Precision Input Cost Management: Focus on Nitrogen

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Mississippi State University

Disclaimer

- ***Cotton Incorporated will neither confirm nor deny my existence, let alone agree with or disagree with any of the thoughts or data provided henceforth. The thoughts presented from this point forward are done so by a guy from Illinois who works cotton in Mississippi.***

- ***Dealing with any aspect of cotton production may produce the highest of highs, the lowest of lows, and may lead to the need for a banker, a preacher, a doctor, a liquor store, a gun salesman, or a combination of all.***

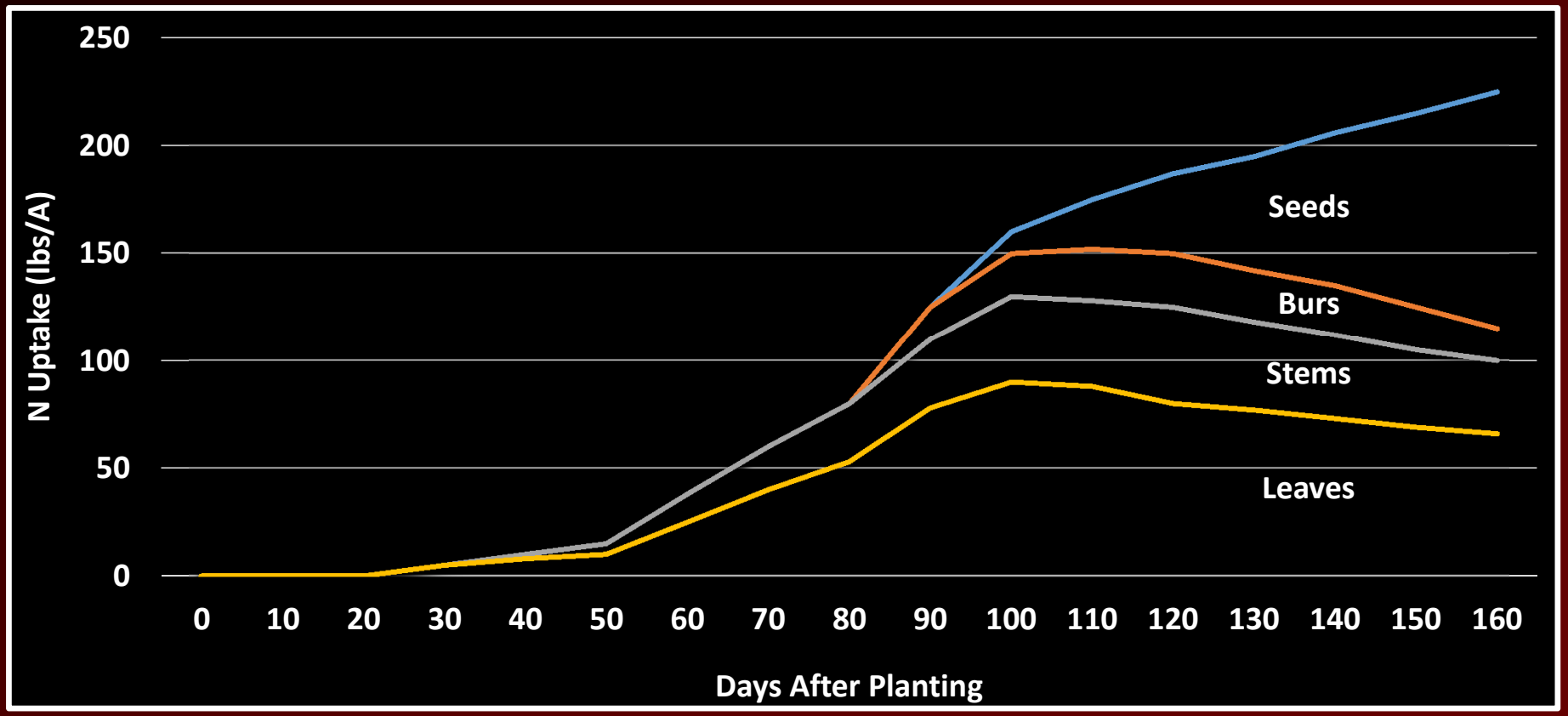
Nitrogen

- **Provided to the plant in greatest quantity**
  - **Not used efficiently by the plant (Hunt et al. 1998; Hutmacher et al. 2004)**
- **Significant expense**
  - **$350 – $450 per ton depending on which dealer you talk to**
  - **1 ton = 181 gallons (11.06 lbs/gallon)**
  - **1 gallon = 3.54 lbs N**
  - **1 ton = 640 lbs N**
  - **100 lbs/Ac = $55-$70 per acre**
- **Bollgard II/Roundup Ready Flex Technology fee in GA: $412.20 per bag**
- **45,000 seeds per acre = $74.20 per acre Technology Fees**

Nitrogen Recommendations

- **Georgia: Based on yield goal**
  - 750 lbs/A = 60 lbs N/A
  - 1000 lbs/A = 75 lbs N/A
  - 1250 lbs/A = 90 lbs N/A
  - 1500 lbs/A = 105 lbs N/A
- **South Carolina:**
  - Dryland = 70 lbs N/A
  - Irrigated = 90 lbs N/A
  - Adjust both up or down 20-30 lbs/A depending on yield potential and field history
- **Mississippi: Based on yield goal & soil texture**
  - 50-60 lbs N/bale on light textured soils
  - 60-70 lbs N/bale on medium textured soils
  - 70-80 lbs N/bale on heavy soils
- **Average application rates:**
  - Georgia: 70 – 120 lbs/A
  - South Carolina: 90 – 120 lbs/A
  - Mississippi: 90 – 120 lbs/A

N Uptake and Partitioning By Cotton



Source: Univ. of Arizona

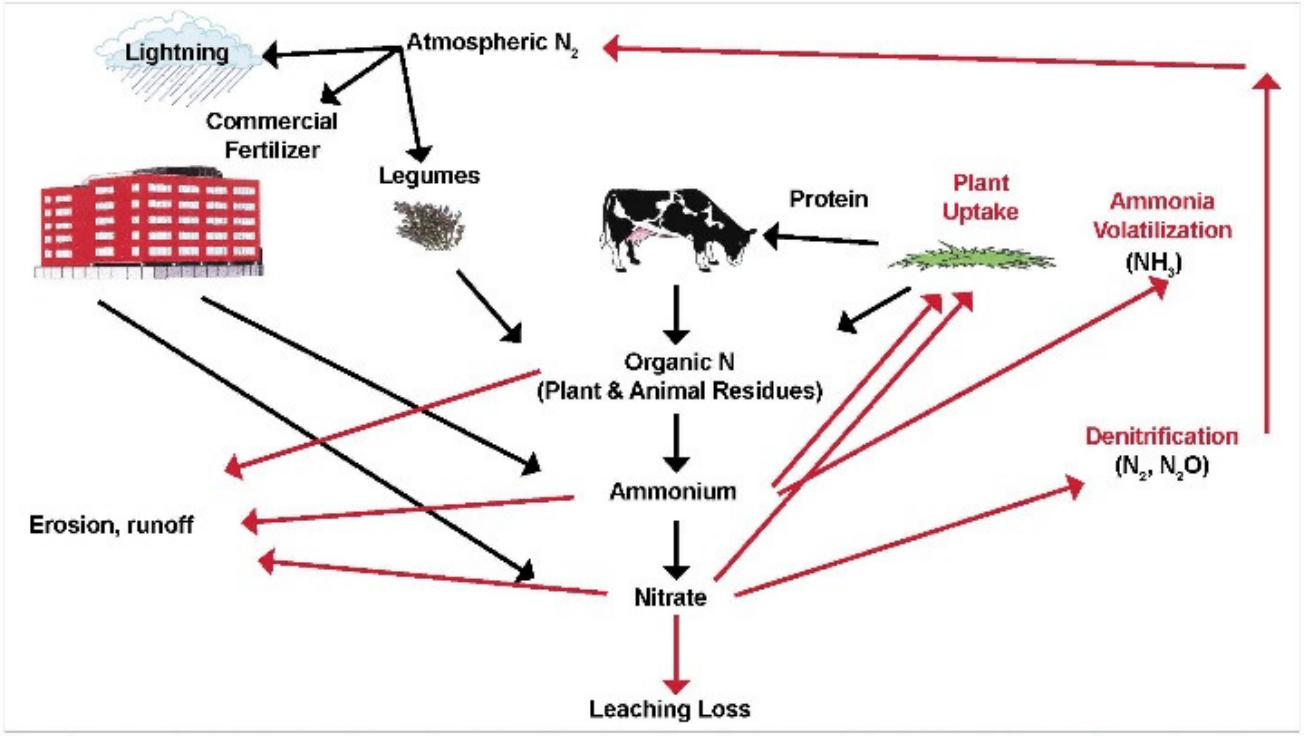
Nitrogen Removal

	Yield/A	N	P_2O_5	K_2O	Ca	Mg	S	Cu	Mn	Zn
Seed & Lint	2600	63	25	31	4	7	5	0.18	0.33	0.96
Stalks, Leaves, & Burs	3000	57	16	72	56	16	15	0.05	0.06	0.75

- **2600 lbs seed & lint = 1000 lbs lint**
- **What about a 1500 lb crop?**
- **Question: If we are applying 120 lbs and removing 63 – 94 lbs, where is the remainder?**

Source: NC State University

The Nitrogen Cycle



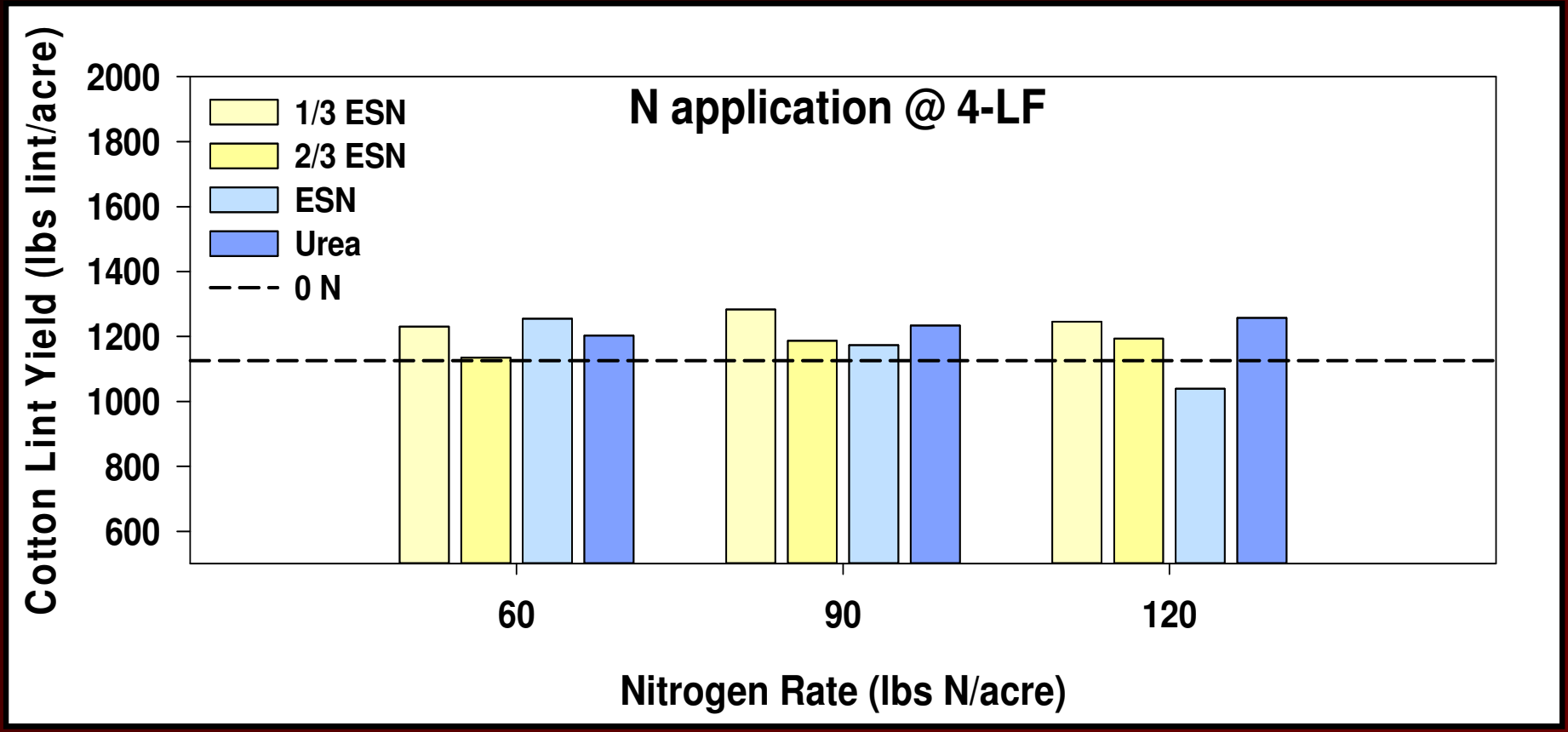
The nitrogen cycle, including most inputs, losses and transformations. Red arrows indicate potential losses from soils, while black arrows indicate inputs or transformations.

Source: Texas A & M

The Eternal Question

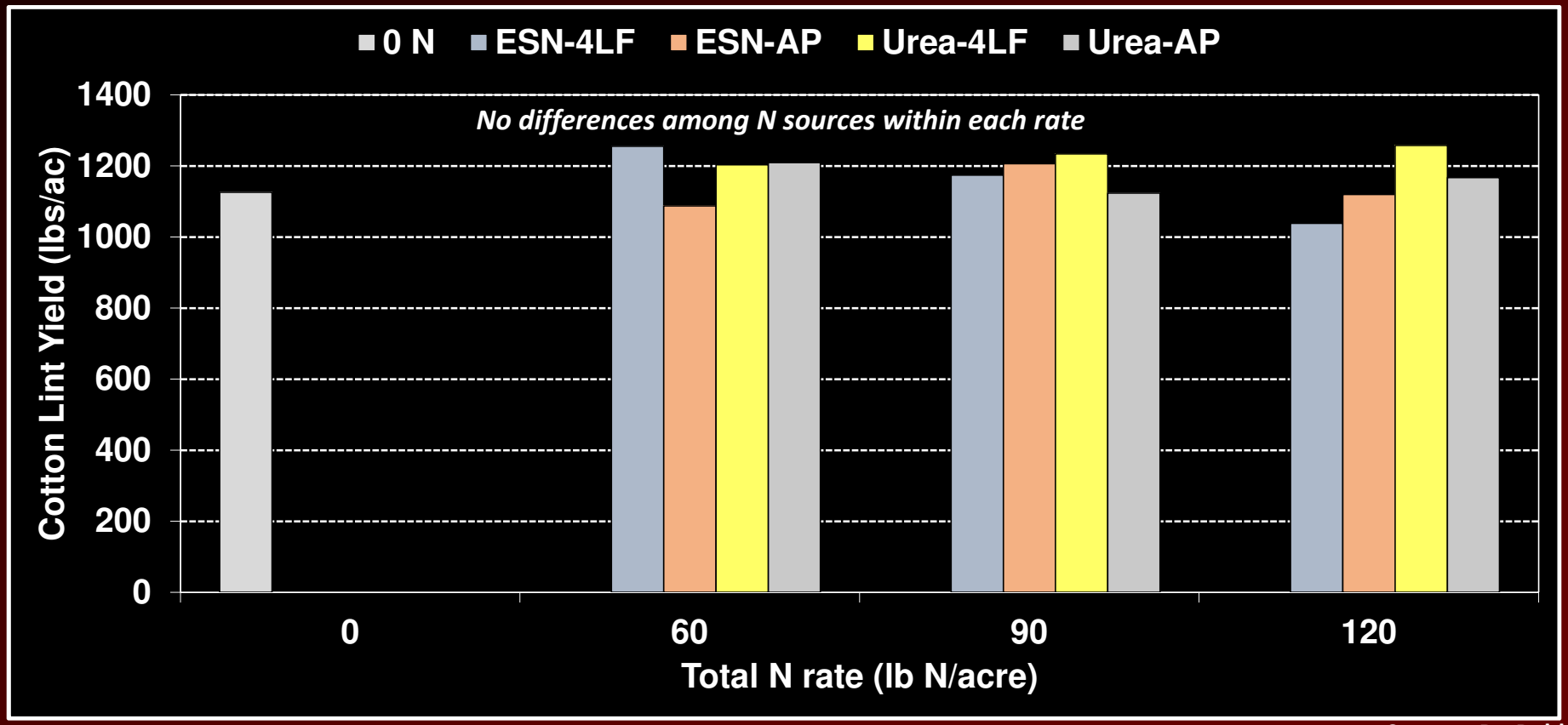
- **How much nitrogen should I apply?**
- **Answer: depends**
- **Things to consider:**
  - **Yield potential**
  - **Field history**
  - **Previous crop**
  - **Soil texture**
  - **Nitrogen source**
  - **Application method**

Mississippi Cotton 2011



Source: Dr. Bobby Golden

Cotton Yield Response to Nitrogen



Source: Dr. Bobby Golden

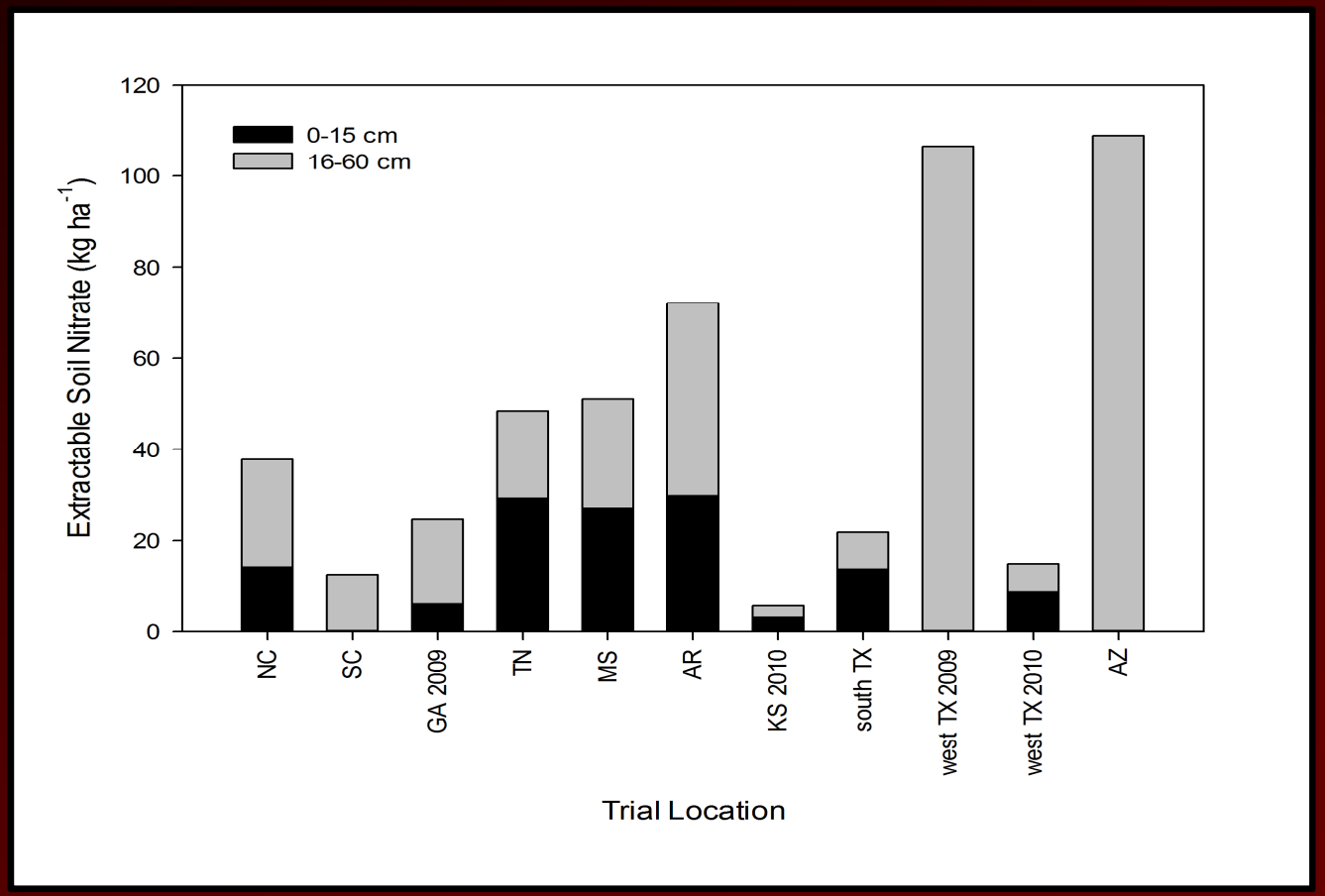
No Yield Response to Nitrogen???

- **Is Bobby Golden a lunatic?**
- **20 studies were conducted across the Cotton Belt in 2009 and 2010**
  - **11 of 20 locations had no response to nitrogen**
- **Why was there no response to N is so many studies?**
  - **“This is why research isn’t relative on my farm”**
- **Mentality**

Pre-Sidedress Soil Nitrate Tests

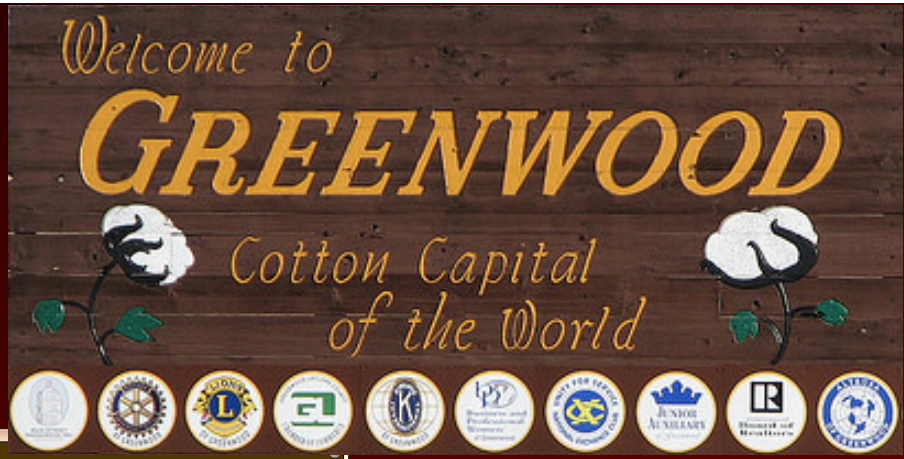
- **Have been beneficial for predicting N fertilizer needs in other crops**
- **Not used to a great extent in cotton production**
- **Beltwide N project confirmed residual NO_3^- is present in Cotton Belt soils**
- **Data indicates that 21 lbs N are required per bale of lint produced**

Extractable Soil Nitrate



Source: Main et al. 2013

Field Variability



Search

Map Unit Legend

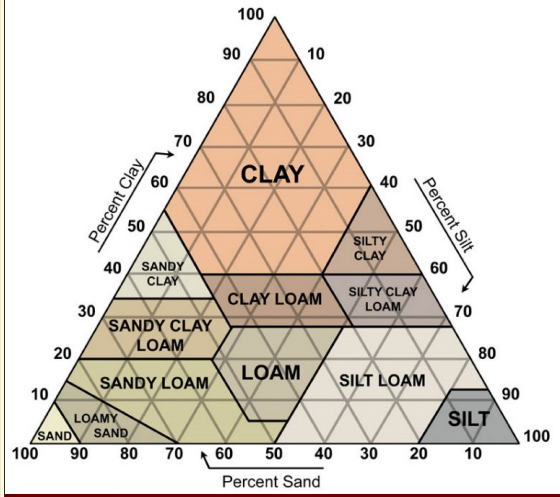
Leflore County, Mississippi (MS083)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10	Arkabutla and Falaya soils, 0 to 5 percent slopes, frequently flooded	0.1	0.1%
17	Dubbs loam, 1 to 3 percent slopes	57.7	51.2%
28	Tensas silty clay loam, 1 to 3 percent slopes	53.4	47.4%
29	Tensas silty clay loam, 3 to 8 percent slopes	1.6	1.4%
Totals for Area of Interest		112.7	100.0%

Soil Map

Legend

Scale (not to scale)



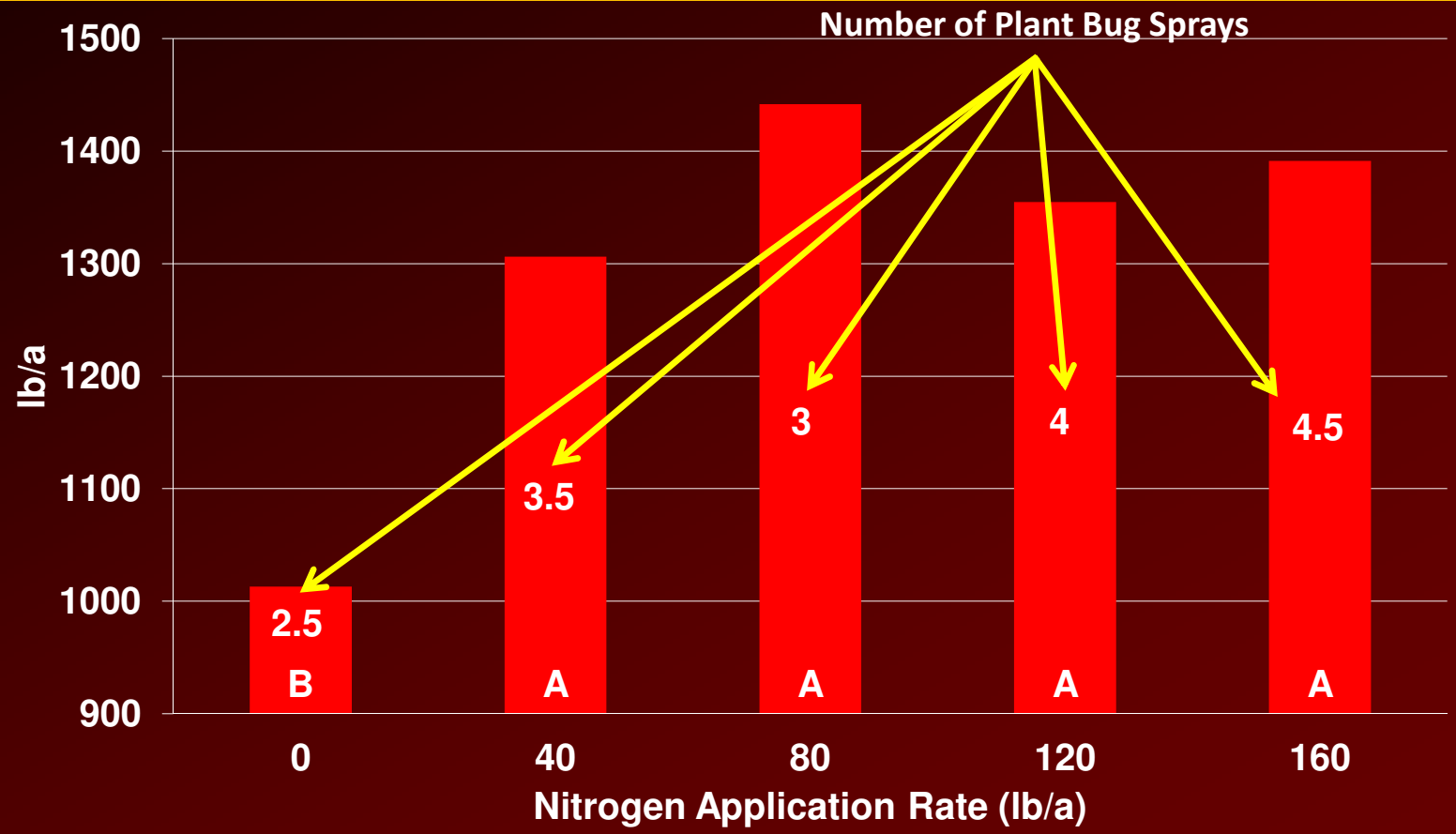
Source: www.soilsensor.com

Effects of Excessive Nitrogen Application

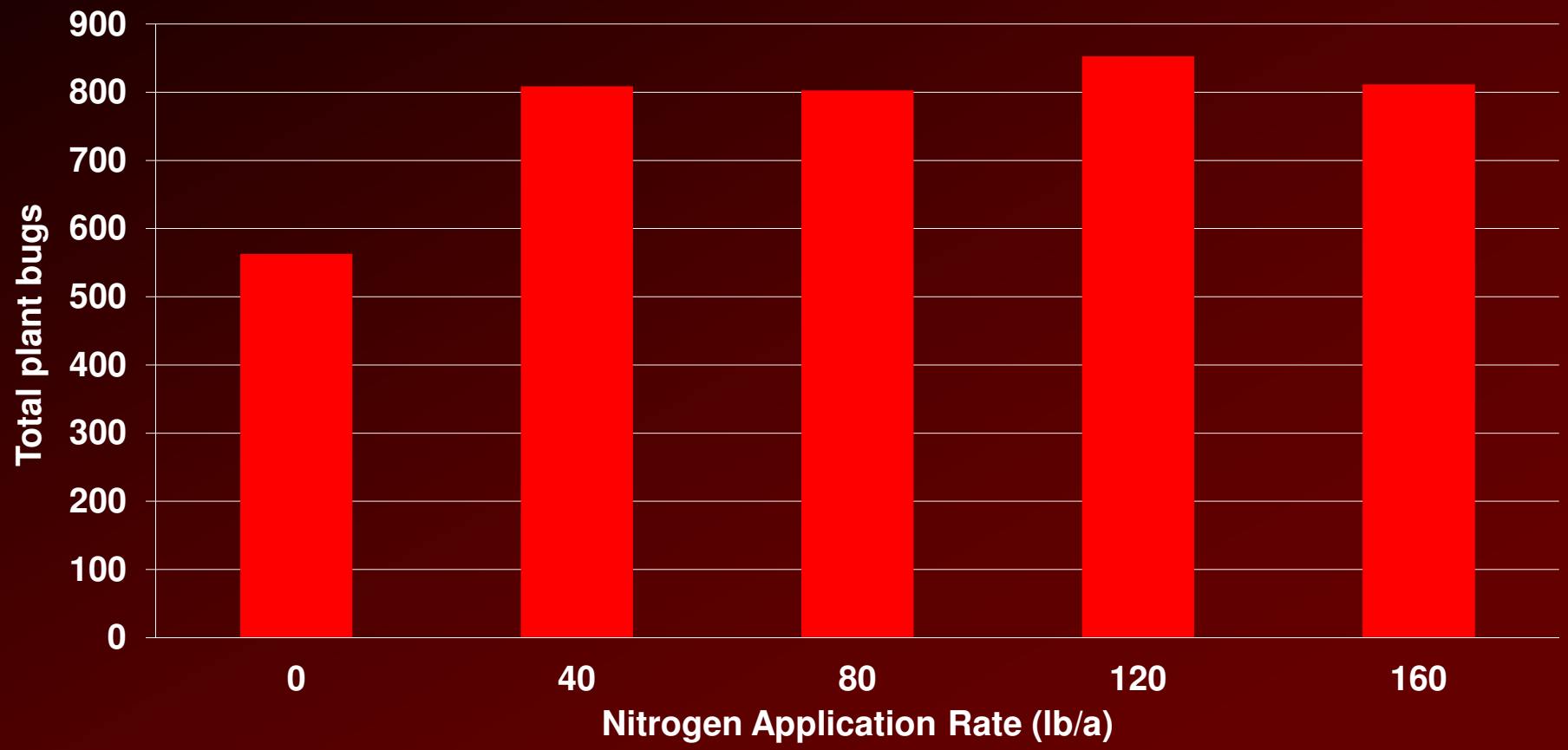
- **Alter vegetative and reproductive growth**
- **Delay maturity**
  - **Clawson et al. 2008**
  - **Varco et al. 1999**
- **Insects are drawn to rank, lush cotton**
  - **Willers et al. 2001**
- **Decrease profitability**

Nitrogen	Plant height	Plant nodes	NACB[1]
Lb/A	Inches	#	
0	29.2	16.6	4.3
40	31.4	17.1	4.9
80	33.1	18.0	5.3
120	34.7	18.5	5.9
LSD (0.05)	0.9	1.0	0.5

Nitrogen Application Rates and Tarnished Plant Bugs



Total Plant Bugs – Unsprayed Plots



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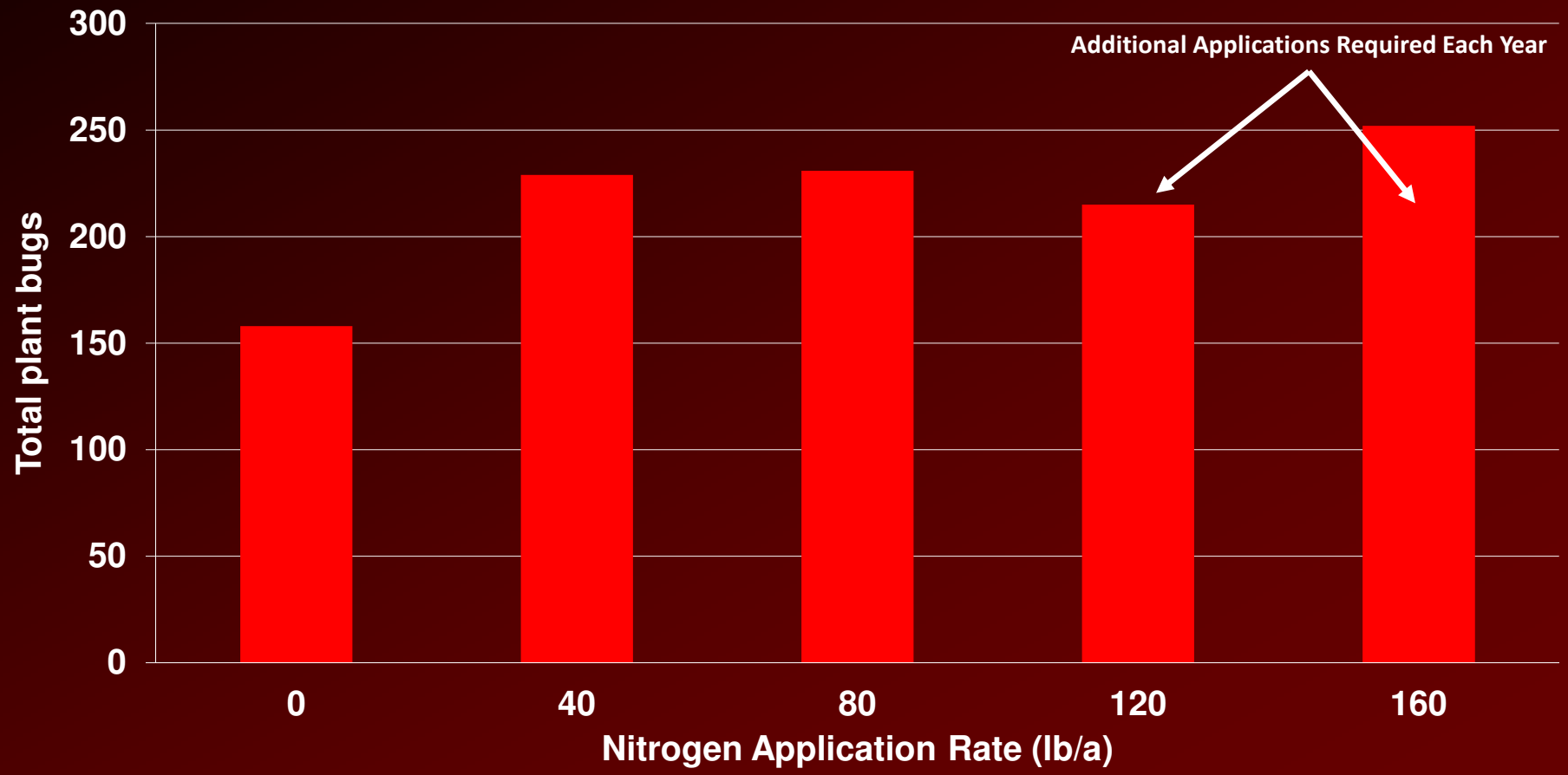
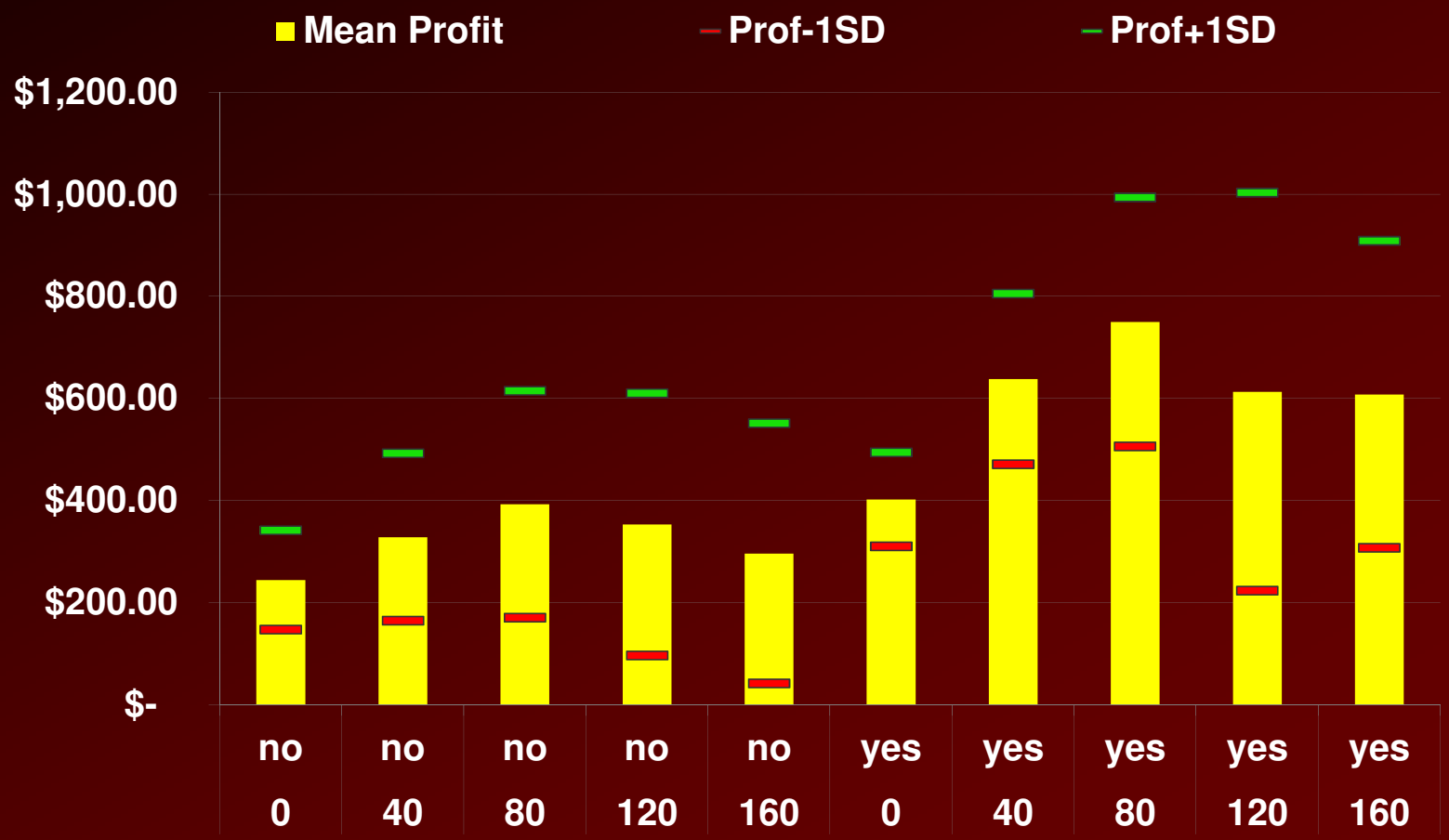


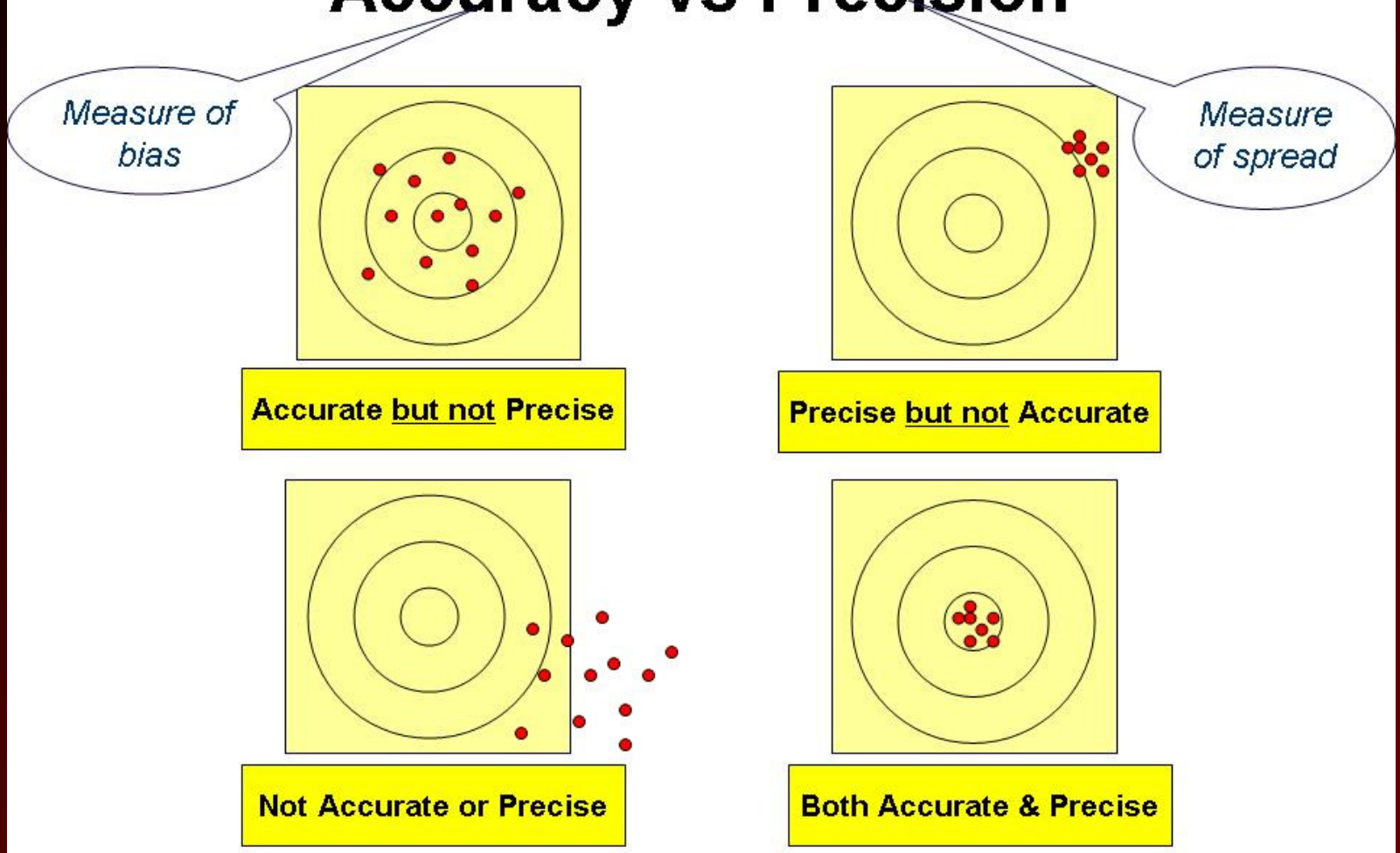
Profitability



Where Are We Going?

- **Precision agriculture**
  - **Somewhat of a misnomer**
- **Field management on a spatial level**
  - **Multiple factors may need to be included to get the most bang for your buck**
- **More convenient access to massive amounts of reliable data than ever before**

Accuracy vs Precision



Source: http://1.bp.blogspot.com/_LpvA4lv5DbE/SwVFCc5oK7I/AAAAAAAAADo/PR25UL3t4tw/s1600/Accuracy+vs+Precision.jpg

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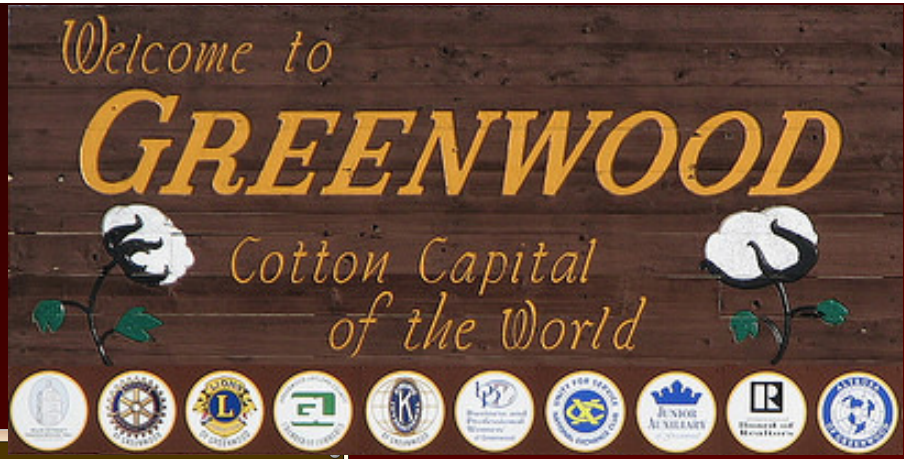

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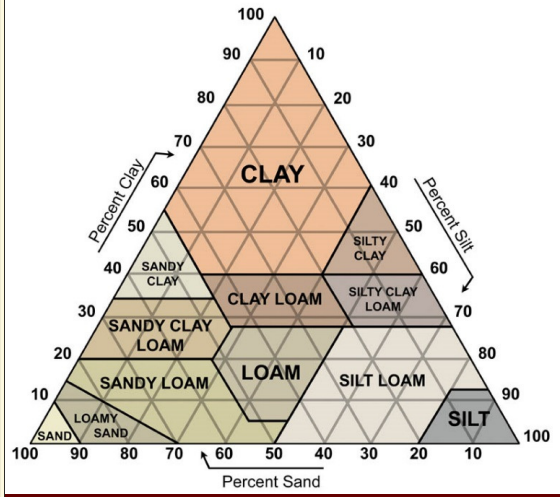

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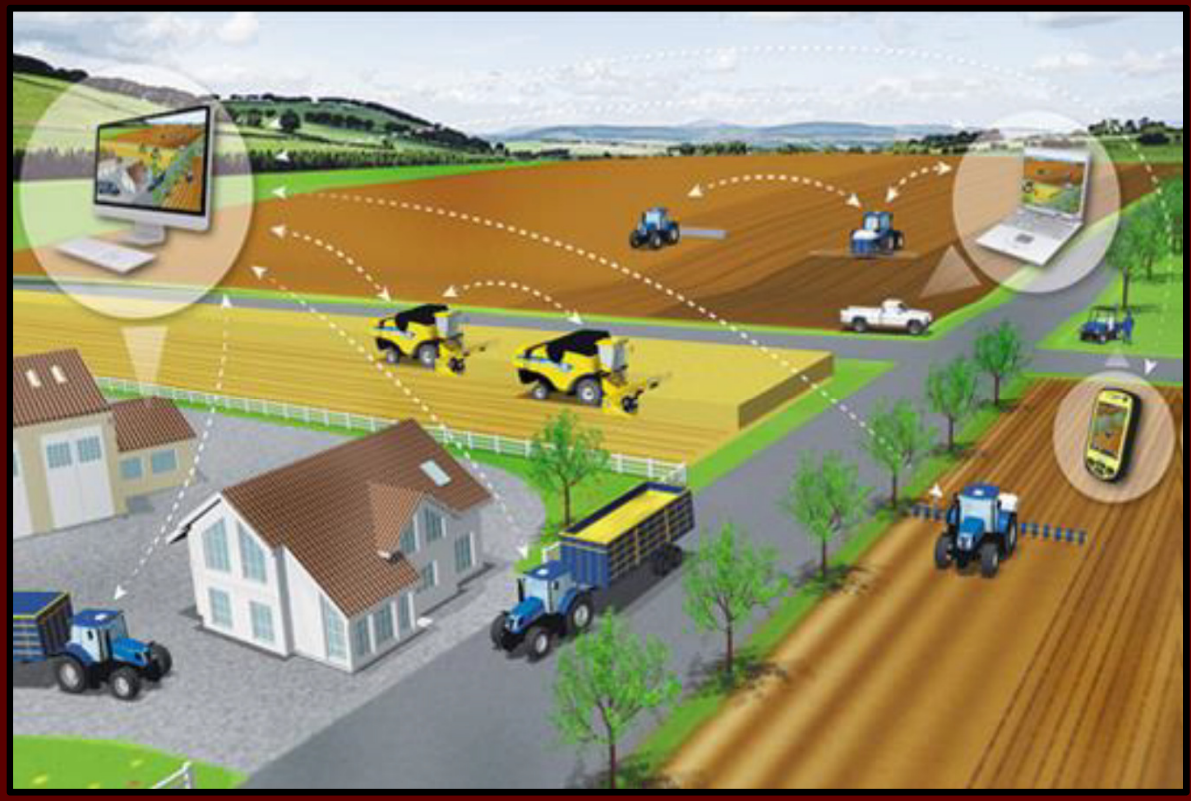
Information Collection and Processing

- **Agriculture has seen unprecedented advances in information collection capabilities**
- **Soil maps, Veris maps, site-specific soil sampling, application maps, yield maps, elevation, etc…**
- **What do we do with this data?**



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Closing Thoughts

- **Given current market prices and environmental concerns, we must continue to refine and improve nitrogen use efficiency**
- **Willingness to change/adapt**
- **Experiment**
- **Change is going occur**
  - **“Shift happens”**

Thank You

- **Contact information:**

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Questions