On-farm tracking of Nitrogen Transformations To Improve Farm Profitability And Environmental Quality

Illinois Fertilizer & Chemical Association

Supply • Service • Stewardship

Est. 1965

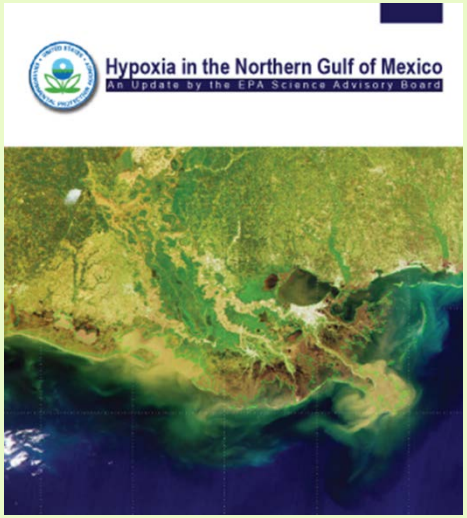
Dan Schaefer, IFCA

About Illinois…..

- **Ag is $120 billion industry with 22 million acres in production, mostly corn & soybeans**
- **Nearly 5 million tons of agricultural fertilizer used per year; 650 ag retail outlets**
- **65% of nitrogen used for crops is in the form of anhydrous ammonia; 30% UAN; 5% Urea**
- **13 million people in a mostly agricultural state and Nearly half from 2 counties**

Water Quality Challenges

- Gulf of Mexico Hypoxia
- Surface Water Drinking Supplies – High Nitrates when N Utilization is Poor
- Pressure to Ban Fall Applied Nitrogen Assuming it is Major Source of Loss (50% fall applied)
- Weather Impacts Everything



Illinois' Cropping System Makes Controlling Nutrient Losses Particularly Challenging

INLRS: The Easy Buttons

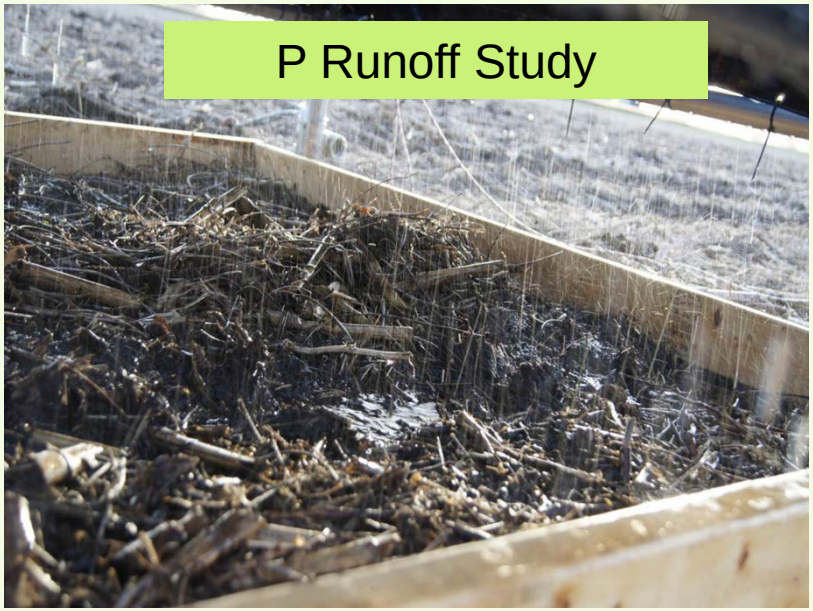
Includes Many of the 4Rs:

- Maximum Return To Nitrogen Calculator
- Use of Nitrification Inhibitors
- Fall BMPs
- Split Application of Nitrogen

ILLINOIS
NUTRIENT LOSS
REDUCTION STRATEGY

Improving our water resources with collaboration and innovation

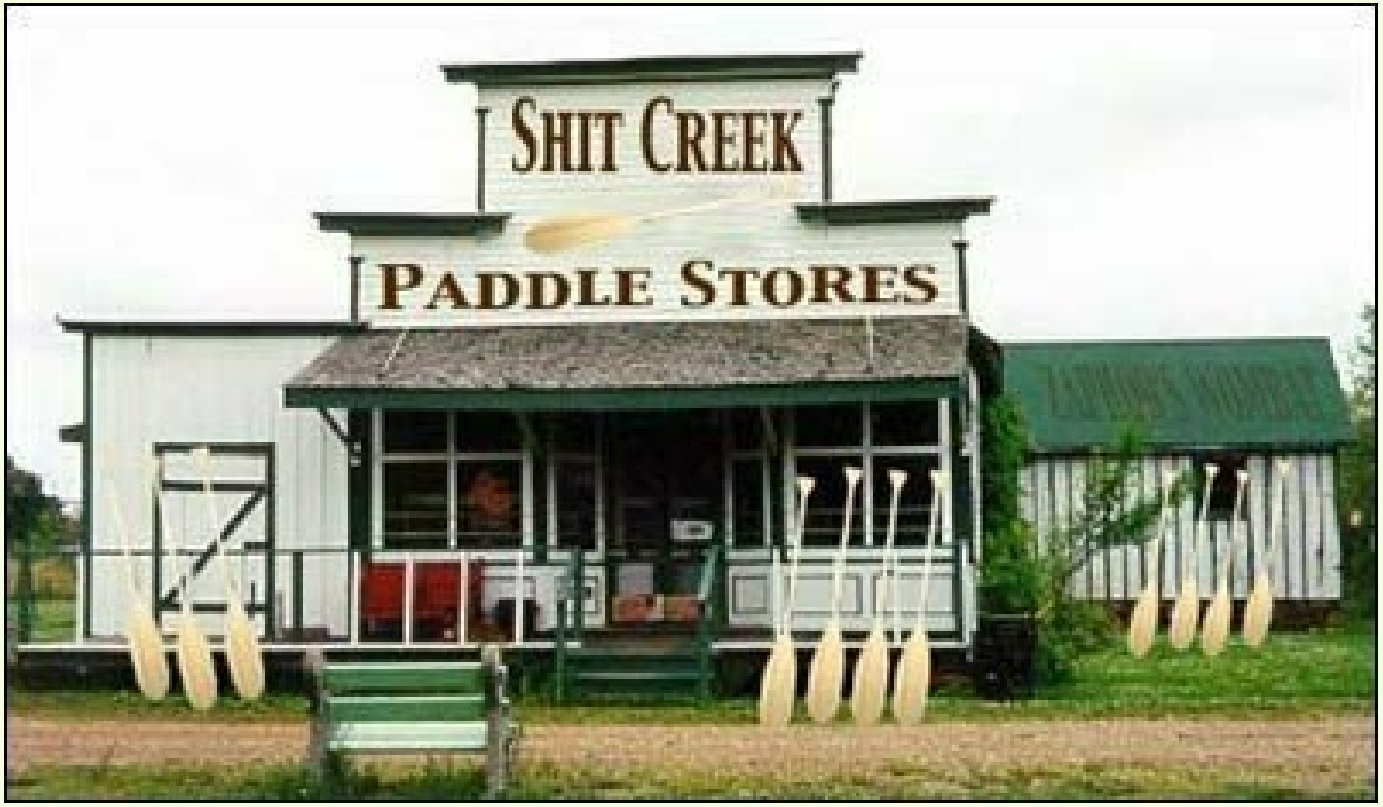
Other Recommendations: Wetlands, Bioreactors on Field Tiles, Cover Crops, Growing Perennial Crops



Examples of On-Going NREC Projects on Reducing Nutrient Losses

With NREC and Innovation, We Can Ensure Freedom of Nutrient Choice;

The Alternative is to Invest in Lawyers.

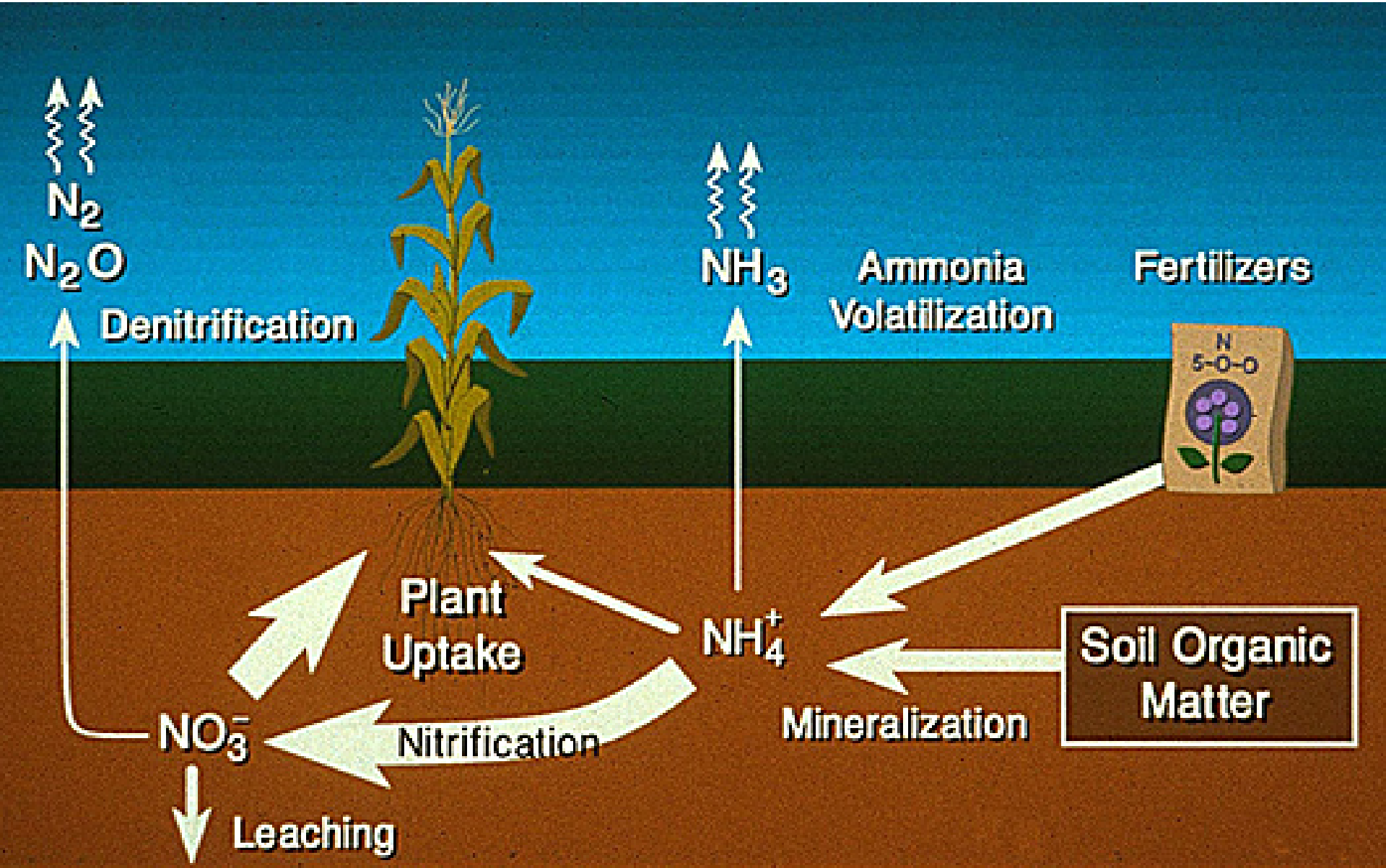


NWATCH

A Tool to Estimate the **Where**, **What** and **How Much**

- Inventory Residual N
- Identify & Track Fall Applied Nitrogen
- Track Conversion of Ammonium to Nitrate for Fall and Spring Applications
- Determine N Movement in Soil Profile Throughout Growing Season
- Educational Tool for Ag and Water Supplies

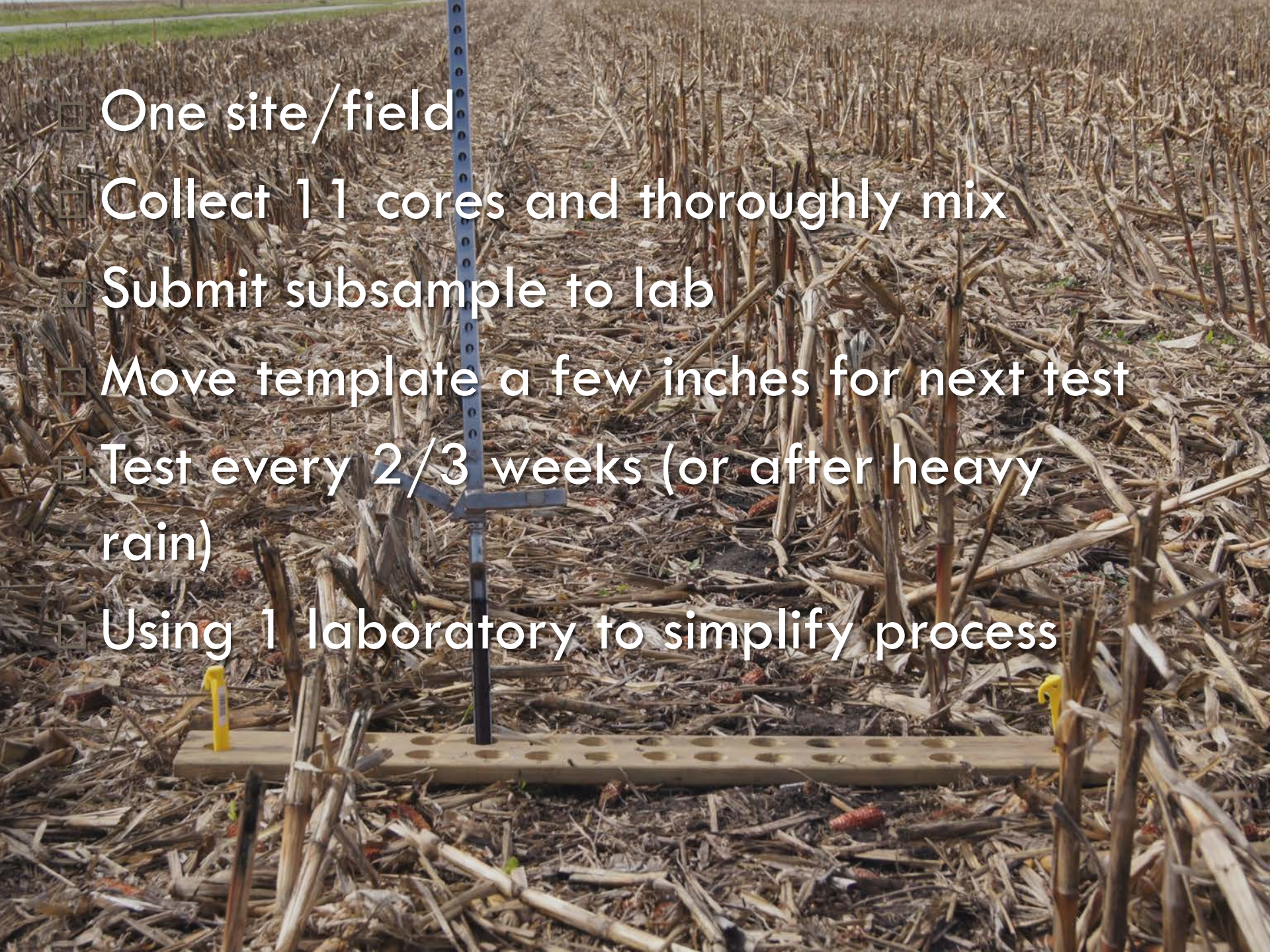
Nitrogen Transformation



NWATCH


Notch For 12”


Mark for the
24” Depth

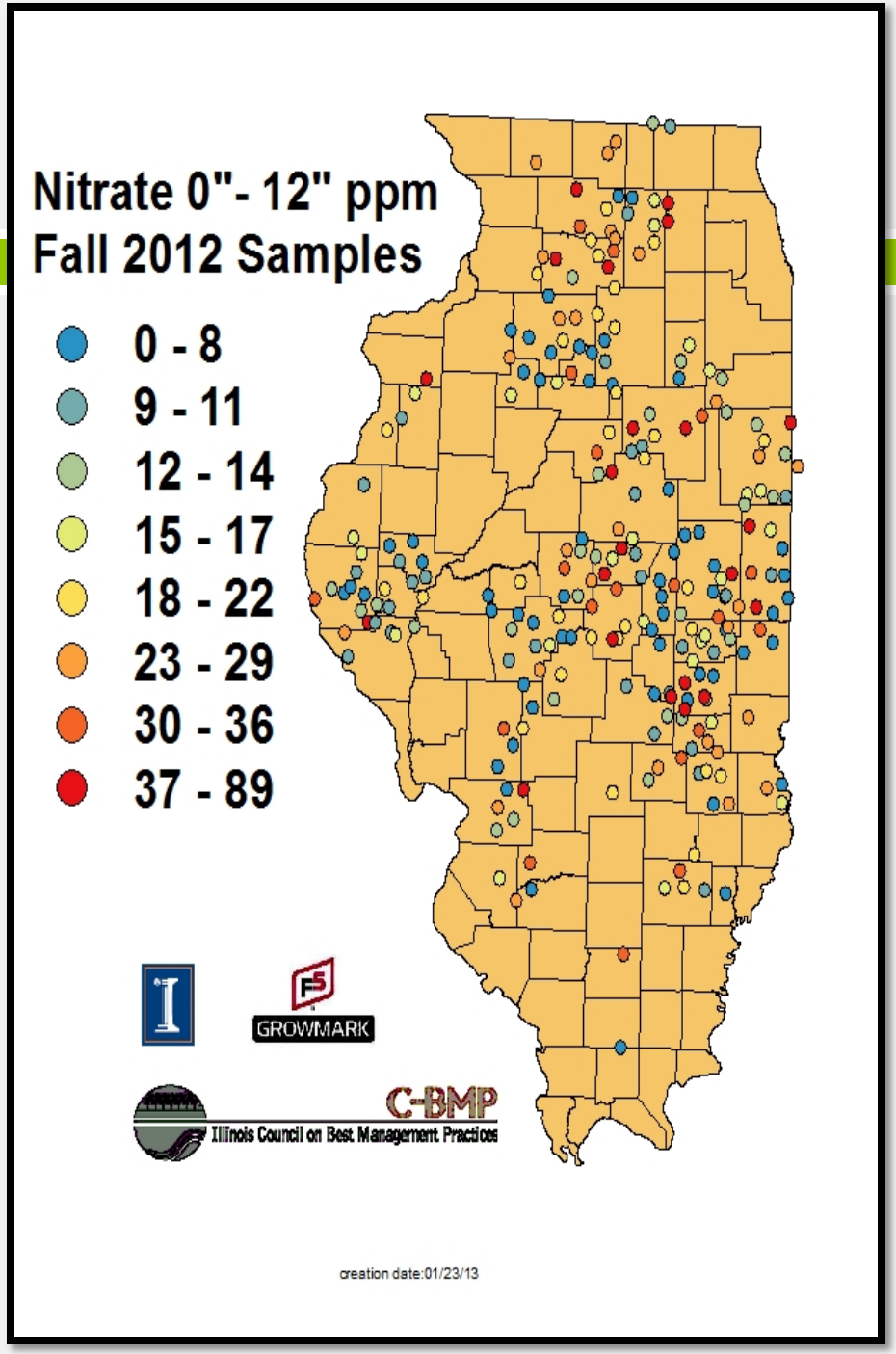


- One site/field
- Collect 11 cores and thoroughly mix
- Submit subsample to lab
- Move template a few inches for next test
- Test every 2/3 weeks (or after heavy rain)
- Using 1 laboratory to simplify process


Template
Image Source: Noland Farms, I

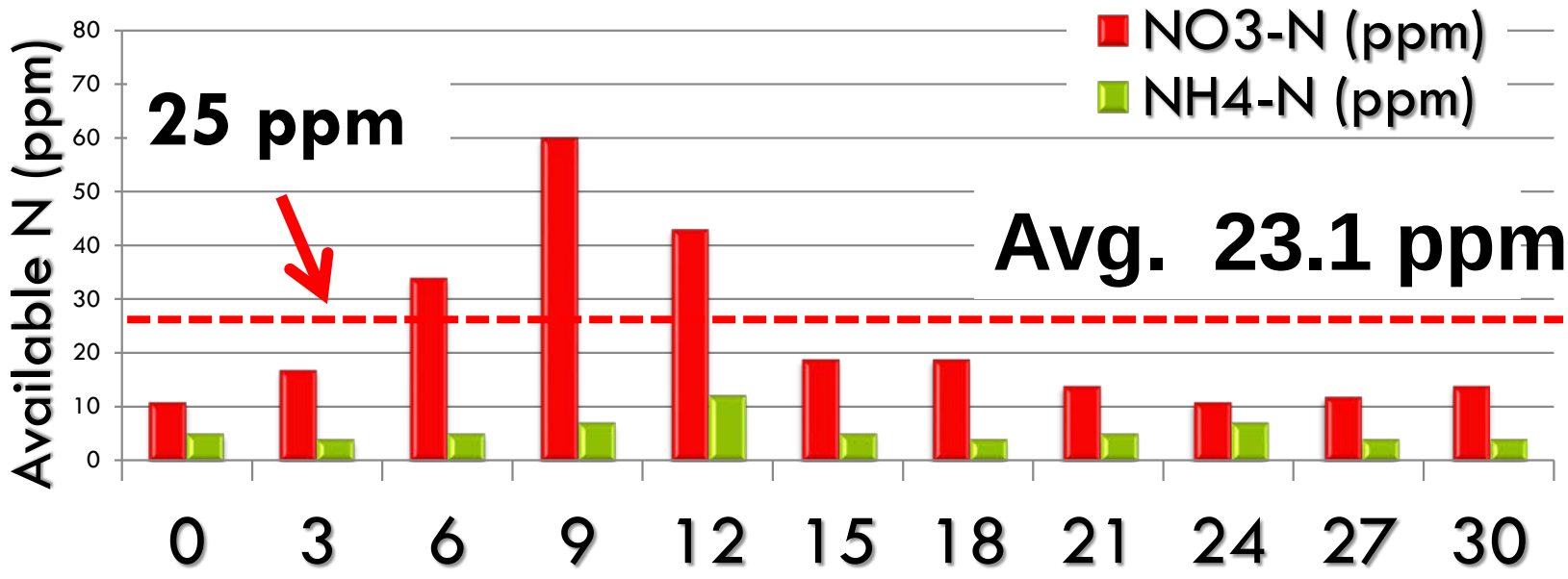

4
5
6
7
8
9
10
11

- What was left as a result of the drought?
- Learning more about applied N

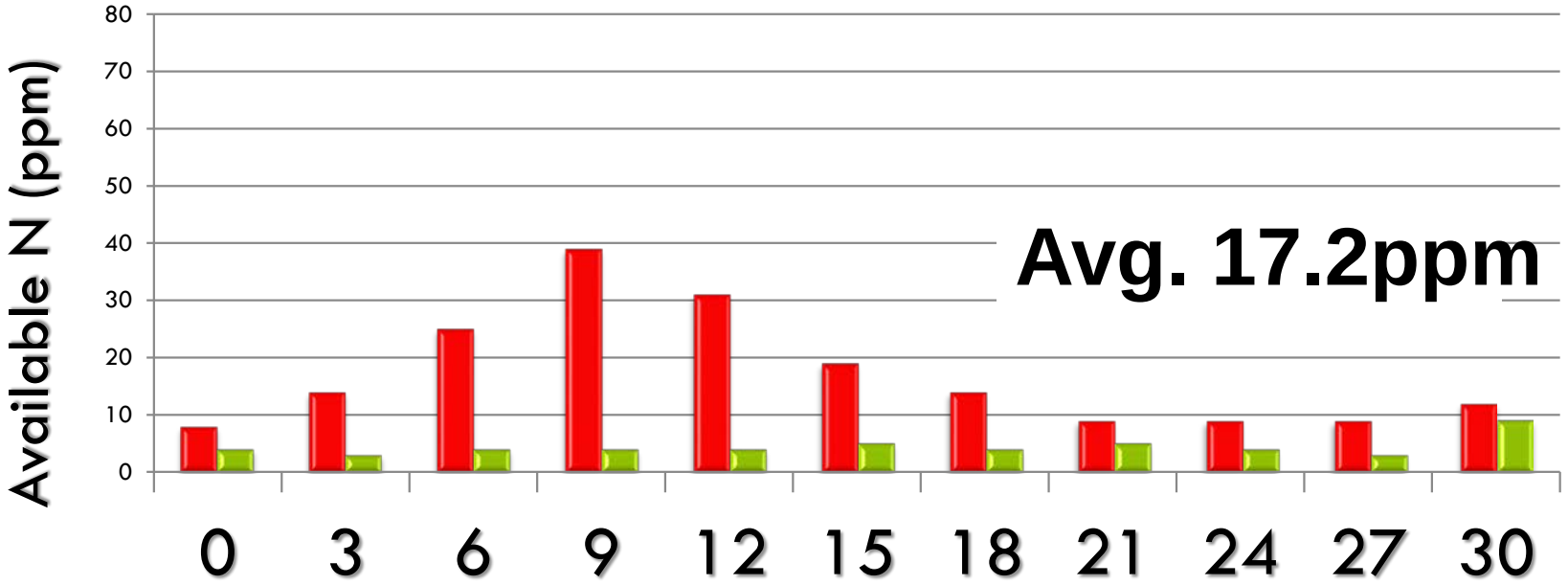


SAMPLED NOV. 2012 (Residual N)

Surface



Subsurface



Fall Soil Nitrate Sampling

Number of Counties Reporting	39
Total Number of Sites Tested	200
Number of sites with 2+ App.	78
N03-N PPM 0-12”	19
N03-N PPM 12-24”	13
Total LBS of N Both Depths	128

N Inventory Report 2014

N Inventory Report

Sampling Date:	4/1/2014	**Company:**	
Customer:	Corn after Beans	**Submitted By:**	Dan Schaefer
Farm/Field Name:	H N 80	Nearest Town:	
Latitude:		**County:**	
Longitude:			

AVAILABLE N	**0-12"**	**12-24"**
NO3-N (ppm)	**9.5**	**4.0**
NH4-N ((ppm)	24.5	3.4
Tot. Available N	**33.9**	**7.4**
% N as NO_3:	**28%**	**54%**
% N as NH_4:	**72%**	**46%**

0 to 12-Inch Sampling Depth		
Position (inches)	**NO_3-N (ppm)**	**NH_4-N (ppm)**
0	6	5
3	10	5
6	8	5
9	11	6
12	17	102
15	19	122
18	8	6
21	7	4
24	6	4
27	5	4
30	7	6

12 to 24-Inch Sampling Depth		
Position (inches)	**NO_3-N (ppm)**	**NH_4-N (ppm)**
0	3	3
3	4	3
6	5	4
9	4	3
12	5	3
15	5	4
18	4	3
21	3	3
24	3	3
27	4	4
30	4	4

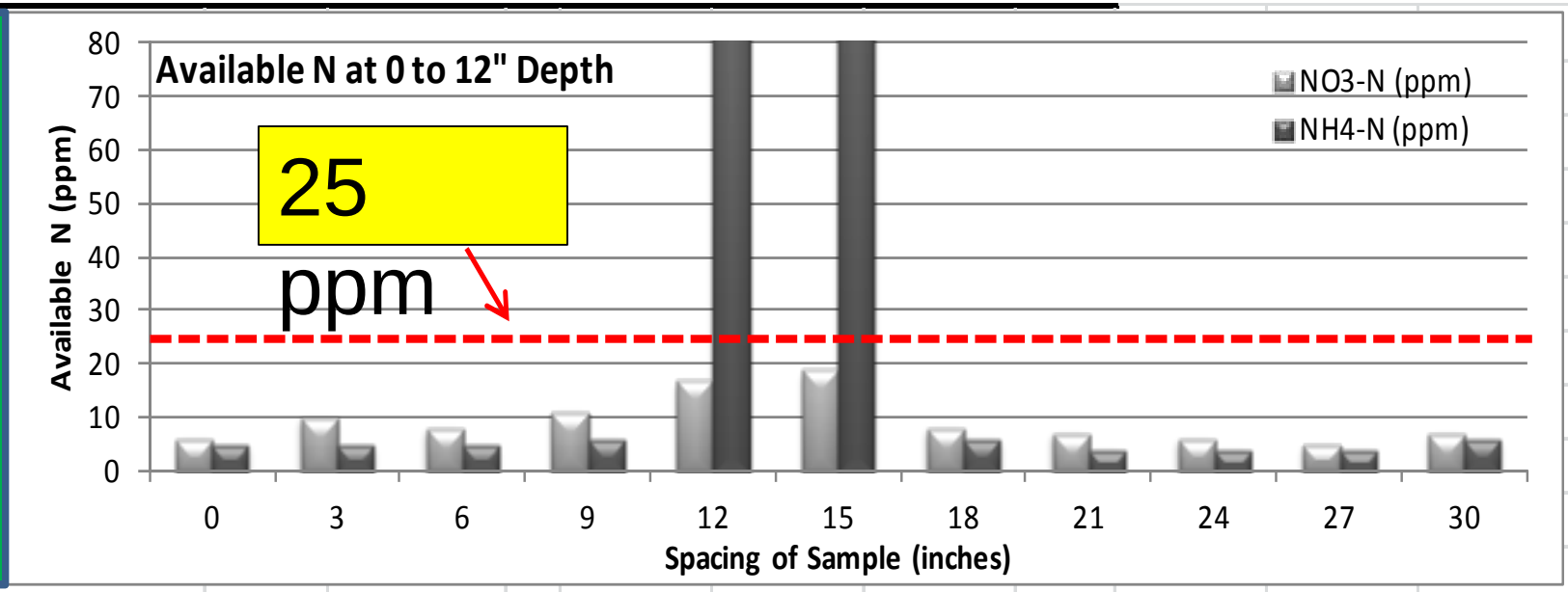
2013-2014 N MANAGEMENT

Crop:	2014 Corn
Yield	

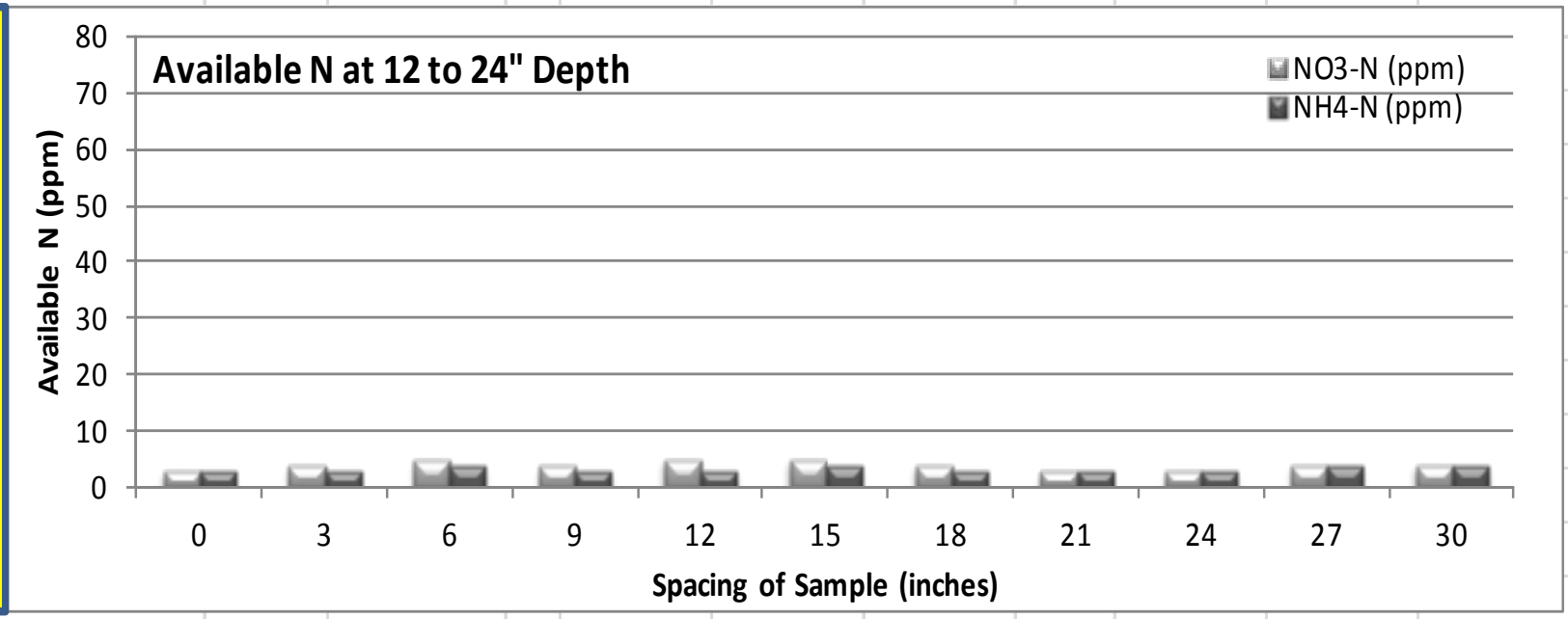
N Source	Application Date	Placement	Rate (N)	Stabilizer Used
NH3	Nov-13	Inject	180	None

Note: ppm conc. below 5 ppm not significant. May be caused by interfering ions in soil.

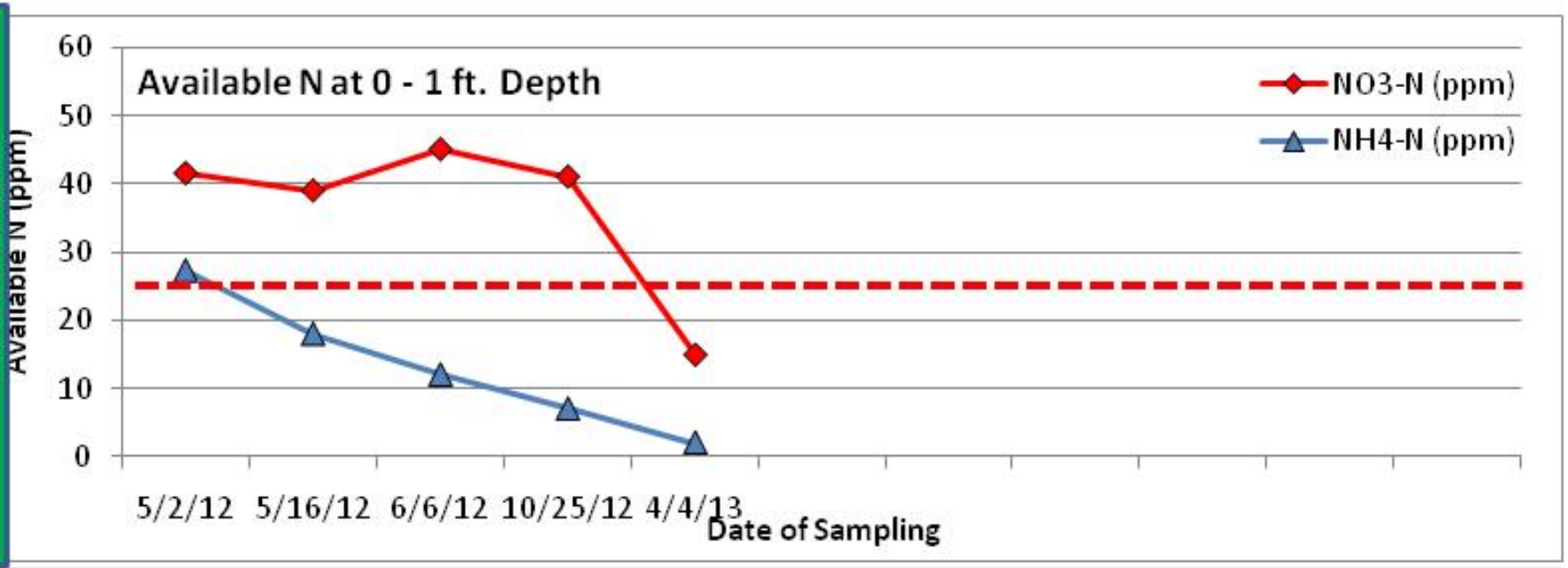
Surface



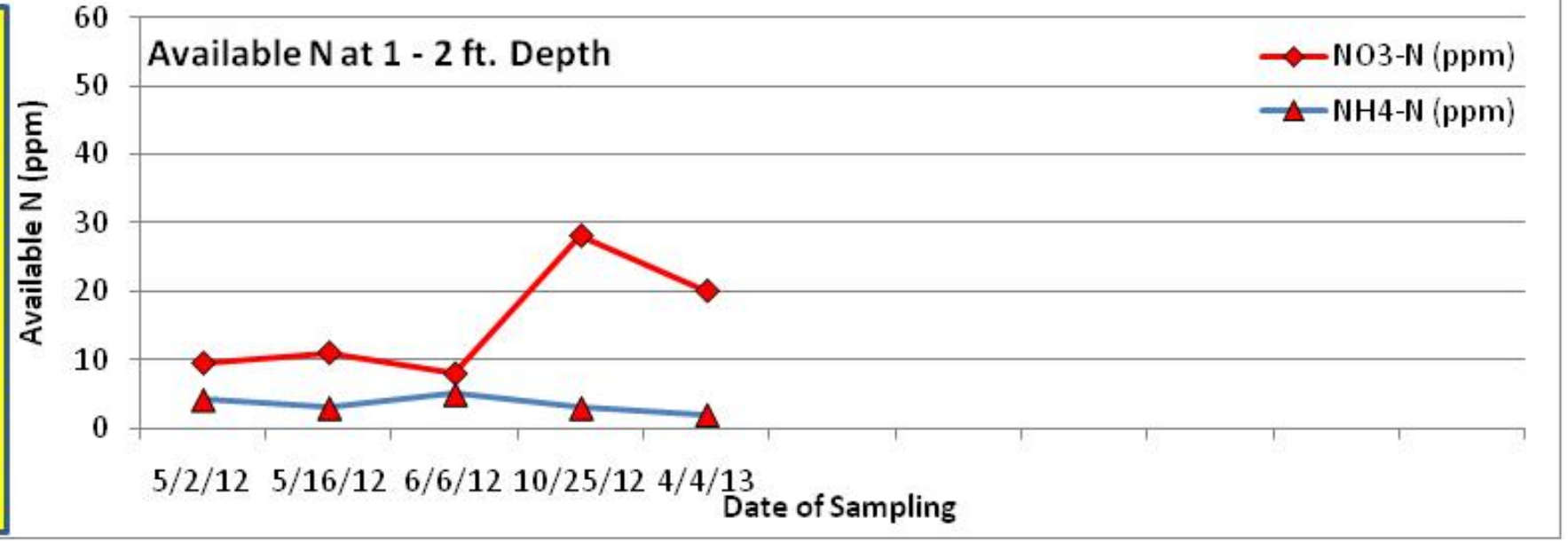
Subsurface



Surface

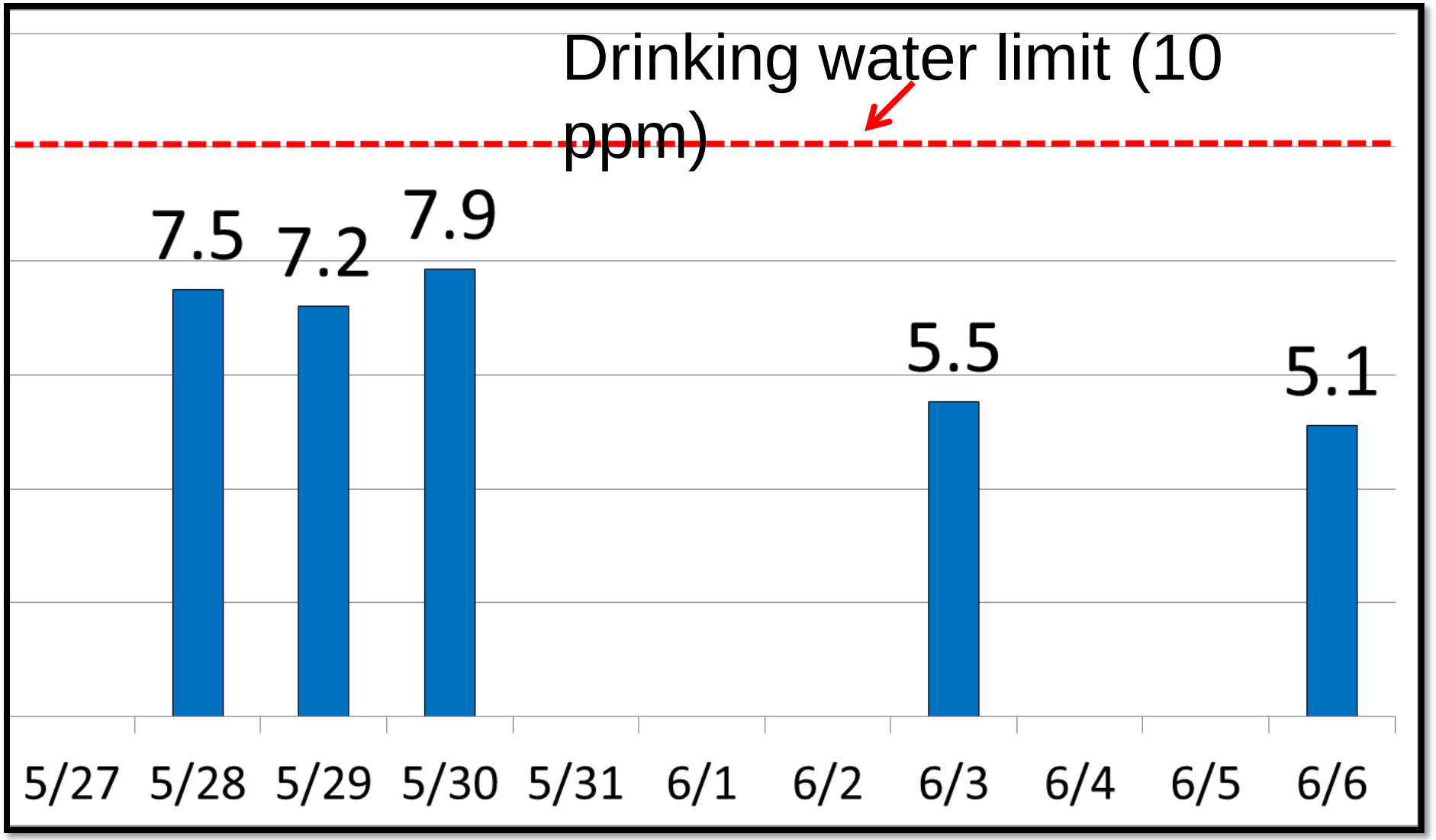


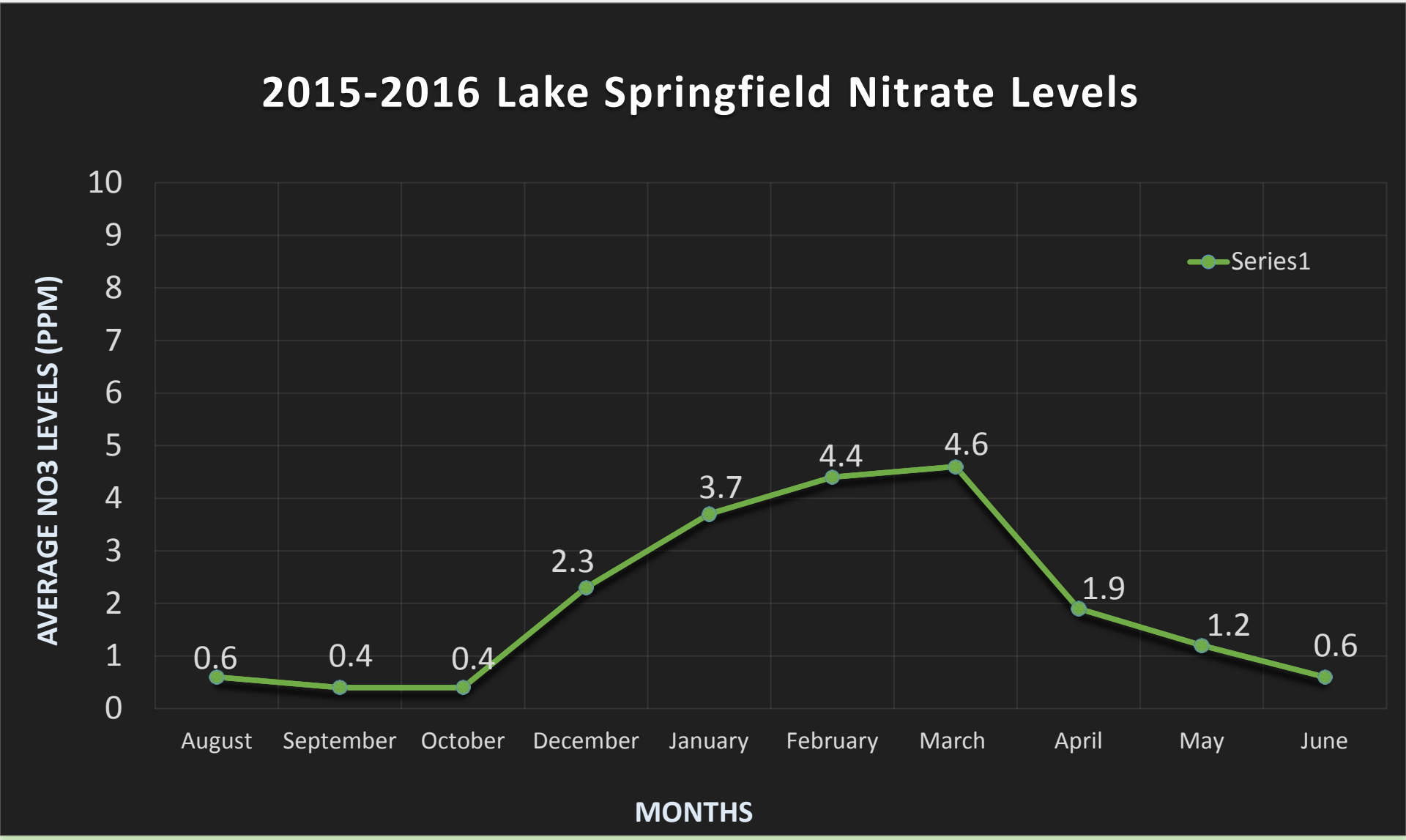
Subsurface

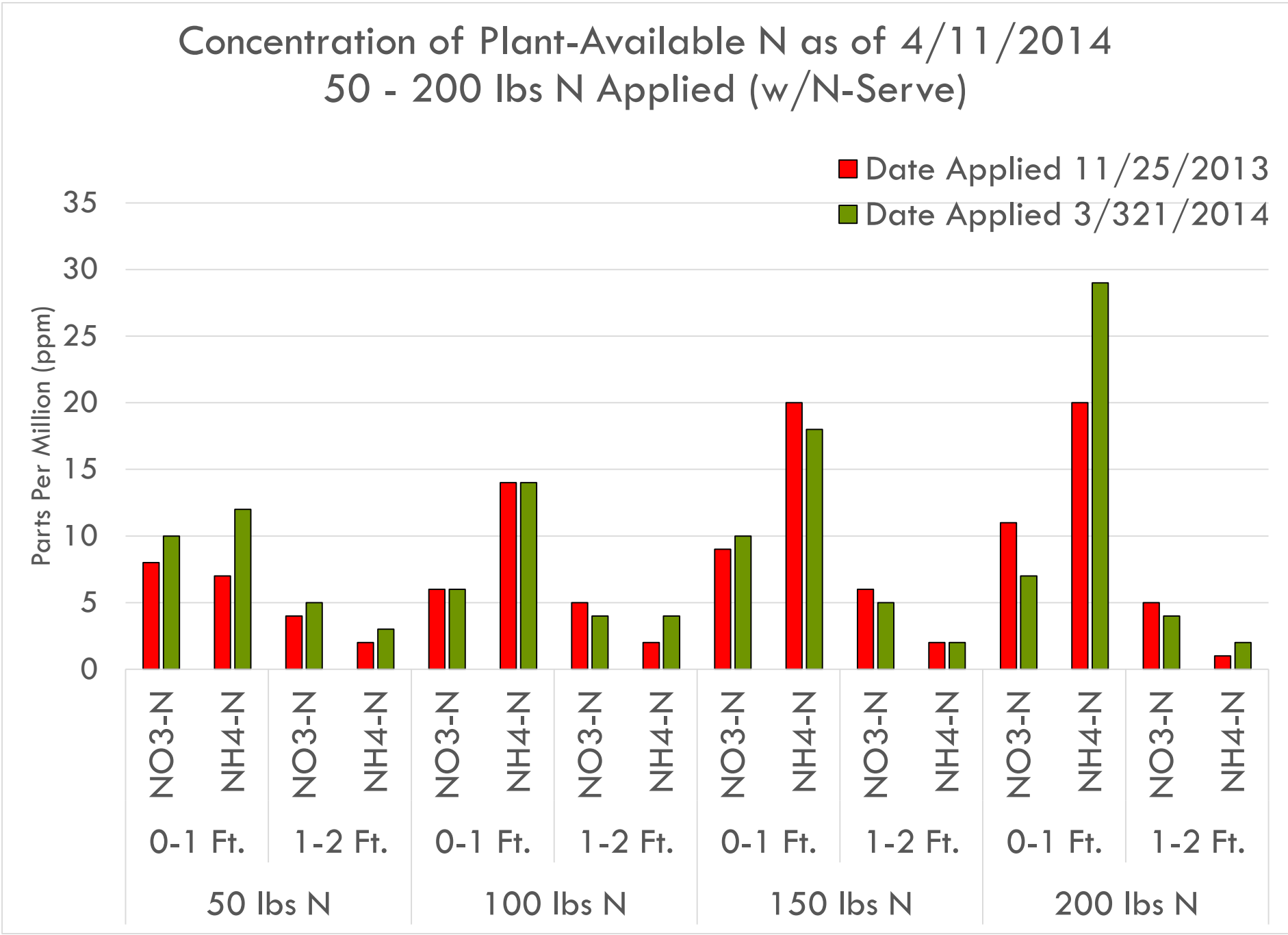


2013 – FOLLOWING DROUGHT

Lake Springfield – Finished Water




2015-2016 Lake Springfield Nitrate Levels
AVERAGE NO3 LEVELS (PPM)
10
9
8
7
6
5
4
3
2
1
0
Series1
0.6
0.4
0.4
2.3
3.7
4.4
4.6
1.9
1.2
0.6
August
September
October
December
January
February
March
April
May
June
MONTHS


Concentration of Plant-Available N as of 4/11/2014
50 - 200 lbs N Applied (w/N-Serve)
Date Applied 11/25/2013
Date Applied 3/321/2014
Parts Per Million (ppm)
35
30
25
20
15
10
5
0
NO3-N
NH4-N
0-1 Ft.
1-2 Ft.
50 lbs N
100 lbs N
150 lbs N
200 lbs N

Fall N-Serve/No Serve

Fall NH3 No N-Serve

AVAILABLE N	0-12	12-24
NO3-N ppm	20.3	7.7
NH4-N ppm	11.0	3.2
Total Available N	31.3	10.9
% N as NO_3:	65%	71%
% N as NH_4:	35%	29%

Fall NH3 With N-Serve

AVAILABLE N	0-12"	12-24"
NO3-N ppm	12.3	6.2
NH4-N ppm	24.5	2.5
Total Available N	36.7	8.6
% N as NO_3:	33%	72%
% N as NH_4:	67%	28%

GROWER PROFILE:

Grower: Ben

County: Logan

Application: 175 lbs.

Anhydrous Ammonia

Application April 14, 2015

Test Taken May 5, 2015

N WATCH

N Management System

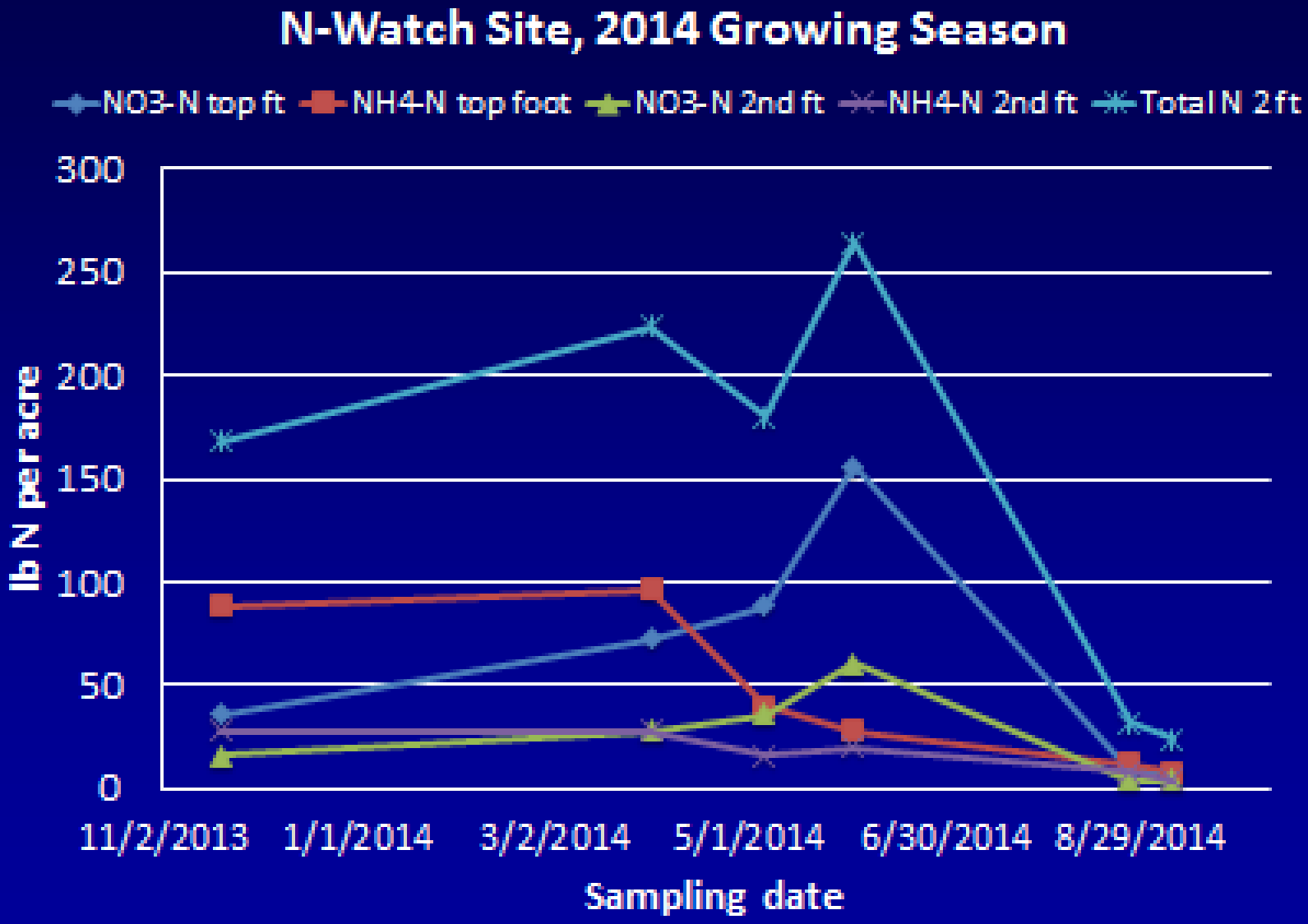
With N-serve

Available Nitrogen	0-12”
Nitrate ppm	23
Ammonium ppm	67
N as nitrate:	26%
N as ammonium:	74%

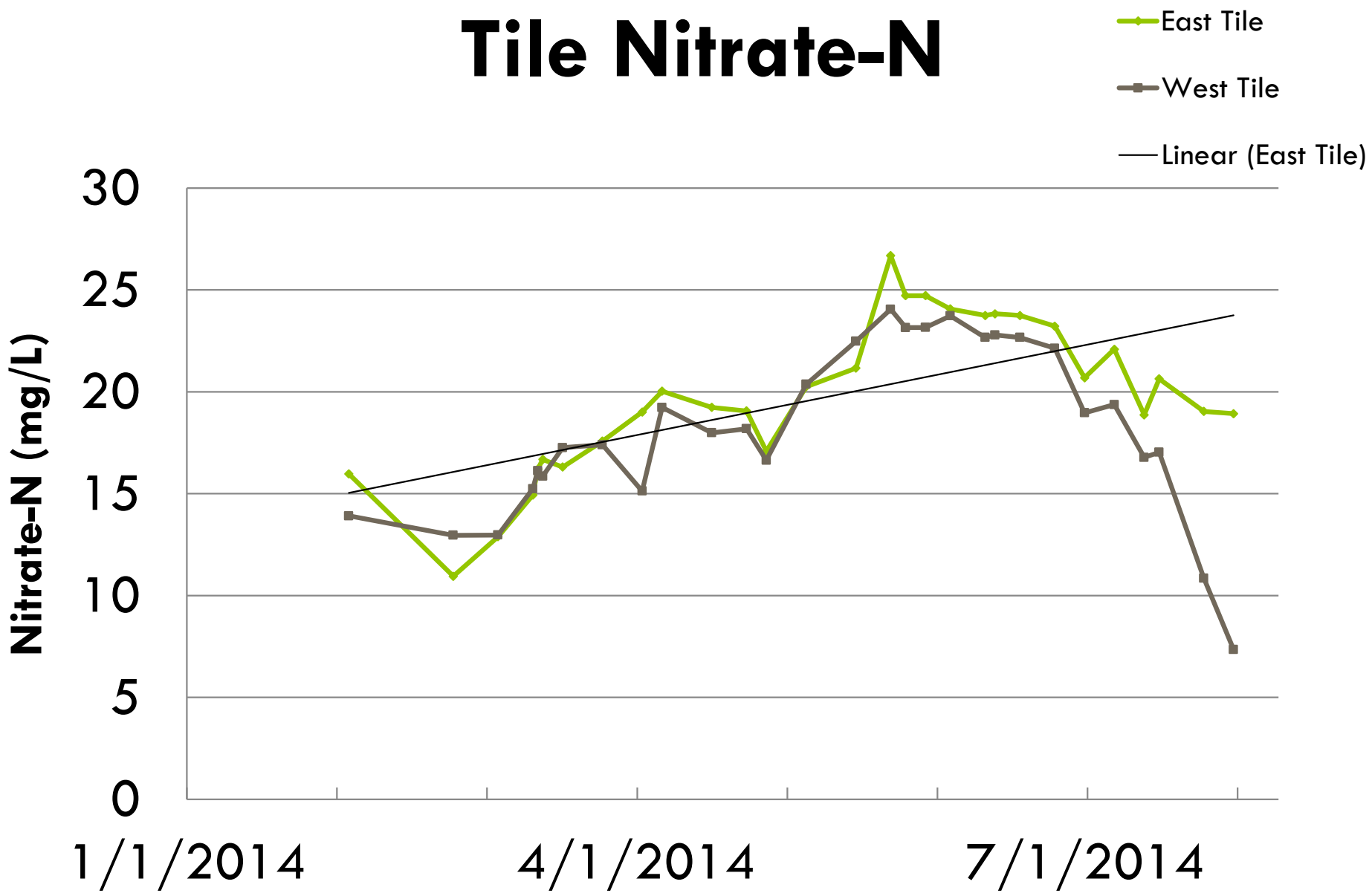
Without N-serve

Available Nitrogen	0-12”
Nitrate ppm	36
Ammonium ppm	9
N as nitrate:	80%
N as ammonium:	20%

140 lb N as NH_3 + NS applied 11/11/2013



Tile Nitrate-N



N-WATCH™

N Management System

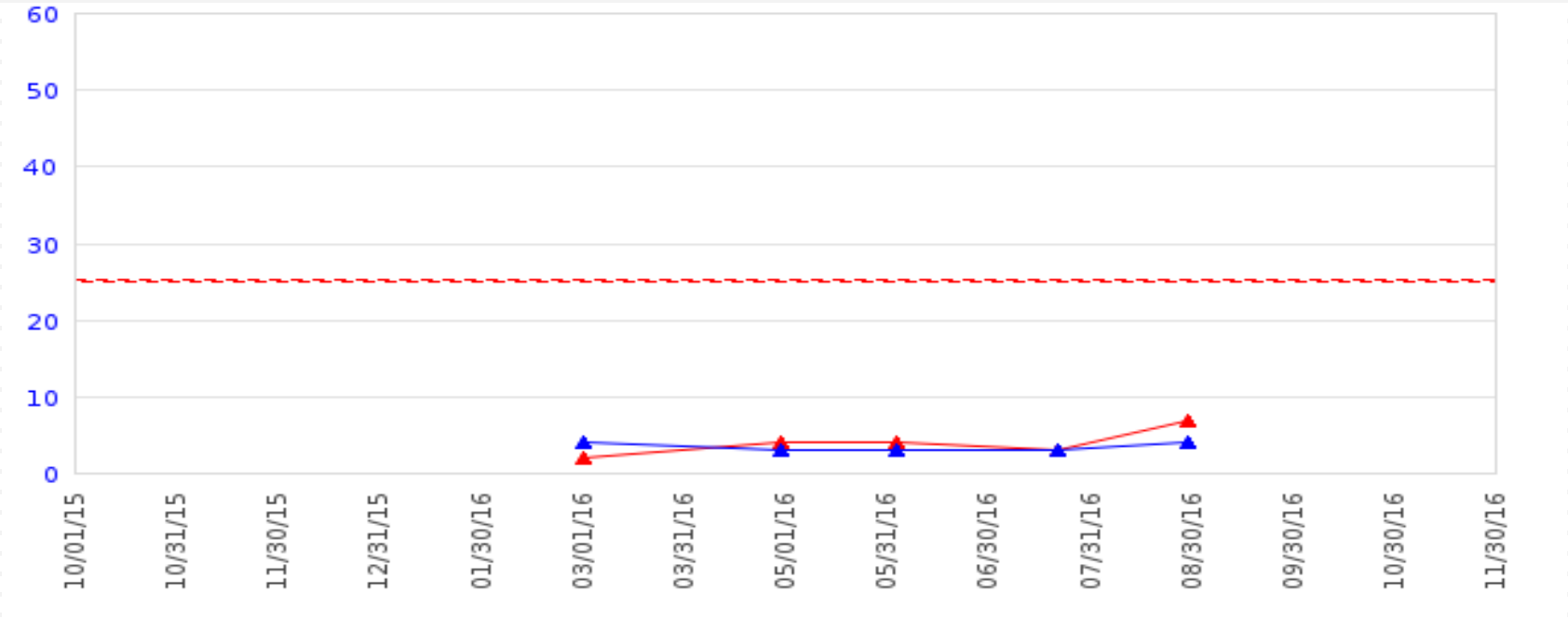
PURPOSE

- Inventory
- Track
- Verify
- Apply

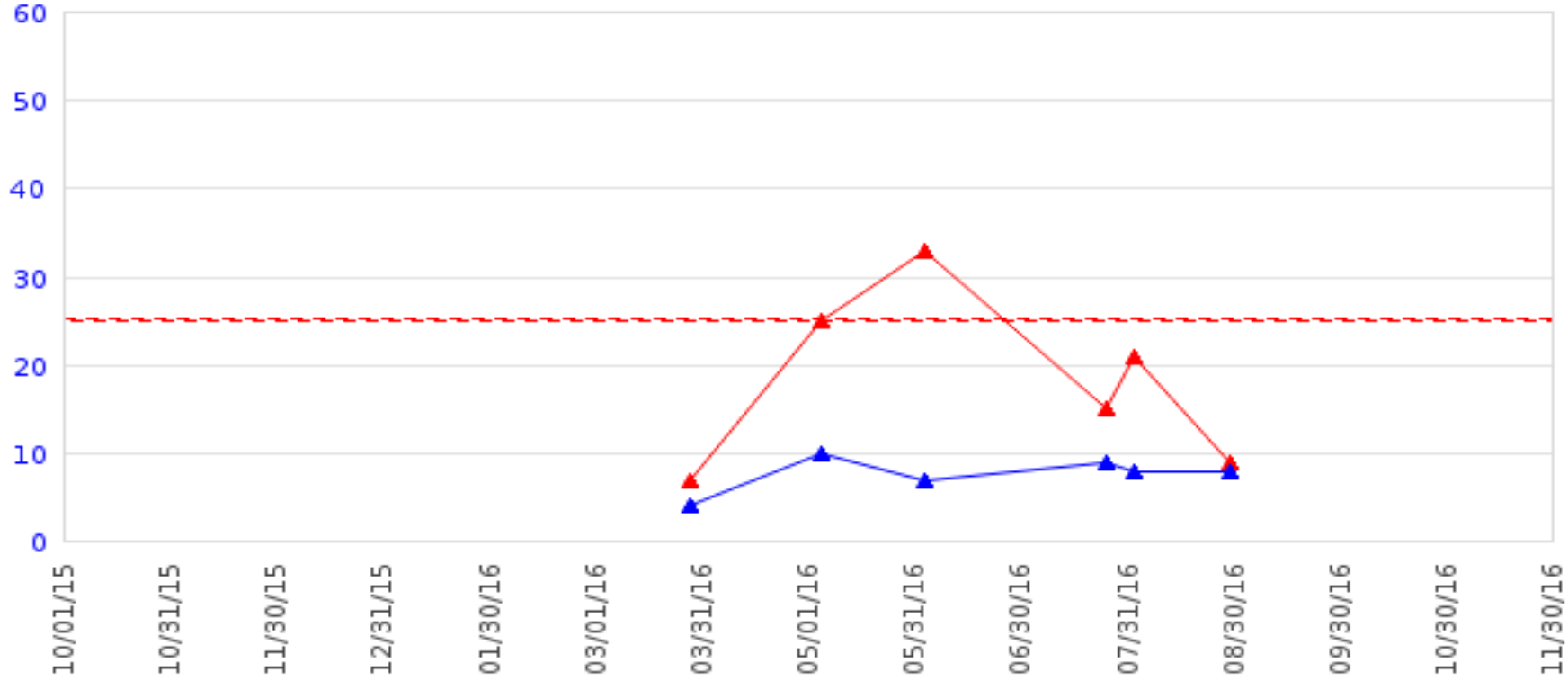
- Only Management Tool
- Not a Recommendation System

N-Watch has become a tool to teach CCA's, Farmer's, Agricultural Students and the general public about nitrogen transformation in the soil. If we can understand the nitrogen cycle as agricultural producers, we can then be understood by the public for our nutrient practices.
N-Watch is a tool not a recommendation but a guide in a systems approach to nitrogen management.

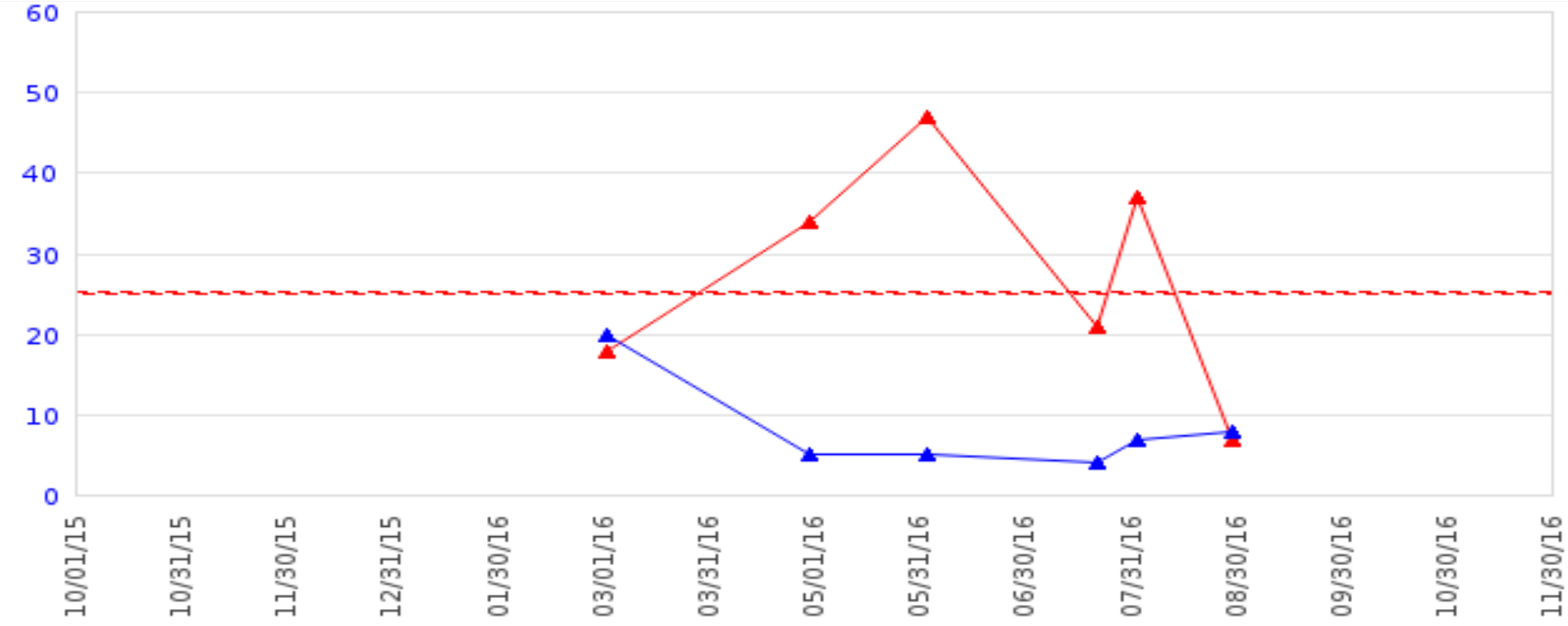
N-Watch Cover in SYB



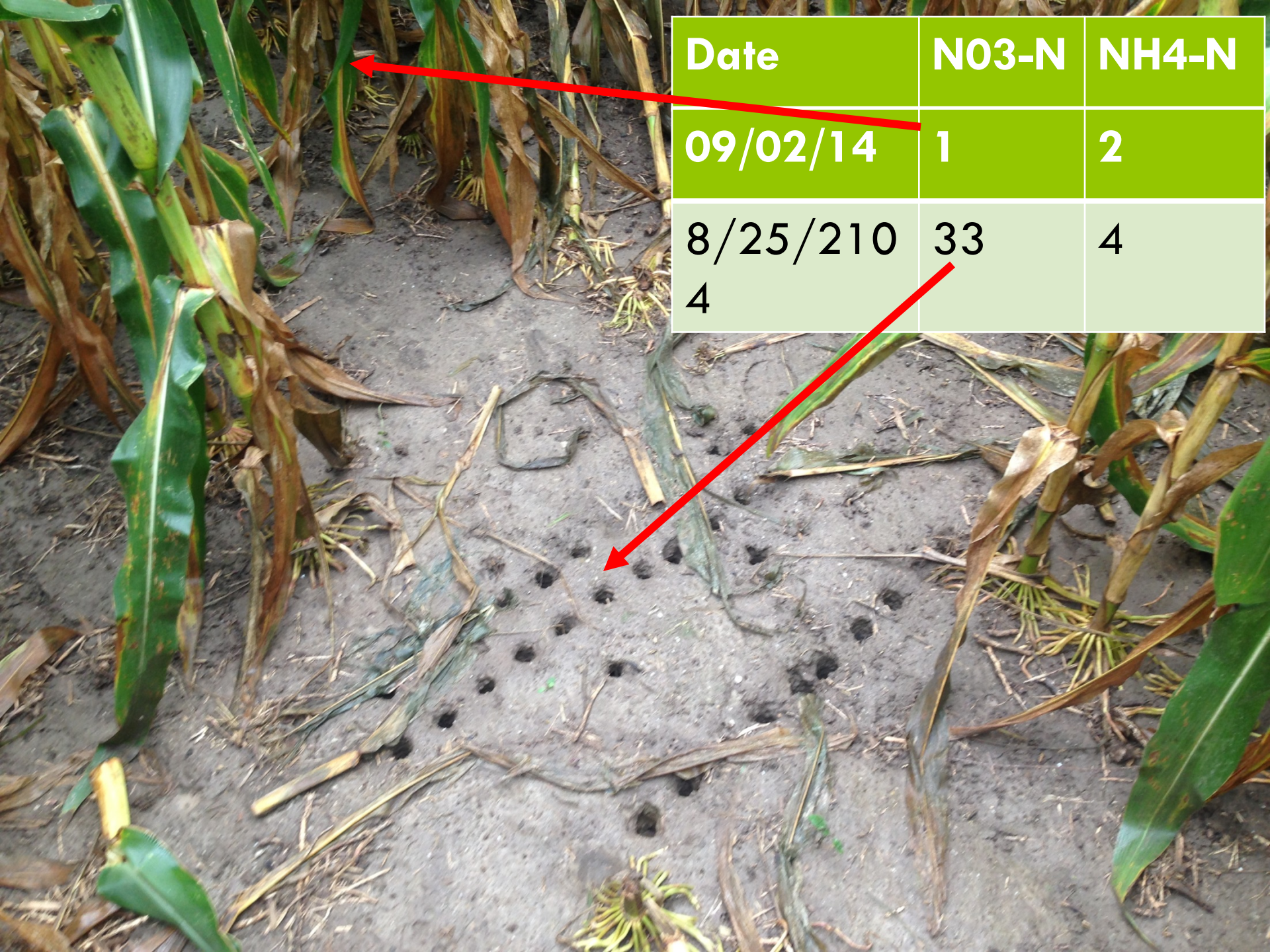
N-Watch Corn


60
50
40
30
20
10
0
10/01/15
10/31/15
11/30/15
12/31/15
01/30/16
03/01/16
03/31/16
05/01/16
05/31/16
06/30/16
07/31/16
08/30/16
09/30/16
10/30/16
11/30/16

N-Watch Fall 180 lbs N.



Lack of Crop to Take up the remaining N



Date	N03-N	NH4-N
09/02/14	1	2
8/25/2104	33	4

REVIEWER COMMENTS

Data Review and Interpretation

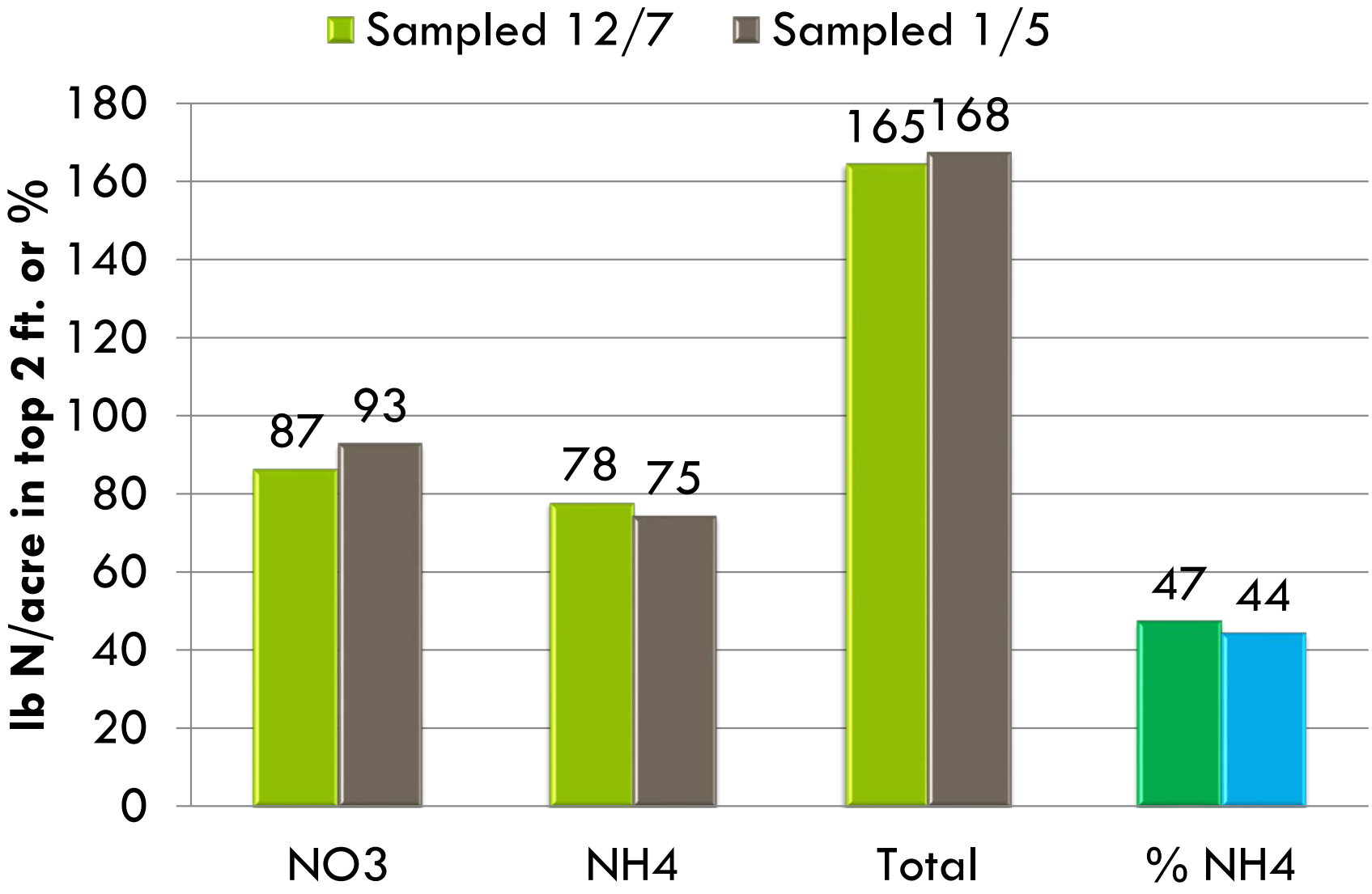
07/19/16 Save Changes **Last modified: 07/26/16 05:49**

It is difficult to interpret what the test results show at this stage of growth due to a lack of applied research. However, based upon N-WATCH data over the past four years the graph is following a similar pattern to historic sites at this time of the growing season. A decrease in Plant-Available N (PAN) has occurred prior to or following tassel emergence. A significant amount of N is in the plant by this stage of growth, reflected by the significant drop in PAN. The plant likely has most of the N it needs for grain fill with additional N entering the plant with soil water as it moves into the fill period. The developing grain relies significantly on remobilization of N from this point forward, moving N from the older tissues (roots and lower stalk) to the developing seeds.

Those areas receiving timely rain during July will likely benefit from an additional flush of N released from microbial breakdown of soil organic matter and residues (mineralization). The rewetting of a warm, dry soil stimulates microbial activity.

Potential issues that we may still face include loss of leaf area due to leaf disease, insect feeding on developing grain or plant parts, wind damage, and the lack of continued nutrient movement and plant health due to a lack of soil moisture.

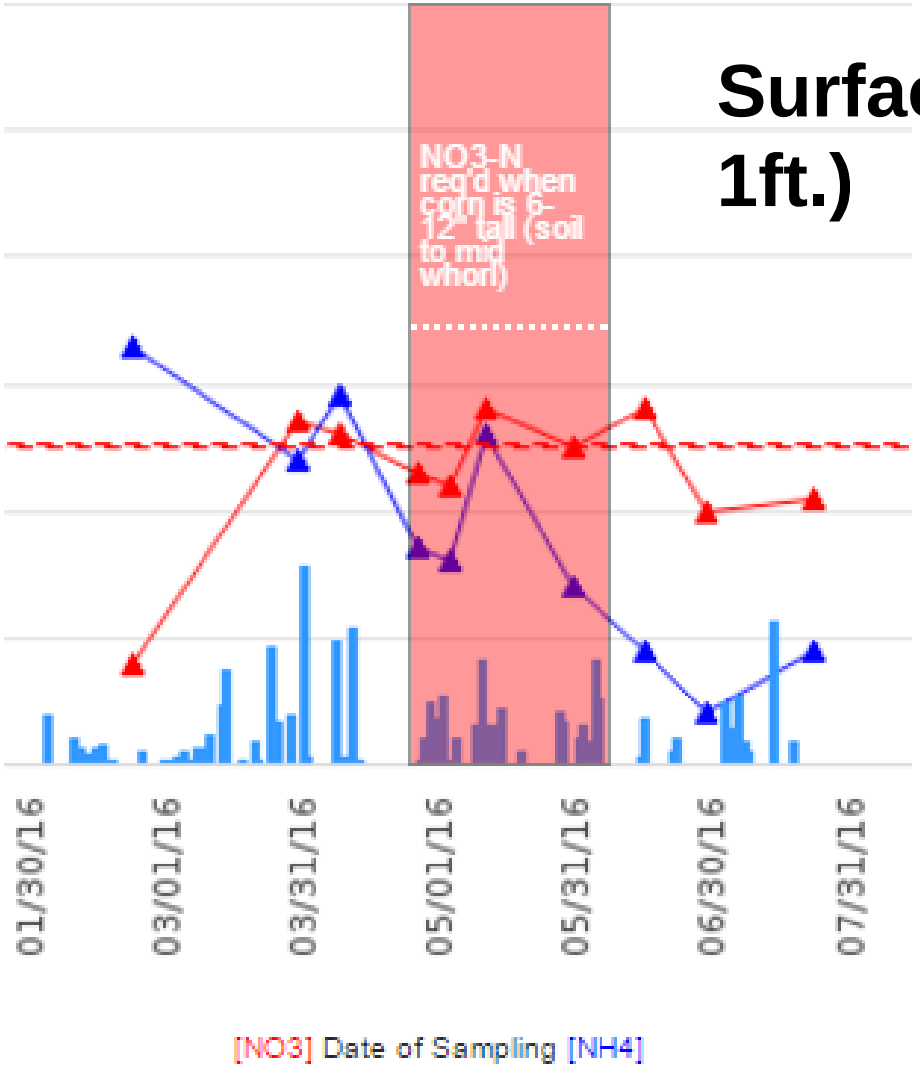
EC IL 8 sites, 163 lb NH_3-N applied Nov. 5-13

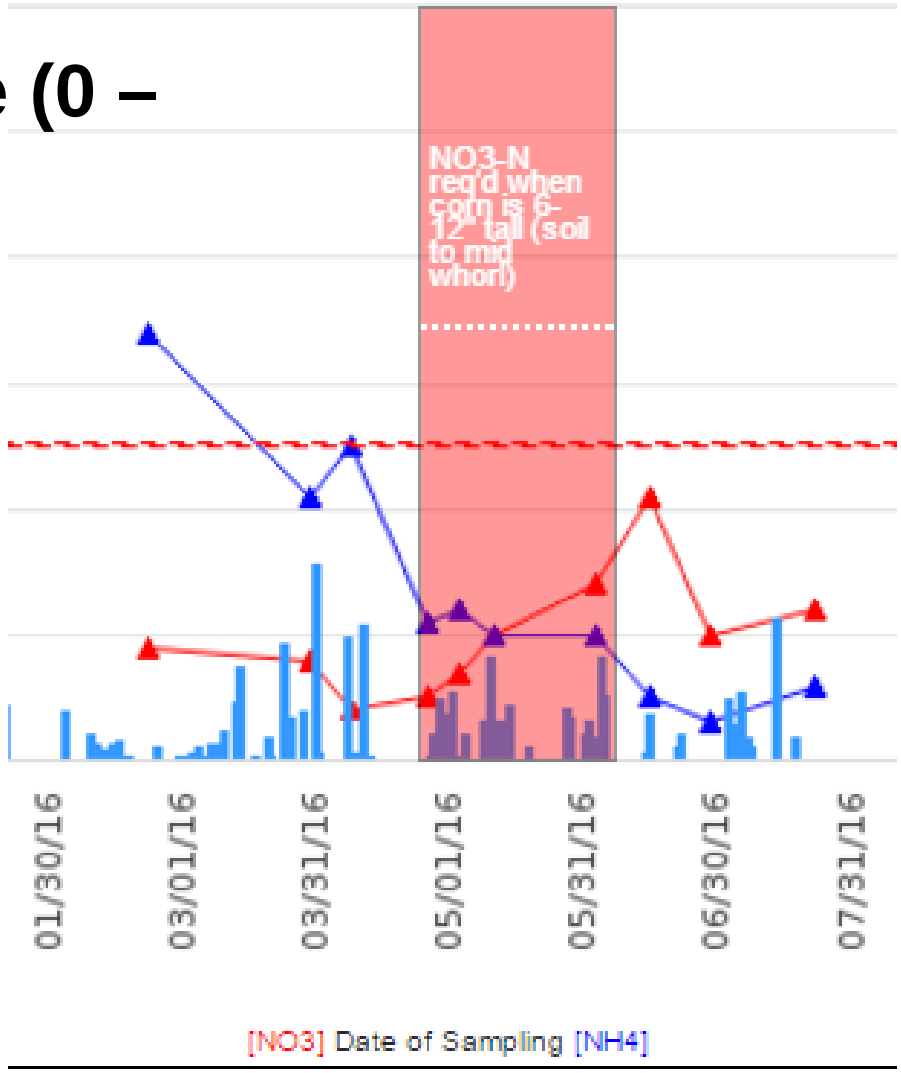


No Cover Crop

Cover Crop

Surface (0 – 1ft.)

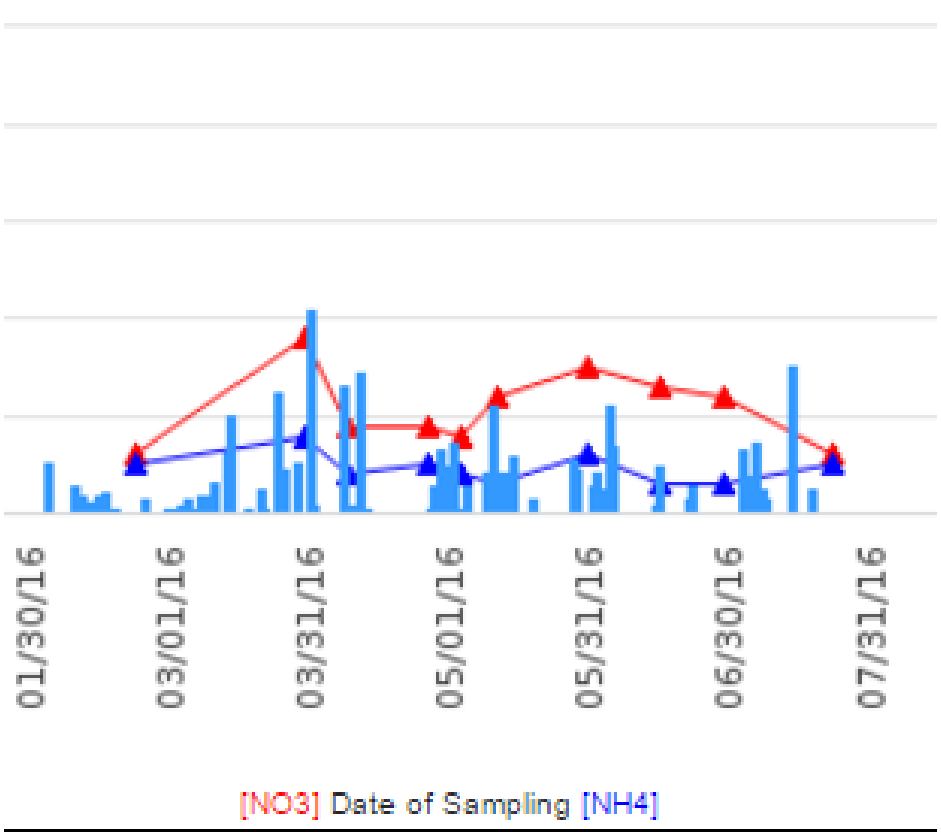


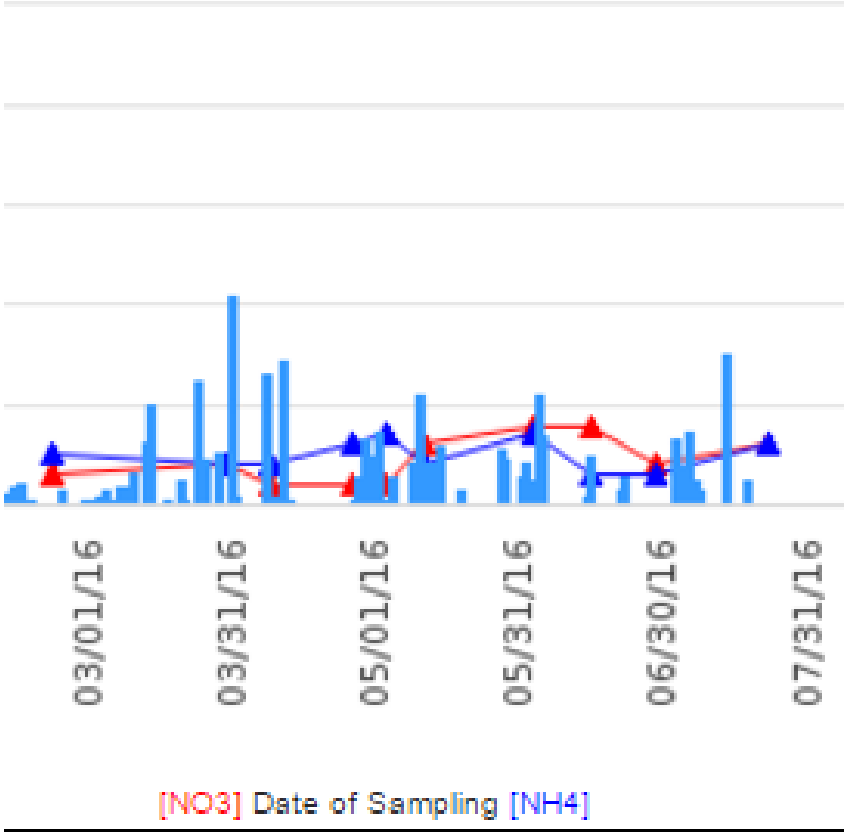


No Cover Crop

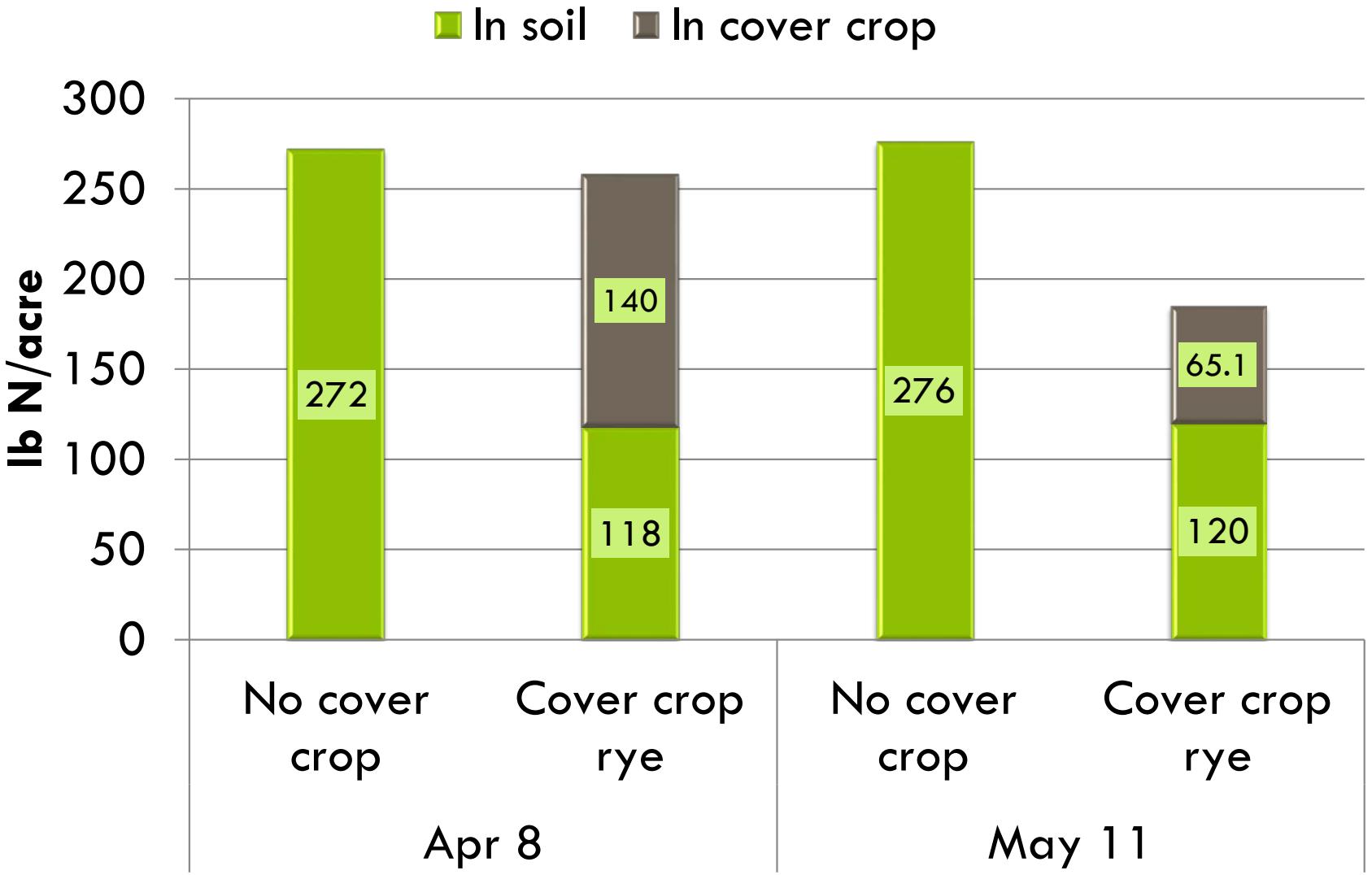
Cover Crop

Subsurface (1 – 2 ft.)





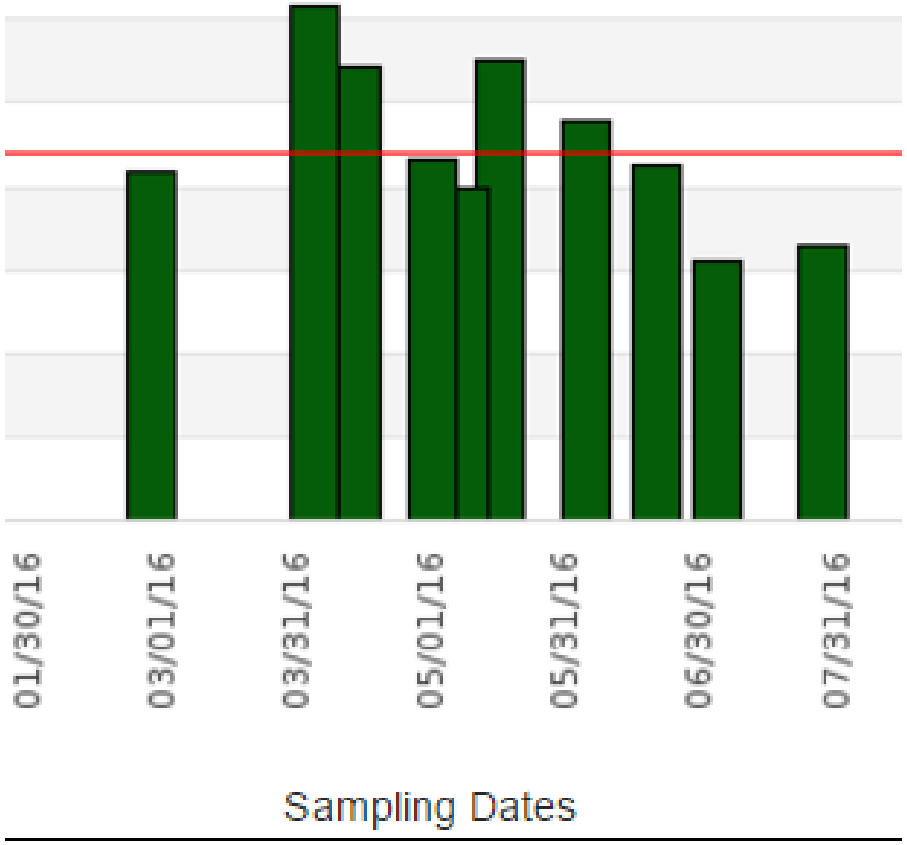
Macon County site, 2016
175 N as NH_3 + 45 lb N as DAP fall 2015

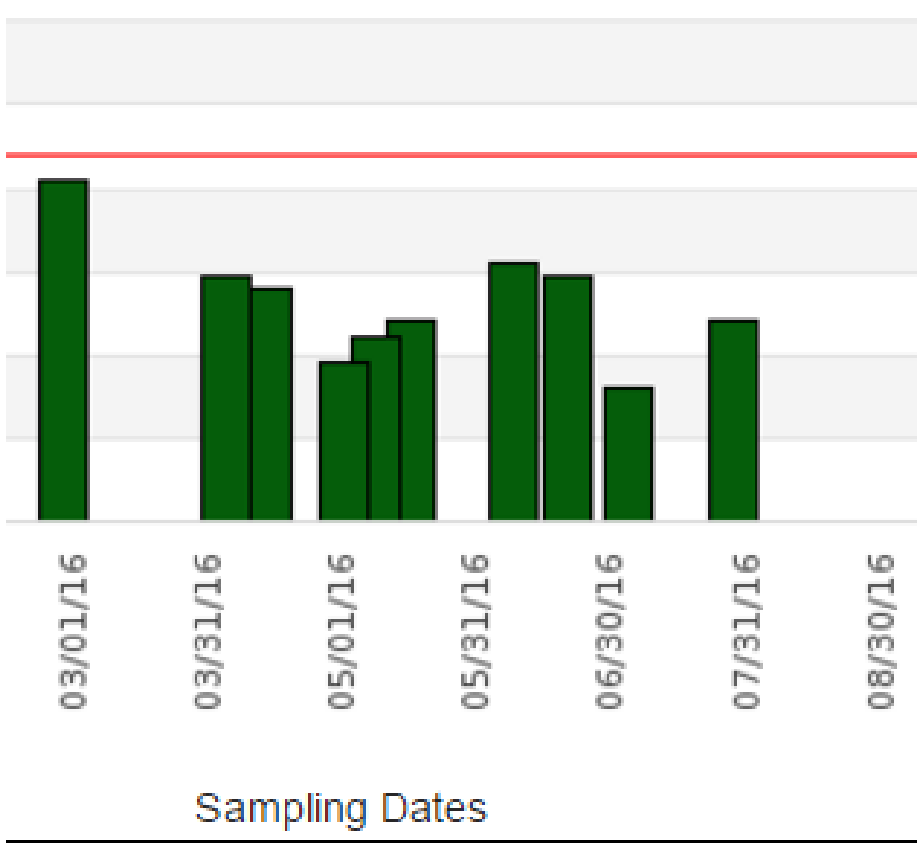


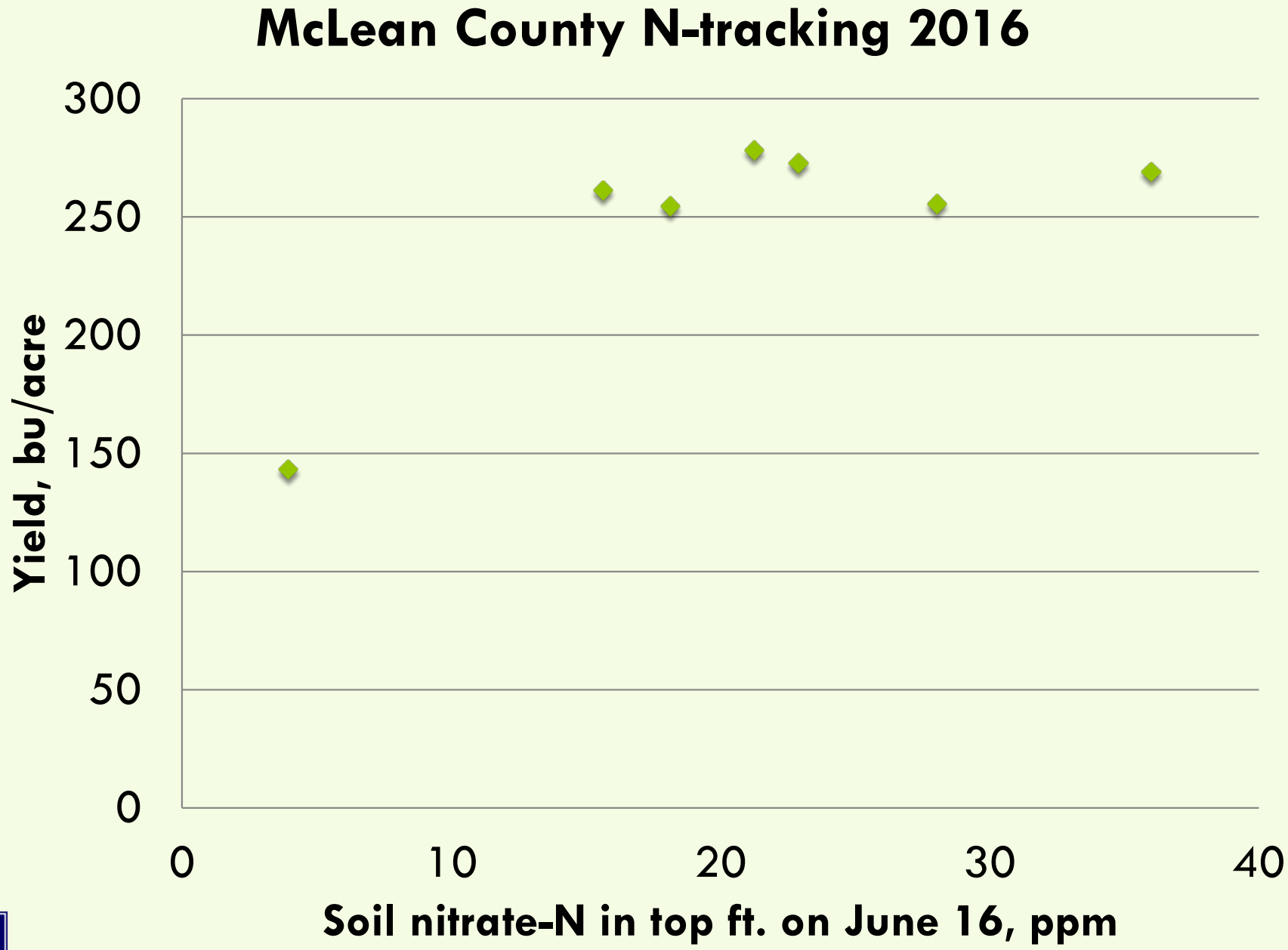
No Cover Crop

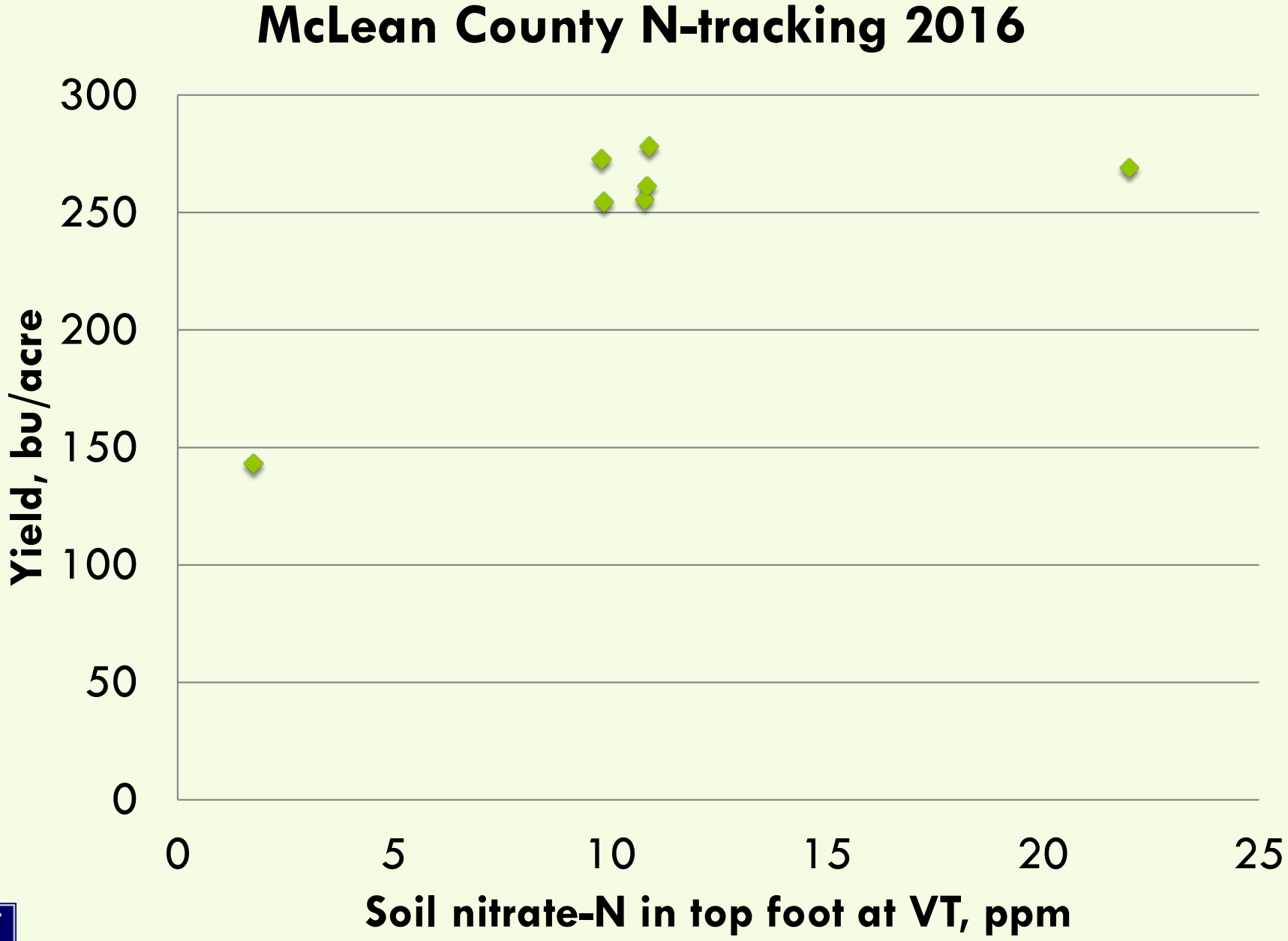
Cover Crop

Upper 2 ft.






McLean County N-tracking 2016
300
250
200
150
100
50
0
Yield, bu/acre
0
10
20
30
40
Soil nitrate-N in top ft. on June 16, ppm


McLean County N-tracking 2016
300
250
200
150
100
50
0
Yield, bu/acre
0
5
10
15
20
25
Soil nitrate-N in top foot at VT, ppm

WHAT HAVE WE LEARNED?

- Fall 2012 – Enough N to raise a crop of corn
- Fall 2014 – Little residual N
- Nitrapyrin (N-Serve) inhibits nitrification
- Cover crops immobilize N
- Some do not like to pull samples
- Each site tells a story

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Bloomington, IL 61705
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Does the Corn Crop Need More Nitrogen?

Emerson Nafziger, University of Illinois

Except for some areas of southeastern Illinois, the 2016 corn crop went in well, and on June 12 was rated at 75% good or excellent. Warm temperatures have speeded up growth, and although below-normal rainfall, especially in western Illinois, is starting to cause some concern, the 2016 corn crop is off to a very good start.

The corn crop this year has excellent stands and there are few drowned-out areas, though there is some unevenness depending on when the crop was planted and how much rain it received after planting. The most noteworthy feature, though, is the dark green color of the crop, especially the crop that was planted in mid-April. This is among the greenest corn crops I have seen in Illinois.

Not only is the crop green where N fertilizer has been applied, it is also green where no N fertilizer was applied. In a June 9 photo taken in one of our N trials, the zero-N treatment shows slightly less growth than the treatment with 200 lb. N applied on April 18 as NH3, but leaf color is about the same without N as with a full N rate (Figure 1). We don't expect this to last as N uptake kicks into high gear, but the crop has taken up a fair amount of N that didn't come from fertilizer.

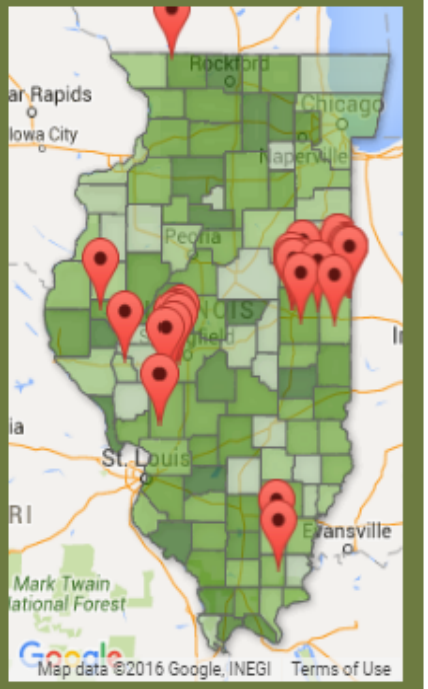
Figure 1. Photo taken on June 9 of V7 corn in a research trial near Urbana, Illinois. The crop followed soybean, and was planted on April 18.

Soil N changes

IFCA Sites

IFCA has several participating sites that provide live information complimenting the the research that Dr Nafziger discusses.

Click on the site markers for more info.



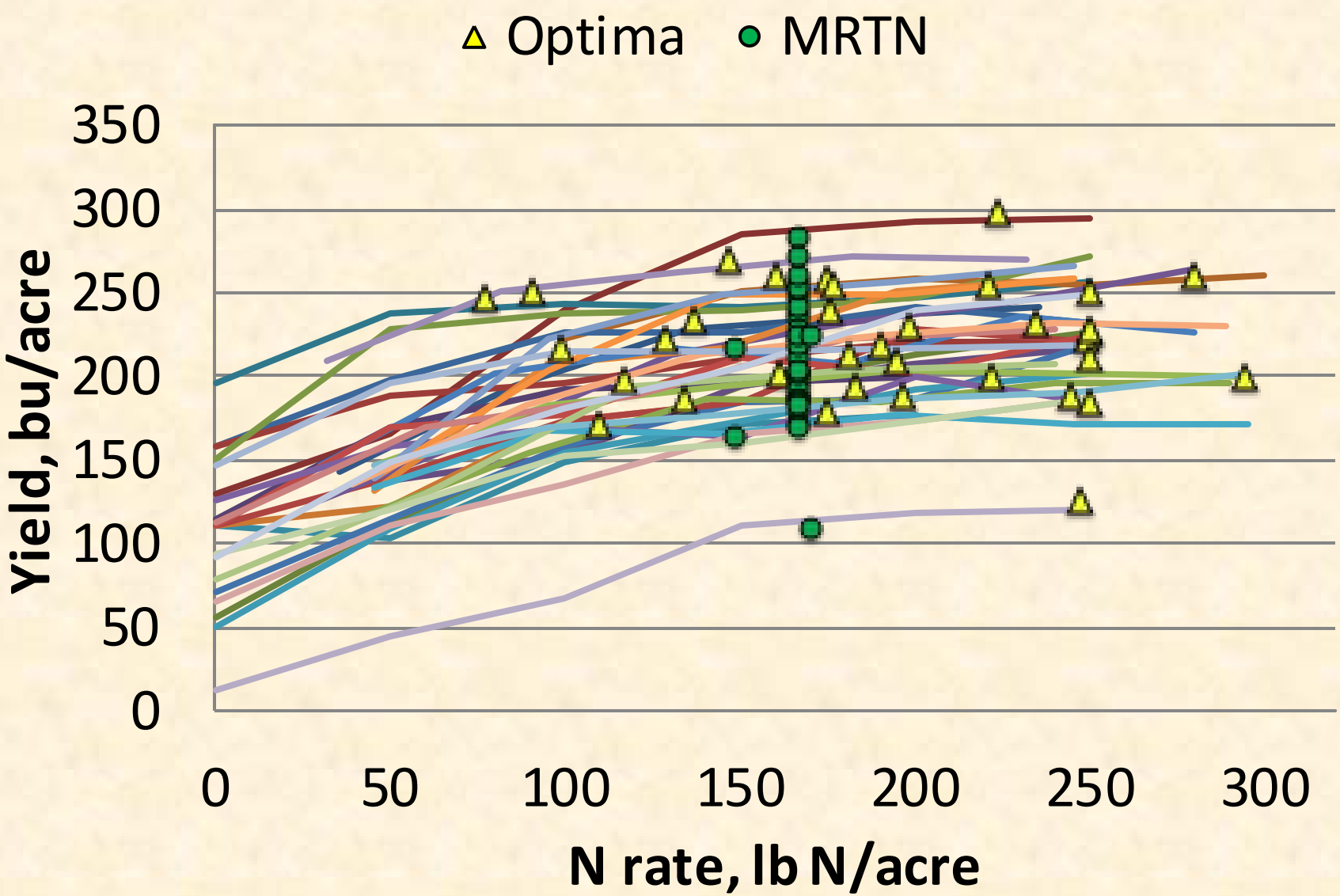
Champaign County Site
Champaign County Site
Champaign County Site
Champaign County Site
Champaign County Site
Champaign County Site
Champaign County Site
Champaign County Site
Champaign County Site
Vermilion County Site
Vermilion County Site

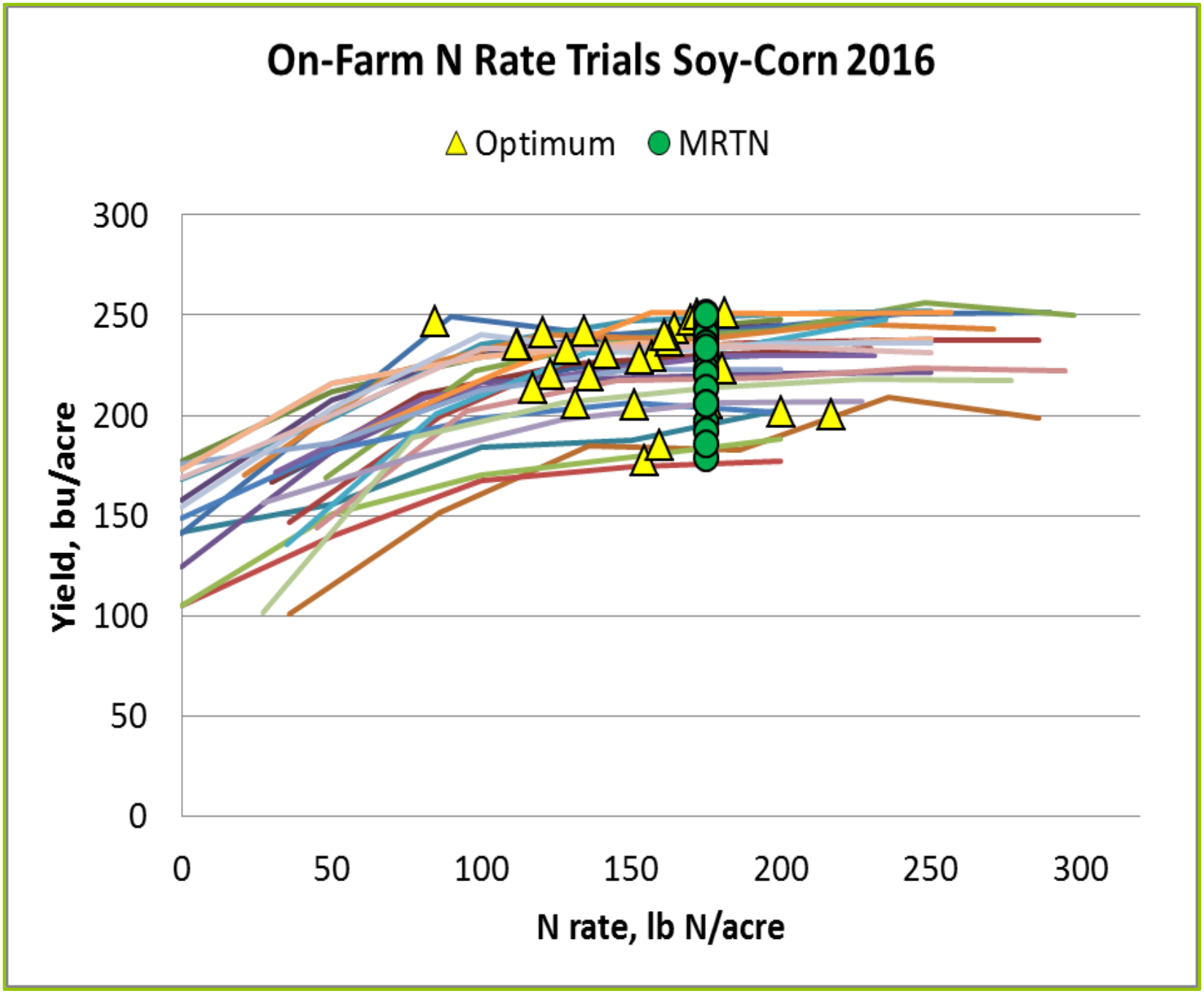
N RATE CALCULATOR BASED ON LAKE SPRINGFIELD WATERSHED DATA 2014-16

Dan Schaefer, IFCA


14 11.03.58
Ag Leader
1.23
3.9
200.00
200.00
10:03am

35 on-farm trials Soy-Corn 2015




On-Farm N Rate Trials Soy-Corn 2016
Optimum
MRTN
300
250
200
150
100
50
0
Yield, bu/acre
0
50
100
150
200
250
300
N rate, lb N/acre

Database

- On-farm N rate trials were coordinated by Dan Schaefer & Jason Solberg of IFCA in 2014, 2015, and 2016
  - Most had rates ranging from 0 (or planter-applied or MAP/DAP) to 200 or 250 (plus base) by 50-lb increments
  - N form and timing varied from fall NH_3 to sidedress UAN
- In addition to Lake Springfield Watershed project sites, several other sites on similar soils within 50 miles of Springfield were added
- We ended up with a total of 11 corn-following-corn sites and 22 corn-following soybean sites to use in the analysis

Lake Springfield Watershed calculator results

Used N price of $0.375/lb N and corn price of $3.75/bu; ratio = 0.1

Corn Nitrogen Rate Calculator

Finding the Maximum Return To N and Most Profitable N Rate

A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

	SC	CC	
Maximum Return to N (MRTN) Rate:	**165**	**207**	**lb N/acre**
Profitable N Rate Range:	**152 - 178**	**197 - 224**	**lb N/acre**
Net Return to N at MRTN Rate:	**$270.78**	**$308.03**	**$/acre**
Nitrogen Cost at MRTN Rate:	**$61.88**	**$77.63**	**$/acre**
Percent of Maximum Yield at MRTN Rate:	**98%**	**98%**	

Central Illinois Calculator Results
214 S-C sites; 155 C-C sites

Using N price of $0.375/lb N and corn price of $3.75/bu; ratio = 0.1

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Finding the Maximum Return To N and Most Profitable N Rate

A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

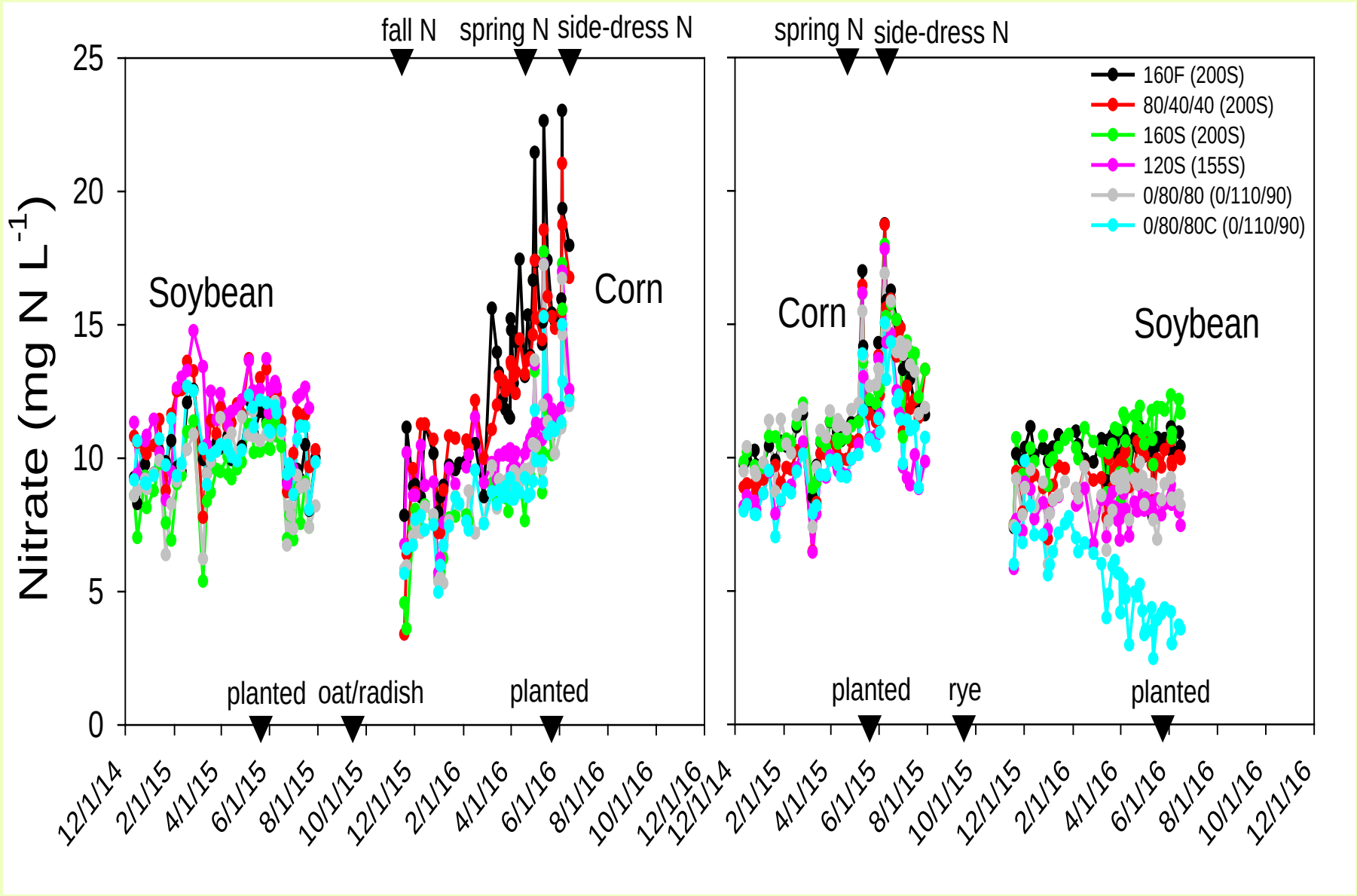
	SC	CC	
Maximum Return to N (MRTN) Rate:	**175**	**200**	**lb N/acre**
Profitable N Rate Range:	**160 - 189**	**189 - 215**	**lb N/acre**
Net Return to N at MRTN Rate:	**$275.50**	**$346.83**	**$/acre**
Nitrogen Cost at MRTN Rate:	**$65.63**	**$75.00**	**$/acre**
Percent of Maximum Yield at MRTN Rate:	**98%**	**99%**	

Comparing Lake Springfield and central IL N rate calculator results

- Corn following soybean:
  - The MRTN N rate for the LSW calculator (22 sites) is 165 lb N/acre
  - For the Central Illinois calculator (214 sites) the MRTN is 175 lb N/acre, 10 lb more than the LSW rate
- Corn following corn:
  - The MRTN N rate for the LSW calculator (11 sites) is 207 lb N/acre
  - For the Central Illinois calculator (155 sites) the MRTN is 200 lb N/acre, 7 lb less that the LSW rate
- MRTN rates are surprisingly similar, given the limited number of sites in the LSW calculator and the wet year of 2015, when optimum N rates for C-C were high

Tile Nitrate Concentrations Averaged across Treatments

(from 12/12/14 to 6/15/16)



The MRTN N Rate Calculator

- Uses all recent data (combined) to predict "best" fertilizer N rates for corn
- Converts yield responses to economic return responses, based on current prices
- Includes "most profitable ranges" usually +/- 15 lb or so of N
- Provides a "guideline" more than a recommendation"
- Is seldom exact for a given field, but we know of no other N rate "guess" likely to be better

USING MRTN AND N RATE STUDIES HELPS US COME UP WITH:

- RELIABLE
- RESPONSIBLE
- DEFENSIBLE

NITROGEN RECOMMENDATIONS

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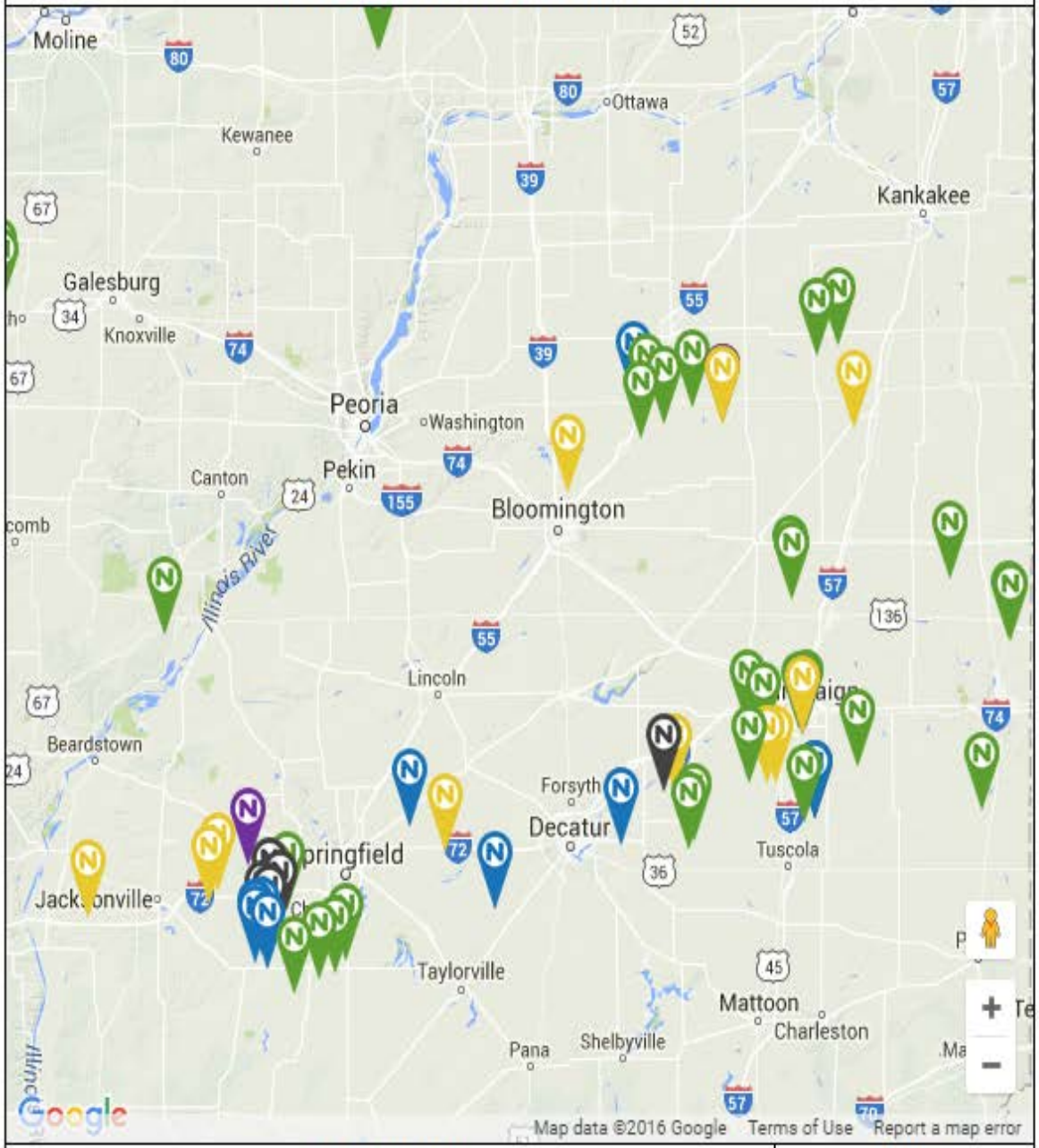
Keep It 4R Crop N-Rate Trials



Description	Year
On-Farm Nitrogen Rate Trials done in cooperation with farmers and ag	All

IFCA 4R Code of Practice:

Educate & Recommend

- Stewardship on Fall Applied N – 50 degree soil, nitrification inhibitor and consider split application
- Discourage applying majority of nutrient needs on frozen, snow covered soils – offer a 4R approach instead
- Use Appropriate Rate & Nitrogen Management Systems MRTN
- Soil Testing – P, K, pH (recommend spring testing)
- Promote overall good crop production practices to optimize yield and nutrient utilization

Is This a BMP? Is it the Right Time? The Right Place?

There is a Better Time and Place to Apply Nutrients

"We're seeing a significant drop in customer complaints since we stopped answering our phones."

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