Nitrogen loss and Late-season N application for corn
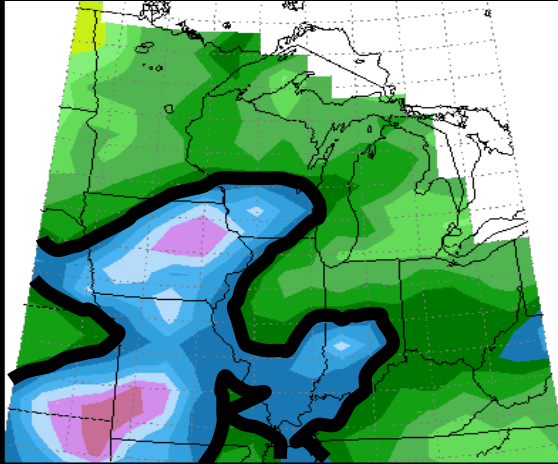
Peter Scharf

University of Missouri
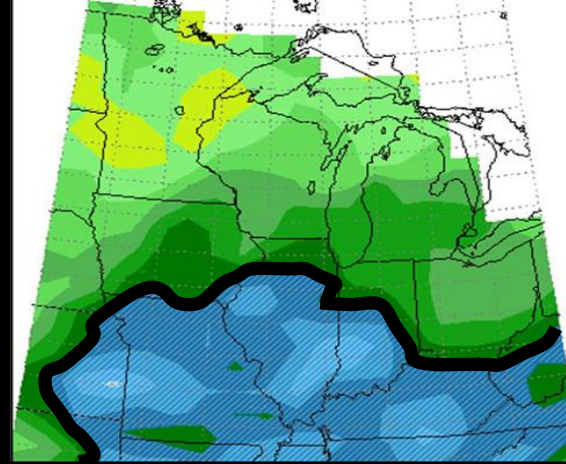
Four wet springs…

Outlined areas > 16 inches rain April-June
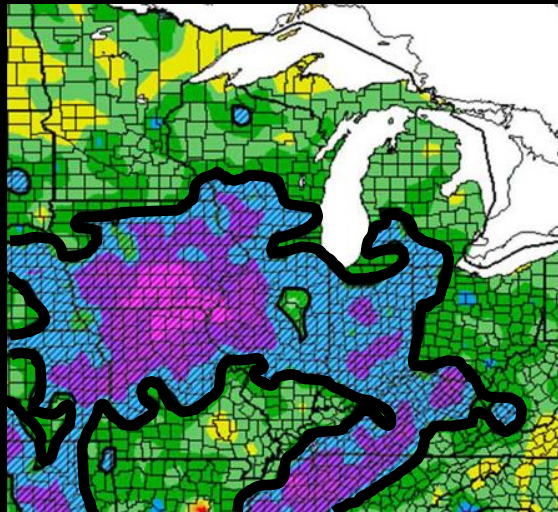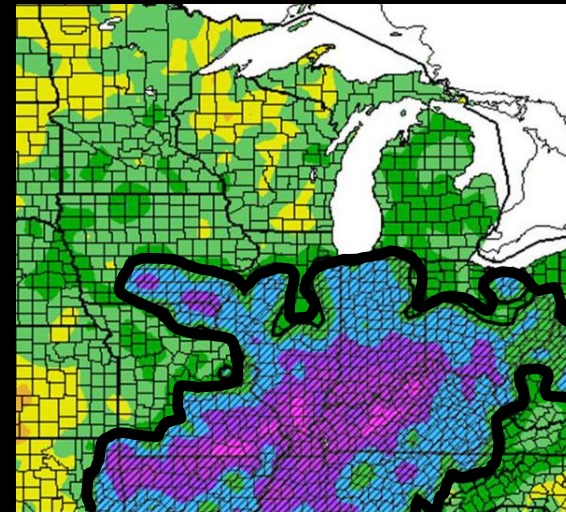
2008

2009

2010

2011

…Four years with about 500 million bushels of corn lost EACH YEAR due to N deficiency

Central Illinois

Southern Iowa

Western Missouri

Central Missouri

This field got 150 lb N/acre as NH_3 in very late November (+ DAP)

Yield maps: yellow corn yields poorly

2009 georeferenced photo

2009 Yield Map

250

$y = -3.01x + 514$
$R^2 = 0.52$

Absolute Green

Average yield loss = 45 bu/acre
Total yield loss = 11,925 bu
        (45 bu/ac x 265 acres)
Total economic loss = **$44,720**
        (11,925 bu x $3.75/bu)

Eastern Missouri

Southern Indiana

Eastern Illinois

Eastern Illinois

More images of N deficiency on my website

- On my nitrogen loss page:

http://plantsci.missouri.edu/nutrientmanagement/nitrogen/loss.htm

- Currently images from 2009 and 2010 are available

- Images from 2008 will be posted in the future

- Grouped by nearest town

Plan B

- What will I do if we get enough rain to cause N loss?
  - Diagnosis & decision
  - Application
- Every producer should have a plan!
- Consultants and retailers should too!

Can rescue N really work?

Miami County, Kansas

Same field

with extra N

without extra N

Photo: Andy Holzwarth

Yield response, bu/acre

- ● -30 - 0
- ● 1 - 6.8
- ● 6.9 - 17.9
- ● 18.0 - 27.7
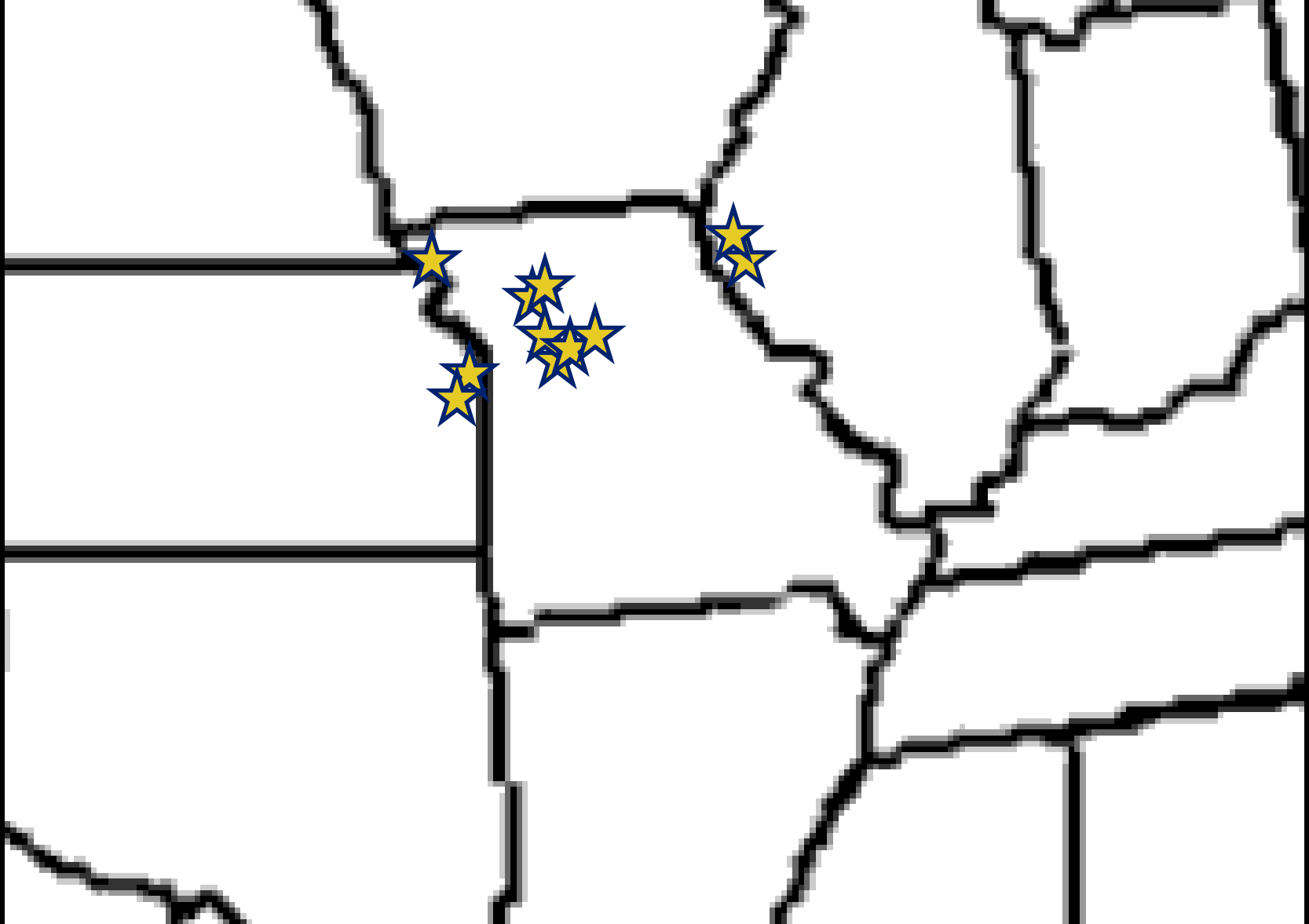- ● 27.8 - 42.0
- ● 42.1 - 68.9

Yield response:
- **28 bu where stress is visible**
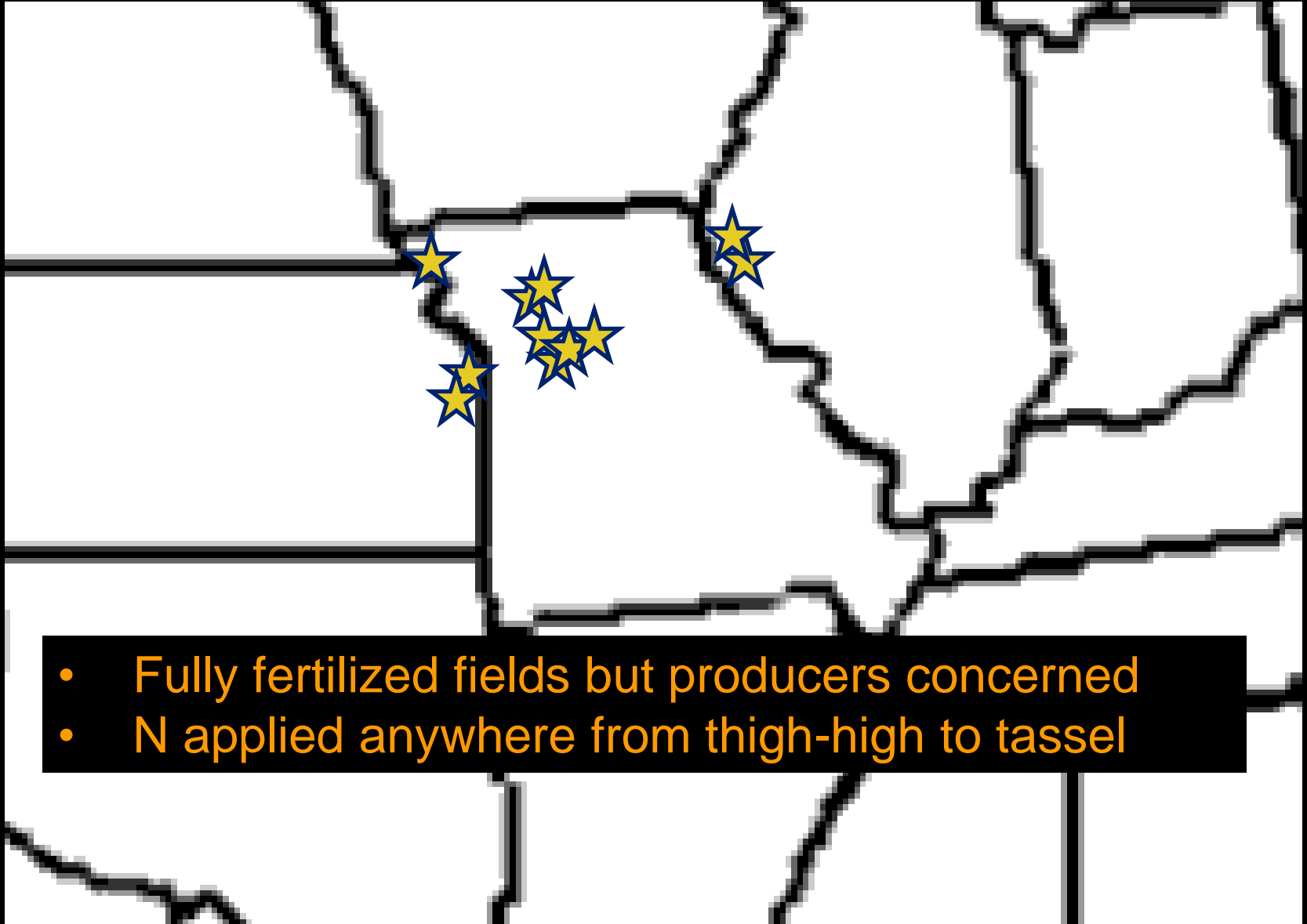- **-2 bu where no stress is visible**

Rescue N

- Yield response can be large
- Rescue applications can be late (7 foot corn in example)
- Size of yield response is related to corn color in aerial photographs

On-farm rescue N demonstrations

# On-farm rescue N demonstrations

- Fully fertilized fields but producers concerned
- N applied anywhere from thigh-high to tassel

Rescue N outcomes

- **11 tests, average yield response 34 bu/acre**
- **Yield response depended on visible stress**
  - High stress: 57 bushels (2 tests)
  - Medium stress: 41 bushels (5 tests)
  - Low stress: 14 bushels (4 tests)
- How late is too late?
  - Six tests in 2010, all applied at tassel, ave 34 bu
  - Give up by 2 weeks after tassel

Rescue N in Illinois: 37 bu


Corn Yield by Fertilizer Treatment
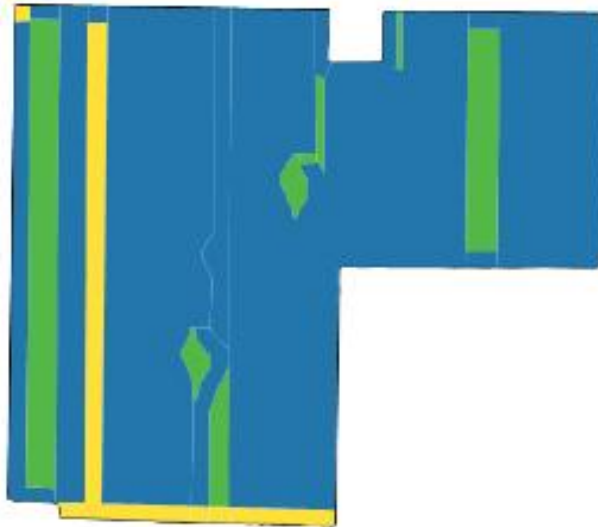
Client: Illini FS_Heritage Family Farms
Farm: Heritage Family Farms
Field: MCCOLL 137
Area: 136.59 ac
Event Date: 7/7/2009
Save Name: Urea 09
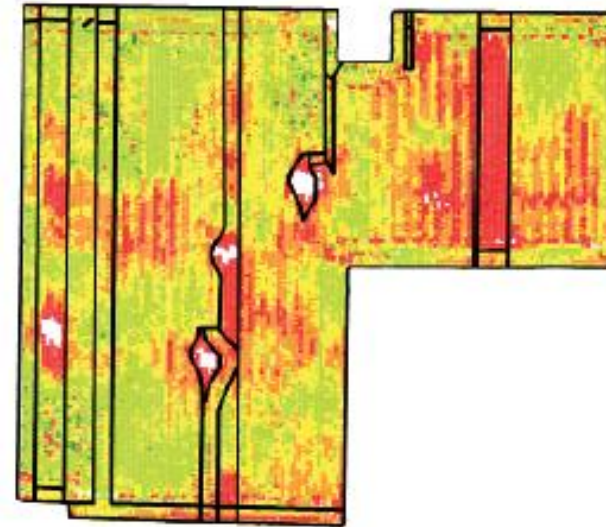
Dry Yield - Corn - 2009
- 12 - 113.51 (19.48 ac)
- 113.51 - 162.49 (32.78 ac)
- 162.49 - 199.31 (39.47 ac)
- 199.33 - 253.25 (40.93 ac)
- 253.33 - 300 (1.66 ac)

Legend	Treatment	Avg.	Dry Yield Min.	Max.	Avg. Moisture	Total Bushels	Acres
	46-0-0 Urea (160 lb/ac)	174.19	12.21	300.00	23.70	1,400.51	8.04
	46-0-0 Urea (150 lb/ac)	172.88	12.04	300.00	23.25	19,386.0	112.13
	None	135.89	12.00	300.00	22.72	1,923.48	14.15

Supplemental N—how late?

yield relative to preplant N

1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0

0

- missouri
- nebraska
- oklahoma
- minnesota
- iowa

Easily until tasseling

Probably until 2 weeks after tassel if deficiency is severe

growth stage of single or main N applic.
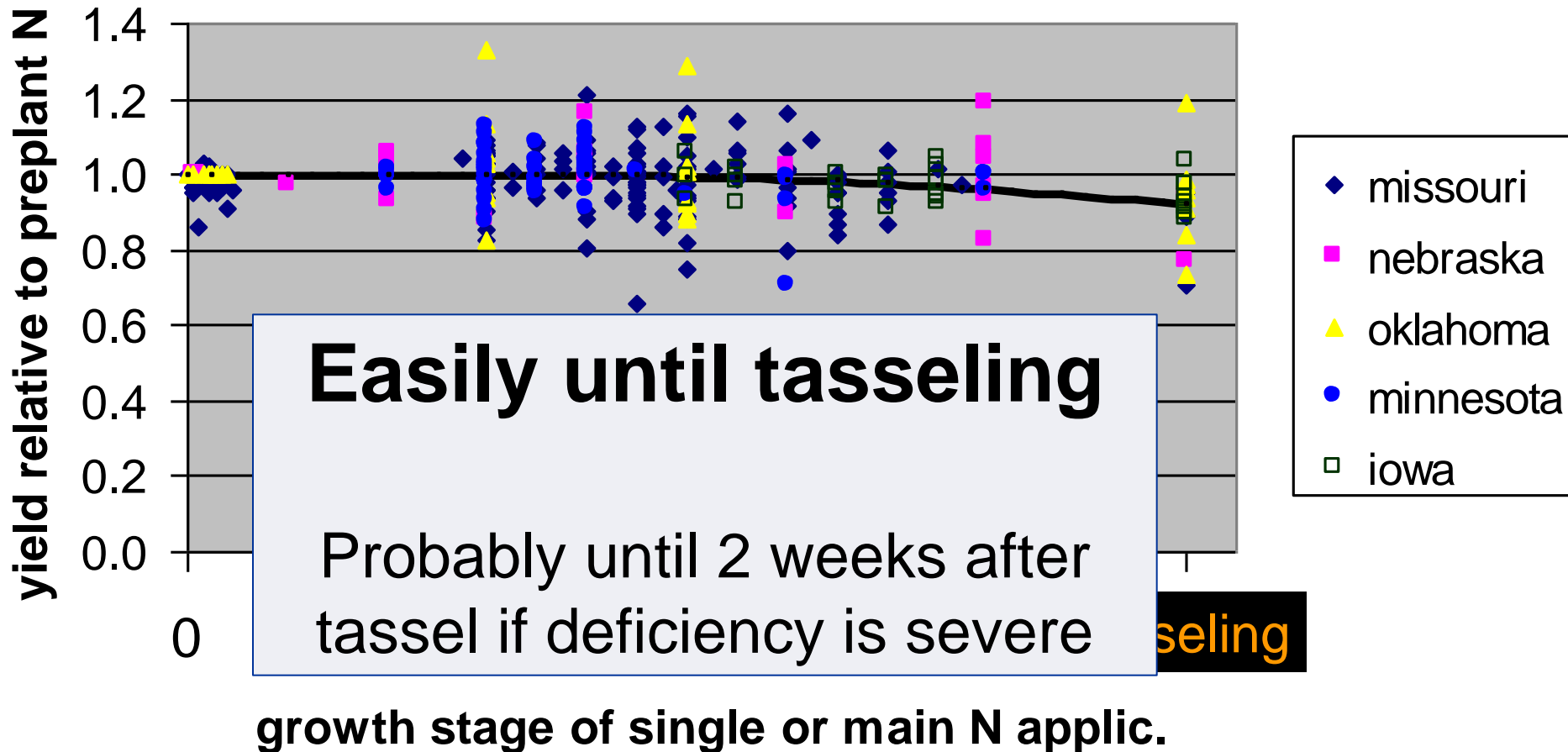
N timing in Indiana 2010
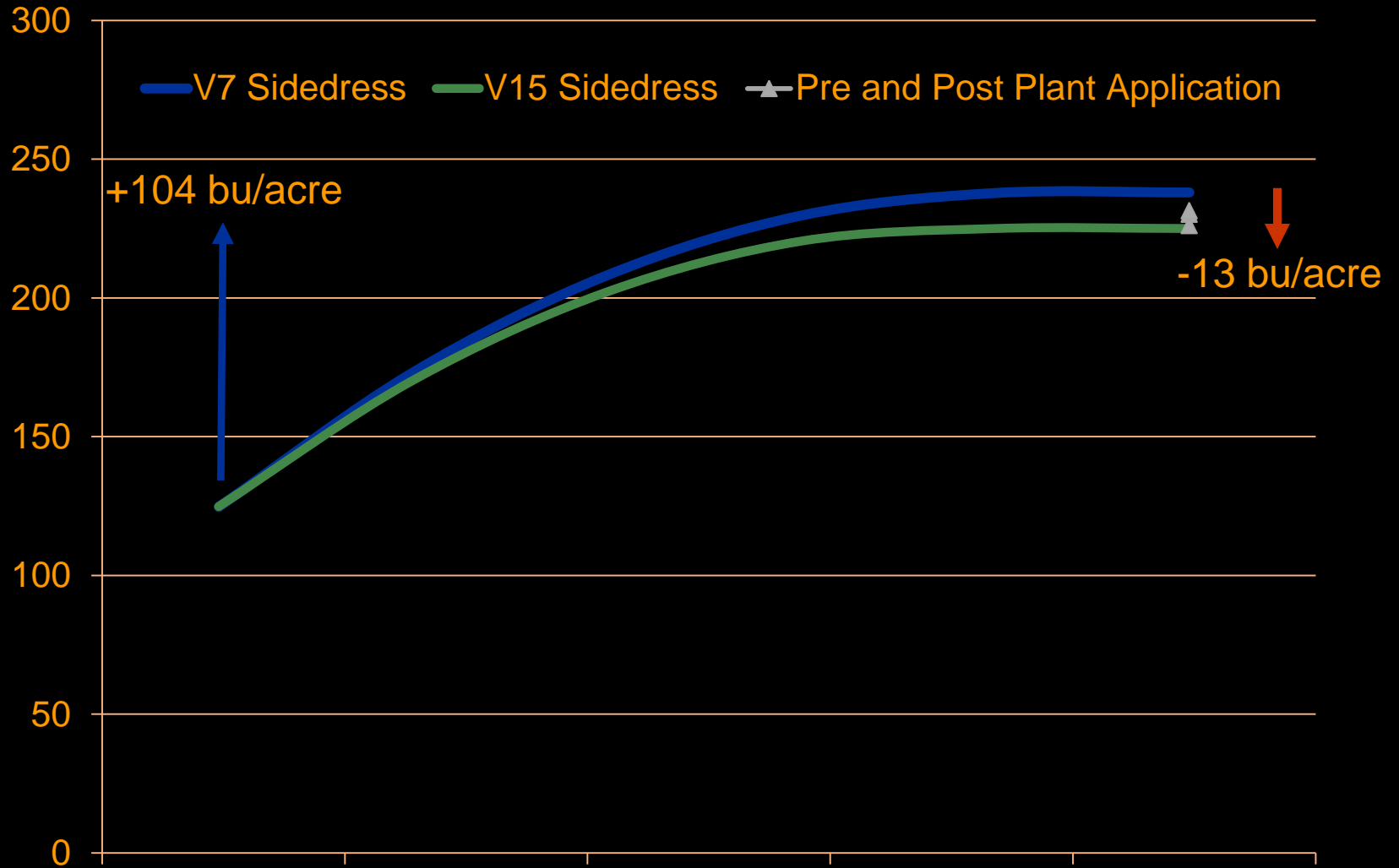
N timing in Indiana 2011

Diagnosis

- N Watch feature on my website
- **Remote sensing**
  - Quantify potential yield loss
  - Prioritize fields (how severe?)
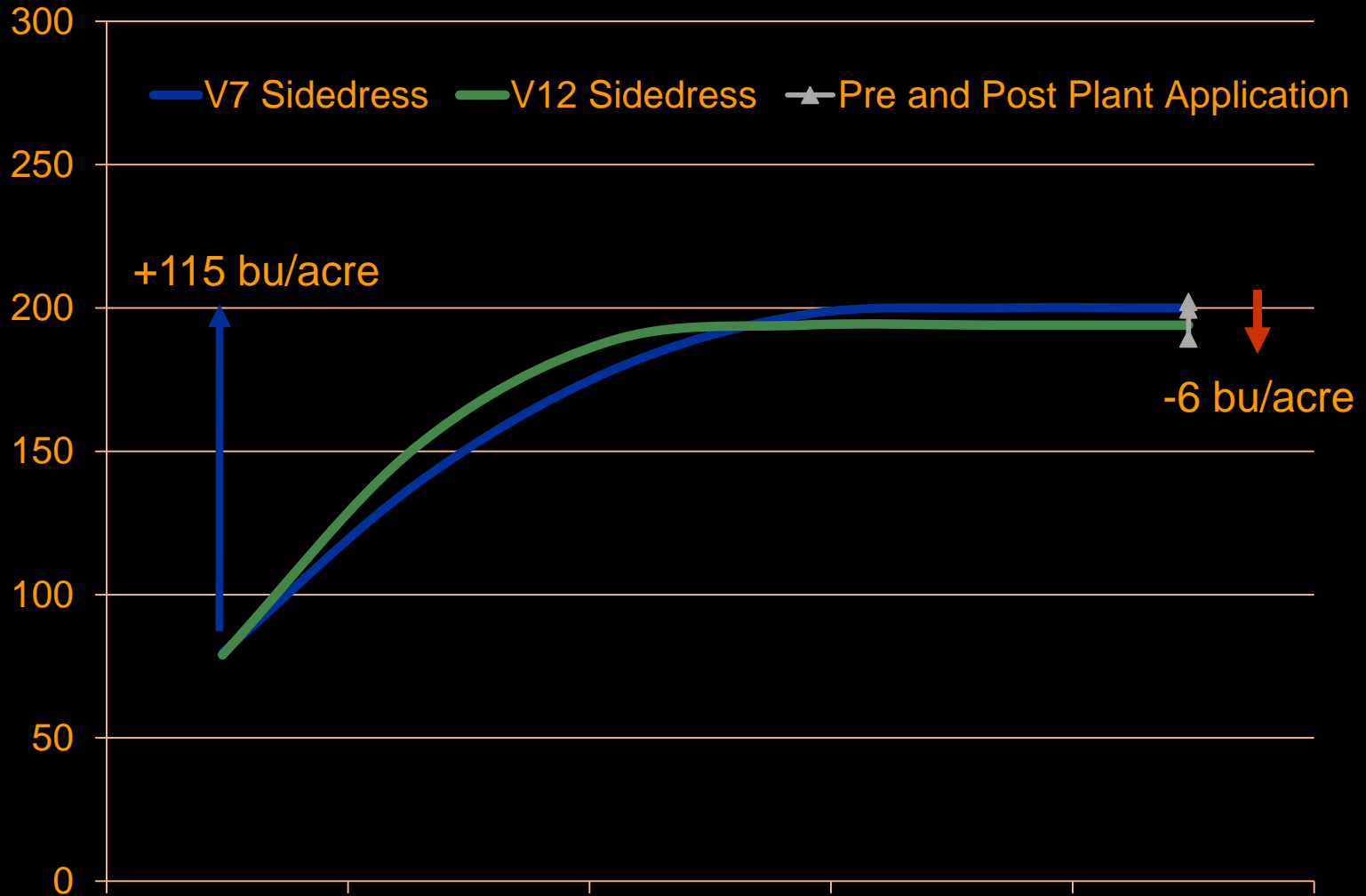 - Diagnose a lot of fields quickly
  - Not until corn is waist high
- Computer models (Adapt-N in New York)
  - More regional, less accurate
  - Can diagnose the problem earlier

Nitrogen watch

- On my Nitrogen Loss web page
    - http://plantsci.missouri.edu/nutrientmanagement/nitrogen/loss.htm
- Updated weekly from late April (or early May) until the end of June
- Tracks rainfall totals, identifies areas at risk for N loss

Nitrogen watch: example

Total Precipitation in Inches
April 1, 2009 to June 29, 2009

0.01 0.6 3 6 8 10 12 14 16 18 20 22
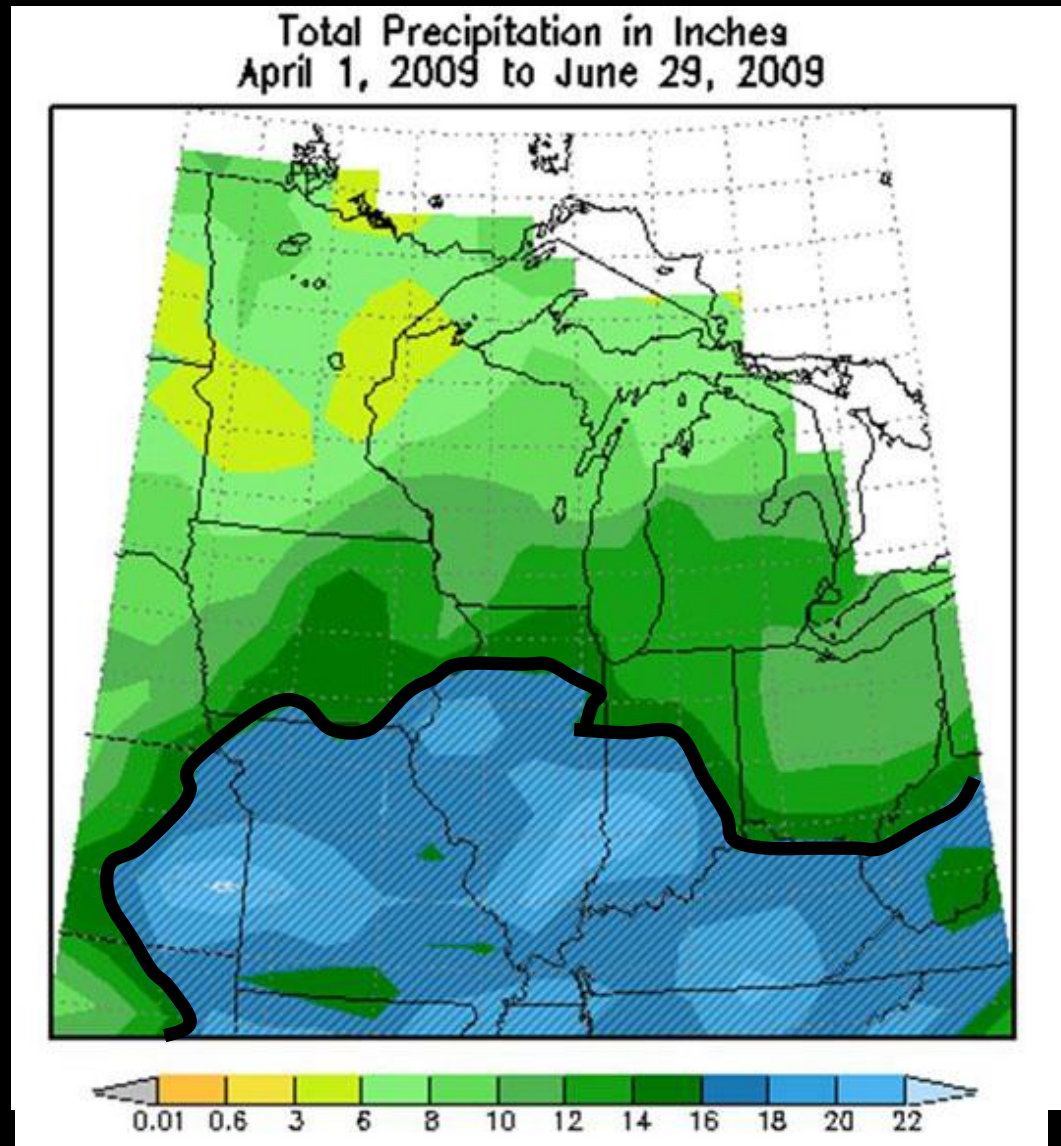
What does the farmer need?

1) An assessment of which fields need supplemental N the most

2) An assessment of how much effort it's worth to get supplemental N applied (sprayer conversion or arranging custom N)

3) How many $ am I losing?

4) How much N should I apply?

Best tool: remote sensing
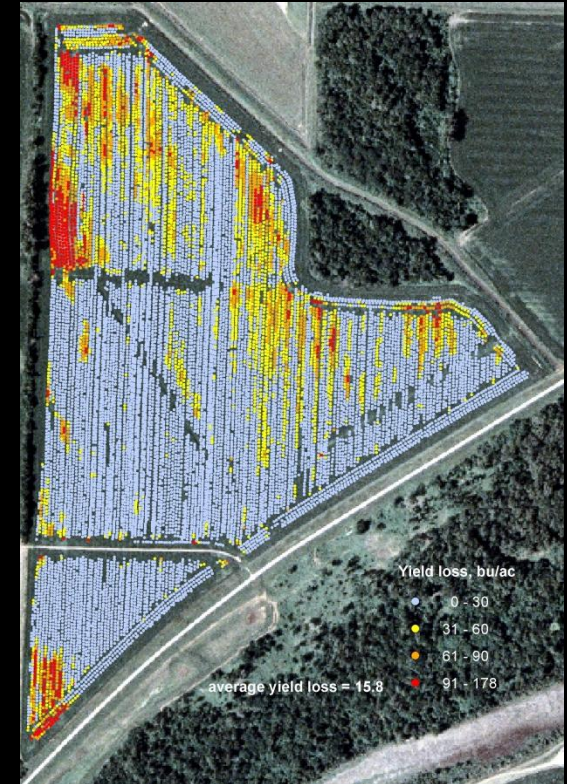
N need in Central Illinois

medium

high

low

Diagnosing yield loss

June 24 aerial photo

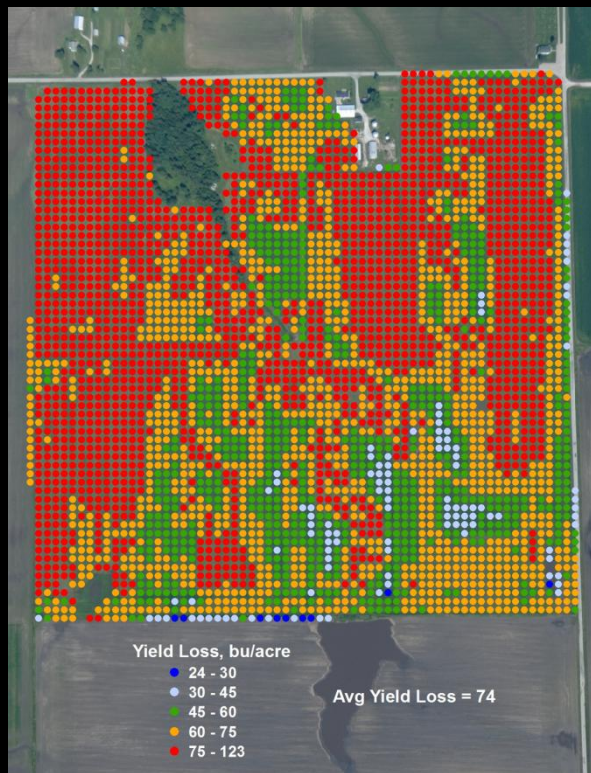**Yield loss map predicted from June 24 aerial photo**

Yield loss map based on yield monitor data (September 30)

NVision:
quantitative decision support

aerial photo

yield loss map (ave 74)

Yield Loss, bu/acre
- 24 - 30
- 30 - 45
- 45 - 60
- 60 - 75
- 75 - 123

Avg Yield Loss = 74
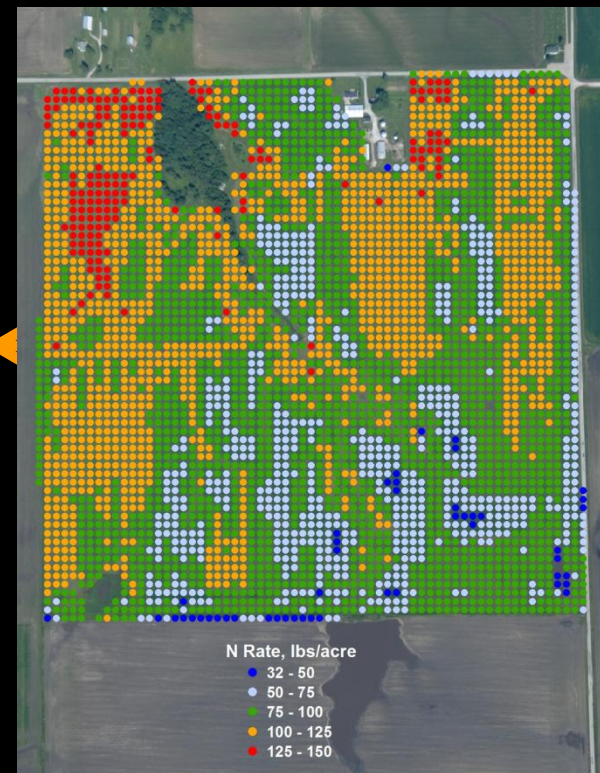
N rate map: fix the problem

N Rate, lbs/acre
- 32 - 50
- 50 - 75
- 75 - 100
- 100 - 125
- 125 - 150

Can it be done?

- Assessing potential yield loss due to N stress: YES

- Getting profitable response to late or rescue N applications: YES

- Assessing N rate needed: YES

- Getting late N applied to most fields in a region where N loss has occurred: MAYBE

So if we know we need more N, and we know how much, how do we get it done?

Answer: Any way is a good way

Delivering the Cure

$5/acre and fast

Delivering the Cure

06/08/2006

Delivering the Cure

$10/acre

Delivering the Cure

$7/acre to apply N

Yield loss to N burn
(average of 7 locations in Missouri, 2003-04)

150 lb N applied broadcast at corn height:

| Treatment	1 foot	2 feet	3 feet	4 feet
Ammonium nitrate	1	8	20	18
28% N solution	9	14	33	61
Urea	0	0		4

Broadcasting N over corn

- Fast & effective
- Urea is the best choice
  - N burn on leaves has minimal effect on yield
  - But make sure it's not dusty
- Corn 2 feet tall or less: use Agrotain on urea to prevent volatile loss of N

Is it worth the cost & effort?

Doubling profit with rescue N?
Missouri 2009 estimates
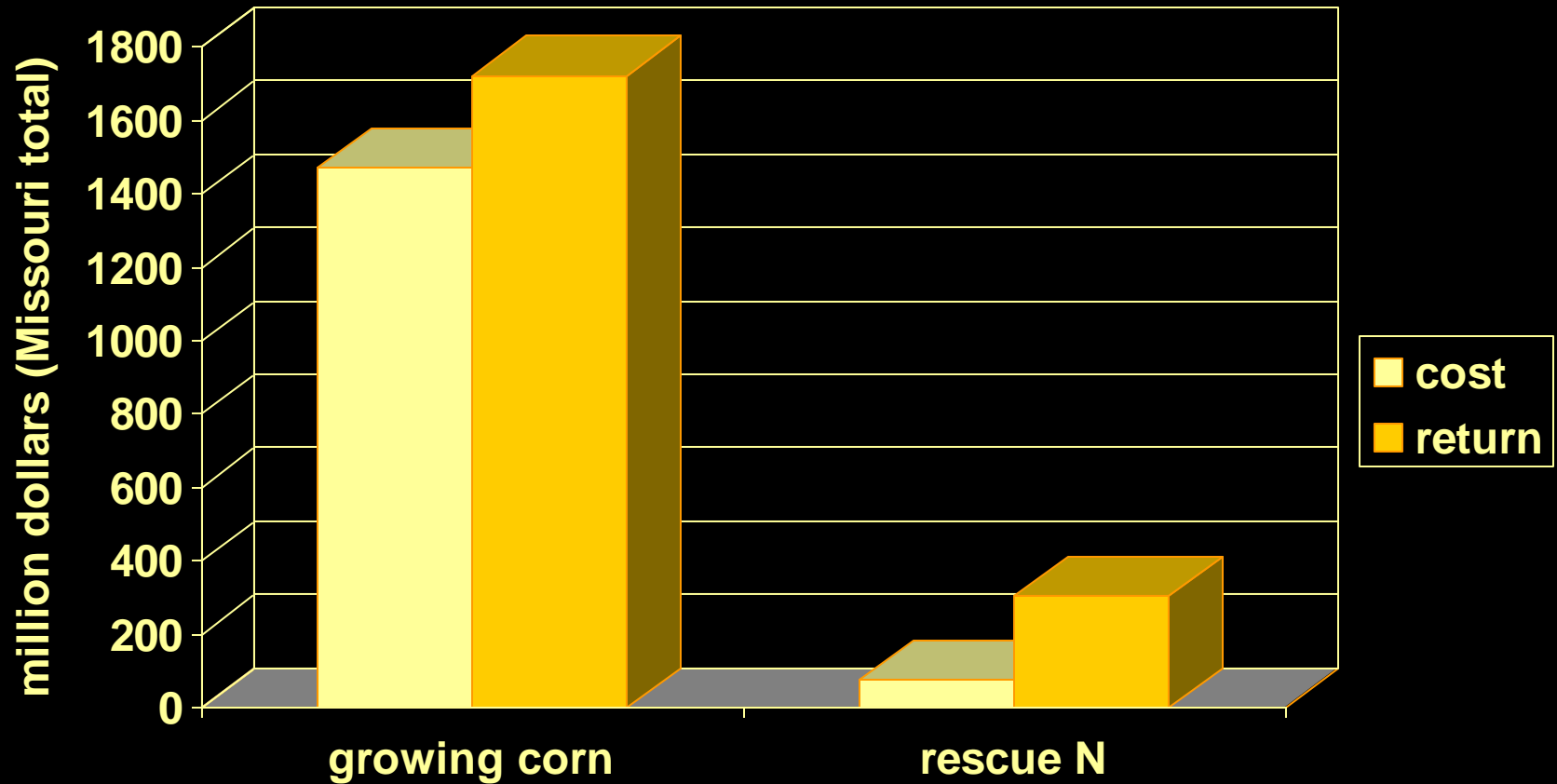
How much does fertilizer timing matter?

In a wet year, A LOT

Central Missouri 2008:
in-season N kicks butt

+ 44 bu/ac

180 N
at planting

110 N
sidedress V7.5

Central Missouri 2009:
in-season N kicks butt again

+ 68 bu/acre

153 N
sidedress V7.5

180 N
at planting

140 PRE
180 PRE
147 SIDE
100 PRE

80 bu difference

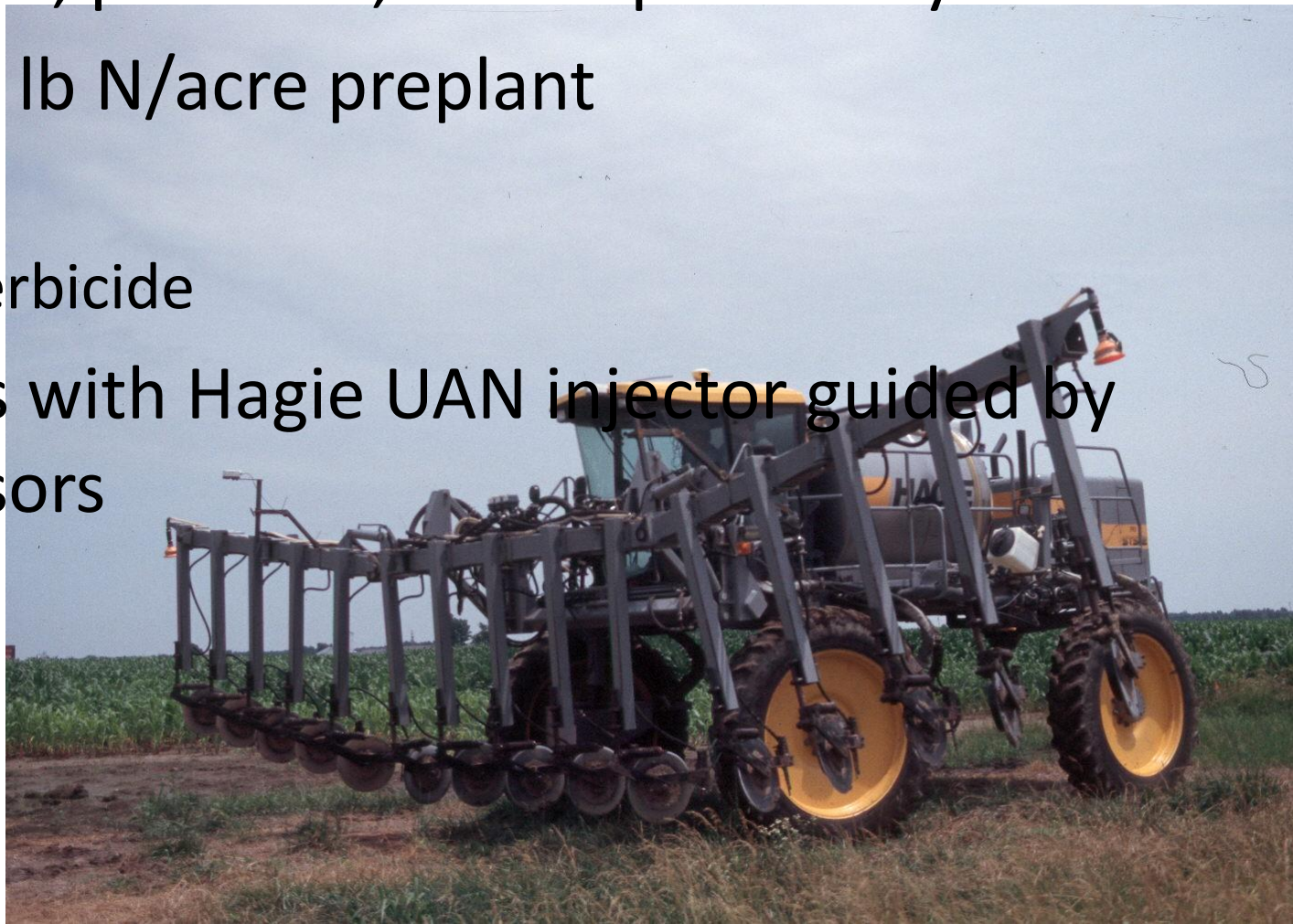Central Missouri 2010:
Can you believe a 3-peat?

0
197 SIDE
124 PRE
202 SIDE

Winning game plans: Sander

- Ted Sander, producer, Randolph County
- About 70 lb N/acre preplant
  - In DAP
  - With herbicide
- Sidedress with Hagie UAN injector guided by crop sensors

Winning game plans: Riekhof

- Gary & Garret Riekhof, producers, Lafayette County
- Fall or spring NH_3
  - Some fields full rate, some fields lean rate
- Chicken litter on some fields (slow release)
- Tractor-drawn sidedress UAN injection for fields with visible stress (esp. lean NH3 rate)
 - Corn up to 40"

Winning game plans: Ramsey

- Gabe Ramsey, Central Missouri Agri-Services (Marshall)

- Producers follow their normal N program
  - Suggest 130-150 lb N/ac as NH_3 + N-Serve

- Spinner with crop sensors
  - **Help producers who experience N loss**

Winning game plans: Schaefer

- Dan Schaefer, Illini FS (eastern Illinois)
- Held organizing meeting to sell new N program
- Reduce preplant N rates to 70% (fall NH_3)
- Apply N with herbicide
- High-clearance spinner to topdress urea
  - Always in corn after corn
  - In rotated corn based on appearance & weather
- Spinners are 'combo' machines
  - Use to spray if low need for topdress
  - Use for topdress if needed, lease sprayer(s)
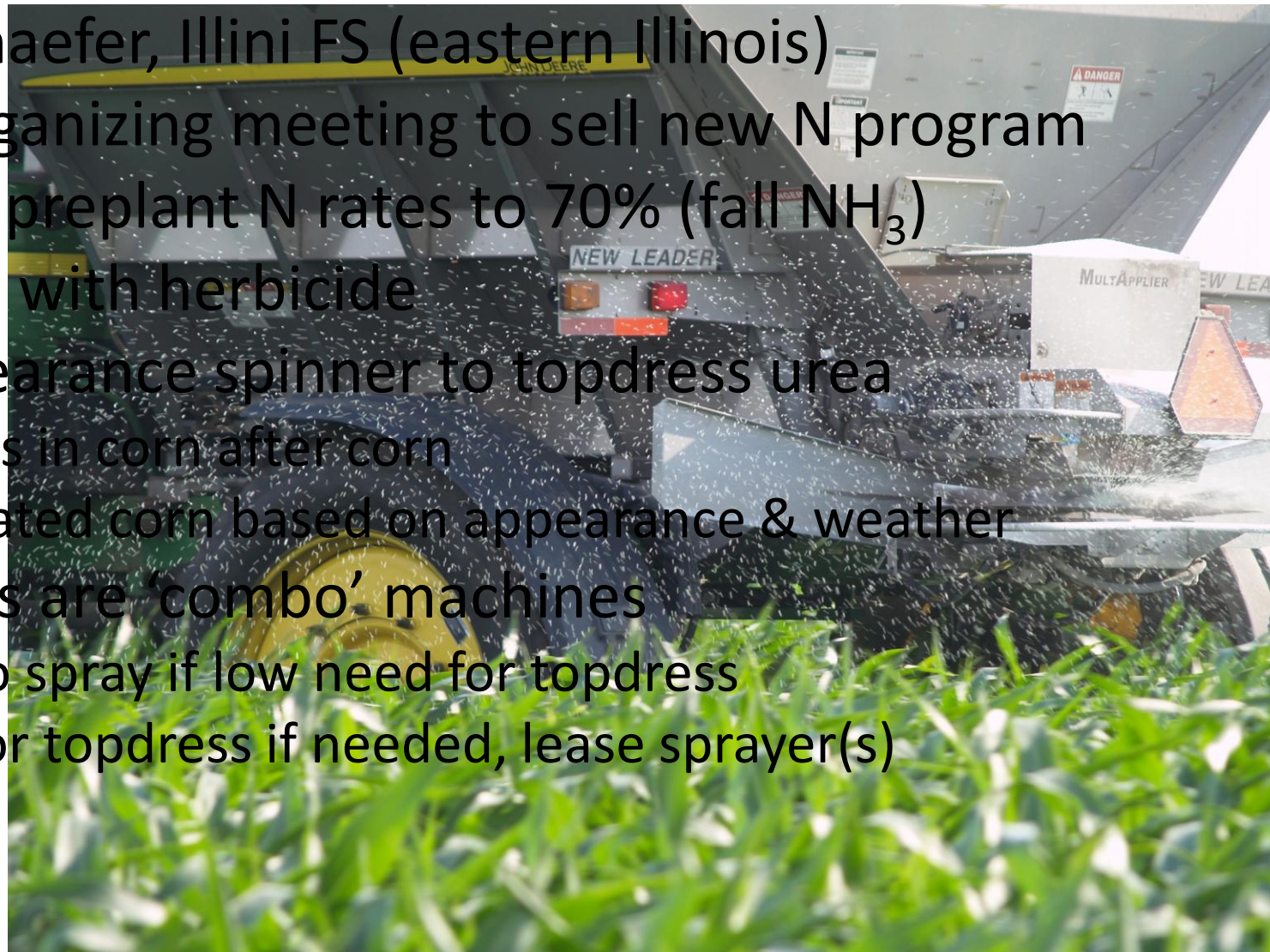
Winning game plans: Brown

- Steve Brown, Macon MFA
- Organized rescue N airplane in 2010
- 2011 started planned in-season N program with some customers, either:
  - Tractor-drawn UAN injection (contractor) OR
  - Plane broadcasting SuperU
  - Choice based on customer preference
  - Reduced preplant N rates

Questions? Comments?

Photo courtesy of Fred Blackmer