Crop Sensors to Guide Nitrogen Fertilizer Application: Reduce N Loss, Not Yield

Peter Scharf

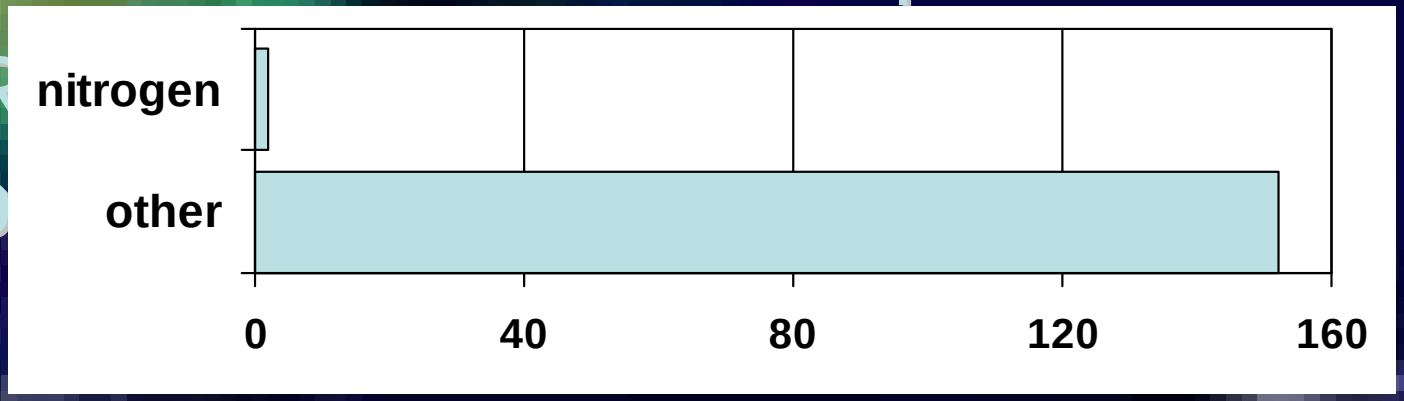
Kent Shannon, Harlan Palm, Ken Sudduth, Newell Kitchen, Luci Oliveira, Scott Drummond, Charles Ellis, Larry Mueller, Vicky Hubbard, and Matt Volkmann

Why?

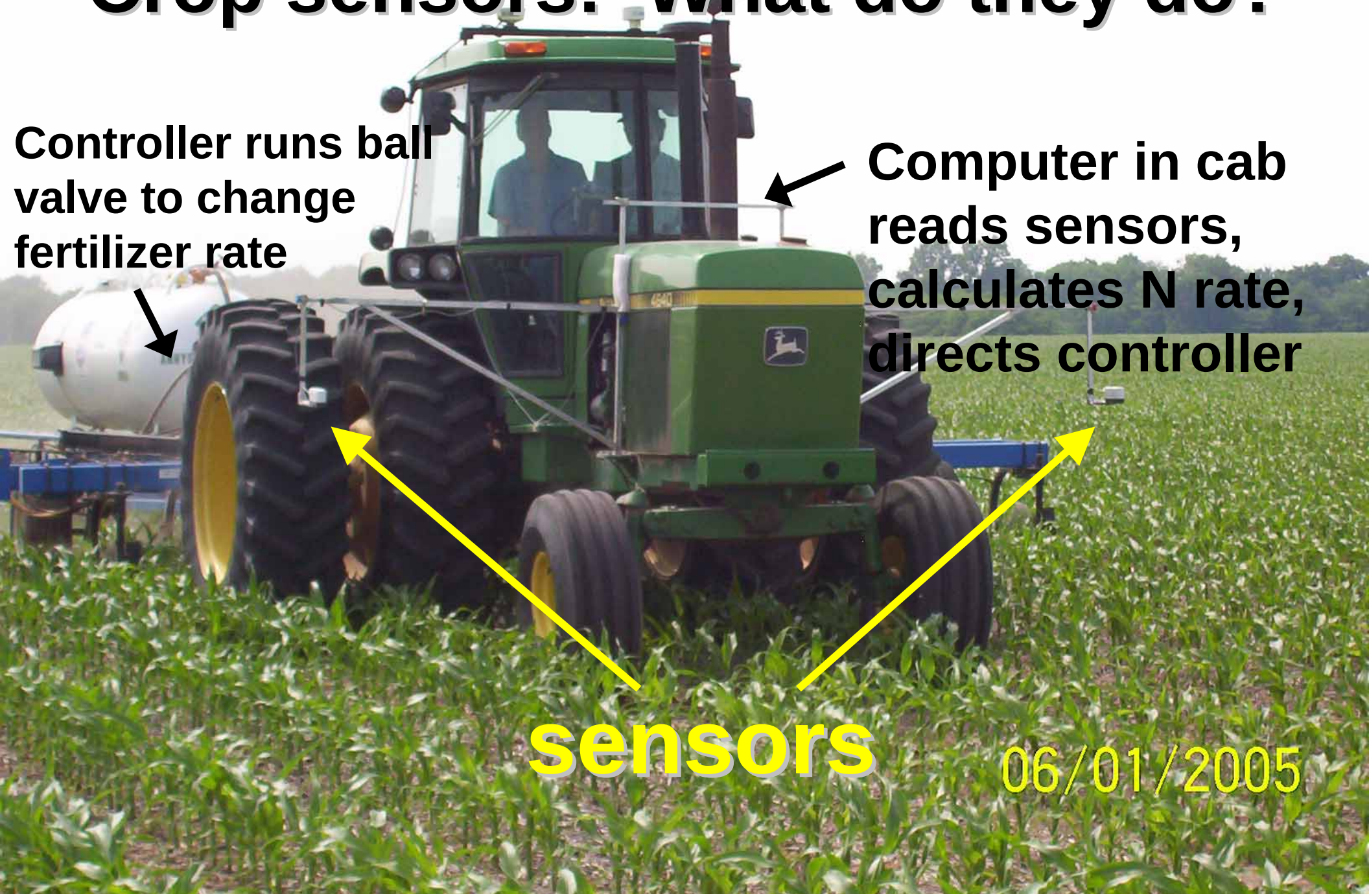

N gets into water
Mouth of
Mississippi River
Huge algal
bloom
Gulf of Mexico

Gulf Hypoxia:
Water quality poster child

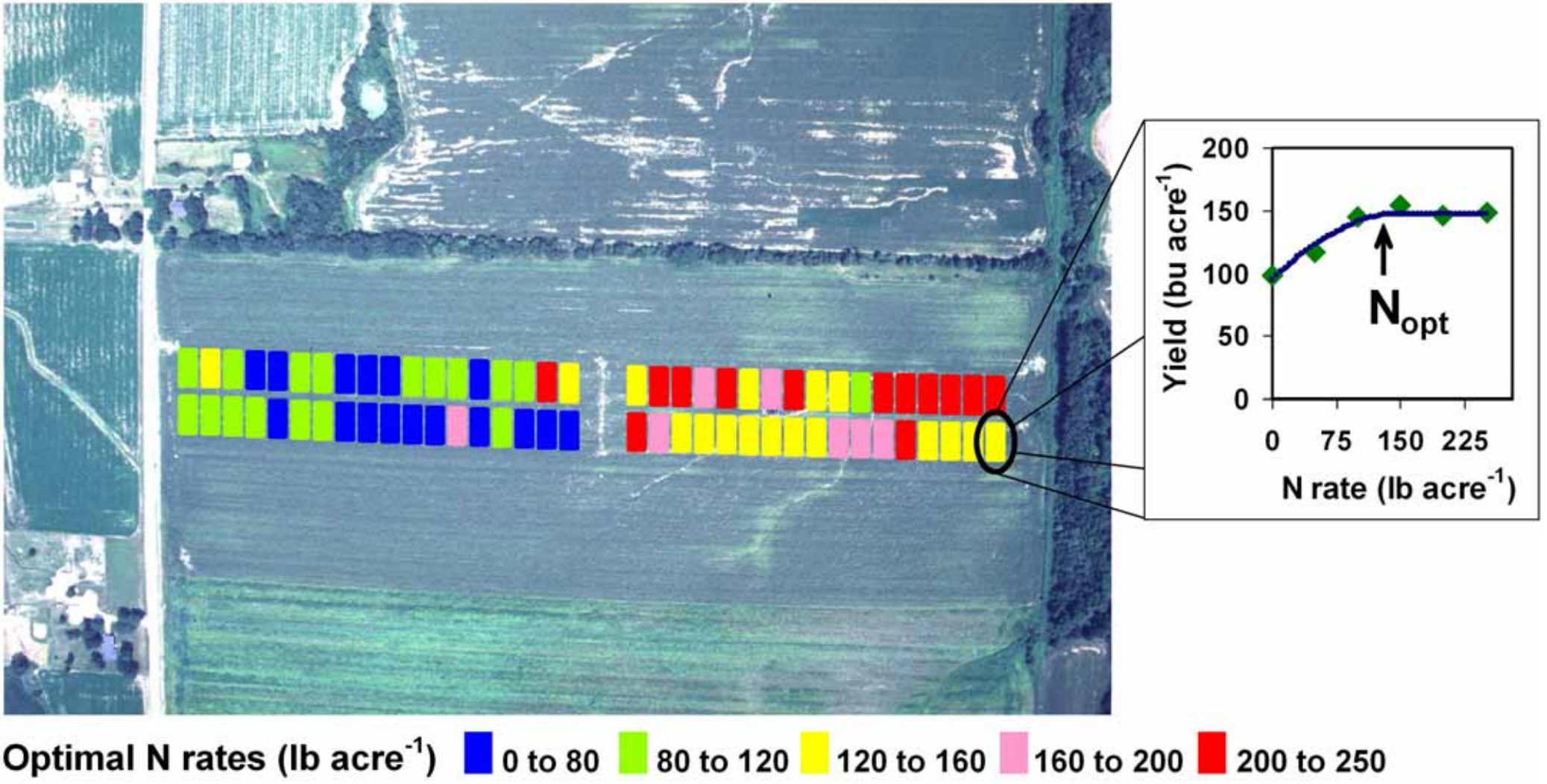
- Rates the General Session for this meeting
- Lots of popular press, very visual
- N is the issue (in textbooks 30 years ago)
- National **Ag Water** Conference: surely potential solutions will be presented?
- CSR
(hyp



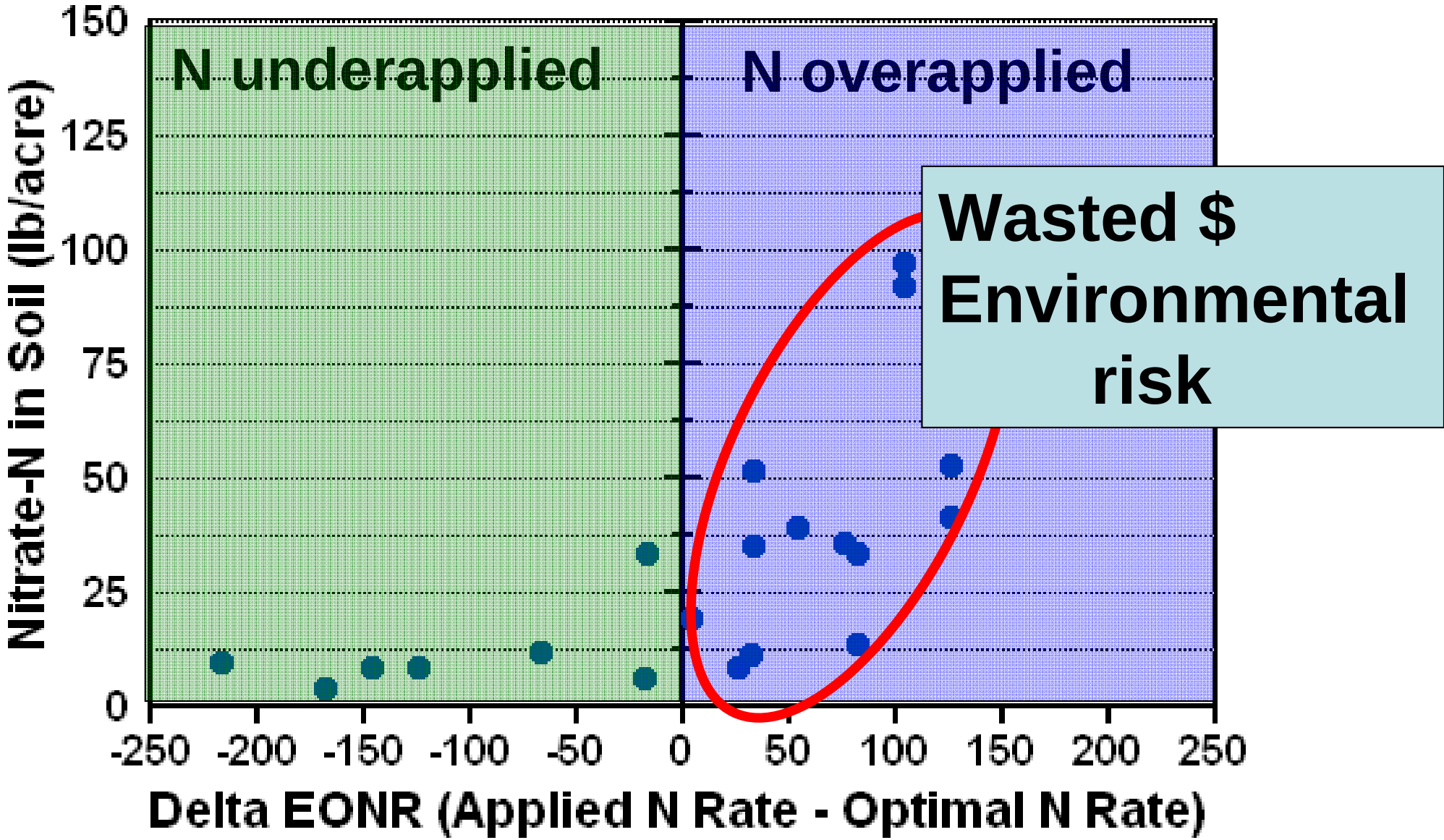
Crop sensors: What do they do?



Crop N need is variable: within a field



Overapplication = leftover N in soil



Putting the right fertilizer rate in the right place:

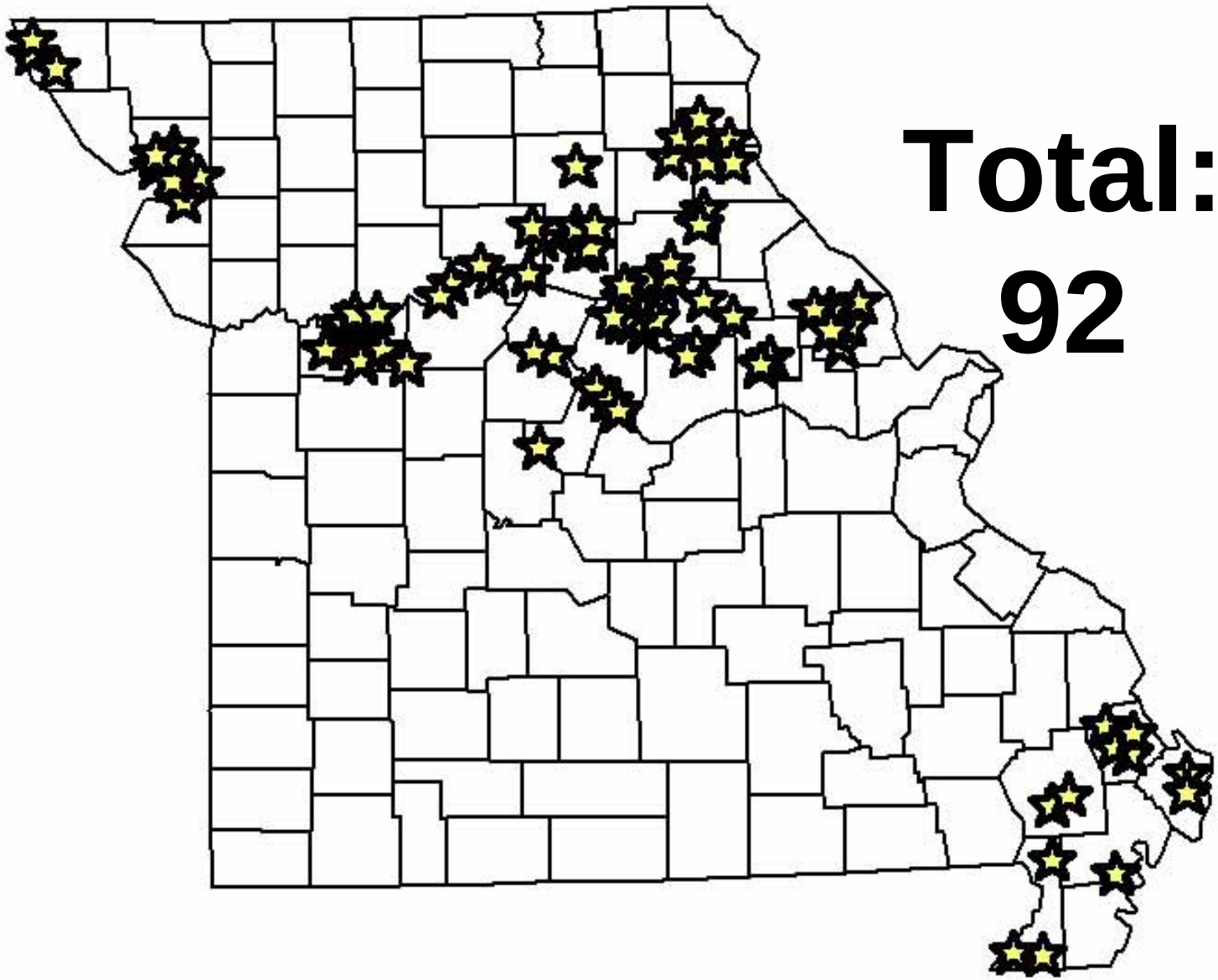
Spatially intensive diagnosis is needed to protect water quality

How?

Diagnosing where to put more N

Predictor	% of variability in N need explained
Yield	2 to 20
Soil nitrate	17 to 25
Soil N quick tests	0 to 18
Soil conductivity	8
Corn color	53 to 77

Locations of sensor demonstration fields 2004-2008



Total: 92

21 with USDA Spra-Coupe, 2004-2007

56 with producer-owned applicators, 2005-2008

16 with retailer-owned applicators, 2006-2008

Sensor outcomes

- 2004-2007: +$15/ac on corn (41-field ave)
  - Broke even on yield
  - Saved 24 lb N/acre
- 2008: +$29/ac (12-field average)
  - 9 bu yield increase (152 to 161)
  - Used 16 lb extra N
  - **Adjusted for wet weather and N loss!**
- 2009-2010: more sensor demos
  - Interested? Let me know

N timing in 2008—Columbia

Missouri EQIP support available

- 2007: $20/acre x 3 years = $60/acre
- 2008: $19/acre x 2 years = $38/acre
- 2009: $36/acre x 2 years = $72/acre


Questions?
06/08/2006

The Future

- N prices, environmental pressures will continue to push tighter N management

Nitrogen loss in 2008: What a mess!

Northwest Missouri, Missouri R. bottom, August 2

What kind of N applicator can you use sensors with?

Injecting anhydrous ammonia


injecting solution
(tractor)

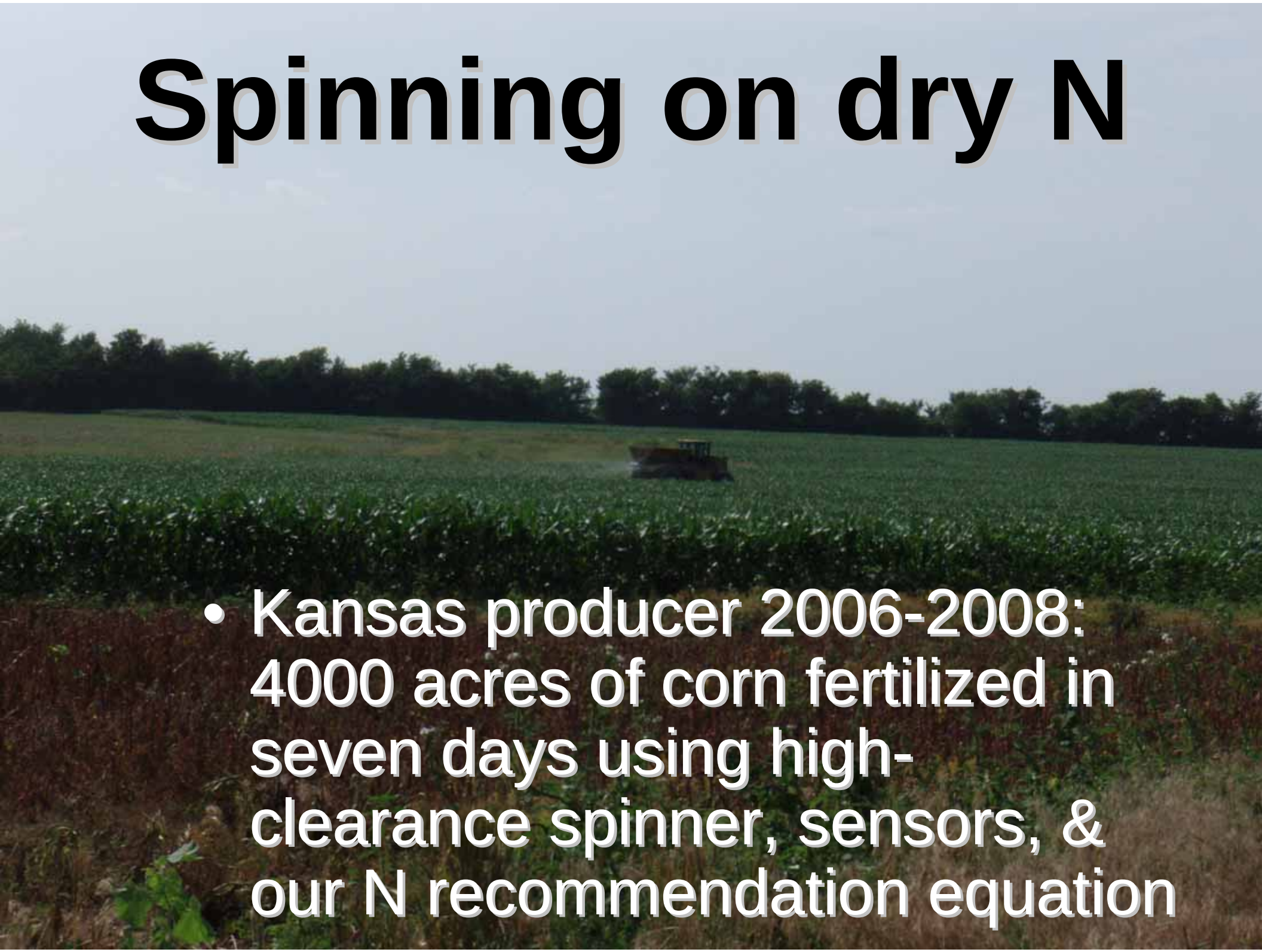
injecting solution (high-clearance)

Dribbling solution

Spinning on dry N

(easier to get a wide range of rates)

Spinning on dry N



- Kansas producer 2006-2008: 4000 acres of corn fertilized in seven days using high-clearance spinner, sensors, & our N recommendation equation

2008: Our first cotton demo

2006-07: Calibration research, looks great

2008 demo: Saved 45 lb N/acre, looks great!!

What have we learned?

- Power of visual reinforcement
  - The machine does what they would do
  - Dark crop = low N rate, light crop = high N
  - But automated to reduce operator fatigue
- Importance of preparation
  - Everything has to be slick
  - We calculate producer time at $11,000/day during spring & fall rush times

What have we learned?

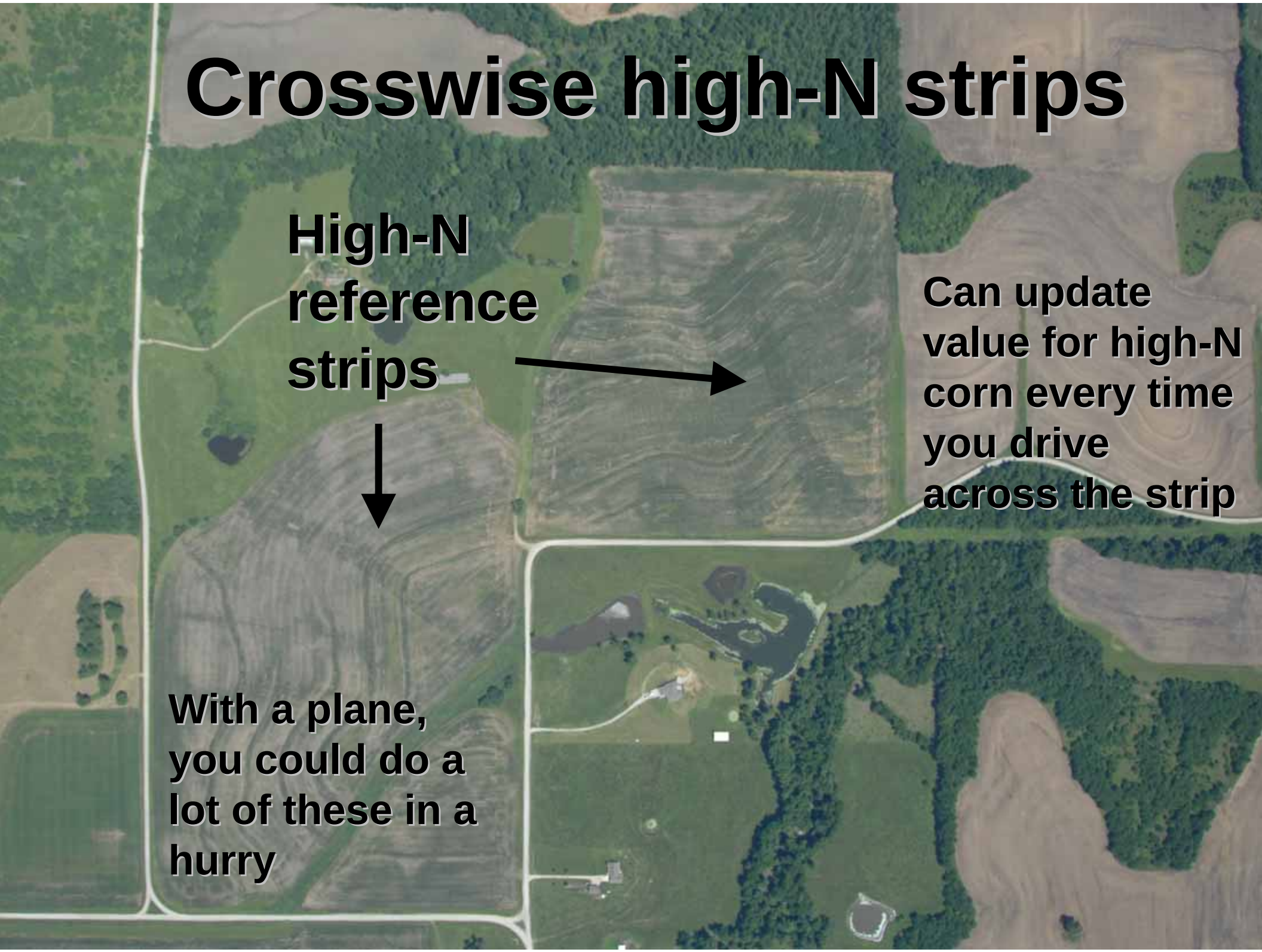
- Sensors can maintain productivity while reducing N use
  - Cut back in smart places
- Sensors can identify places/years that need more N (than the normal producer rate)

What have we learned?

- Obstacles:
  - Good recommendation equations
  - Weed interference (control early)
  - Limited range of rates with liquid
    - New spring-loaded nozzle bodies will help

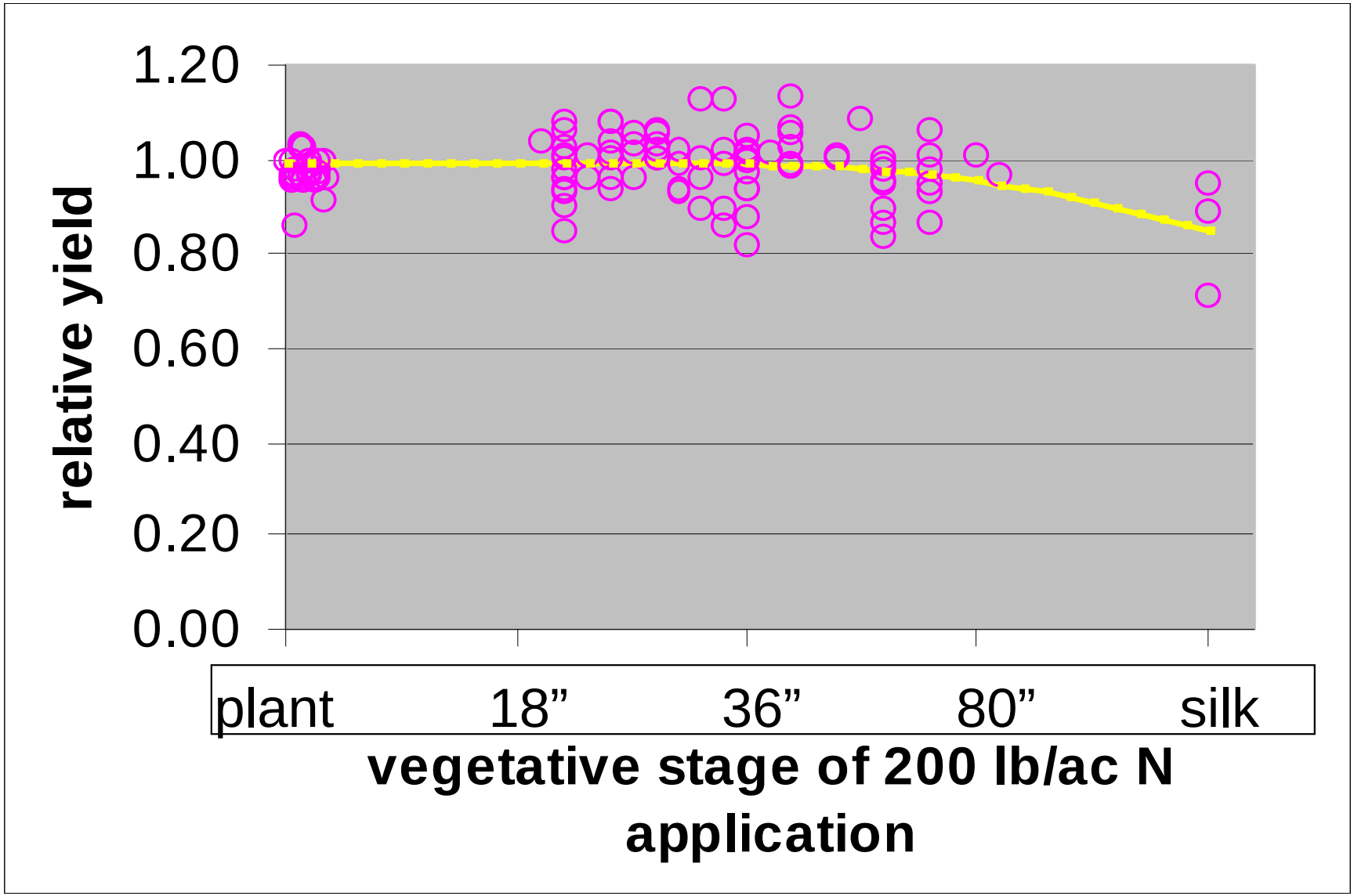
What have we learned?

- Obstacles:
  - High-N reference area
    - Hassle of installing
    - Use—Greenseeker uses best 3 seconds in a round, artificially inflates target appearance
  - Drift of sensor rates during the day


Crosswise high-N strips
High-N reference strips
Can update value for high-N corn every time you drive across the strip
With a plane, you could do a lot of these in a hurry

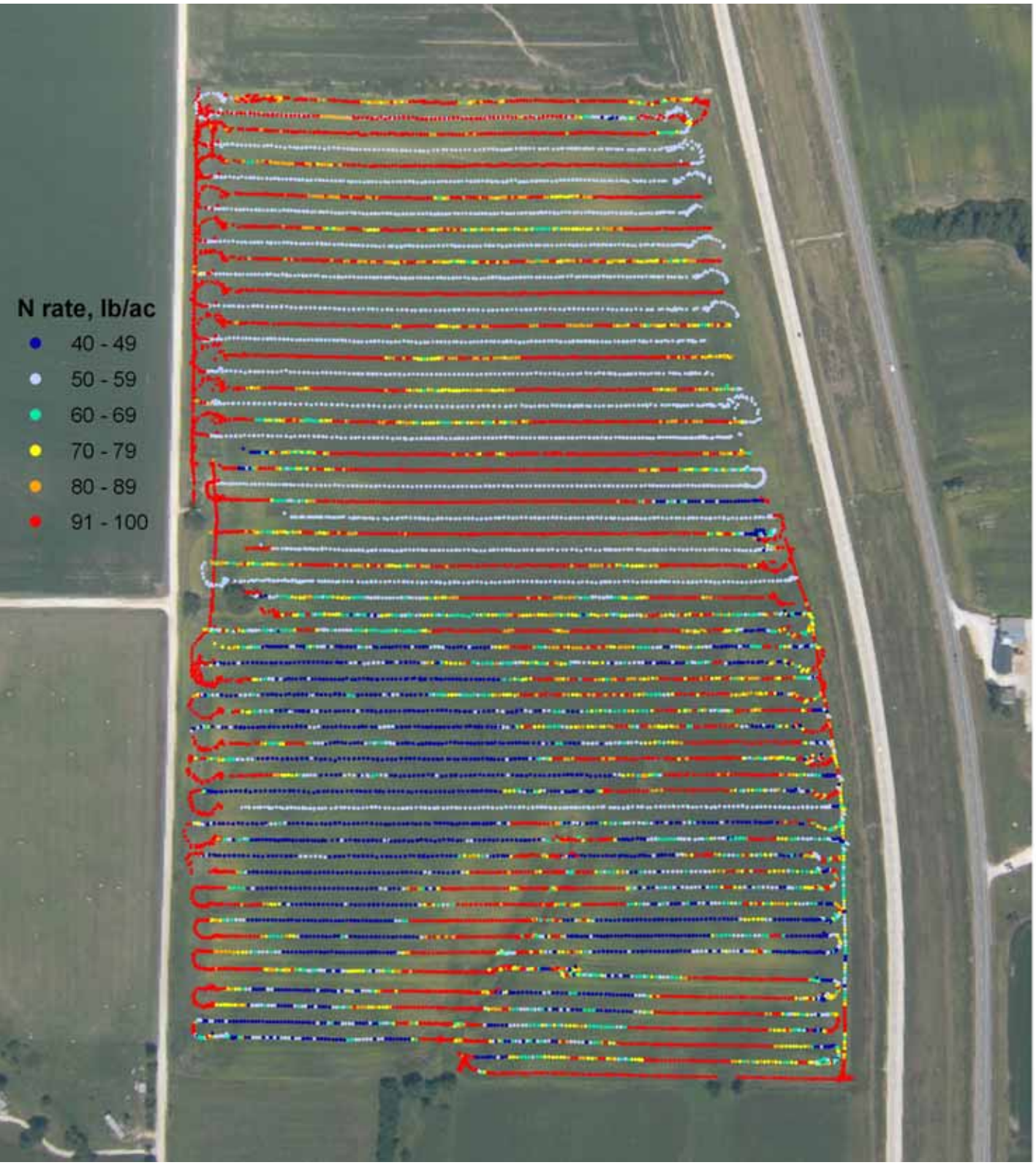
Corn yield is not as sensitive to late N application timing as you might think

28 small-plot trials in producer fields, Missouri, 1997-1999



Sensor Benefits:

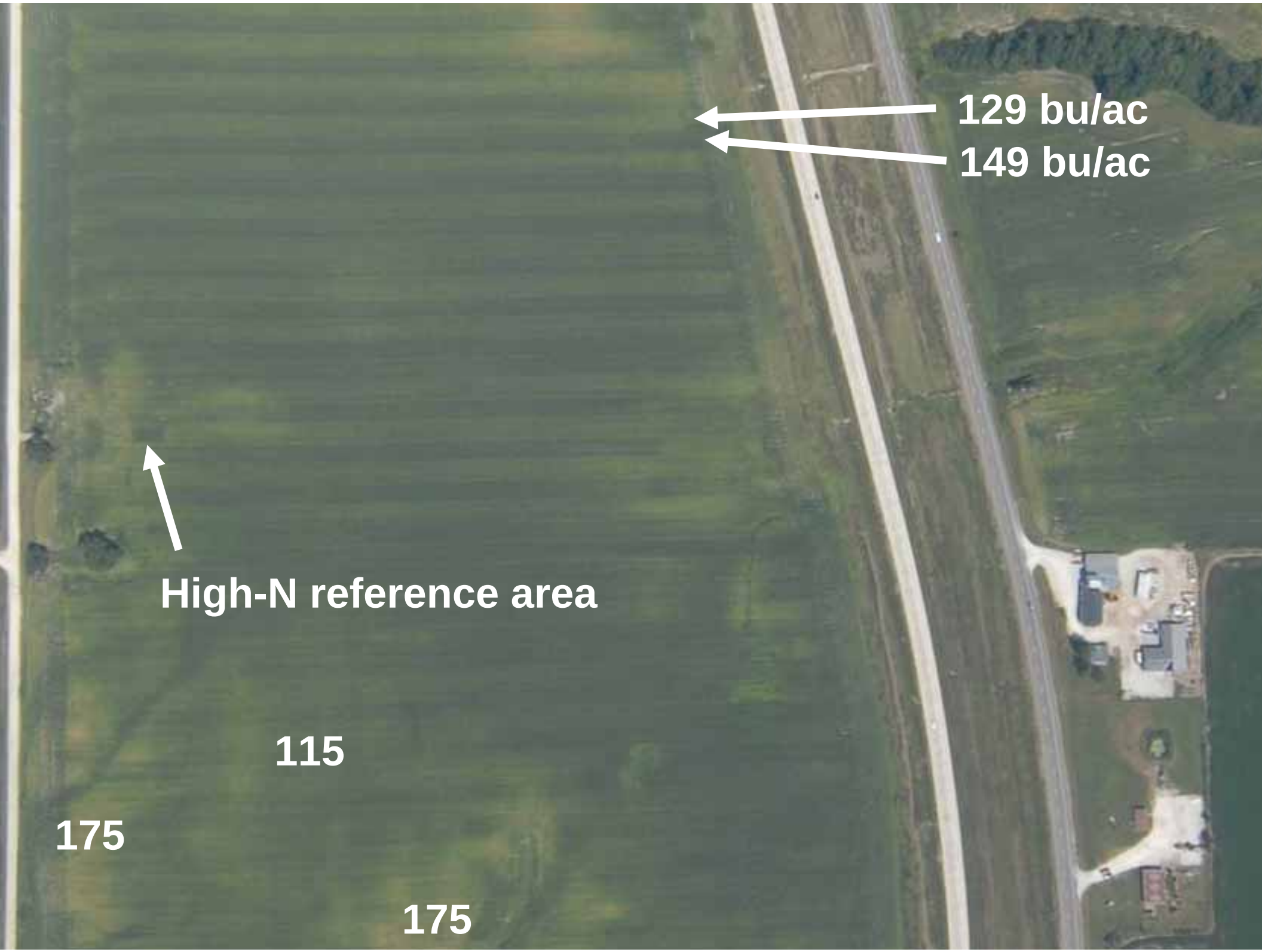
- Make sure enough N is applied
- Avoid unneeded N application



N application to head-high corn

N rate map

June 20, 2007


129 bu/ac
149 bu/ac
High-N reference area
115
175
175

Sensor Benefits:

- Make sure enough N is applied
- Avoid unneeded N application

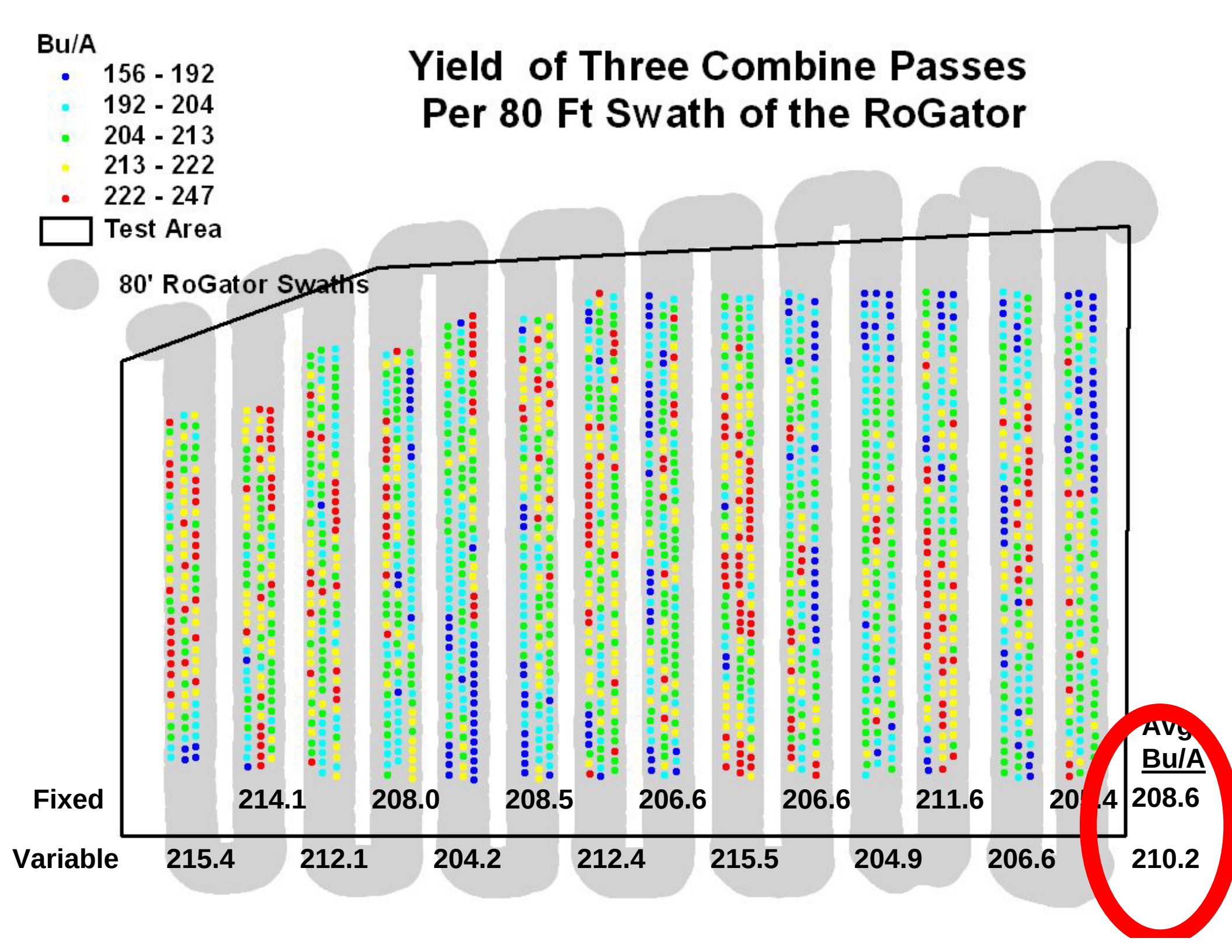
Pounds of Nitrogen As Applied Via UAN on 6/13/07
Becker Farm - Laddonia, MO

As Applied

- 60-81
- 82 - 111
- 112 - 137
- 138 - 164
- 165 - 180

N
W E
S

August 1 Aerial Photo after the June 13 UAN Application


Bu/A
156 - 192
192 - 204
204 - 213
213 - 222
222 - 247
Test Area
80' RoGator Swaths
Yield of Three Combine Passes
Per 80 Ft Swath of the RoGator
Avg
Bu/A
Fixed
214.1
208.0
208.5
206.6
206.6
211.6
208.6
Variable
215.4
212.1
204.2
212.4
215.5
204.9
206.6
210.2