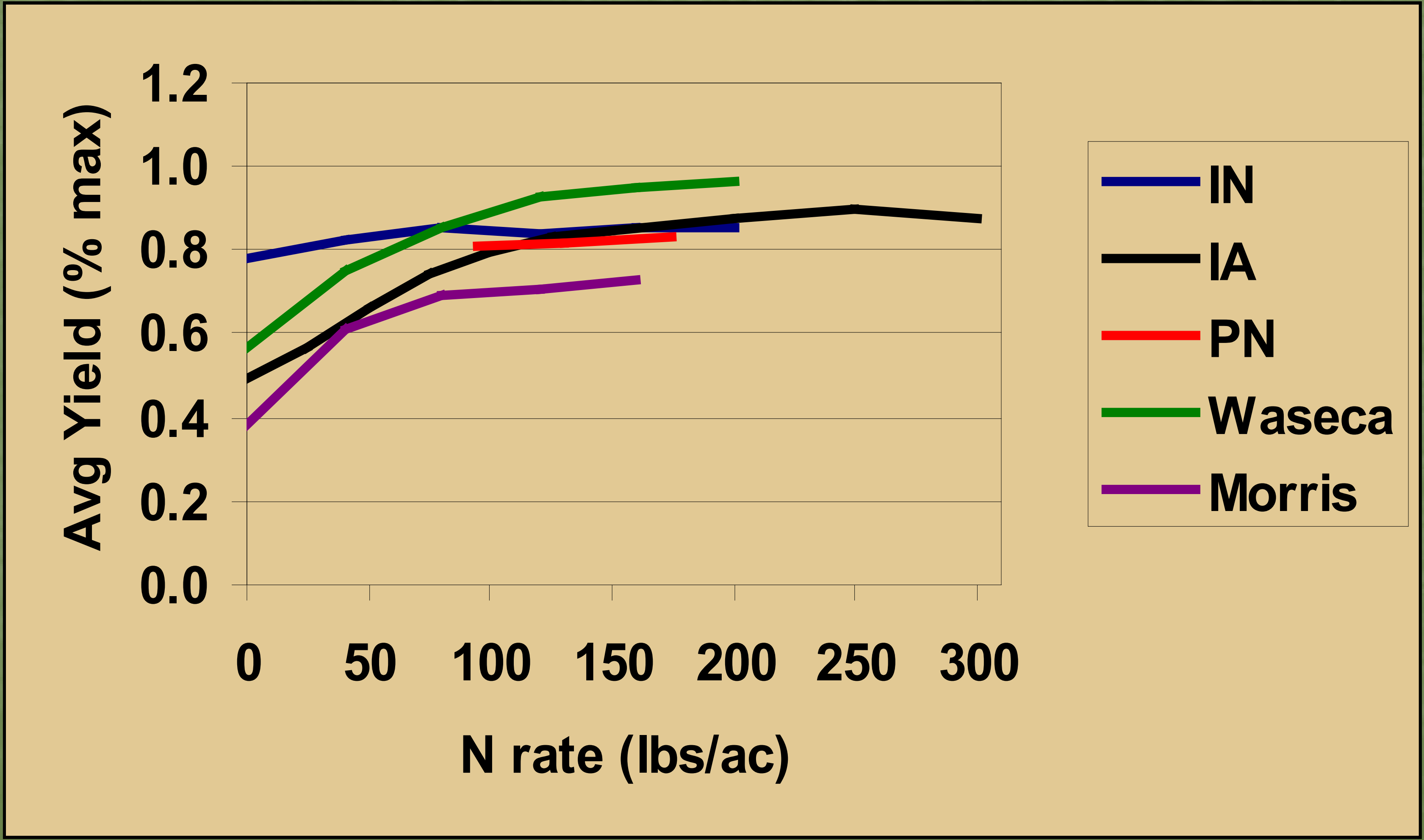


All Site Years from Iowa



2,200 observations

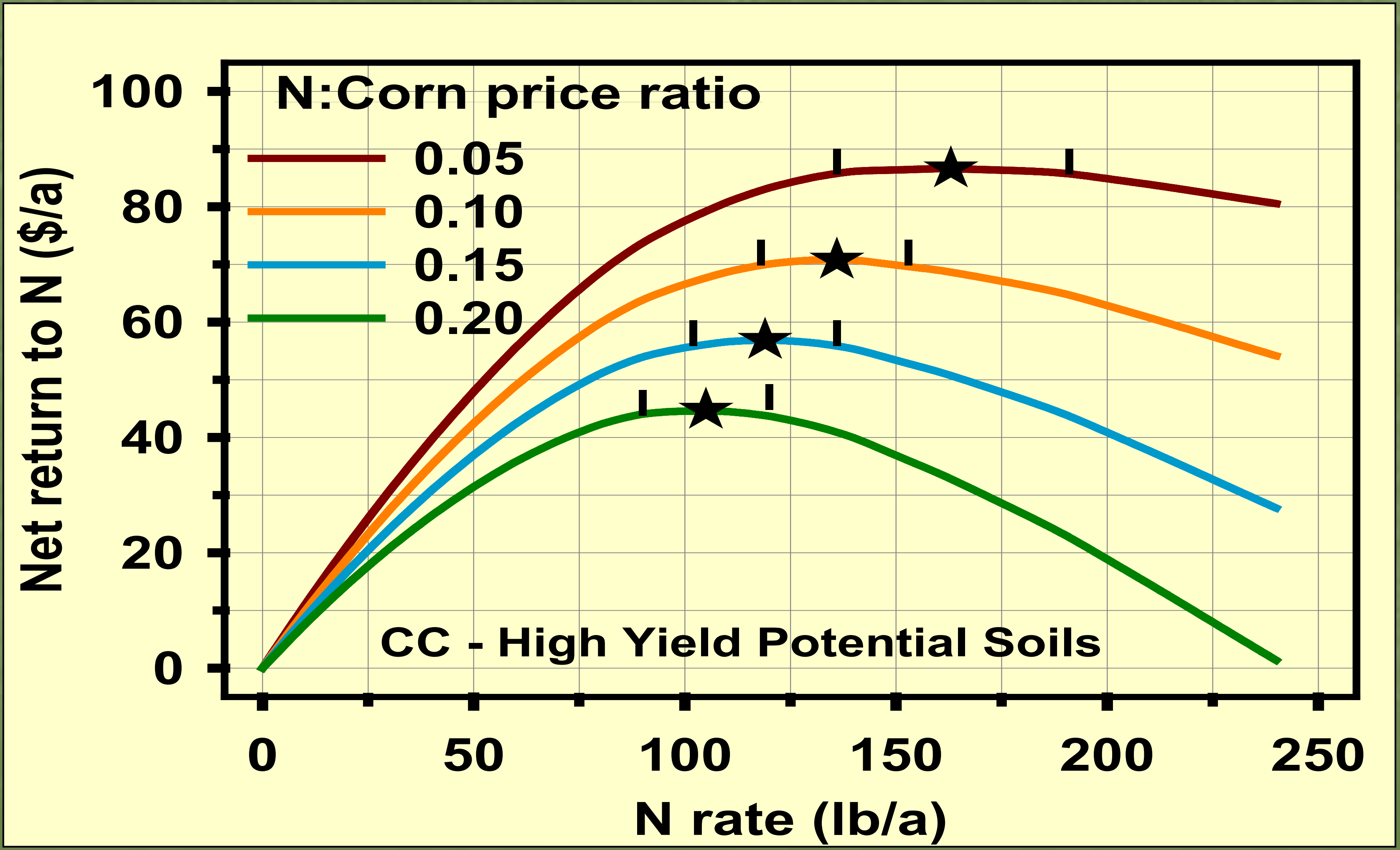
Average Yield by N Rate



Main Point

- Once N rates get above 85-100 lbs/ac, expected (average) corn yield very flat
- Lots of variability around this average
- Makes identifying yield effects of nitrogen on corn statistically difficult/impossible
- Cannot statistically differentiate between flat function (von Liebig's Law of the Minimum) and several gently sloping functions (hyperbolic, exponential, etc.)

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

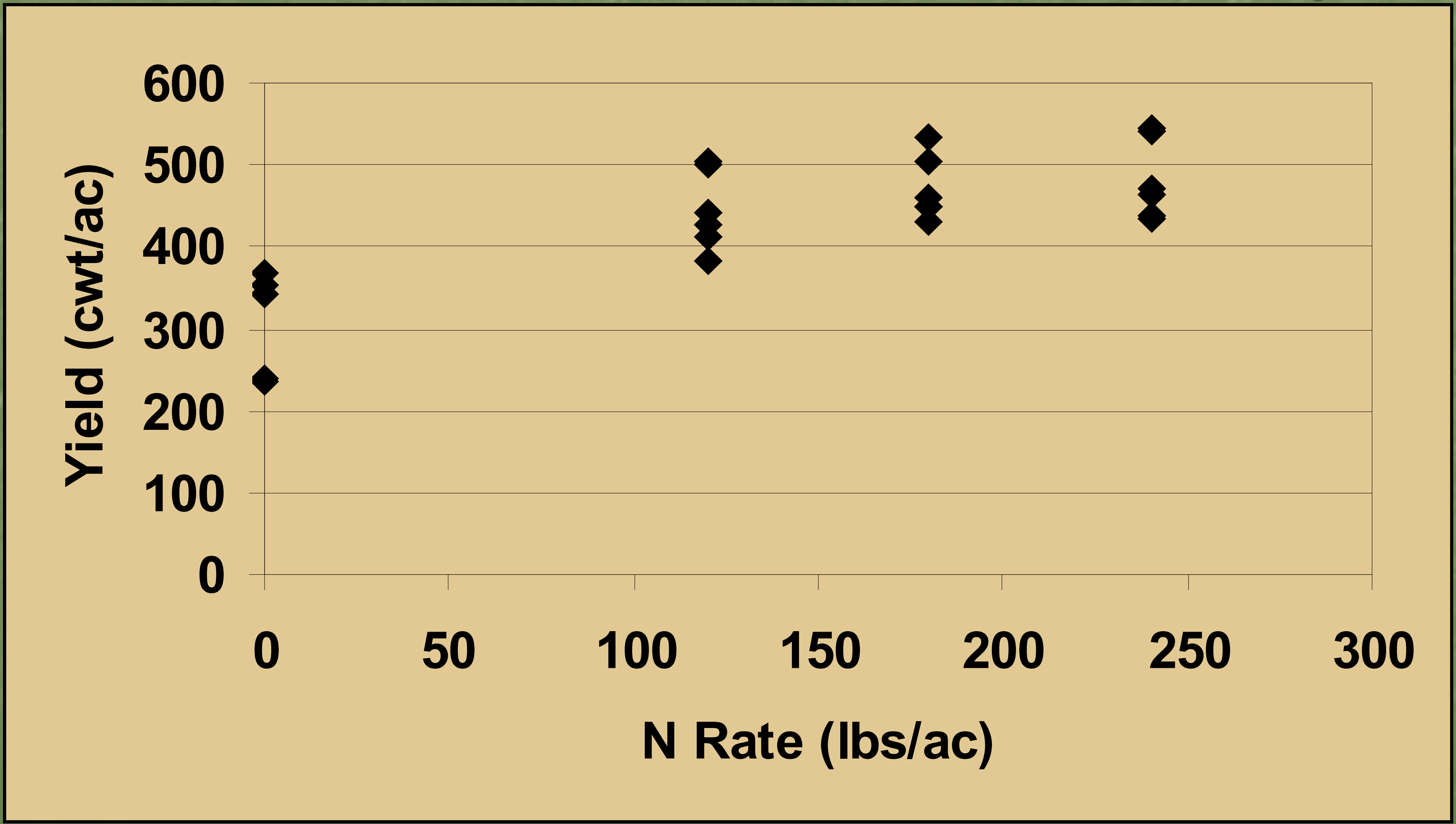
Main Point

- WI nitrogen recommendations for corn give the range of N application rates that are within $1/ac of the maximum return
- Notice how wide the range of N rates is
- Over the range of application rates the recommendations give, expected net returns vary less than $1/ac
- **Expected (average) net returns from applying nitrogen to corn are very flat**

What about Potatoes?

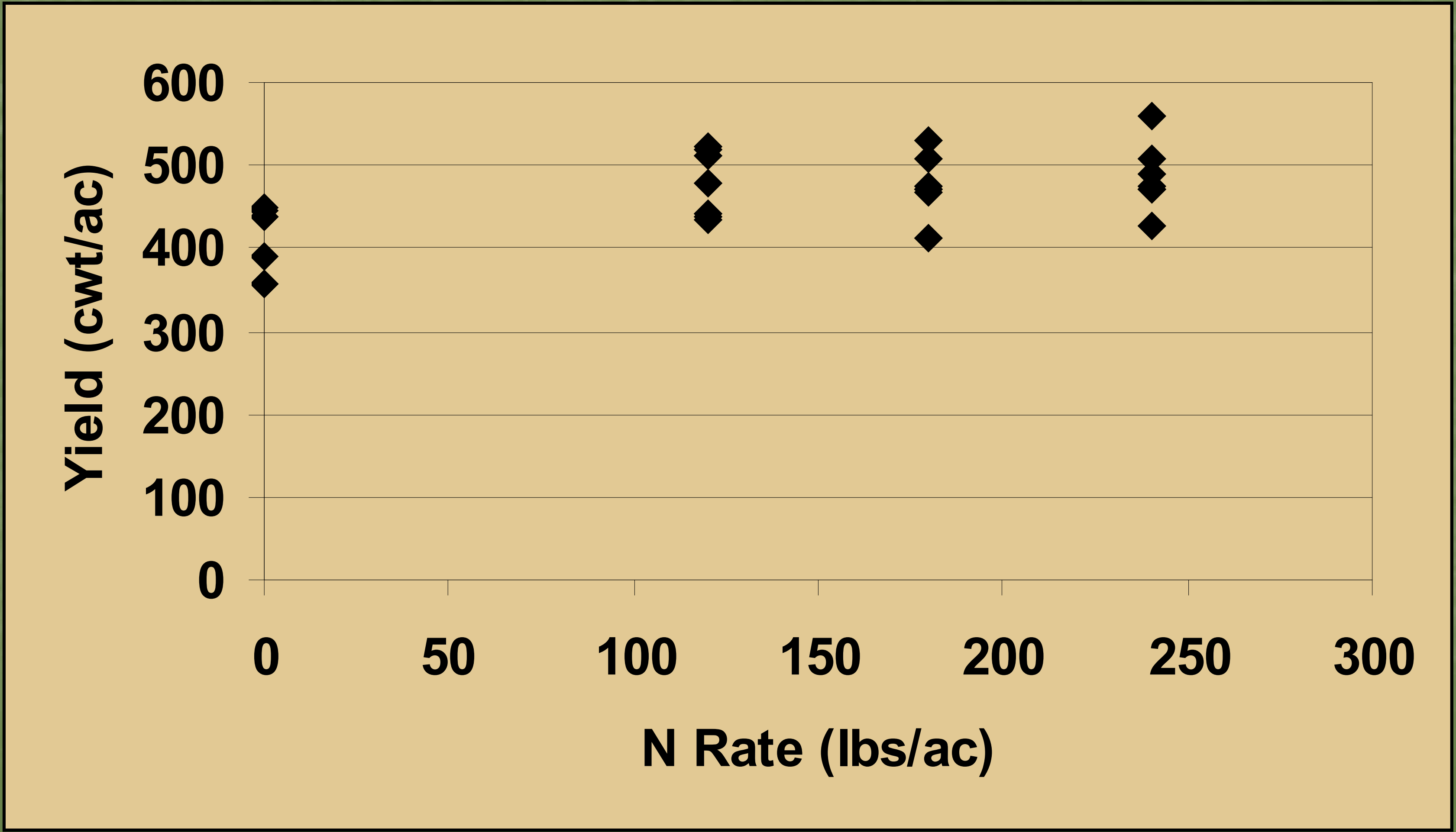
- Used tables from past Proceedings of Wisconsin's Annual Potato Meetings
- Average yields from all replicates receiving the same fertilizer application

Russet Burbank, 2000-2002 at Hancock ARS, surfactant study



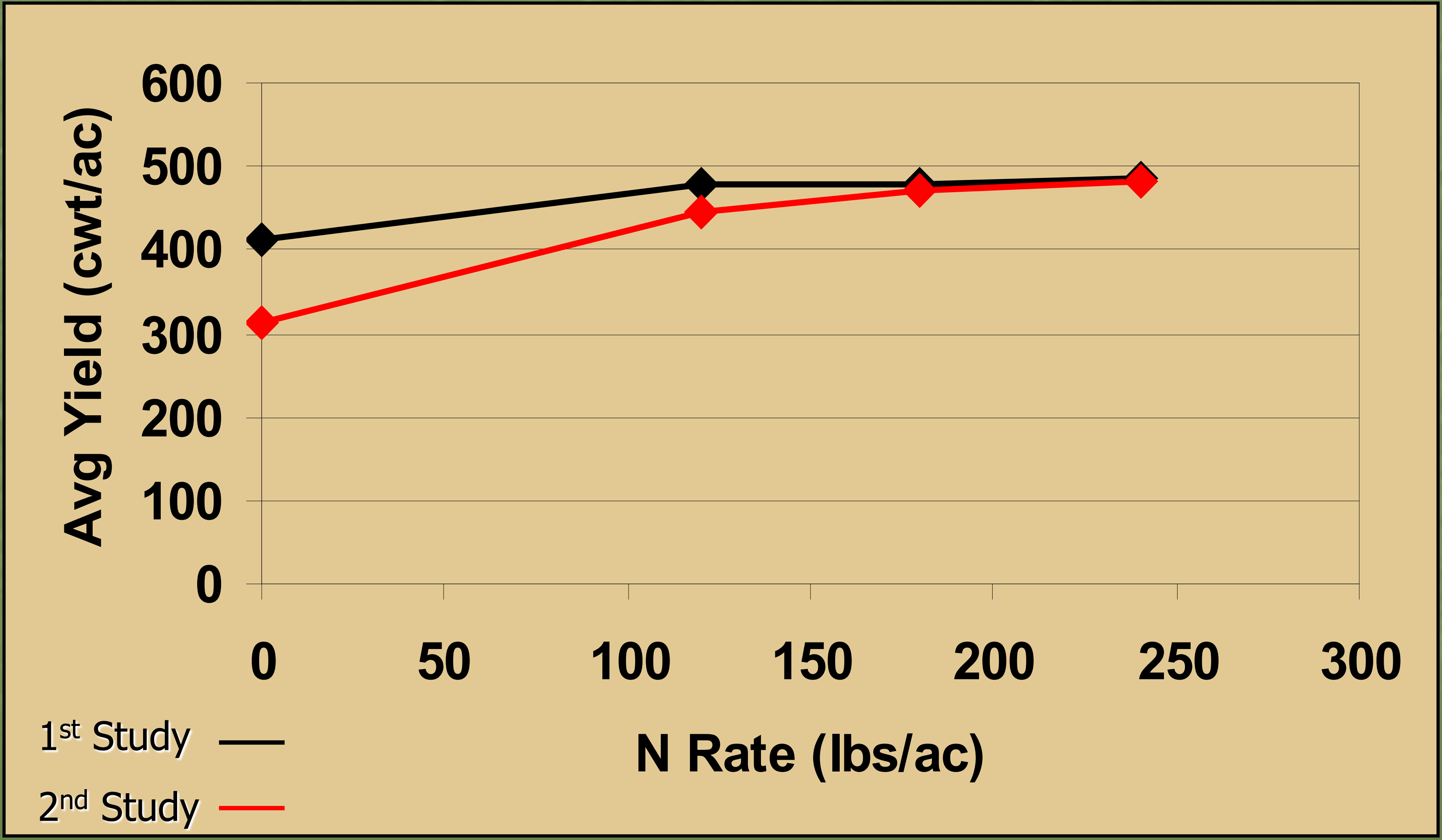
Source: Kelling et al. 2004

Russet Burbank, 2002-2003 at Hancock ARS, hill shape study



Source: Kelling et al. 2004

Average Yields by N Rate



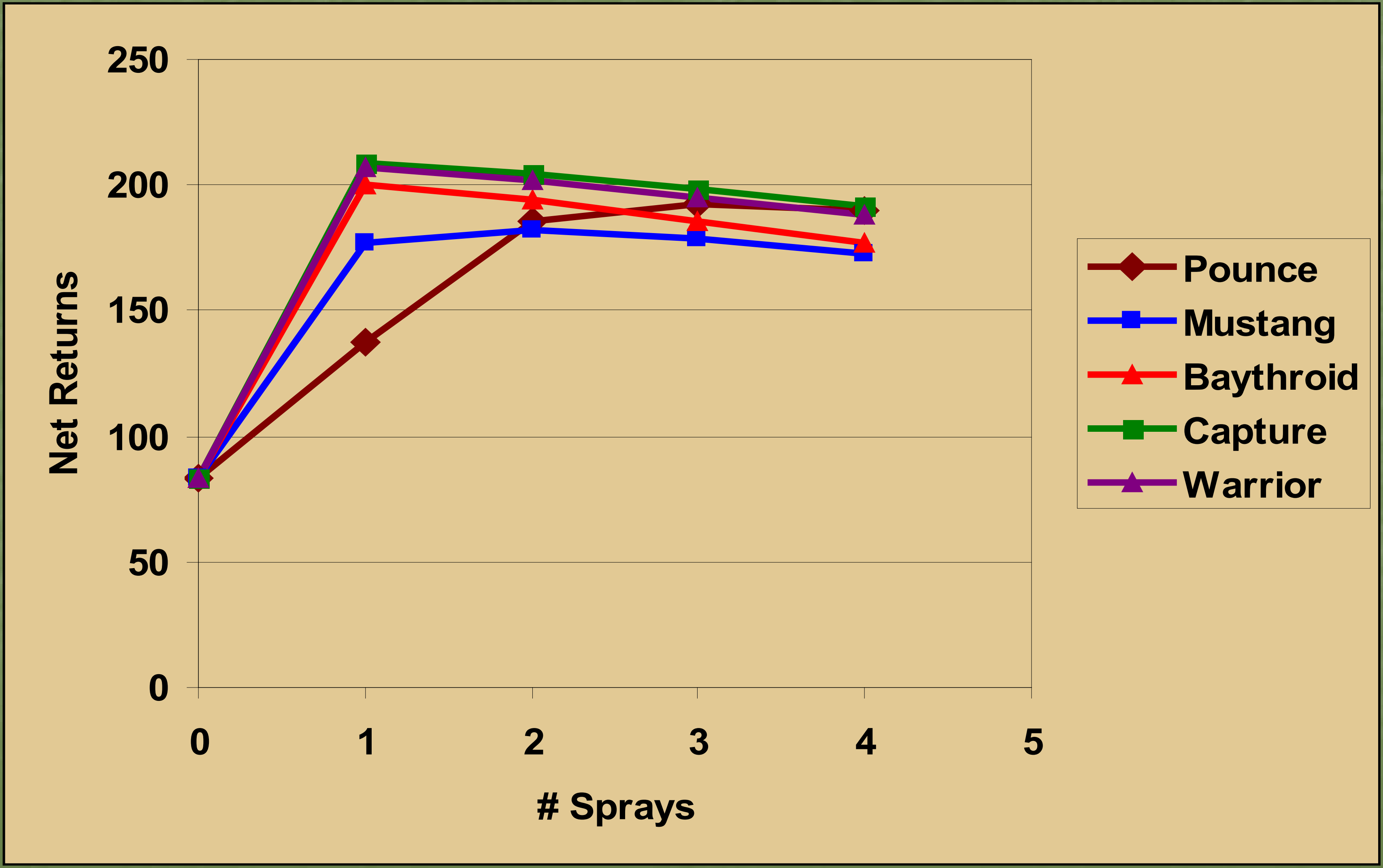
Main Point

- Potato yields become very flat at higher N rates as well, so that more N means little or no yield increase
- "… over 70 N-rate experiments since 1960 have shown that in more than 95% of the cases, yield and quality were maximized by a total of 240 lb N/acre (starter + supplemental N) <u>or less</u>." Kelling et al. (2004)

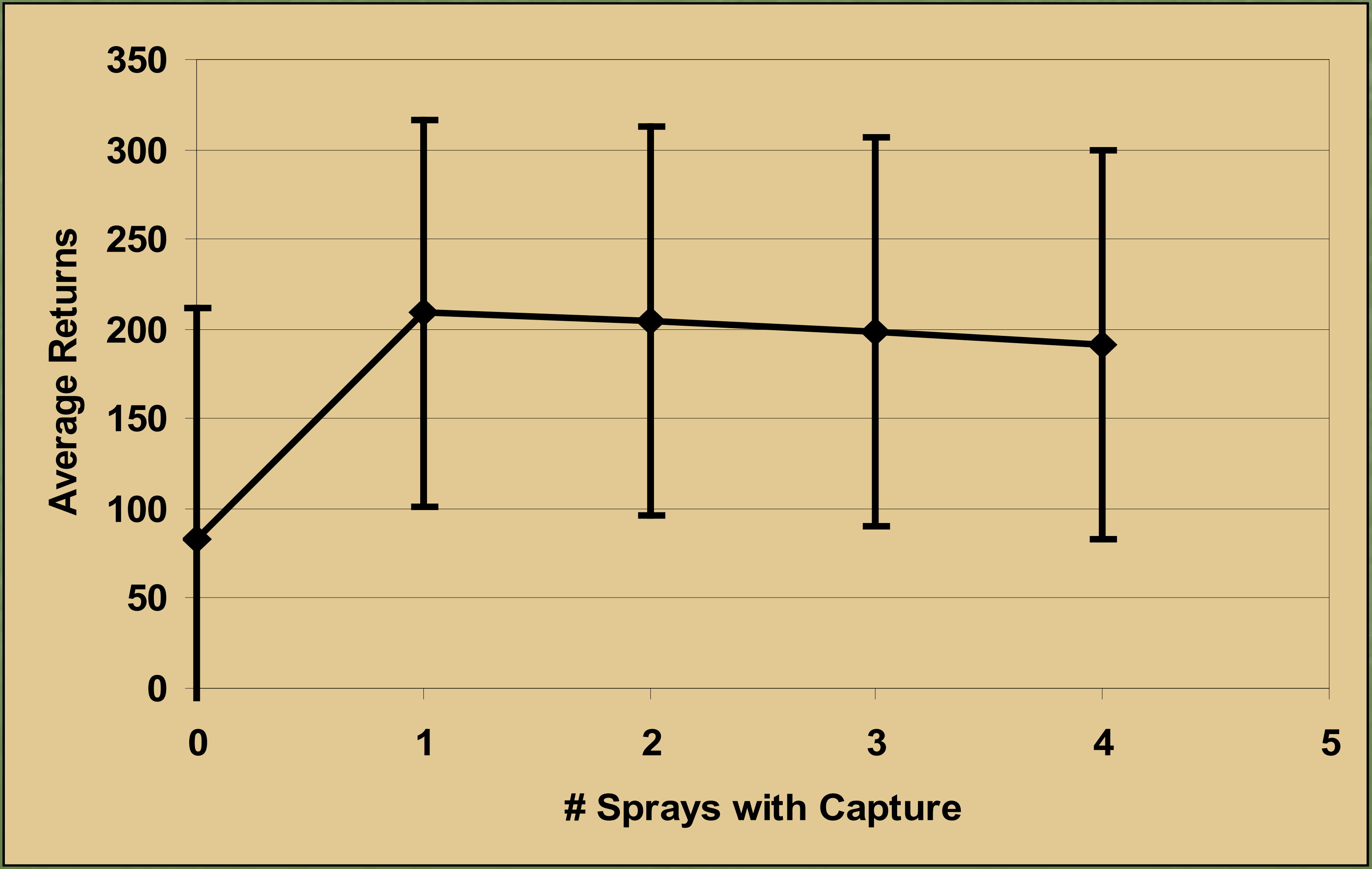
What about other inputs?

- Economic analysis of processing and 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 for several different insecticides

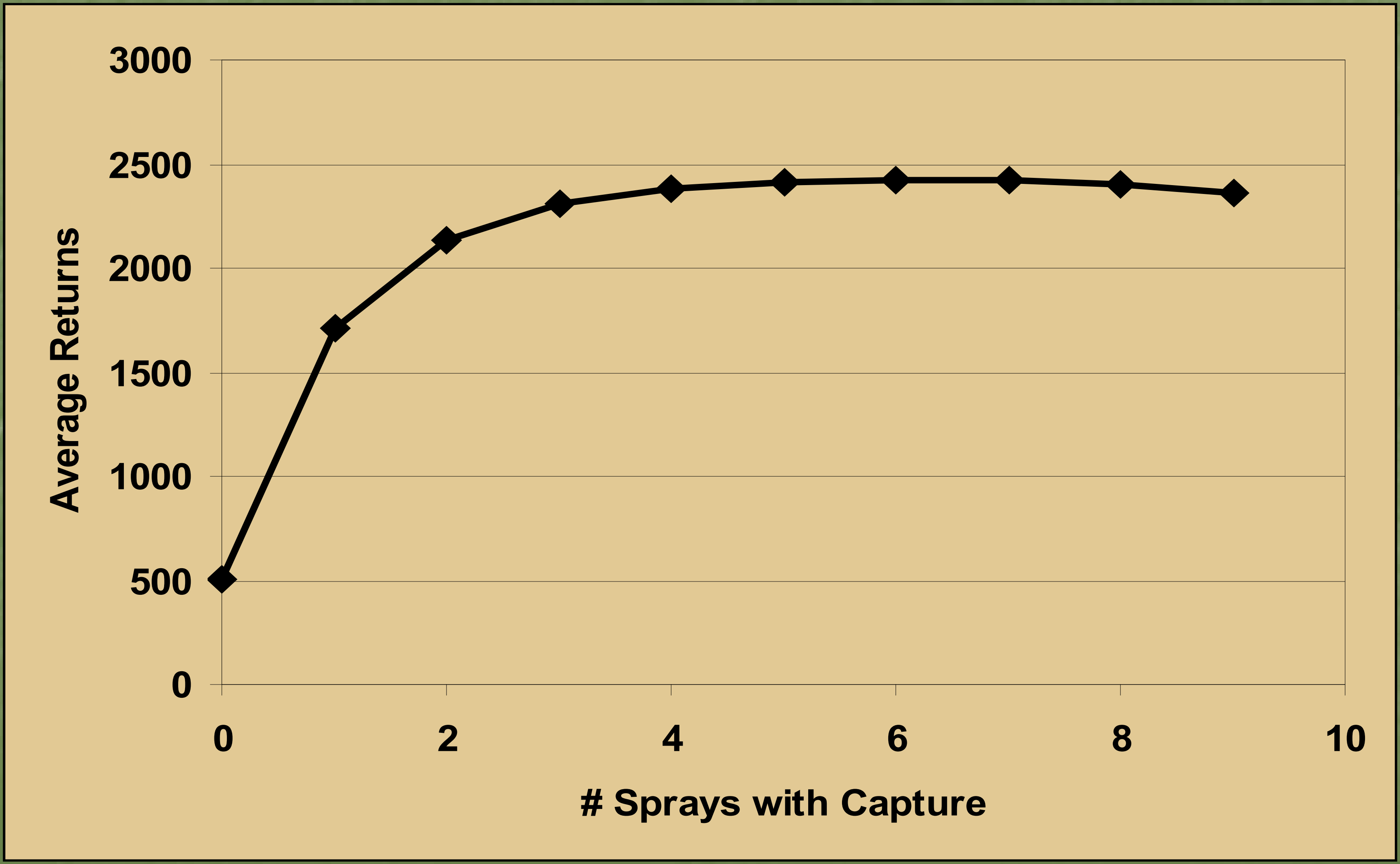
Processing Sweet Corn Insecticides



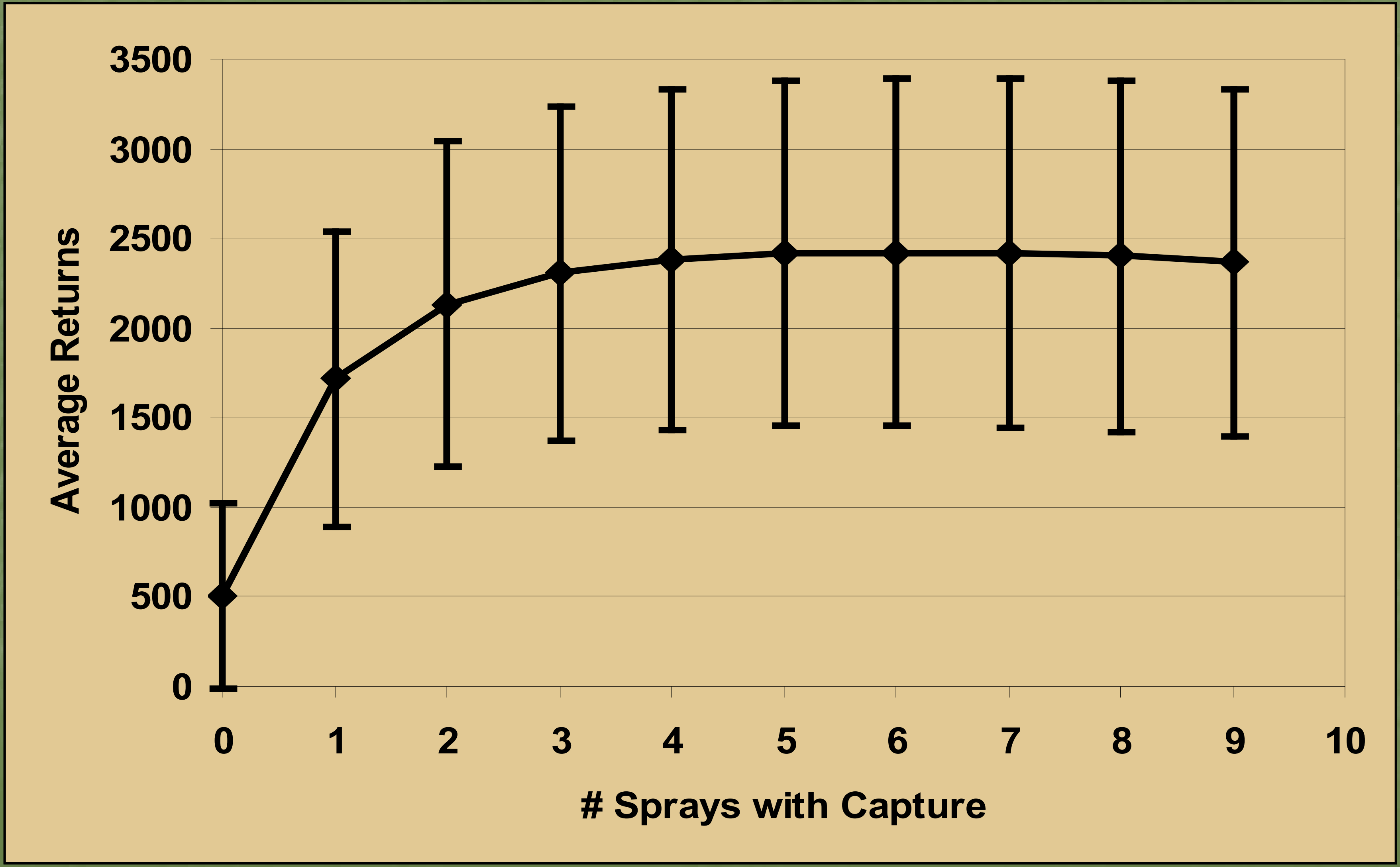
Capture® on Processing Sweet Corn



Capture® on Fresh Market Sweet Corn



Capture® on Fresh Market Sweet Corn



Main Point

- Same flat objective function appears
- Lots of variability around mean returns, so after a few sprays, statistically difficult to identify effect of insecticides on returns

- Likely the same for potato insecticides too
- Likely the same for other potato inputs too

Implications of Flat Objective

- Under use of inputs is often obvious
  - See weeds, insects, blight, yellow/purple crop
- With a "flat objective function"

  <u>Over use of inputs often an invisible cost</u>
- 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"

Flat Objective Problem

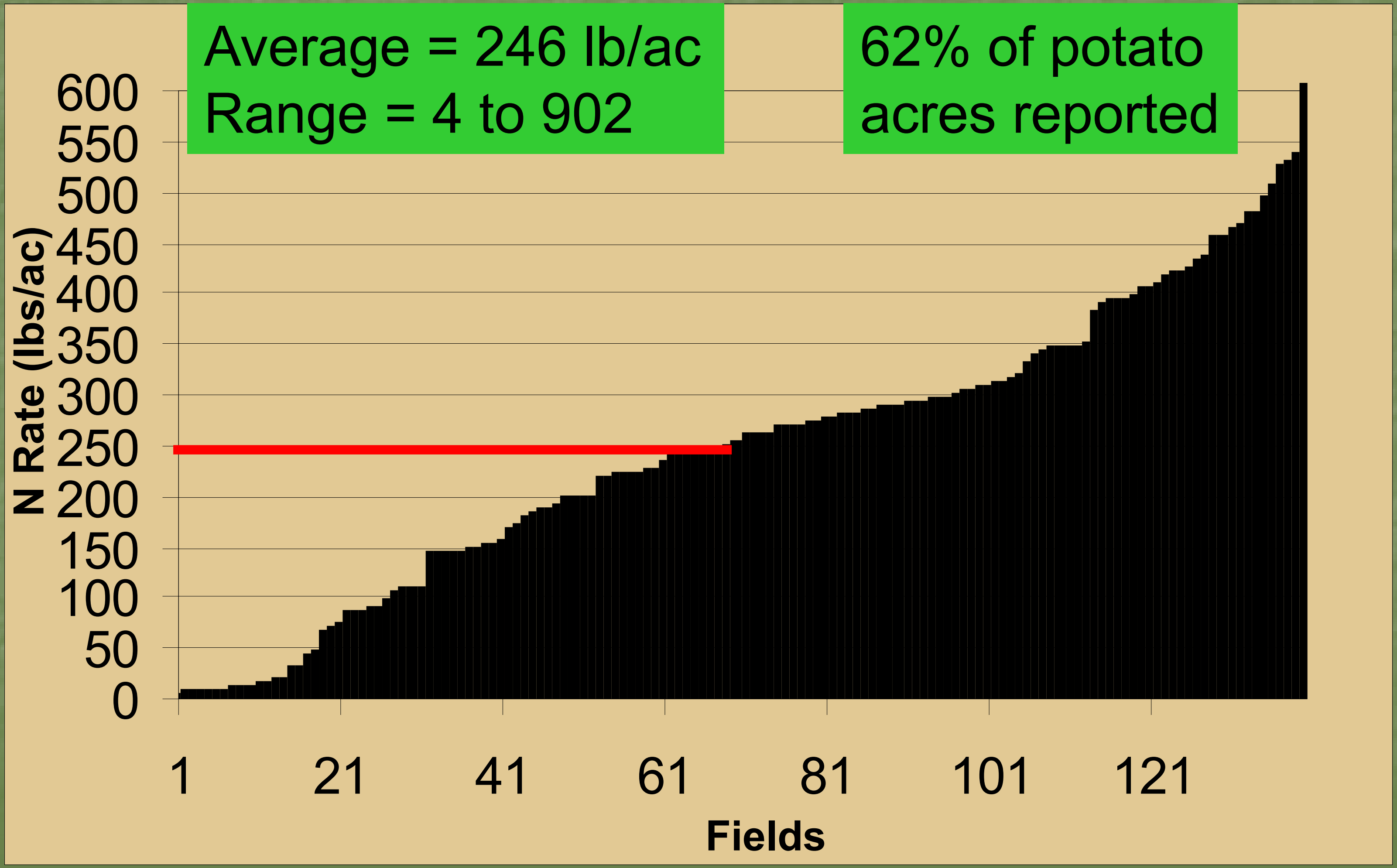
- Yield response to inputs becomes very flat after some level, so that identifying effect of input on yield difficult to find among all the natural yield variability
- Because under use is obvious and over use is invisible, people tend to over use
- Leads to technical inefficiency: using more inputs than others to produce about the same output
- Implies higher costs and lower profits

Example: Wisconsin Potato Farmers and N Fertilizer

- Data from WPVGA's SureHarvest program
  - Contact WPVGA is you want to participate
- Among their services, collect input use data, compare your use to rest of the industry
- 2005: 16,651potato acres, 2006: 11,929

- "… over 70 N-rate experiments since 1960 have shown that in more than 95% of the cases, yield and quality were maximized by a total of 240 lb N/acre (starter + supplemental N) or less." Kelling et al. (2004)

WI Nitrogen Use on Potatoes 2005 (WPVGA via SureHarvest)



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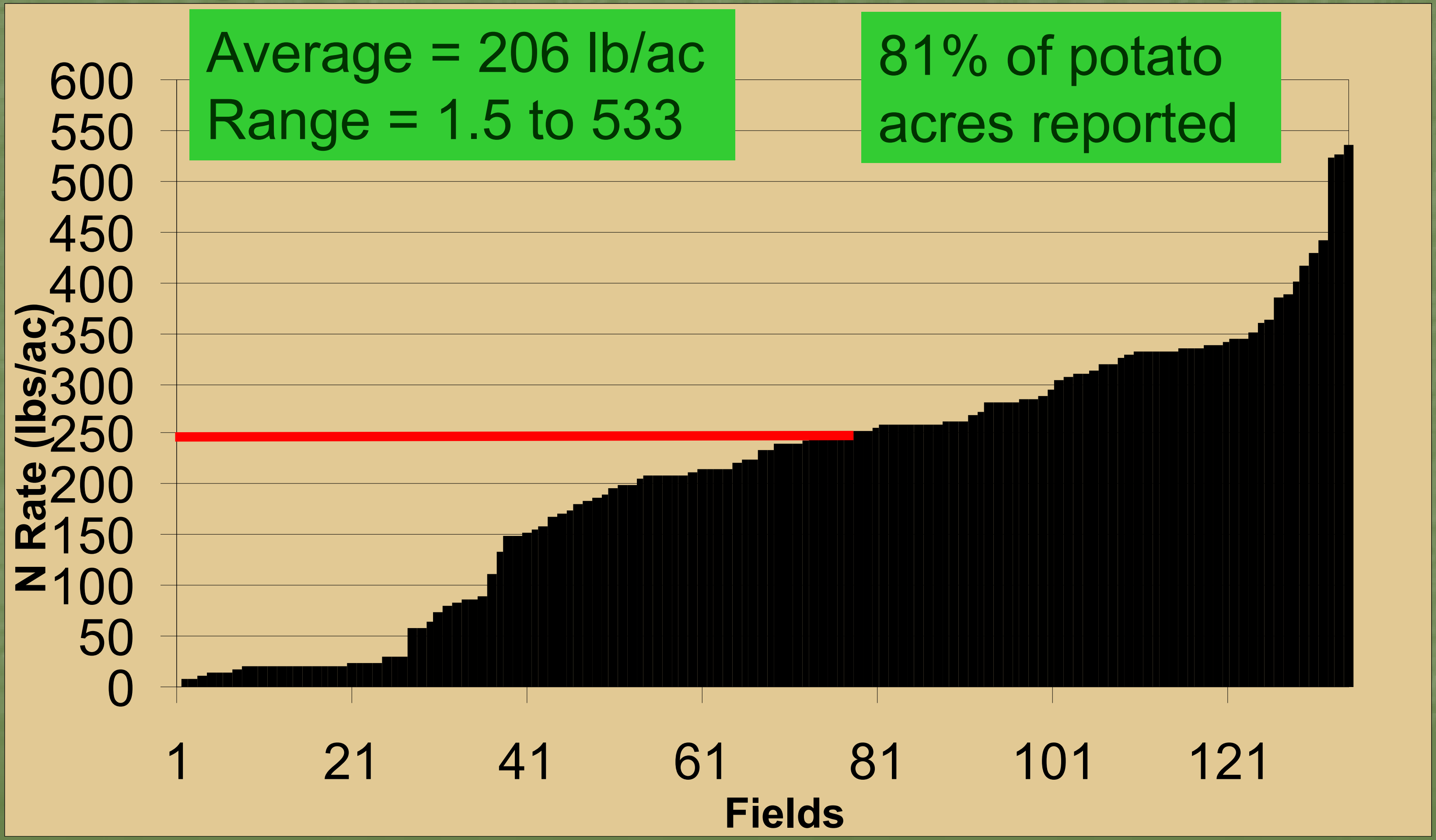

Main Point

- Notice: Can see the effect of high fertilizer prices
  - 2006 average and maximum decreased vs. 2005
- If Kelling et al. is correct, many WI potato farmers seem to be using too much N fertilizer
- How Do We Continue to Grow Quality Potatoes With Skyrocketing Input Costs?
  - **Use nitrogen fertilizer inputs more efficiently**
  - **Likely the same for other inputs too: fungicide, insecticide, other nutrients—room to improve input use efficiency**

Technical Efficiency

- Sub-Discipline of Production Economics
- Carefully examines inputs used and outputs produced to identify what factors explain efficient and inefficient producers
- Short review of empirical findings from papers focused on potato growers

Technical Efficiency Measurement

- Measured as a %
- Example: Technical efficiency = 80% means
- <u>Output Side:</u> Producing 80% of the output as others with the same amount of inputs
- <u>Input Side:</u> Using 100% – 80% = 20% more inputs to produce the same output as others

Literature

- Most analyses are livestock, dairy, and grain operations
- Found four specific to potatoes
- Johnson et al. (1994): Ukraine
- Wilson et al. (1998): United Kingdom
- Amara et al. (1998): Quebec
- Koeijer et al. (2003): Netherlands

Johnson et al. (1994): Ukraine

- Data from 1986, 1989, 1991 to examine ag productivity and efficiency as Ukraine transitioned to a capitalist economy
- More efficient potato farms: pay higher wages, private (not collective), more capital assets, little or no livestock
- Interpretation: Specialized in potatoes and workers had incentives to do well

Wilson et al. (1998): U.K.

- Most important factors to increase technical efficiency in potato production:
- Used irrigation, on farm storage, younger, large (> 100 ac), did not "chit" seed
- Interpretation: Specialized in potatoes, incentives to do well, worked to keep management current

Amara et al. (1998): Quebec

- Most important factors to increase technical efficiency in potato production
- Single owner/operator, more farming experience, not too large, adopted conservation practices to reduce soil erosion and nutrient losses
- Interpretation: Incentives to do well, worked at improving management

Koeijer et al. (2003): Netherlands

- Focus on the effect of managerial ability on technical efficiency
- Workshop on Strategic Management and simulations to learn implementation of new N and P management regulations
- Better Strategic Management synthesis was highly correlated with higher technical efficiency
- Only had 9 observations
- Main point: better mangers more efficient: able to understand and adapt to (regulatory) changes

Lohr and Park (2004): USA

- Focus on organic fruit and vegetable farms
- Organic less efficient than conventional because use more restricted production methods
- Most important factors for high technical efficiency in organic production
- Biggest: “strong research commitment” or what they call lots of on-farm “tinkering”
- More recent conversion to organics
- Rely less on on-farm soil amendments
- Interpretation: Specialized, worked at improving management

Main point

- Incentives to work hard/do well
- Specialized in potatoes
  - Not distracted by too many other activities
  - More risky? (more diversified = less risk?)
- Worked at improving management
  - Latest practices, ways to improve input use
  - On-farm testing/tinkering, learning new things
  - Able to adapt to changes

How Do We Continue to Grow Quality Potatoes With Skyrocketing Input Costs?

- Use less inputs without reducing output
  Be more efficient: How?
- Flat Objective Problem: over use of inputs often a hidden cost or waste of inputs/money
- Data seem to show some potato farmers could reduce inputs without losing output
- Work at improving your production practices
  - Use latest science/information
  - Do your own on-farm tinkering/experiments
- Develop your business/management skills
  - Take classes or read articles/books, think

Questions?

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