Nitrogen decisions and tools to make them

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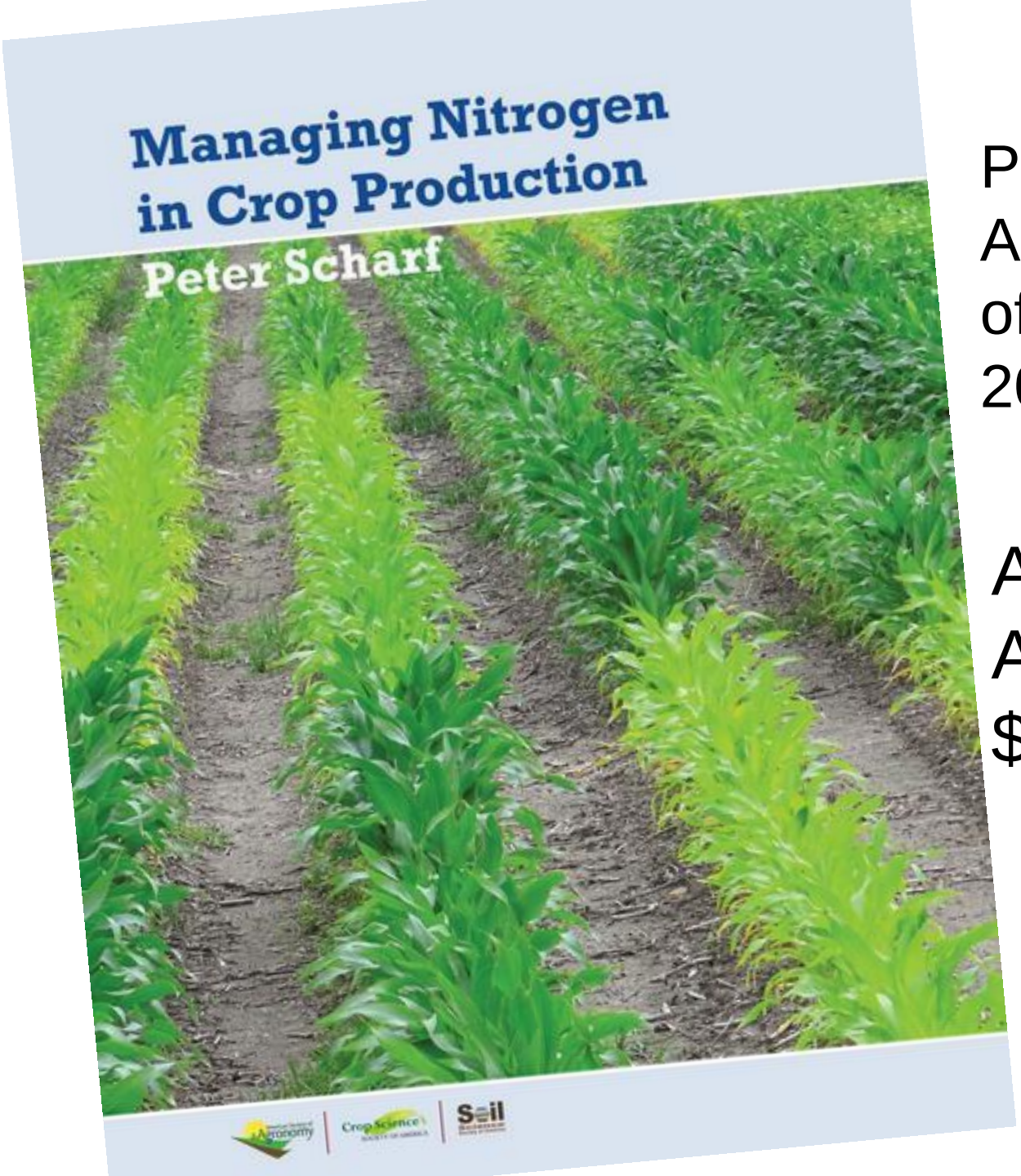


Published by the American Society of Agronomy in 2015

Available via Amazon or ASA $30

Nitrogen decisions

- Timing
- Rate
- Source
- Placement

Biggest impact decision, past 10 years

Nitrogen timing

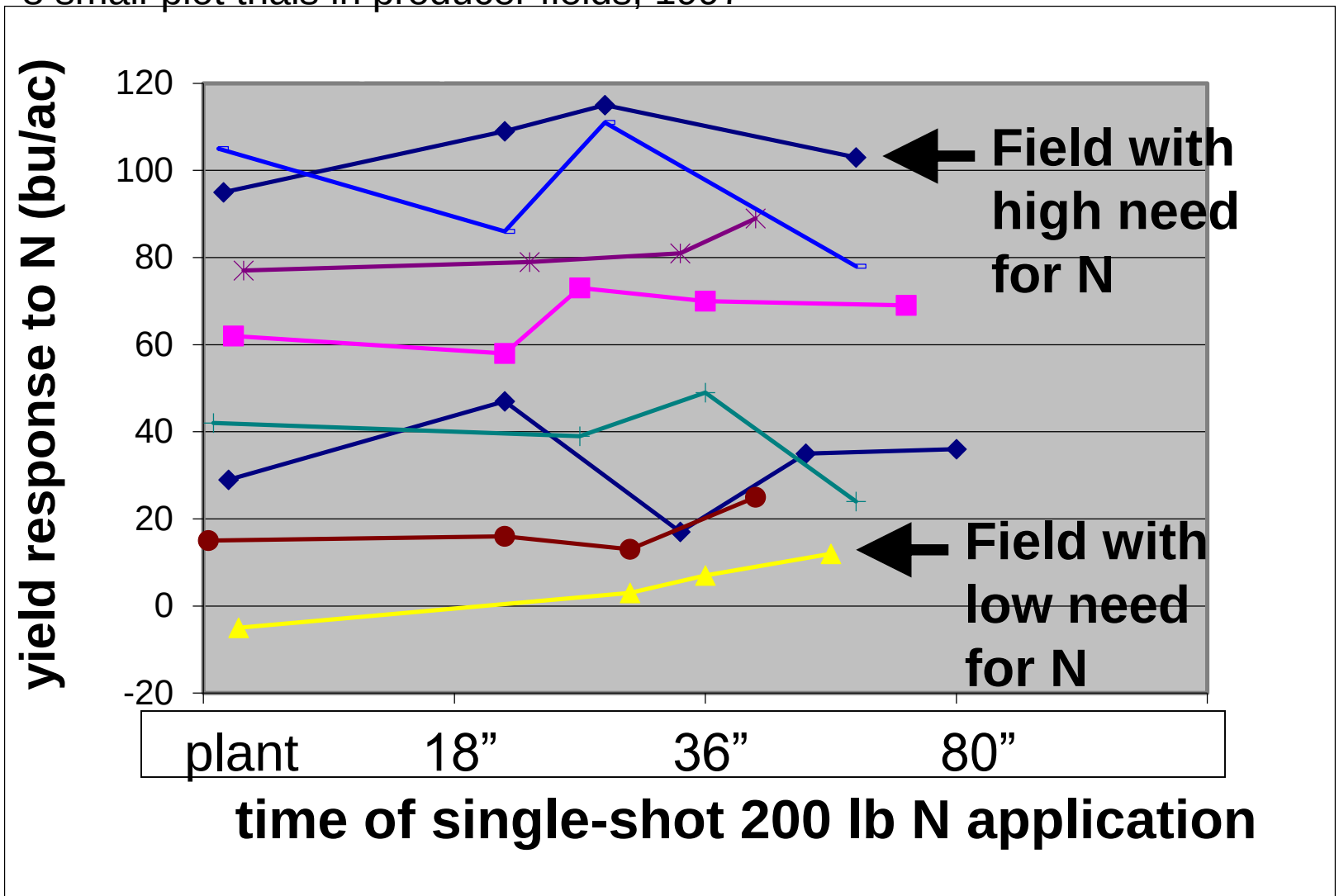
- Biology
- Equipment
- Weather

Nitrogen timing: know the biology

- Corn for grain
  - First application planting to chest-high
  - Last application by tassel
- Corn for silage
  - Last application by waist-high
- Wheat
  - Just before jointing
  - At greenup if tillers are needed
- Cotton
  - First application by first square
  - Last application by first flower

Yield response to N depends a lot on need, not much on timing

8 small-plot trials in producer fields, 1997



Nitrogen timing: equipment matters

1 acre in 3 minutes

3 acres in 1 minute

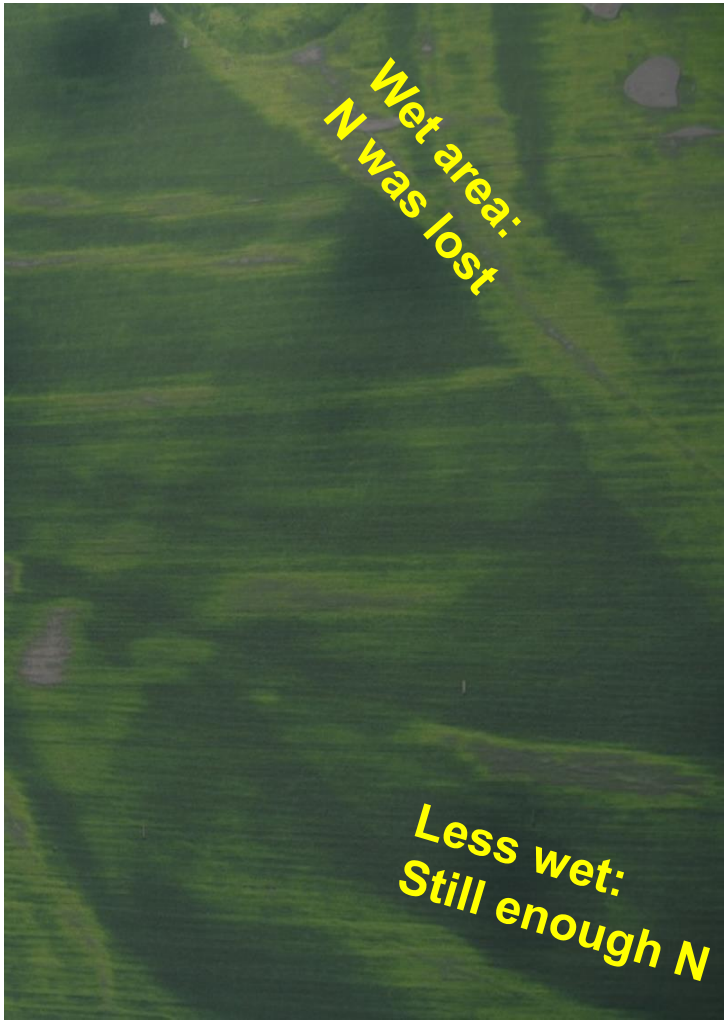
Make your equipment match your system & vice versa

Spring N

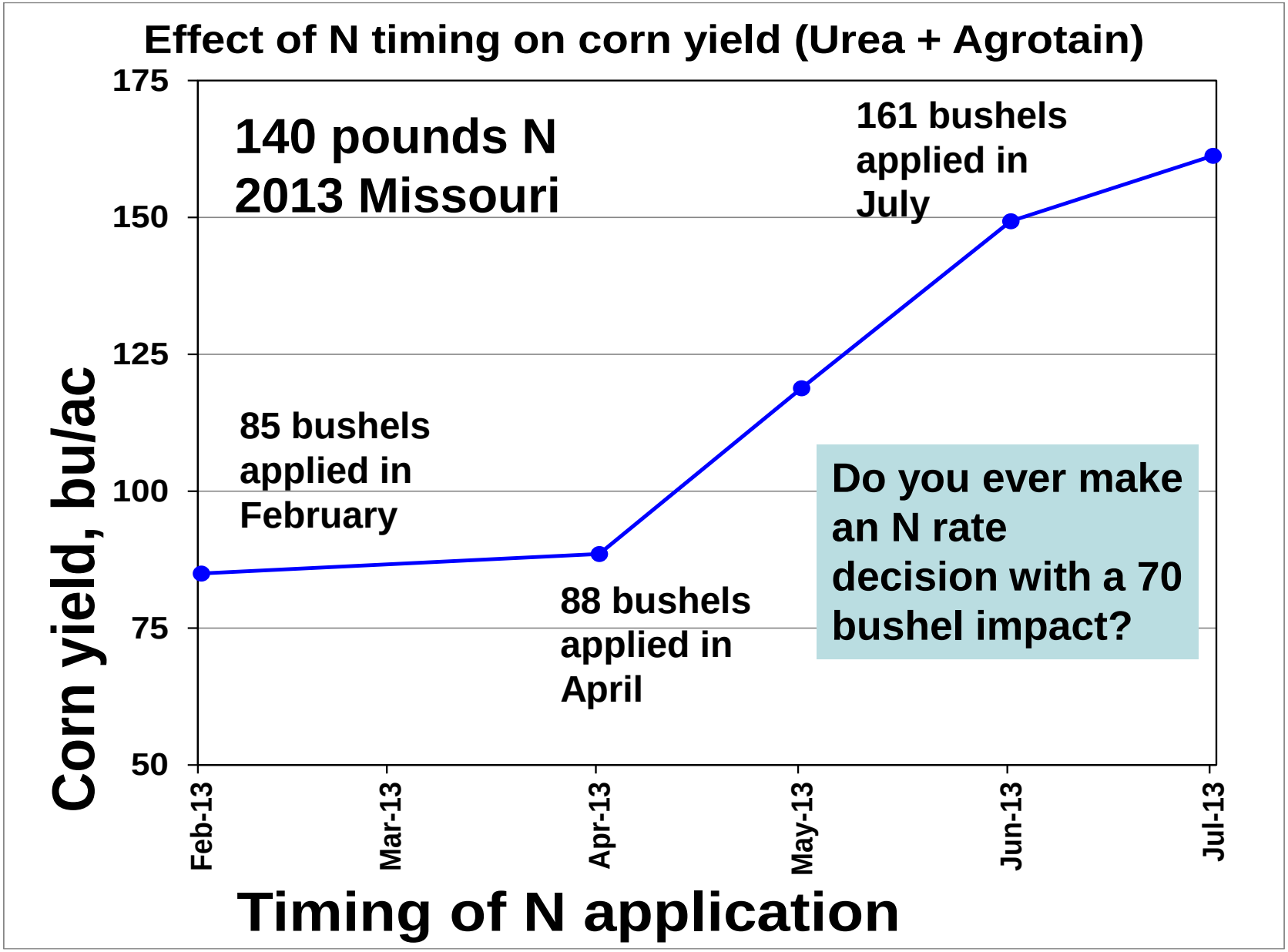
- I like dry with a cart on corn that's 1-2 feet tall (also wheat, cotton, grass…)
- **Fast**
- **Not very expensive**
- **You control it**
- **Unlikely to be lost**

Nitrogen timing: weather is everything

- If you live where there's less than 25 inches of rain, timing probably doesn't matter
- Potential for loss is what makes managing N different than P & K
- Timing matters in wet years (or with over-irrigation)



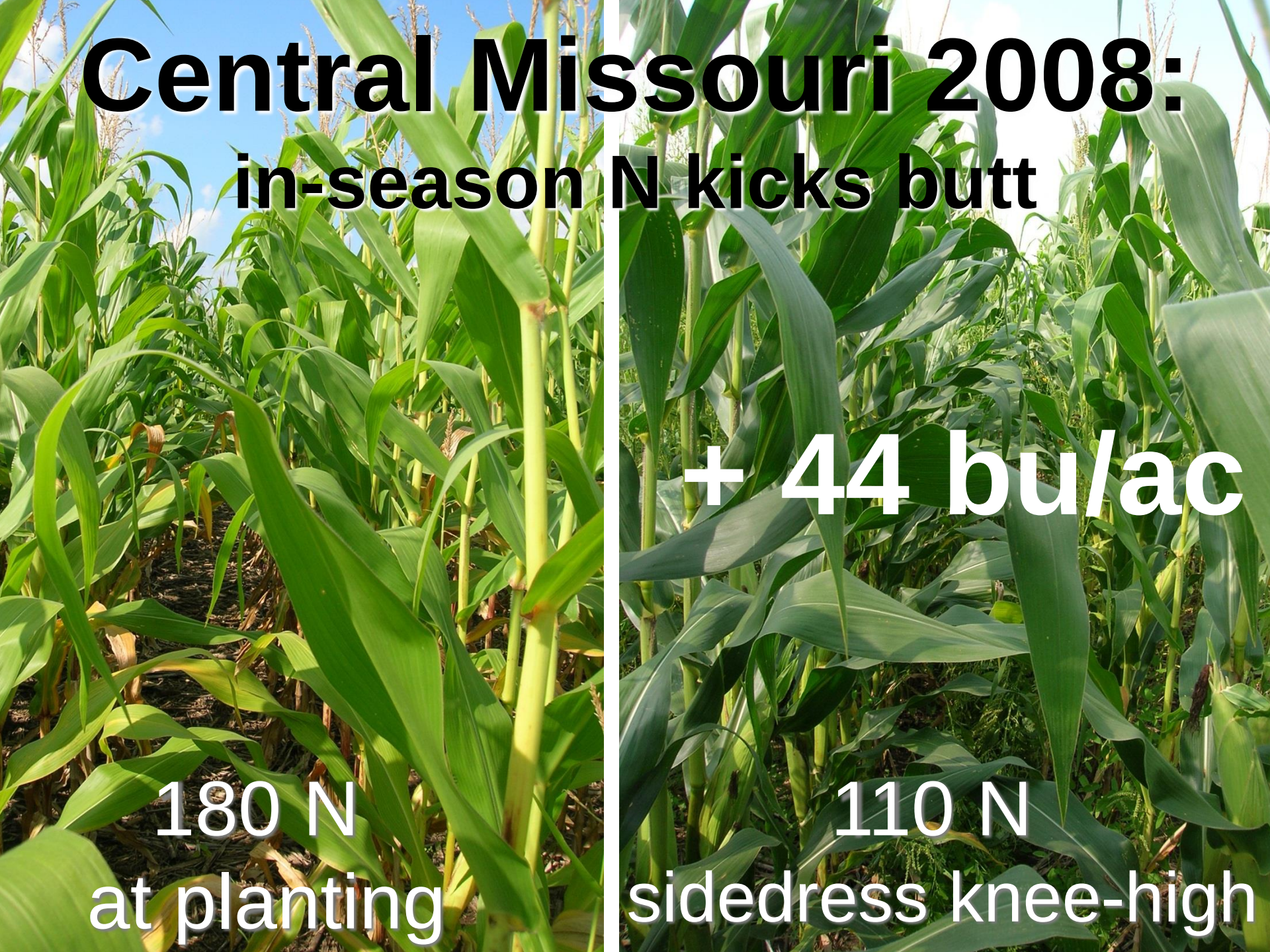
Nitrogen timing in a wet year



Nitrogen timing in a dry year

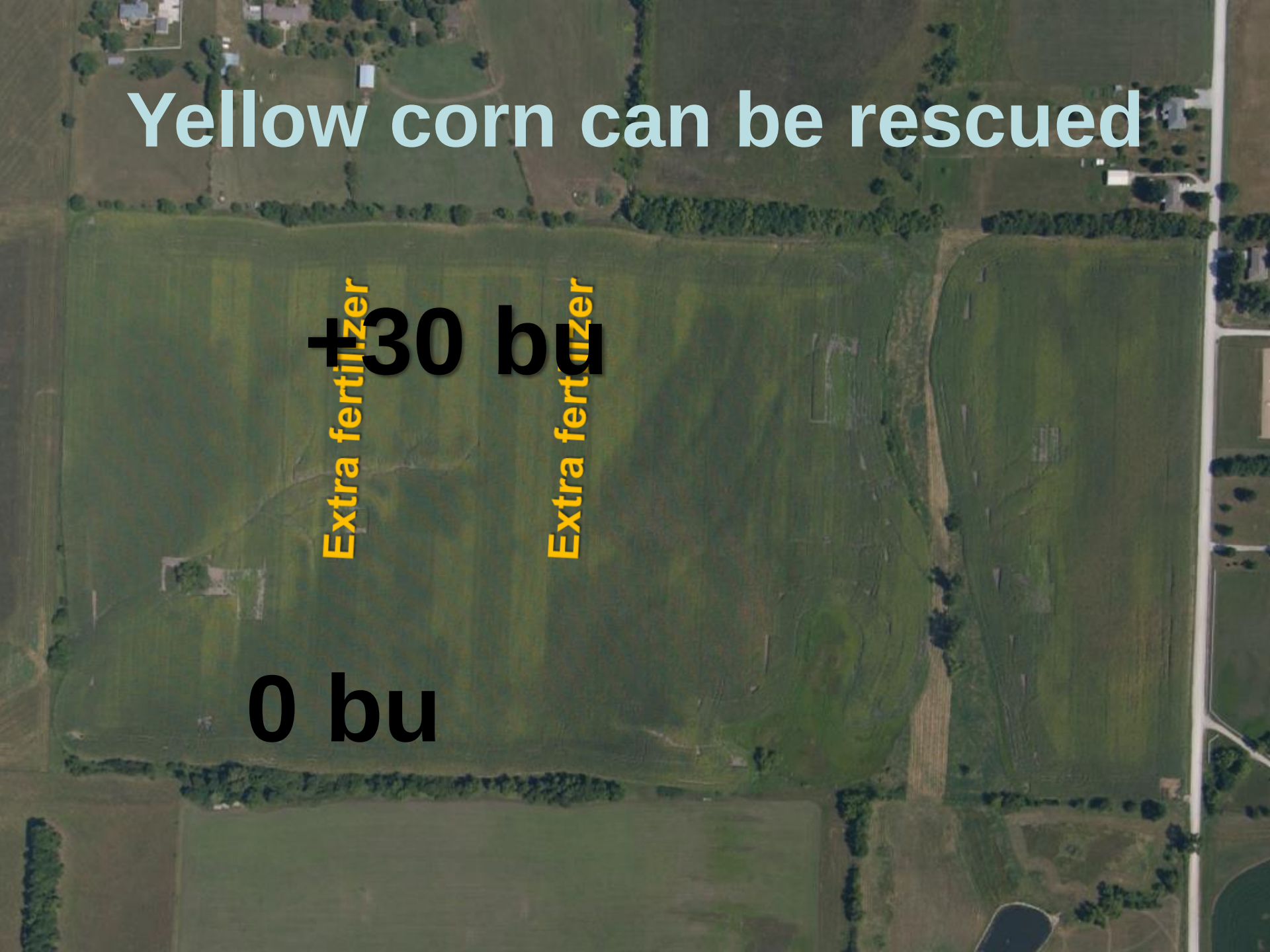
Doesn’t matter

Central Missouri 2008:
in-season N kicks butt



What if N is lost after you apply?

Yellow corn can be rescued



Rescue N trial	Year	Stage	Yield response (bu/acre) to N when stress level was:		
			Low	Medium	High
1	1998	V8		23	57
4	2010	VT	17	42	
5	2010	VT	28	54	57
6	2010	VT	8		
Average			**13**	**40**	**57**

The worse it looks, the more it responds

Tasseling is not too late

Rescue N trial	Year	Stage	Yield response (bu/acre) to N when stress level was:		
			Low	Medium	High
		3		23	57
		3		50	
		4	-2	30	
4	2010	VT	17	42	
5	2010	VT	28	54	57
6	2010	VT	8		
Average			**13**	**40**	**57**

How do I know if it’s yellow?


Look from the air

NVisionAG

I started a company to do this

20% commission/discount for consultants

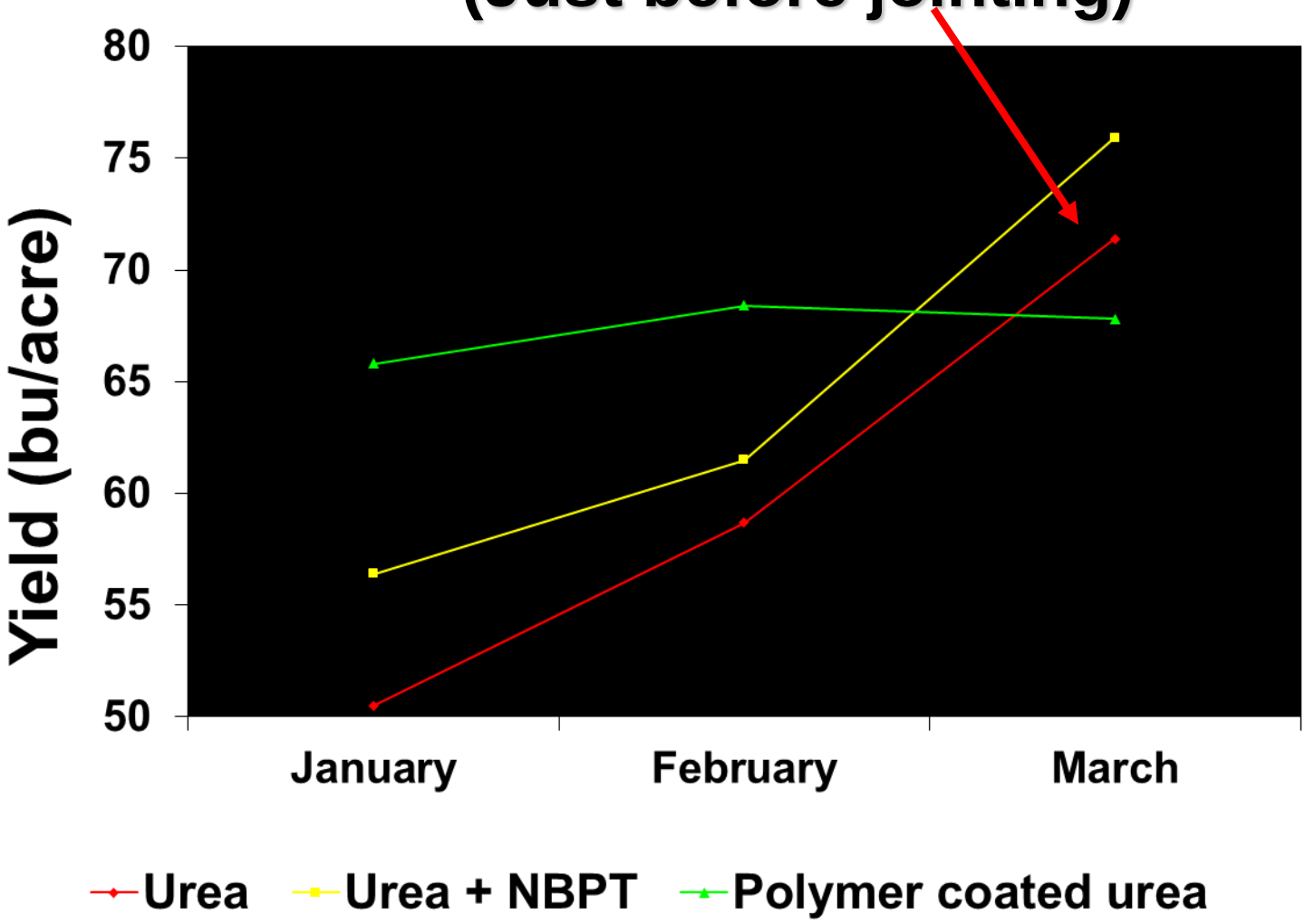
Aerial photo, $2/acre: Any problem?

Yield loss map, $4/acre: How big is my problem?

N rate control file, $4/acre: Solve my problem optimally

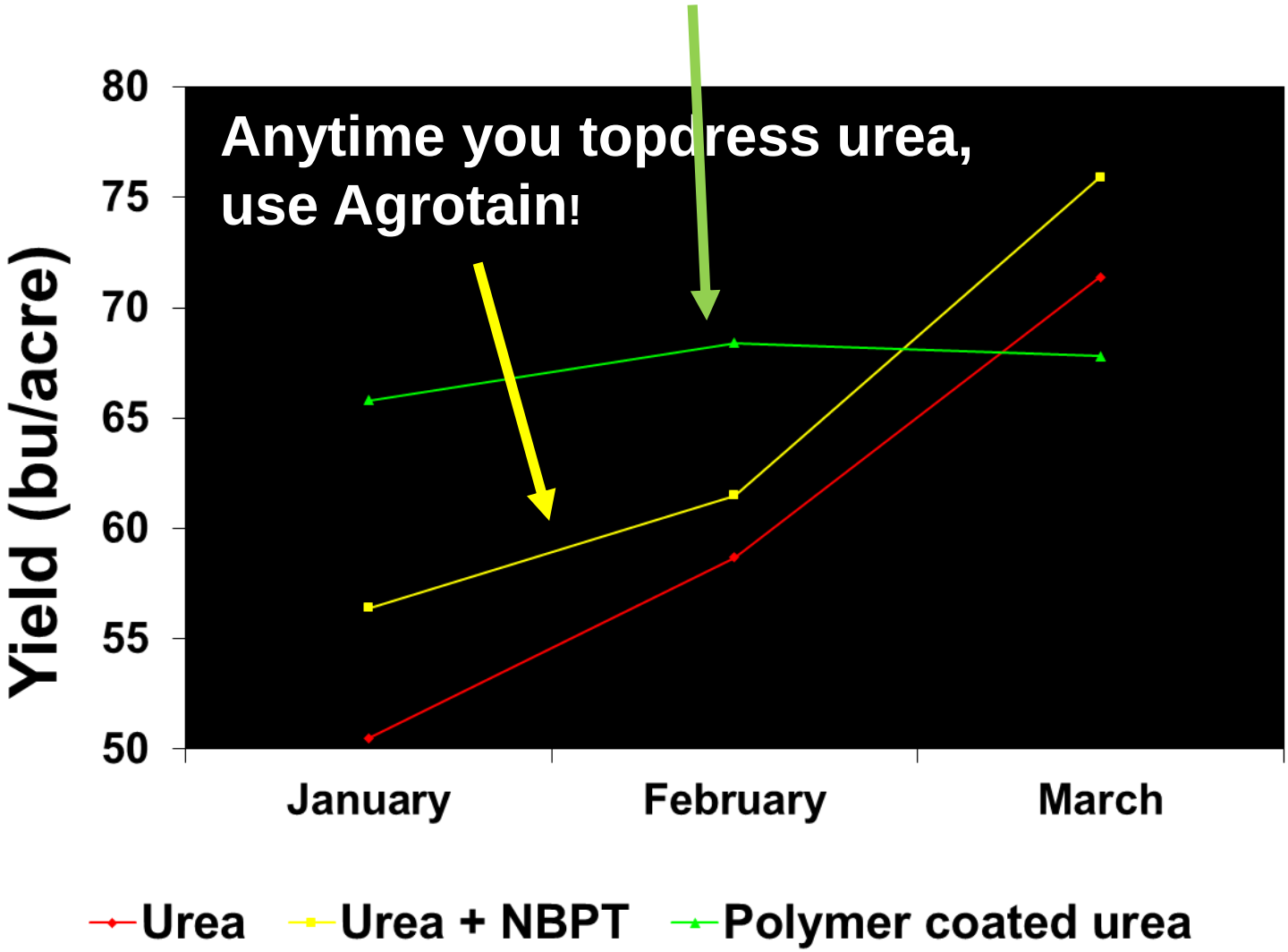
March topdress makes a lot more wheat

(Just before jointing)



Columbia 2005, 2006

If you must topdress early, use ESN!



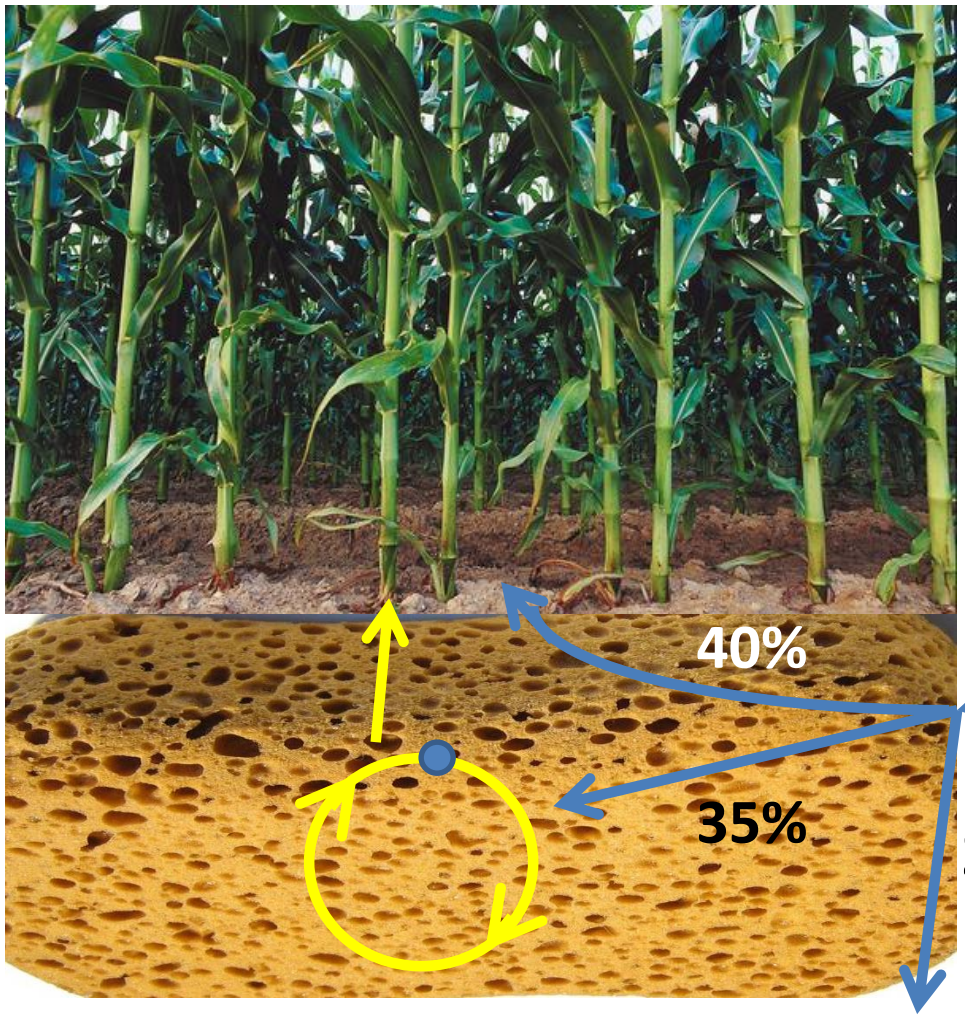
Columbia 2005, 2006

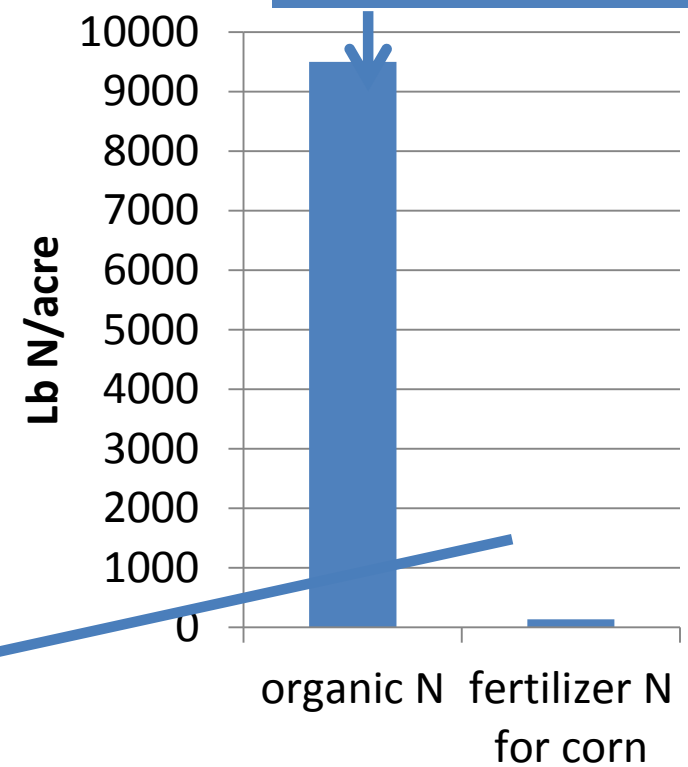
Nitrogen rate

- Soil contribution varies
  - Year to year
  - Field to field
  - Place to place within a field
- Plant color can measure soil contribution, predict best rate
- Best N rate not predicted by yield, soil tests
- Computer models are the newest idea

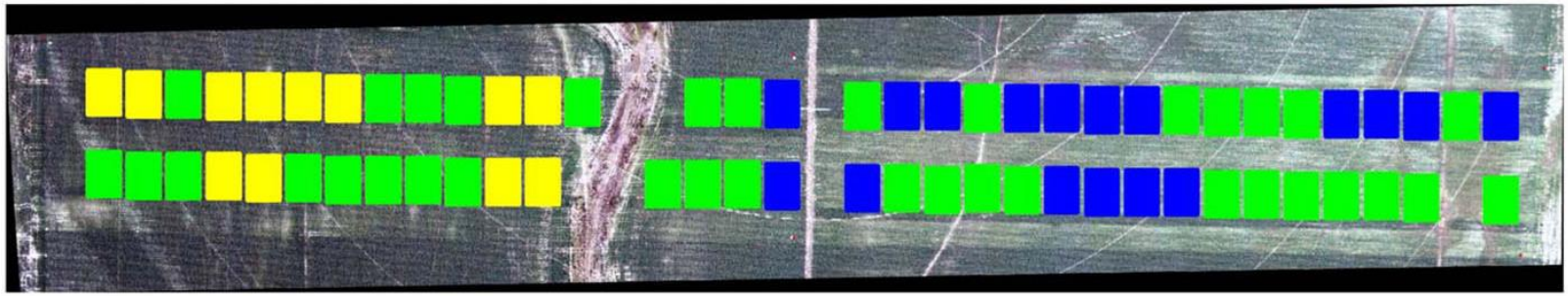
Soil organic matter: the nitrogen sponge

Quite stable; release depends on weather, past N rates, tillage, drainage





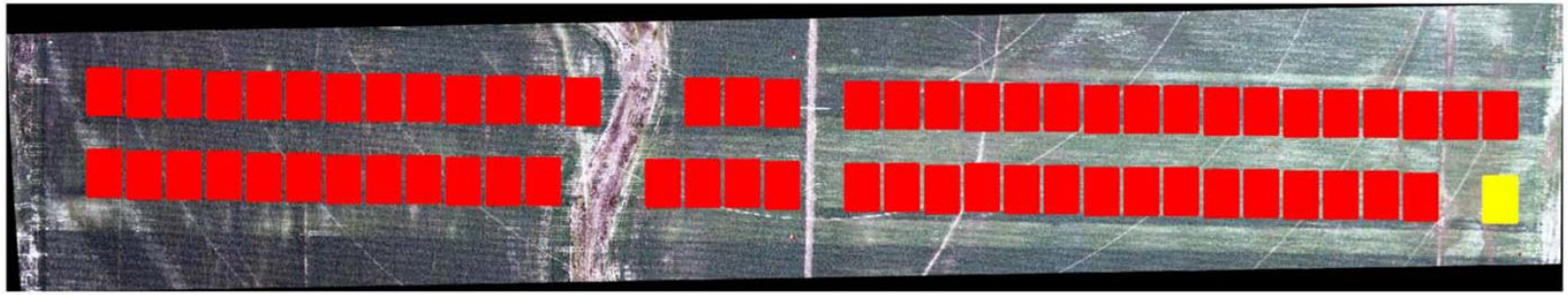
Soil N supply is spatially variable



Yield with no N:
13 to 145 bu/acre

Yield
- 0-50
- 50-100
- 100-160
- 160-220

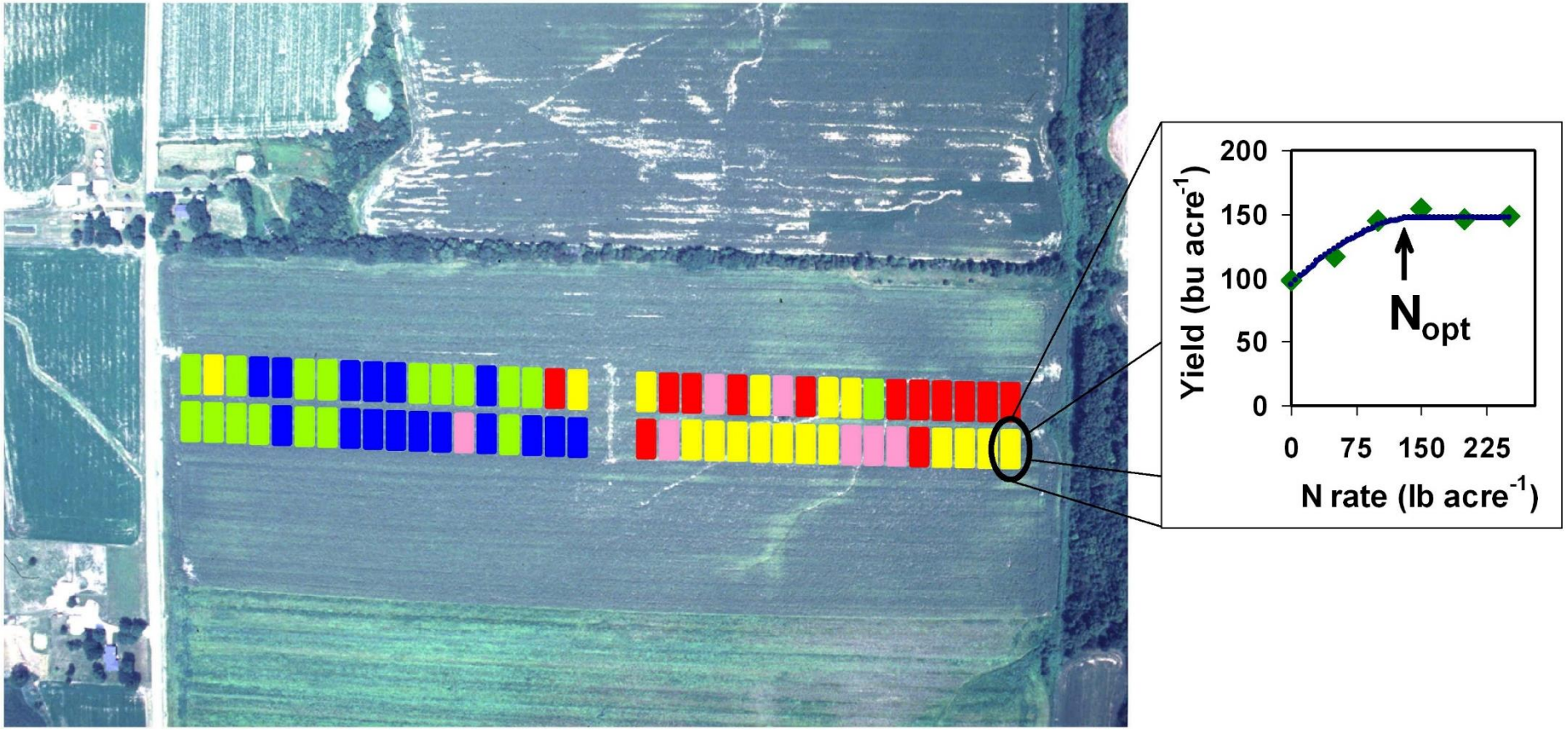
Wide yield variability



Yield with unlimited N:
160 to 220 bu/acre

Adding N reduces variability

Optimal N rate is variable within a field

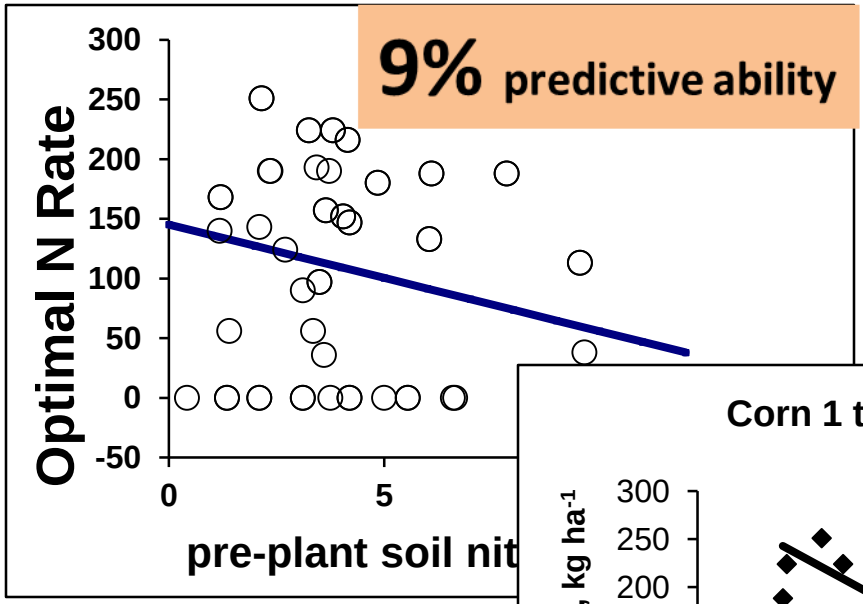


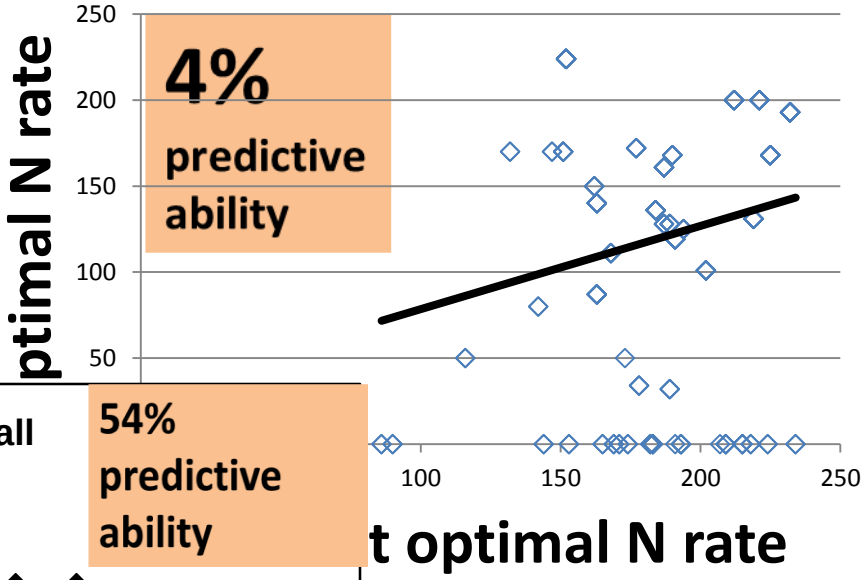
Optimal N rates (lb acre^{-1}) 0 to 80 80 to 120 120 to 160 160 to 200 200 to 250

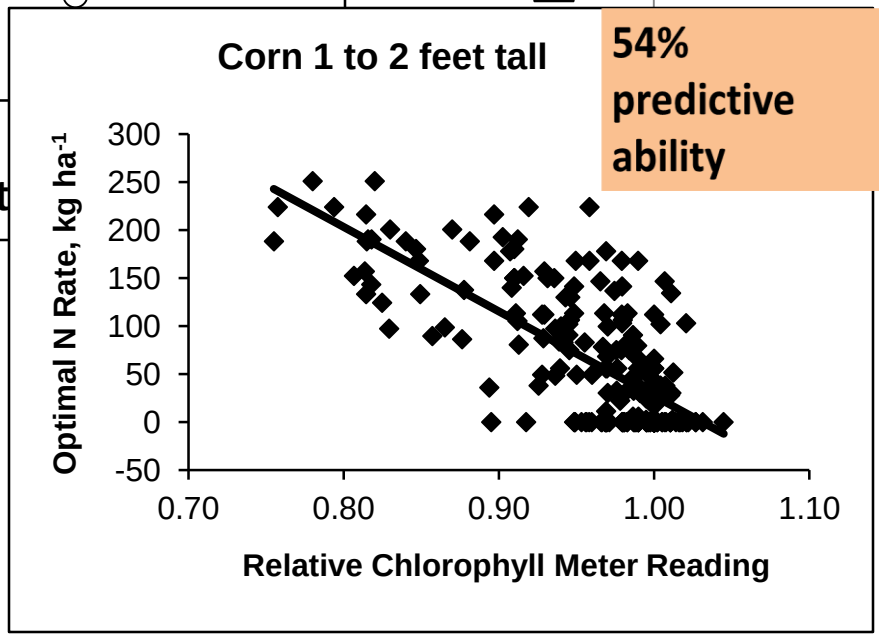
Crop color is the most accurate way I've found to predict how much N is needed

Color measurements are more accurate than soil tests or yield

data from 64 fields, 7 states



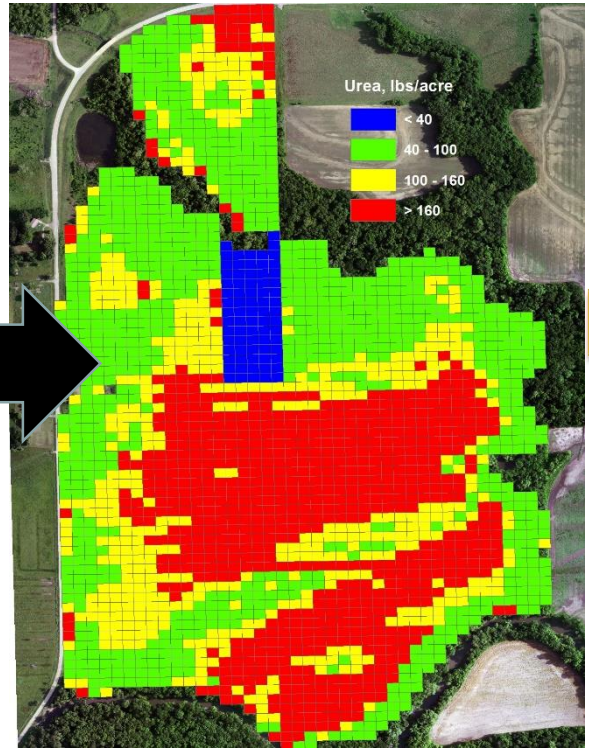




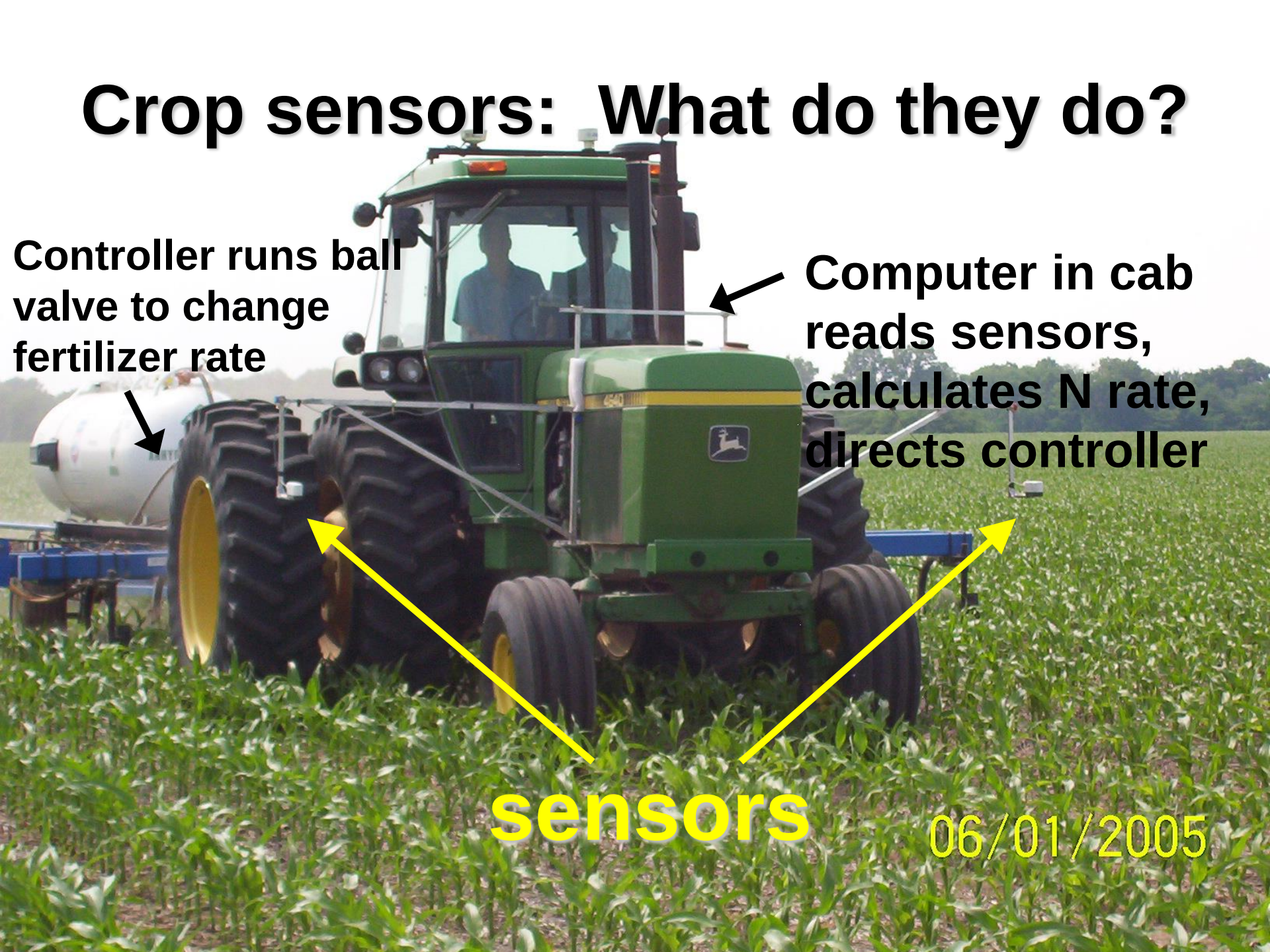
Diagnosing N rate from aerial phot

Research: dark corn needs low N rate, light corn needs high N rate

My company: conflict of interest



Crop sensors: What do they do?



Sensor Demo Outcomes

- **Corn 1 to 7 feet, 55 fields, all N sources**
- Increased yield by 2 bushels/acre
- Saved 14 lb N/acre
- Decreased ‘surplus N’ by 25%
  - ‘Surplus N’ is the difference between N applied and N carried away in grain
- **Cotton ‘mid-square’, 14 fields, urea or UAN**
- Increased lint yield by 19 lb/acre
- Saved 6 lb N/acre

Computer simulation models

- Equations built to simulate the world
  - Water distribution/redistribution in soil
  - Nitrogen conversions
  - Crop growth
  - Updated daily on each of the above
- History
  - Powerful for scenario-building
  - Not very accurate

Computer simulation models

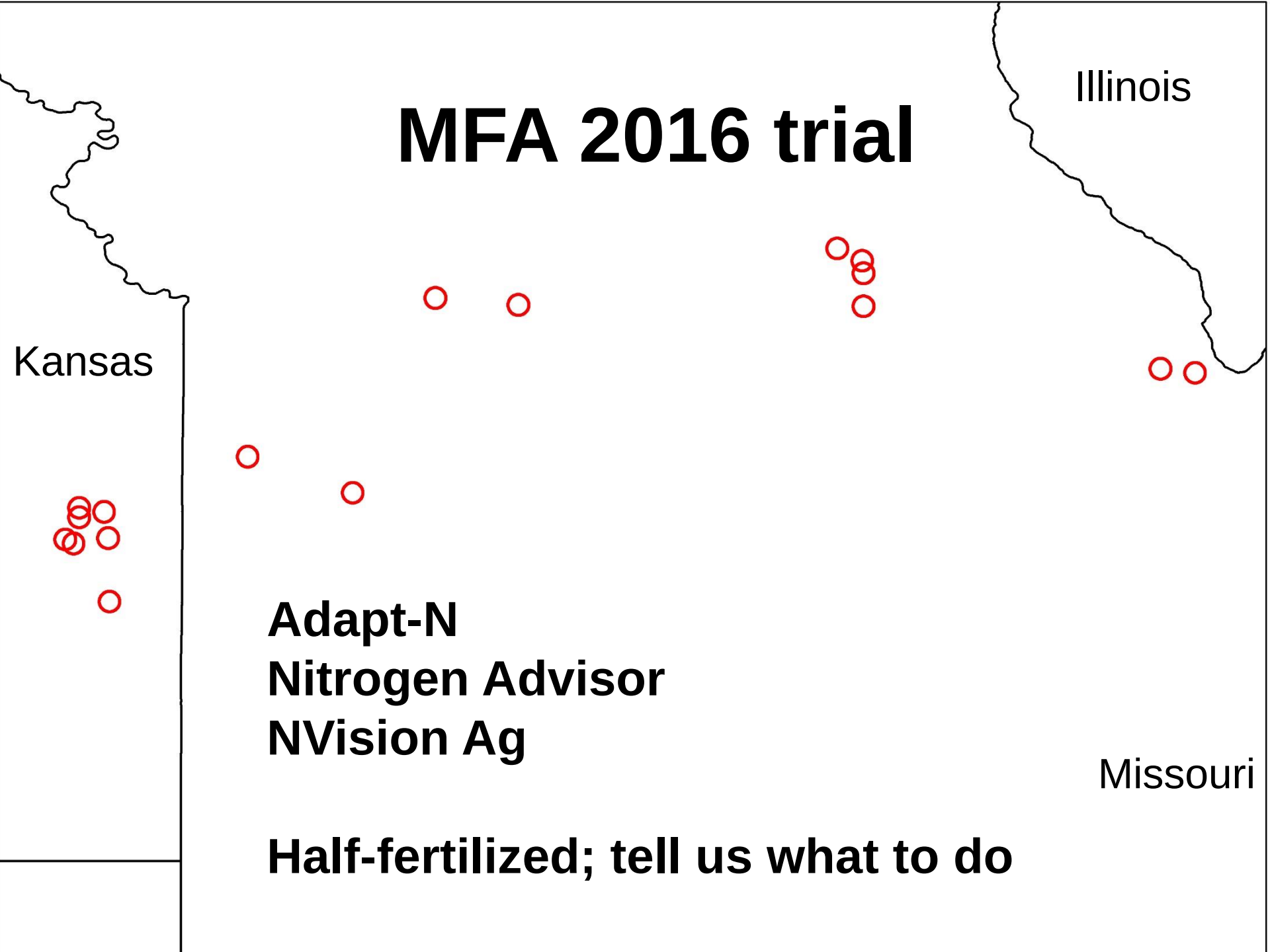
- Three introduced commercially in 2014 for N fertilizer management
- Adapt-N (Agronomic Technology)
- Encirca (DuPont Pioneer)
- Nitrogen Advisor (Climate Corp/Monsanto)

How do they compare?

- Performance
- Price
- Situation

Very little information is available

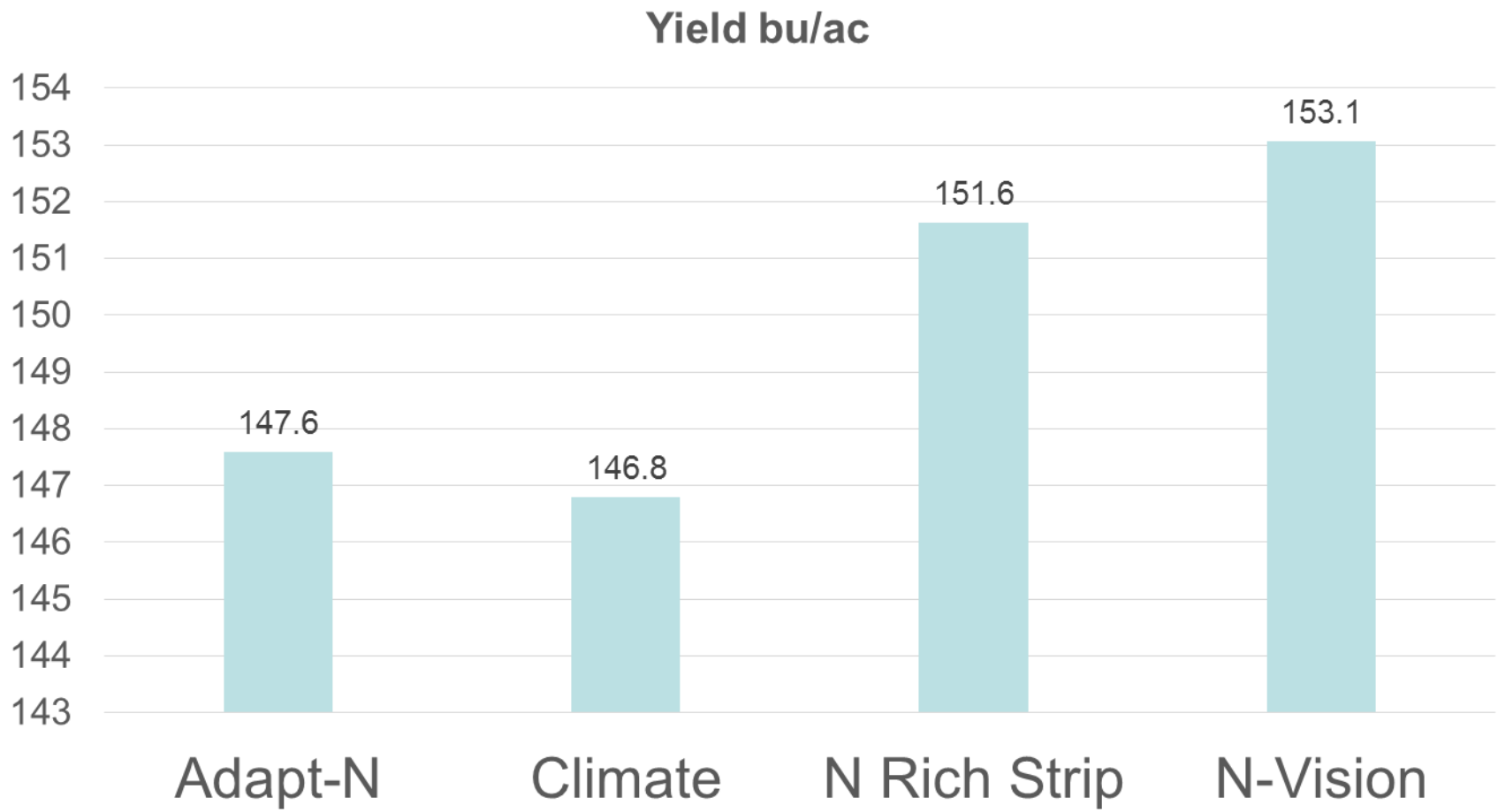
MFA 2016 trial



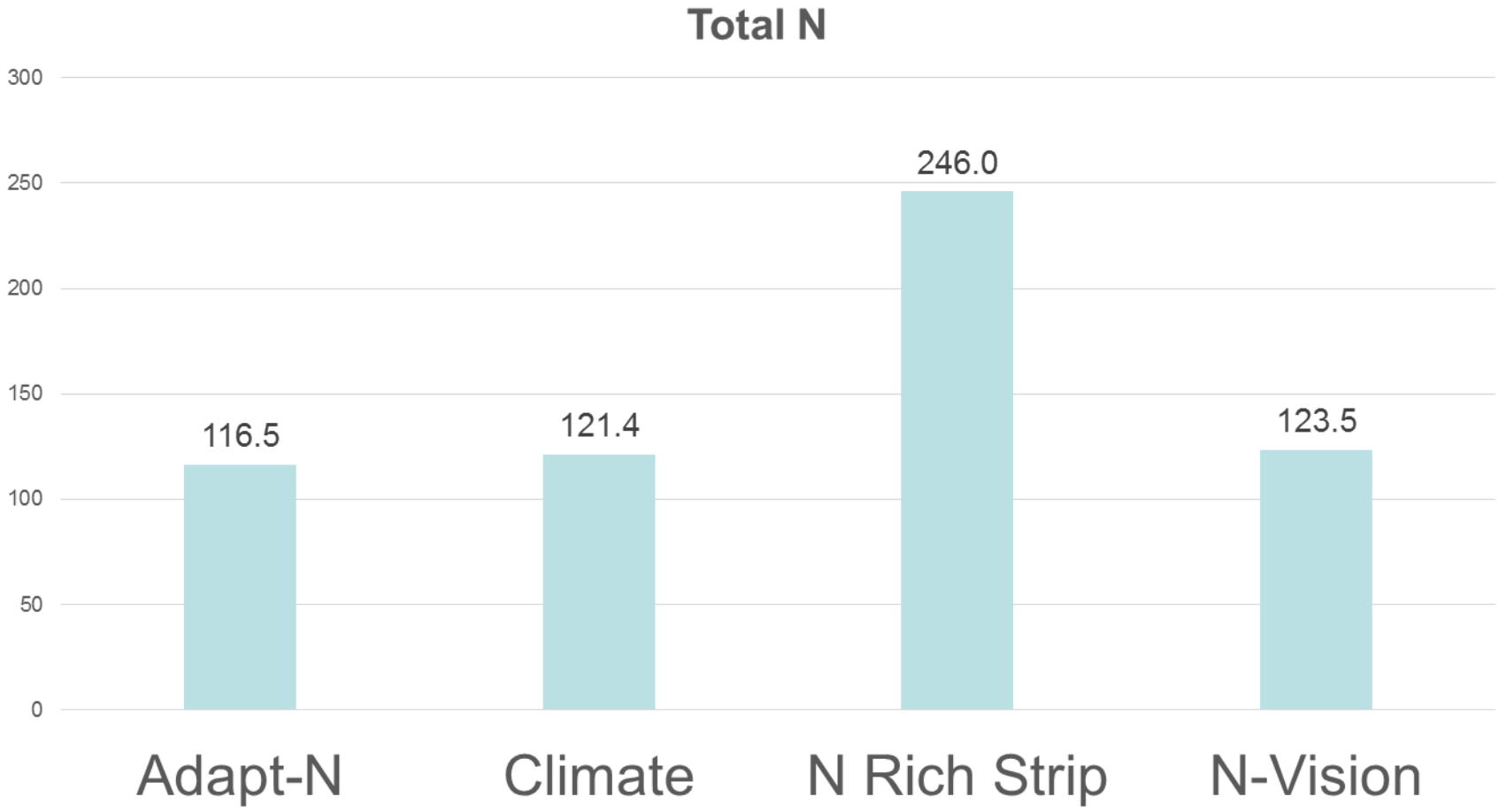
Adapt-N
Nitrogen Advisor
NVision Ag

Half-fertilized; tell us what to do

MFA 2016 trial, Yield by Program



MFA 2016 trial, N Rate by Program



Photos, sensors, computer models: price (planned sidedress)

Product	Price
NVision Ag image + N rate control file	$6/acre
Ag Leader (OptRx) or Trimble (Greenseeker) sensors	~$15,000 to $20,000
Adapt-N model	$3/acre
Encirca model	$10/acre
Nitrogen Advisor model	$1500/farm

Photos, sensors, computer models: price (rescue N)

Product		Price
NVision Ag image	**Wet years only**	$2/acre
NVision Ag yield loss map & summary		$4/acre
NVision Ag N rate control file		$4/acre
Adapt-N model	**Every year?**	$3/acre
Encirca model		$10/acre
Nitrogen Advisor model		$1500/farm

Photos, sensors, computer models: situational ads & disads

Aerial photos

Advantages:

- Fast evaluation
- Simple
- Trust the plant
- Uniform (except UAV)

Disadvantages:

- Wait for plane (daily satellite will fix)
- Need high-N reference if half-fertilized
- Best after canopy

Sensors

Advantages:

- Immediate
- Trust the plant
- Cheap if used a lot

Disadvantages:

- Learning curve
- Greenseeker 'drift'
- OptRx interpretation
- Don't help you decide where to go
- Capital cost upfront
- Need high-N ref

Models

Advantages:

- Multiple times
- Any time (but likely more accurate later)

Disadvantages:

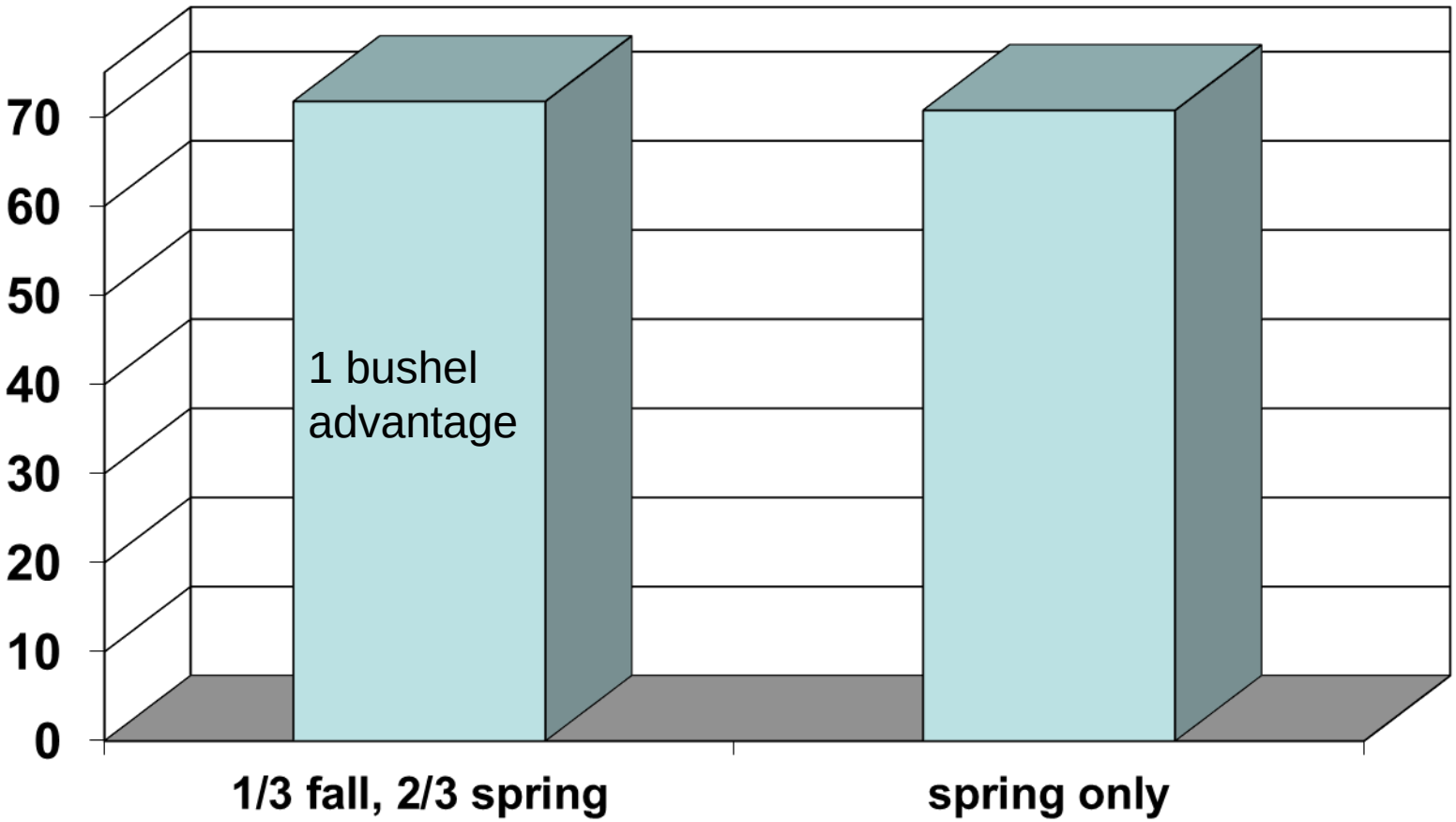
- Accuracy unknown
- Early commitment (pay even if unused)
- Data input needed

= important for rescue N

= important for planned sidedress


Thanks!
Questions?
06/08/2006

Is fall N needed?



Average of 8 Missouri experiments,
ave 80 & 120 lb N rates

Is fall N needed?

- Sometimes but usually not
- Overall a slight yield advantage
  - Just enough to pay for the trip if wheat price is good
- I recommend fall N:
  - for sandy soils (20-30 lb)
  - when P is needed
  - after exceptional corn yields

Splitting spring N

- Who thought of this, anyway?
- Europeans
  - Cool moist summers
  - Long grainfill period
  - Potential for N loss

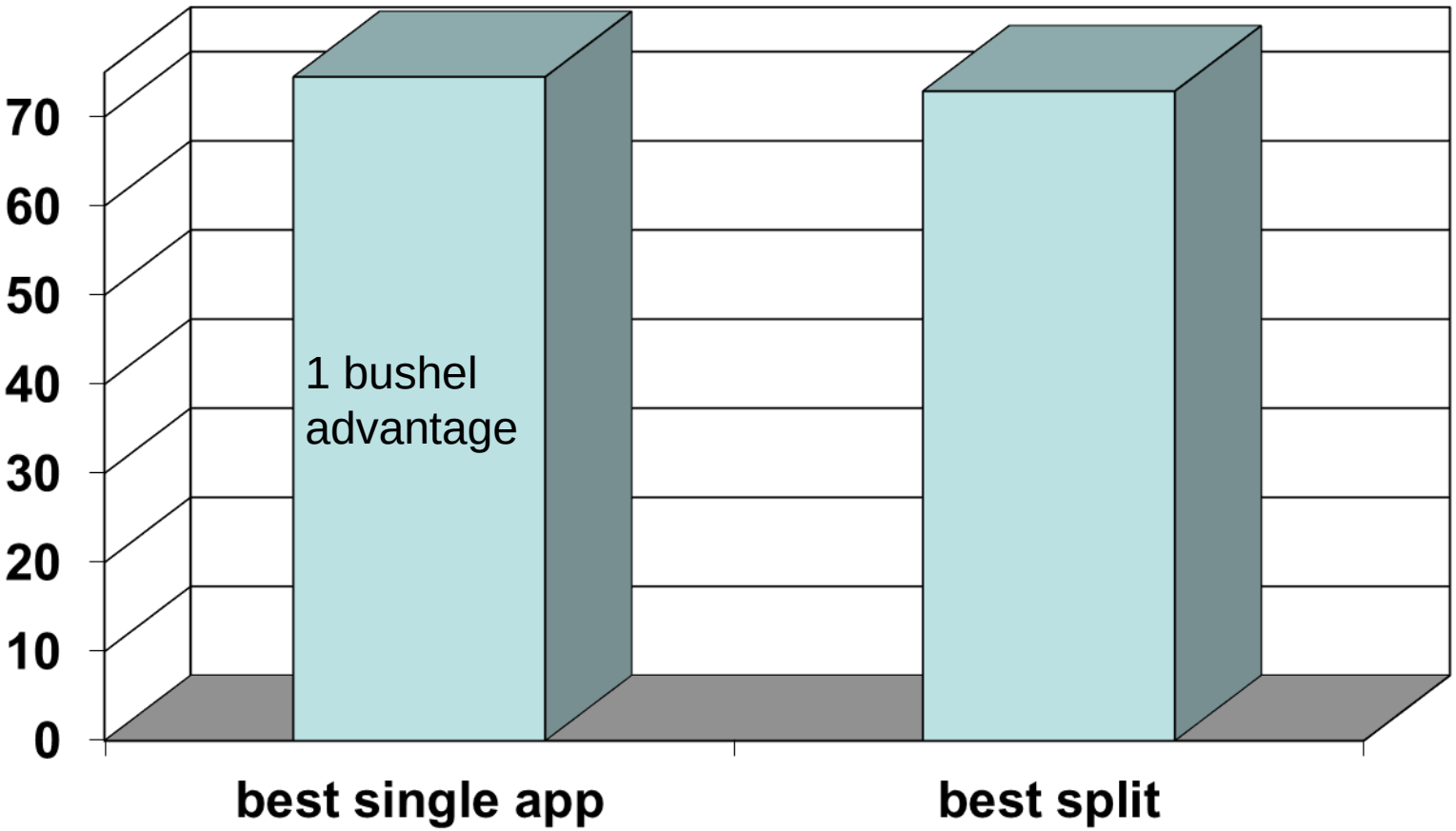
Splitting spring N

- In the US?
- East coast (Virginia, Carolinas)
  - Sandy soils
  - Don’t hold N well
  - Potential for N loss
  - Don’t provide N well (low organic matter)
  - About a 5 bushel advantage on average

Should I split my spring N?

- Do you have above-average potential for N loss?
- Maybe split on sandy soils, otherwise don’t bother

Should I split my spring N?



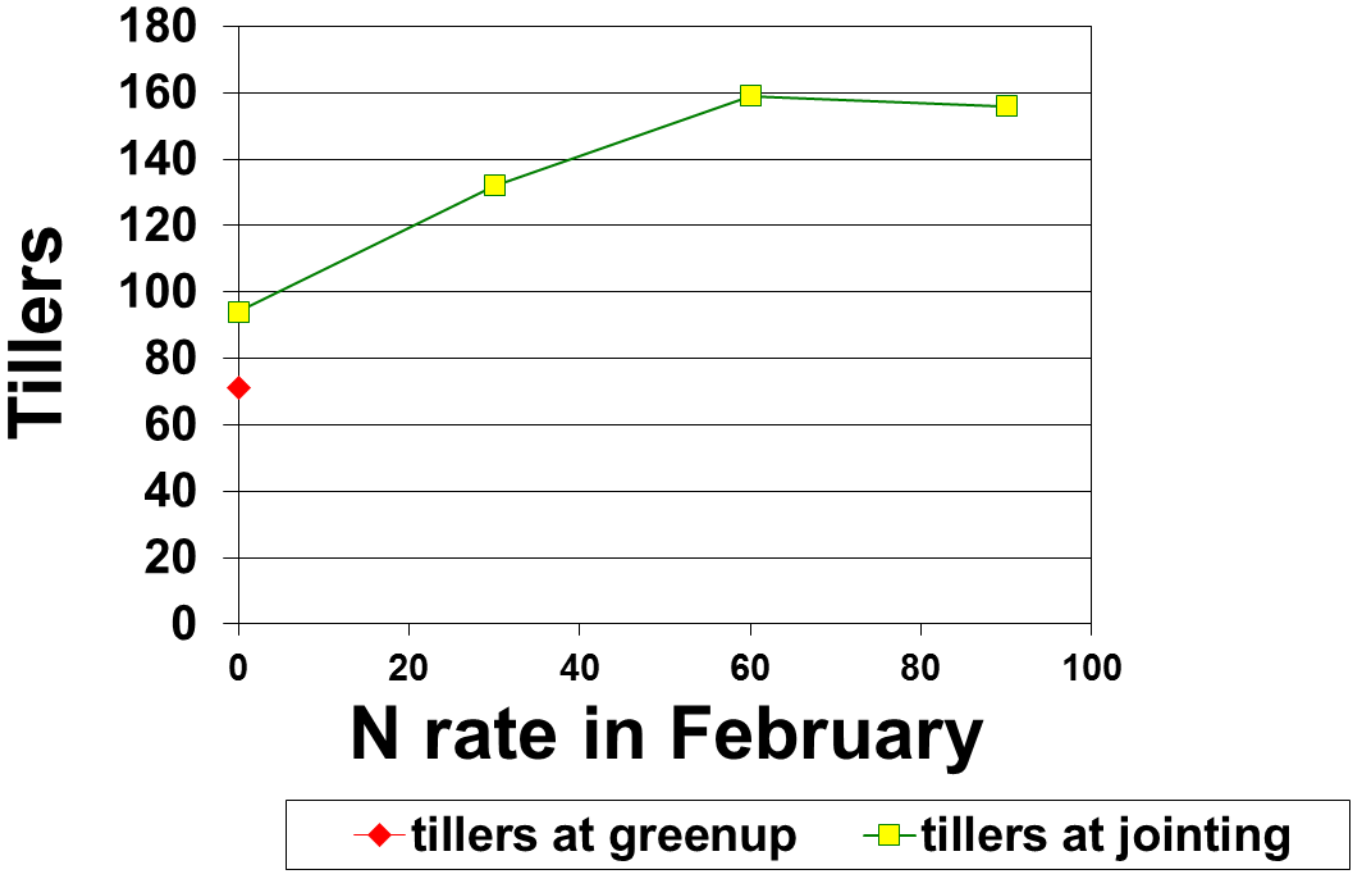
Average of 7 Missouri experiments

When should I apply my spring N?

- **An March!**

- Exception: Thin stand in February
- When the stand is thin, tillering has probably been limited by N availability
- February N will stimulate new tillers

February N will stimulate new tillers



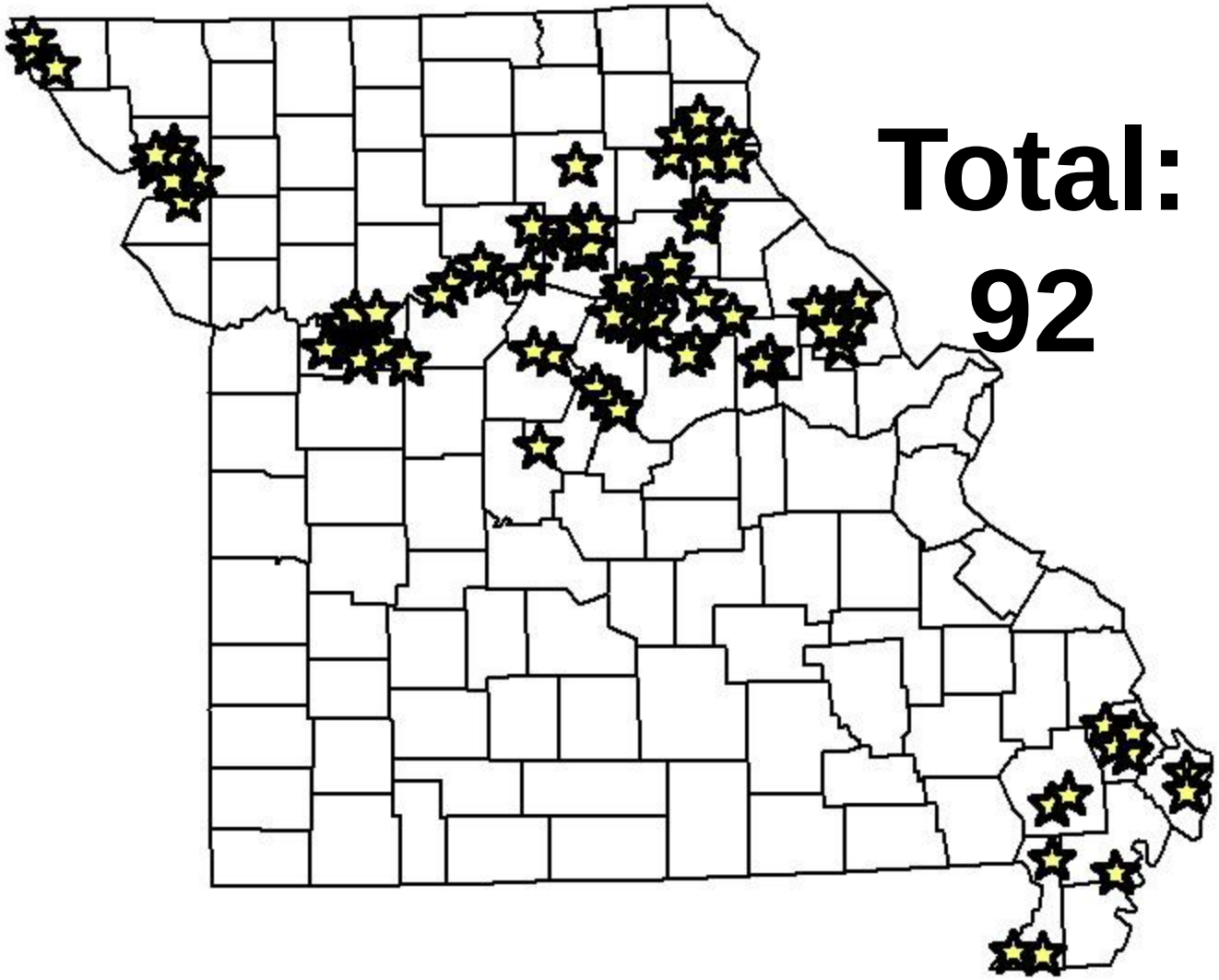
Wheat N timing: Summary

- Fall N probably not profitable except:
  - On sandy soils
  - After exceptional corn yields
- Split spring N probably not profitable except:
  - On sandy soils
- Avoid January topdress
- If you must topdress in January, use ESN

Wheat N management: Summary

- Topdress in February for poorly-tillered fields
  - Stand looks thin
- Topdress in March if <u>not</u> sandy or thin
- **If topdressing urea, USE AGROTAIN!**

Locations of sensor demonstration fields 2004-2008



Total: 92

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)