Drought's Influence on Residual Soil Nutrient Availability…..

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Virginia Tech

January 10, 2013



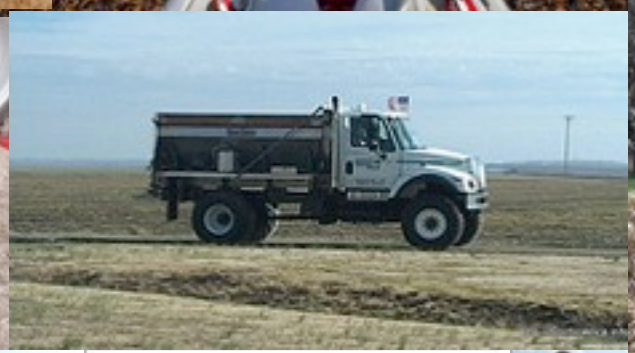


Drought and Yields Highly Variable

Residual Fertility
Lime and Fertilizer Needs in 2013?

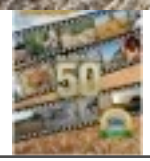












Water-use Efficiency and Balanced Soil Fertility

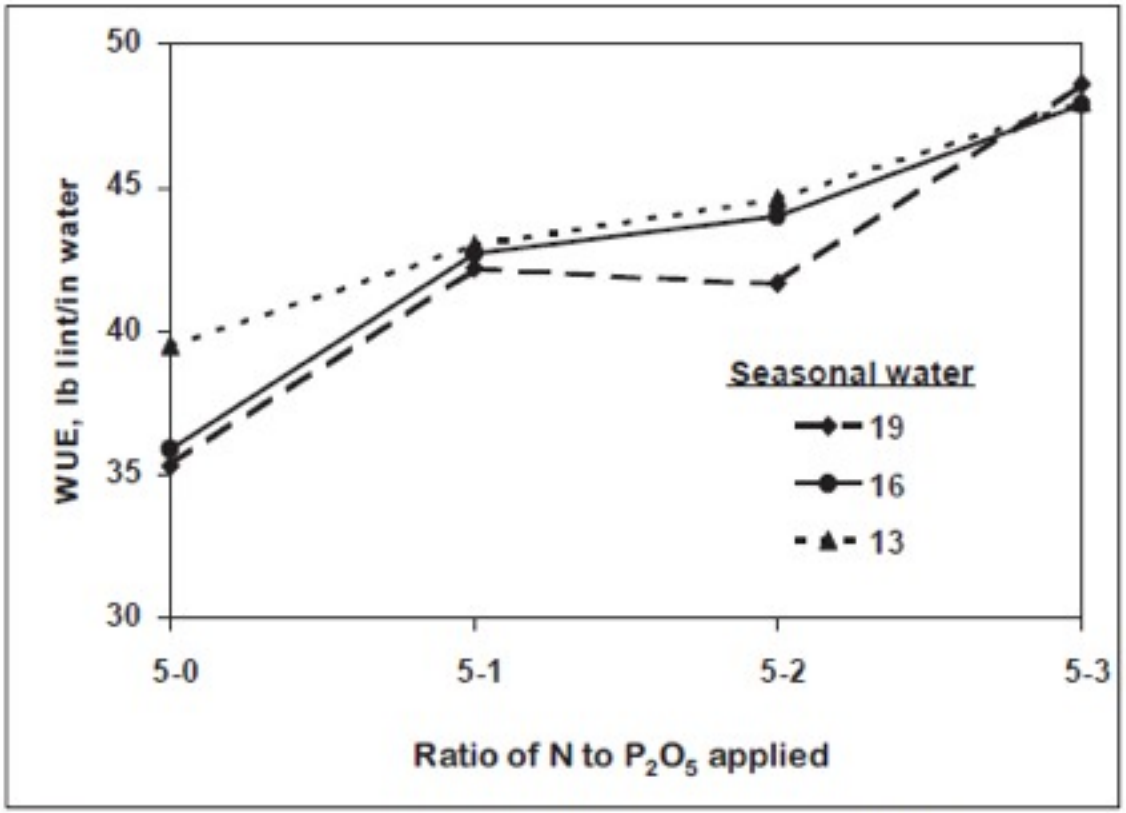
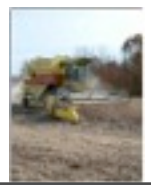


Figure 1. Improved P fertility increases WUE in irrigated cotton production (Krieg; Texas, 1997). Constant N with variable P, averaged across three methods of P placement.

Stewart, W. M. 2001. News & Views. IPNI, Norcross GA





Presentation Objectives

- Basic Principles for Drought and Nutrient Availability
- Process for Determining Nutrient Availability in Your Individual Fields
- Examples of Some Current N Monitoring Programs





What Do We Know?

- 2012 yields
- Estimate nutrient removals
- Soil test levels after the 2012 crop
- Rainfall and temperatures since crop maturity
- Crops to be grown in 2012(?)





Estimated Nutrient Removal for Corn Grain

Yield	N	P_2O_5	K_20	Mg	S
bu/ac	----Removed in Grain (lbs/acre)*----				
50	37.5	22	14.5	2.7	5.3
100	75	44	29	5.4	10.6
150	112.5	66	43.5	8	16

- Plant Food Uptake for Southern Crops, IPNI, Norcross, GA.
- Mg and S Values from Bundy. Corn Fertilization Pub. A3340 U. of WI





Estimated Nutrient Uptake for Corn

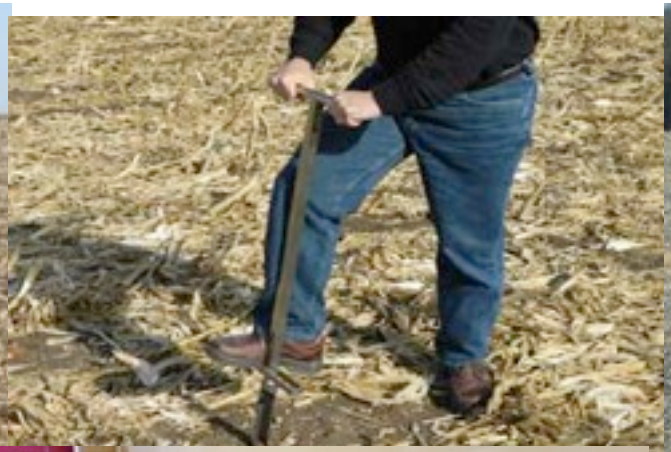
Yield	N	P_2O_5	K_20	Mg	S
bu/ac	----Uptake (lbs/acre)*----				
50	67	28	67	16	8
100	134	56	134	32	16
150	201	84	201	48	24

- Plant Food Uptake for Southern Crops, IPNI, Norcross, GA.
- Mg and S Values from Bundy. Corn Fertilization Pub. A3340 U. of WI

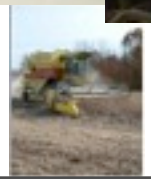
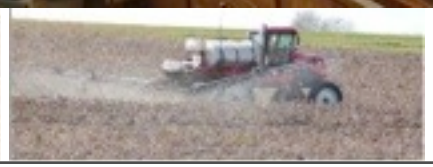




Soil Sampling and Testing for


NO-TILL FARMER


Changes in Residual Soil P

- Mehlich 3 Extractable P*
  - Soil with 10% clay
    - test level changes ~ 0.7 ppm for lb of applied P
  - Soil with 40% clay
    - Test level changes ~0.2 ppm per lb of applied P

*Cox, F.R. 1994.Predicting increases in extractable P from fertilizing soils of varying clay contents. SSSAJ 58:1249-1253





Changes in Residual Soil K and P With Fertilization

- 5 to 7 lbs of K_2O to increase Mehlich 3 soil test value 1 ppm for Kentucky soils (G. Schwab, 2013)
- 3 to 5 lbs of P2O5 to increase soil test P 0.5 ppm when soil test P ranged from 25 to 58 ppm Mehlich 3*

*Thom and Dollarhide, 2002. U. of KY Agronomy Notes 34, No. 2

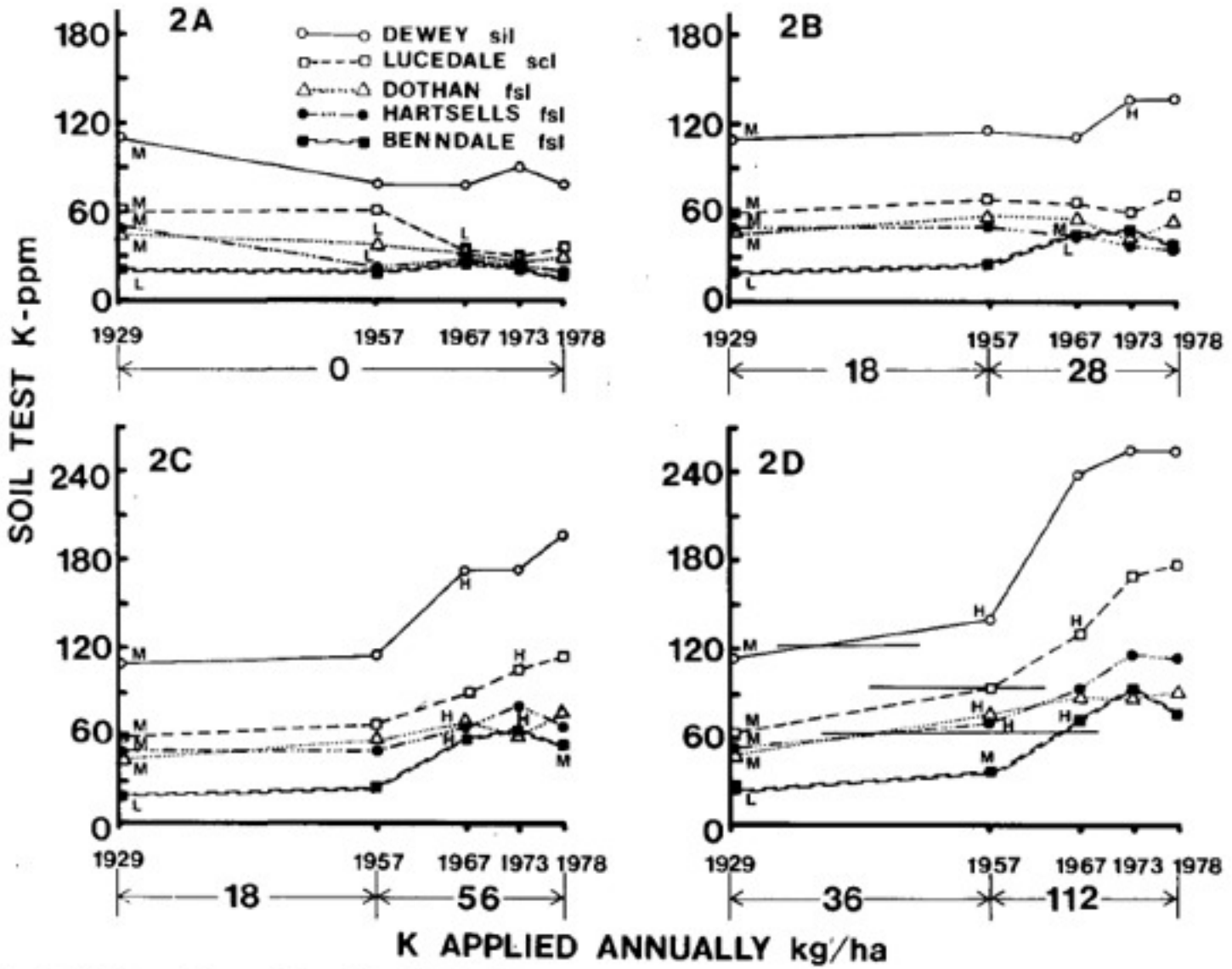


Fig. 2—Soil test K as affected by K fertilizer rates on five soils over the 50-year period, 1929–1978.

Cope. 1981. Agron. J. 45:342-347.

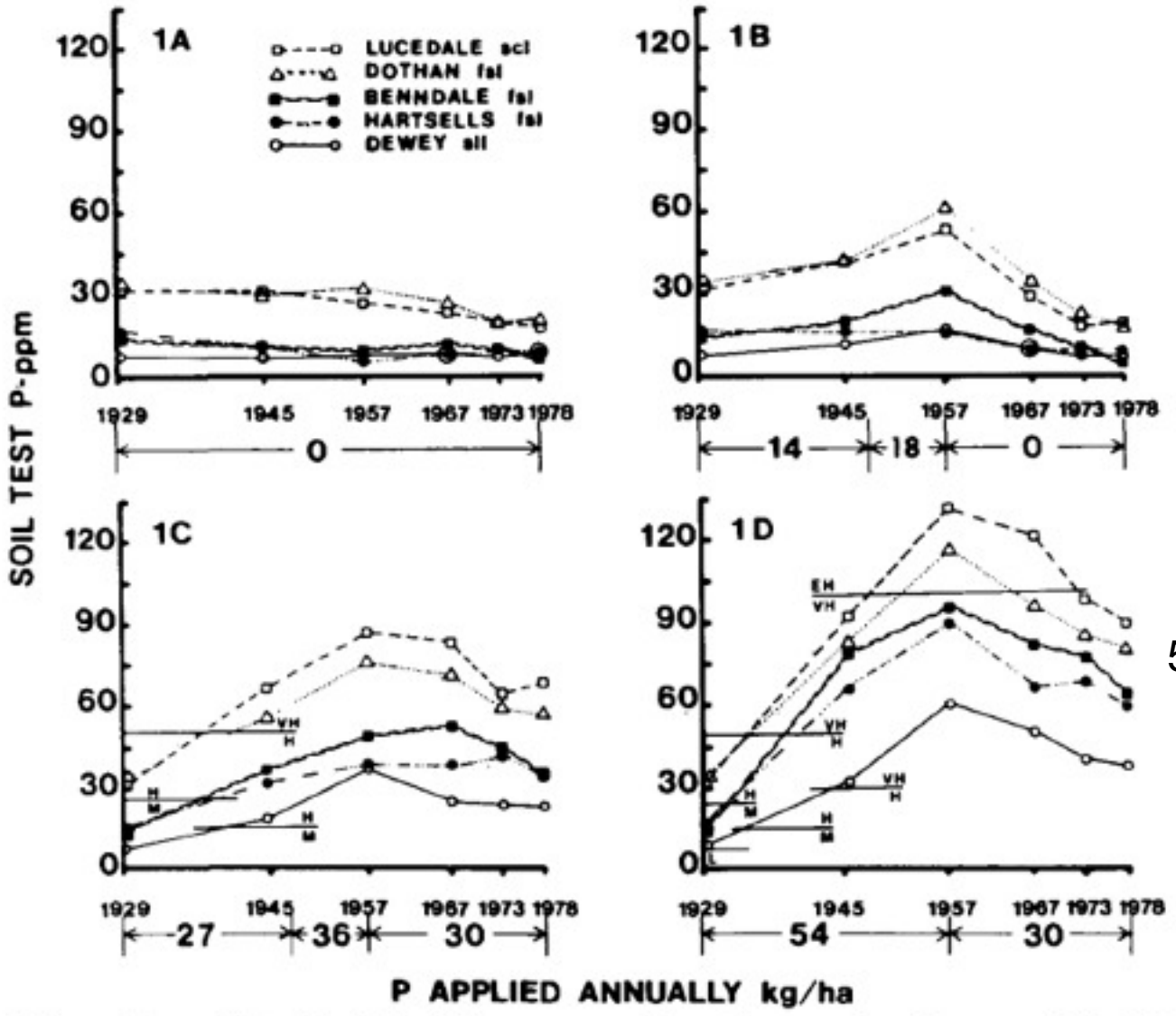
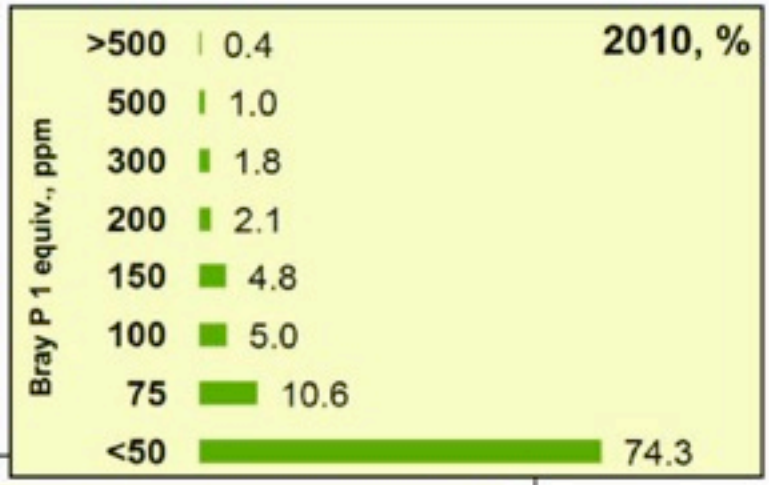


Fig. 1—Soil test P as affected by P fertilizer rates on five soils over the 50-year period, 1929–1978.

54 kg P/ha =
110 lbs P_2O_5/acre

Cope. 1981.
Agron. J.
45:342-347.

Figure 6. Soil test P frequency distribution in 2001, 2005, and 2010.



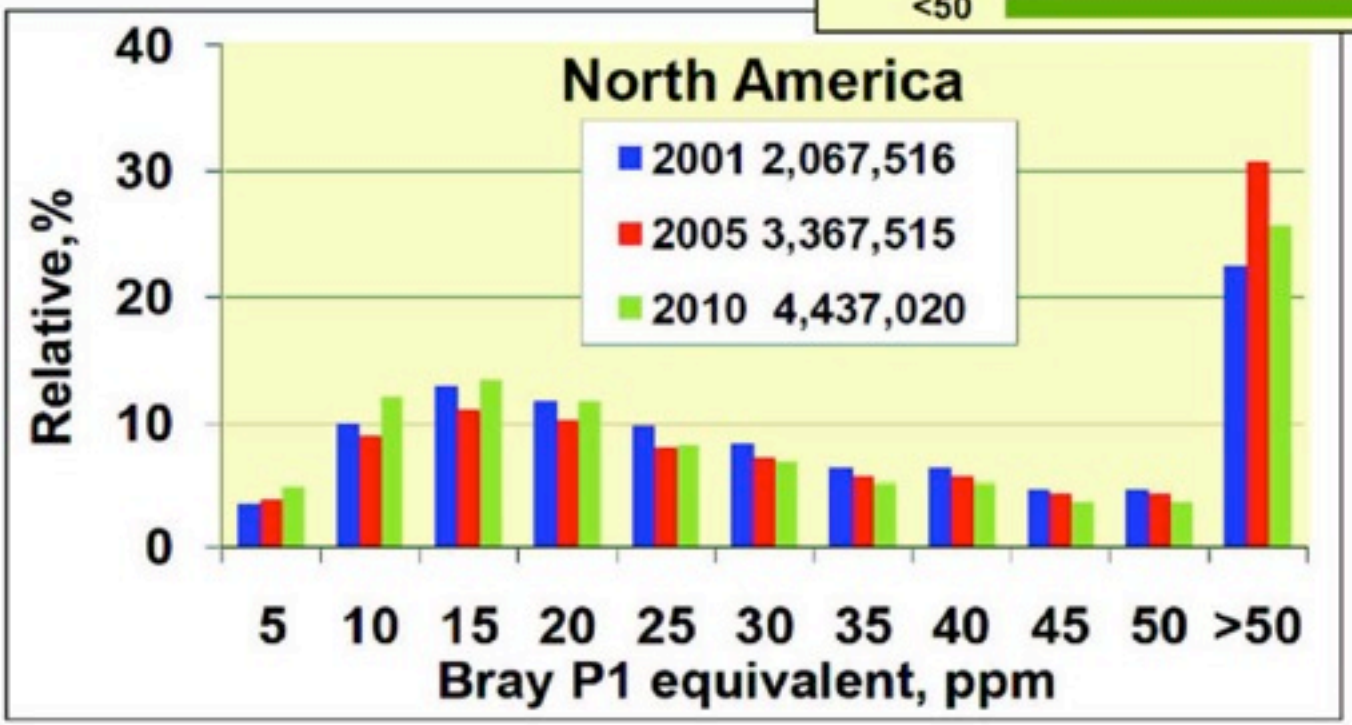
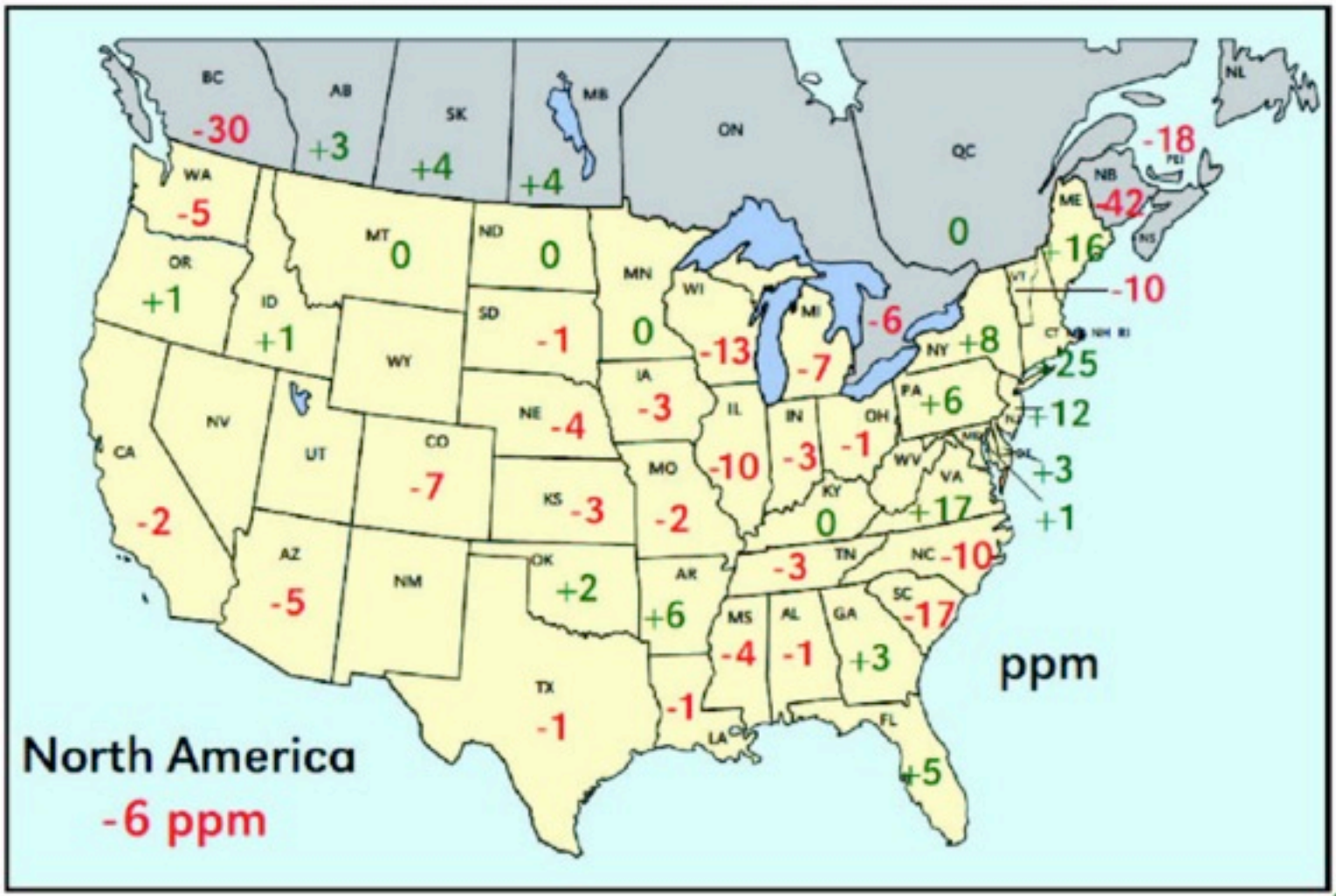
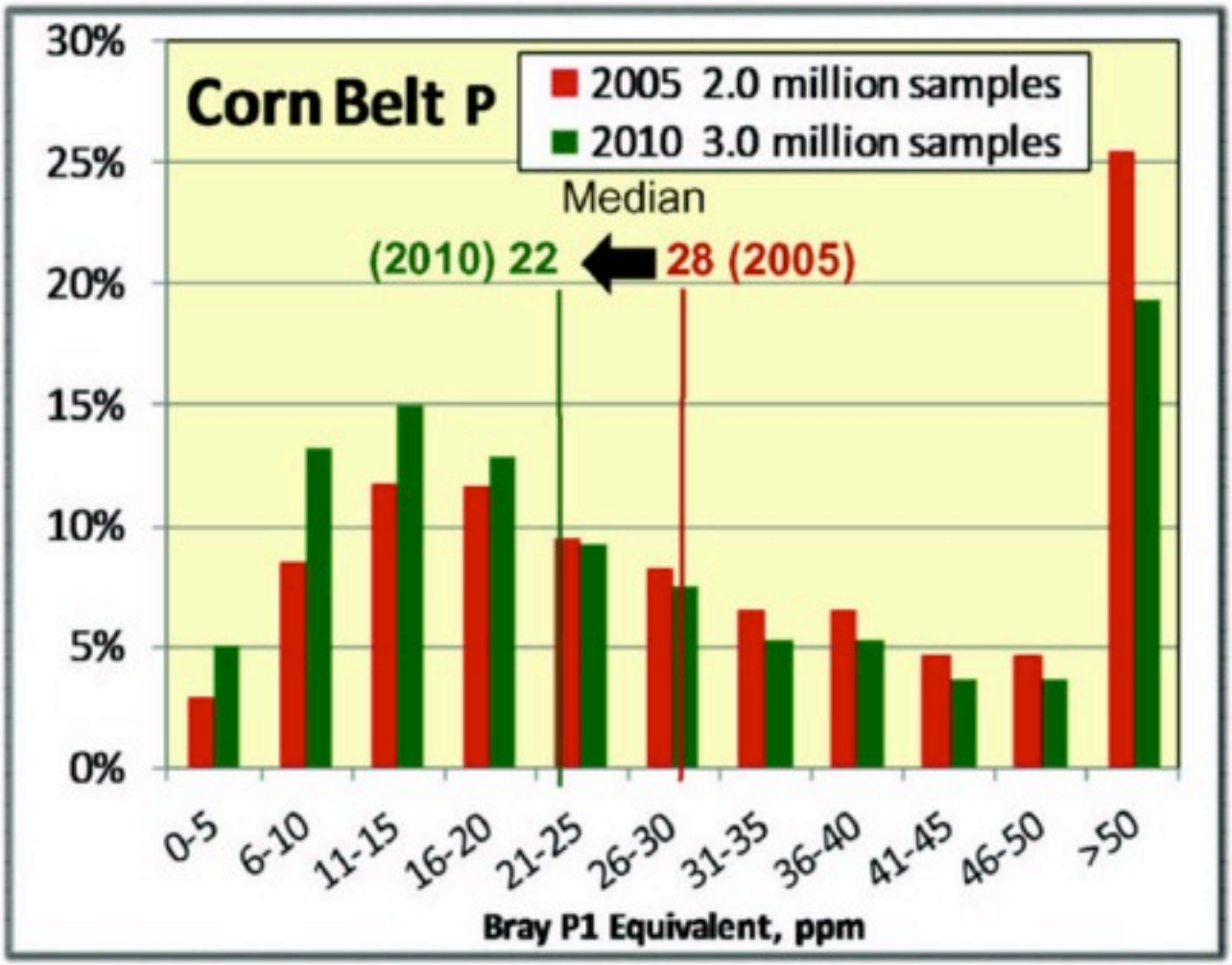


Figure 8. Change in median Bray P equivalent soil test levels from 2005 to 2010.



Soil test P distribution in 2010 compared to 2005 for the Corn Belt (12 states plus Ontario)



Great Lakes Region Soil Test Summaries*

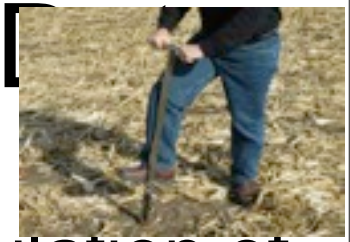
	Year					
Value	2007	2008	2009	2010	2011	2012
	values					
pH	6.5	6.5	6.5	6.5	6.6	6.5
	ppm					
Bray P_1	49	45	47	46	46	47
K	147	150	146	144	141	152

*R. Warden. 2013. Soil Test Summaries, A&L Great Lakes Laboratories, Inc.

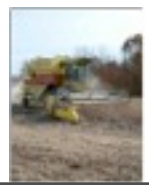




Quality Checking Soil Test D

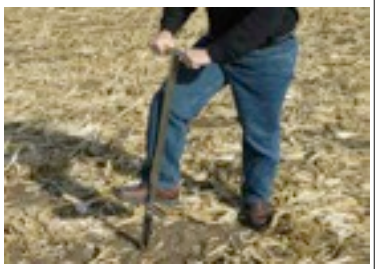


- Soil pH values
  - Lower pH values can result from accumulation of soluble salts or shallow sampling if soils are dry
  - Higher than normal lime recommendations could result, especially on sandy textured soils.
  - Lime requirement test should take this factor into account
  - Check recommendations for historical agreement





Quality Checking Soil Test Data After Dry Season



- Available nutrient values
  - Higher than expected residual values
    - Shallow sampling and stratification may give higher than “normal” values.
    - Compare to historical values
  - Resample selected range of soils after soils become moist and be certain the sampling depth is uniform.



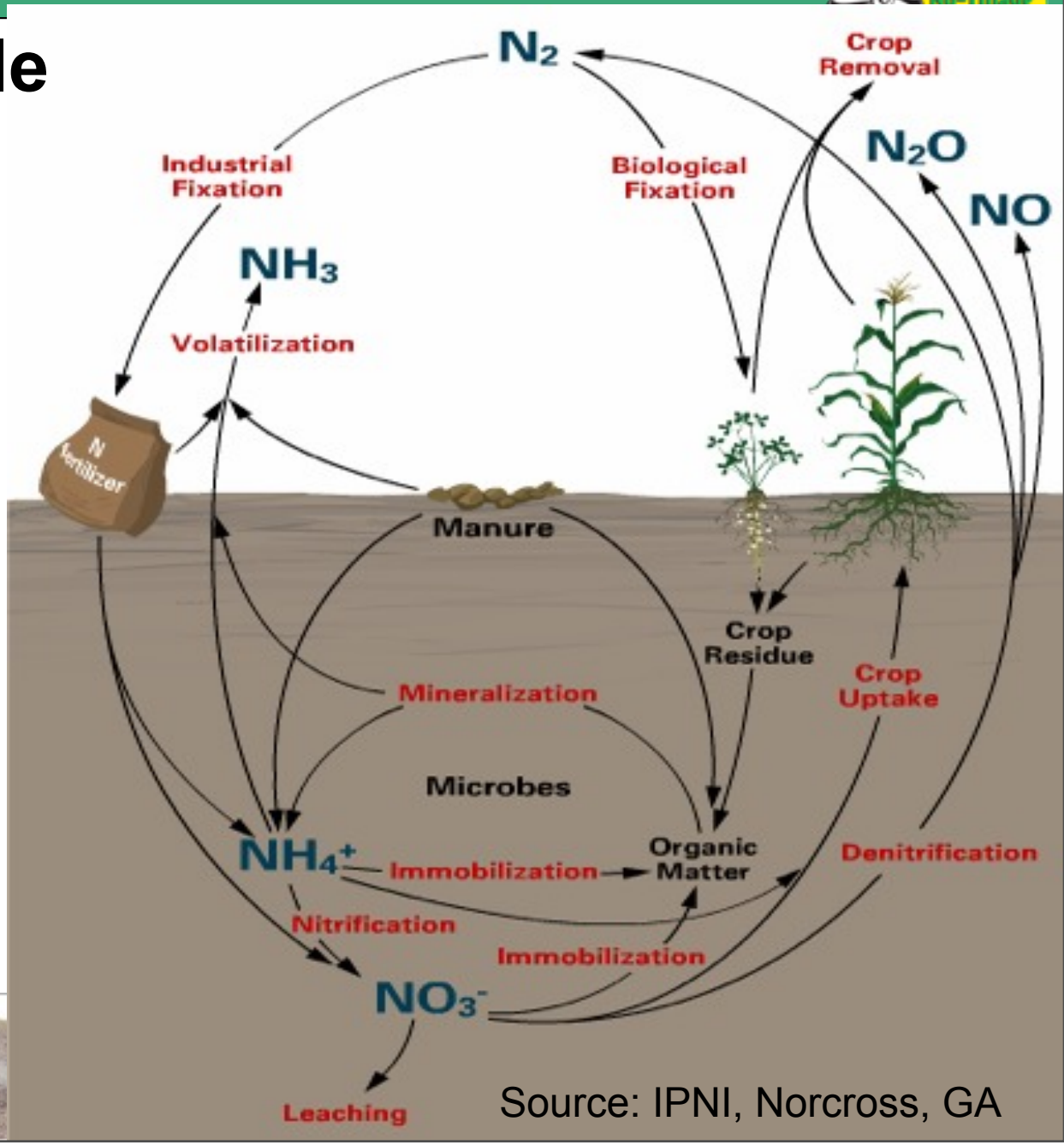


What about Nitrogen???

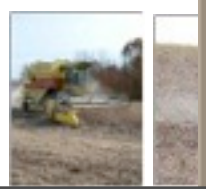
Nitrogen Cycle

Factors Involved

- Rainfall
- Soil and plant microbes
- Temperature
- Moisture
- N inputs
  - Fertilizers
  - Manures
  - Legumes
  - Crop residues
- N Removals
  - Crop yields
  - Denitrification
  - Volatilization
  - Immobilization



Source: IPNI, Norcross, GA



Local Assessment Needed

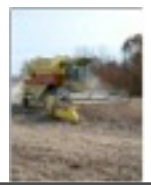
- **N applied**
- **Estimate removal**
- **Collect rainfall data since crop ceased growth**
- **Determine soil moisture holding capacity**
- **Check tile drains**
- **Consider targeted nitrate and ammonium soil tests**





Precipitation-Sept—Dec 2012

Month	Location	
	Indianapolis	Champaign
	Rainfall -- Inches	
September	7.73	5.71
October	3.87	5.46
November	1.33	1.07
December	2.58	2.07
Total	15.51	14.31





Map Unit Description: Drummer silty clay loam, 0 to 2 percent slopes–
Champaign County, Illinois

Champaign County, Illinois

152A—Drummer silty clay loam, 0 to 2 percent slopes

Map Unit Setting
Elevation: 590 to 930 feet
Mean annual precipitation: 32 to 40 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 160 to 180 days

Map Unit Composition
Drummer and similar soils: 90 percent

Description of Drummer

Setting
Landform: Outwash plains, stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over stratified loamy outwash

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 15 percent
Available water capacity: High (about 9.0 inches)

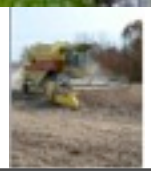
Drummer sicl soil Available Water Capacity is High ~ 9 inches

Web Soil Survey
Websoilsurvey.nrcs.usda.gov





Tile Drains Running?



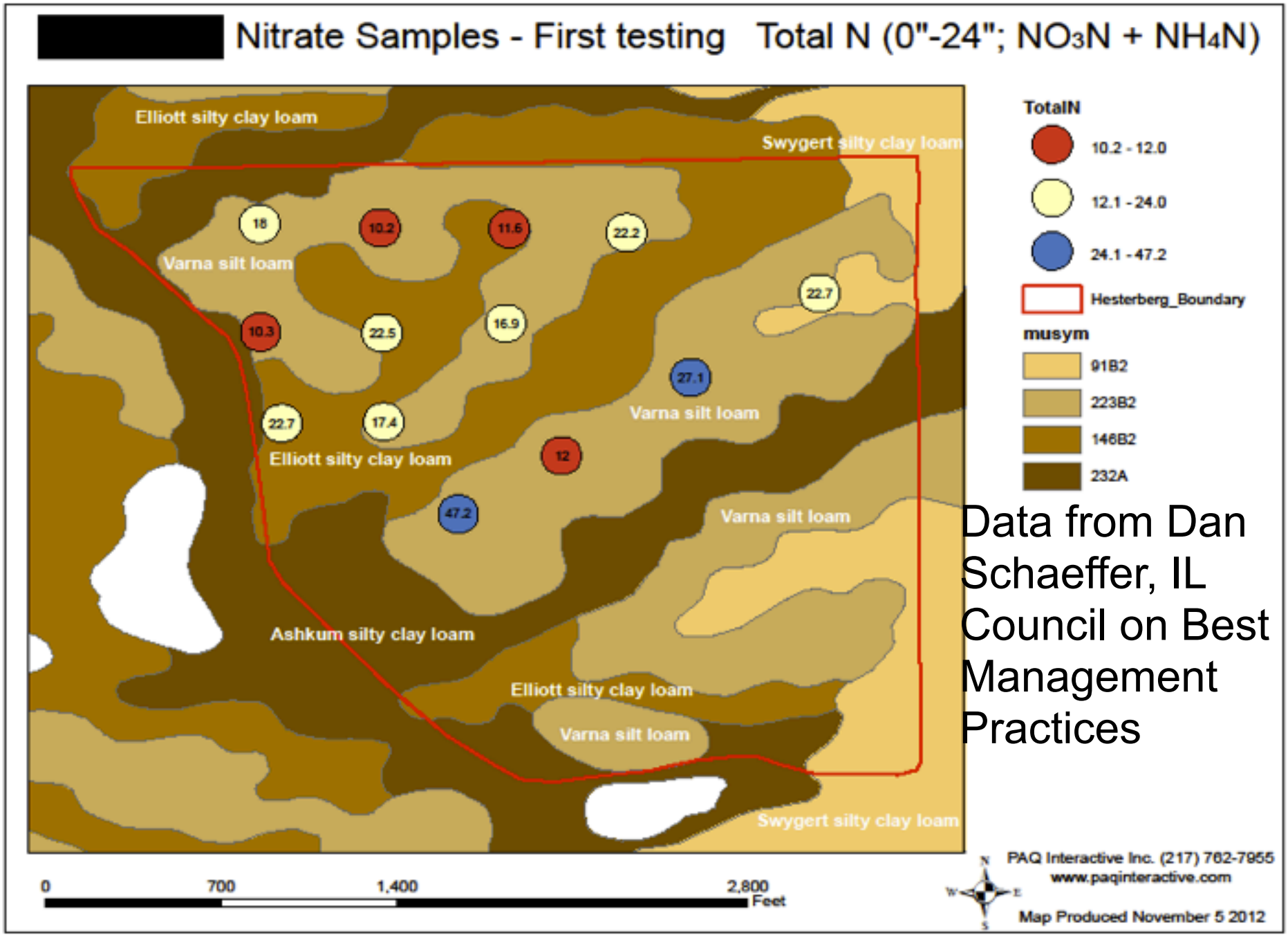


N Deficiency in Wet Areas of Fields

N Watch Program - ILLINOIS

D. Schaeffer, IL Best Management Council

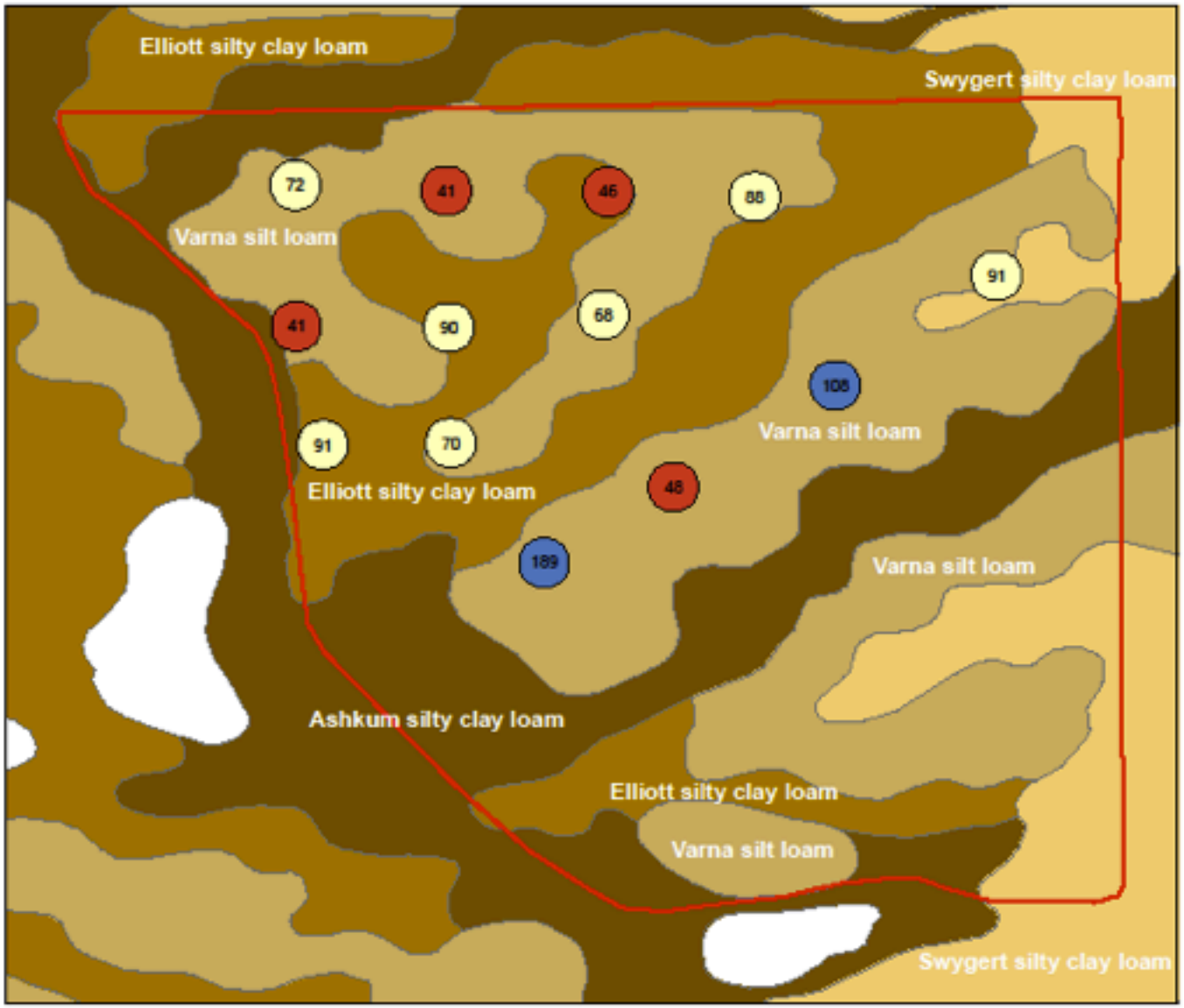

IMC
Notch For 12”



Data from Dan Schaeffer, IL Council on Best Management Practices

[redacted] Nitrate Samples - First testing

Lbs N



Data from Dan Schaeffer, IL Council on Best Management Practices

PAQ Interactive Inc. (217) 762-7955
www.paqinteractive.com

Map Produced November 5 2012

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

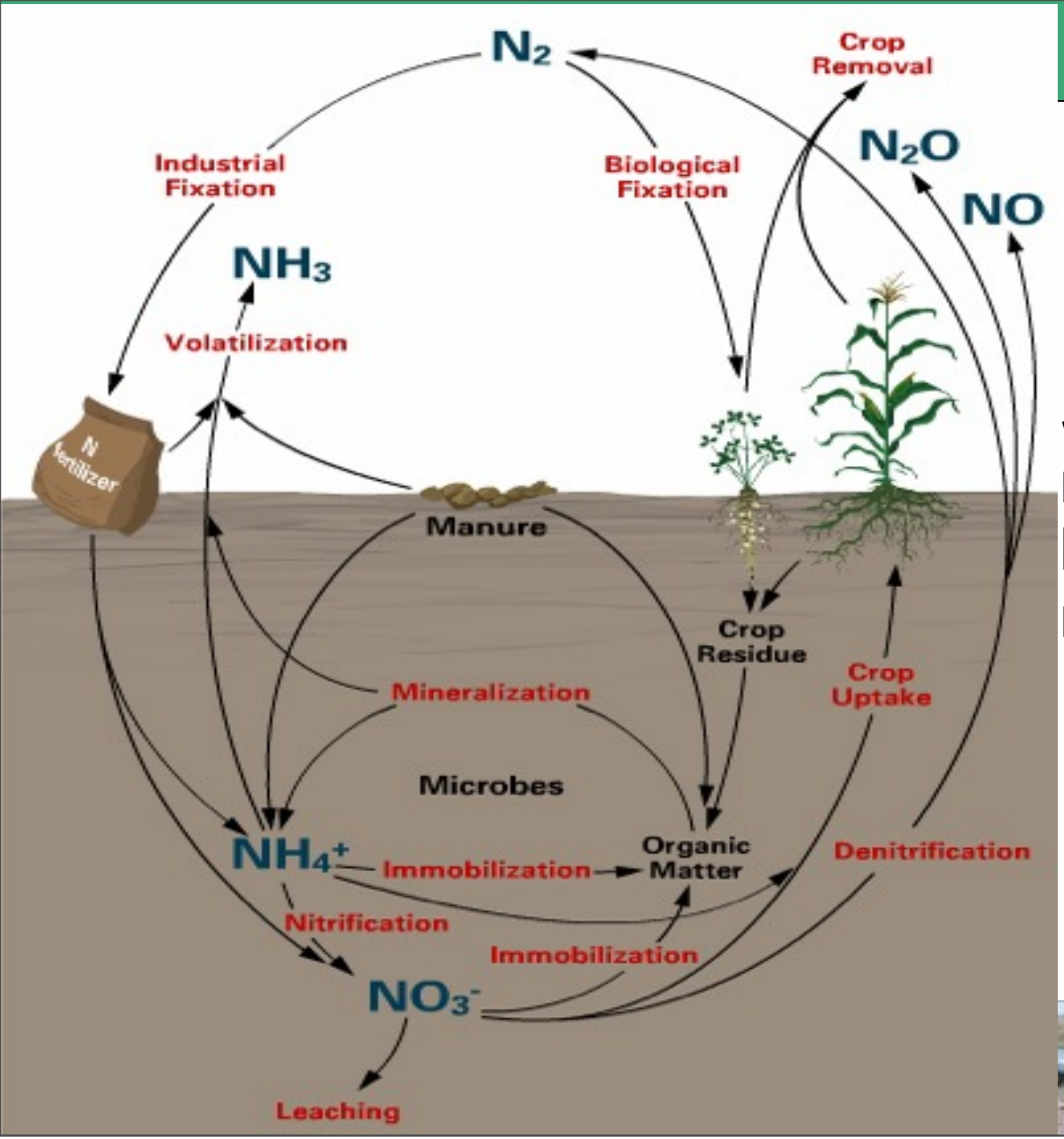
C-BMP
Illinois Council on Best Management Practices

NWATCH

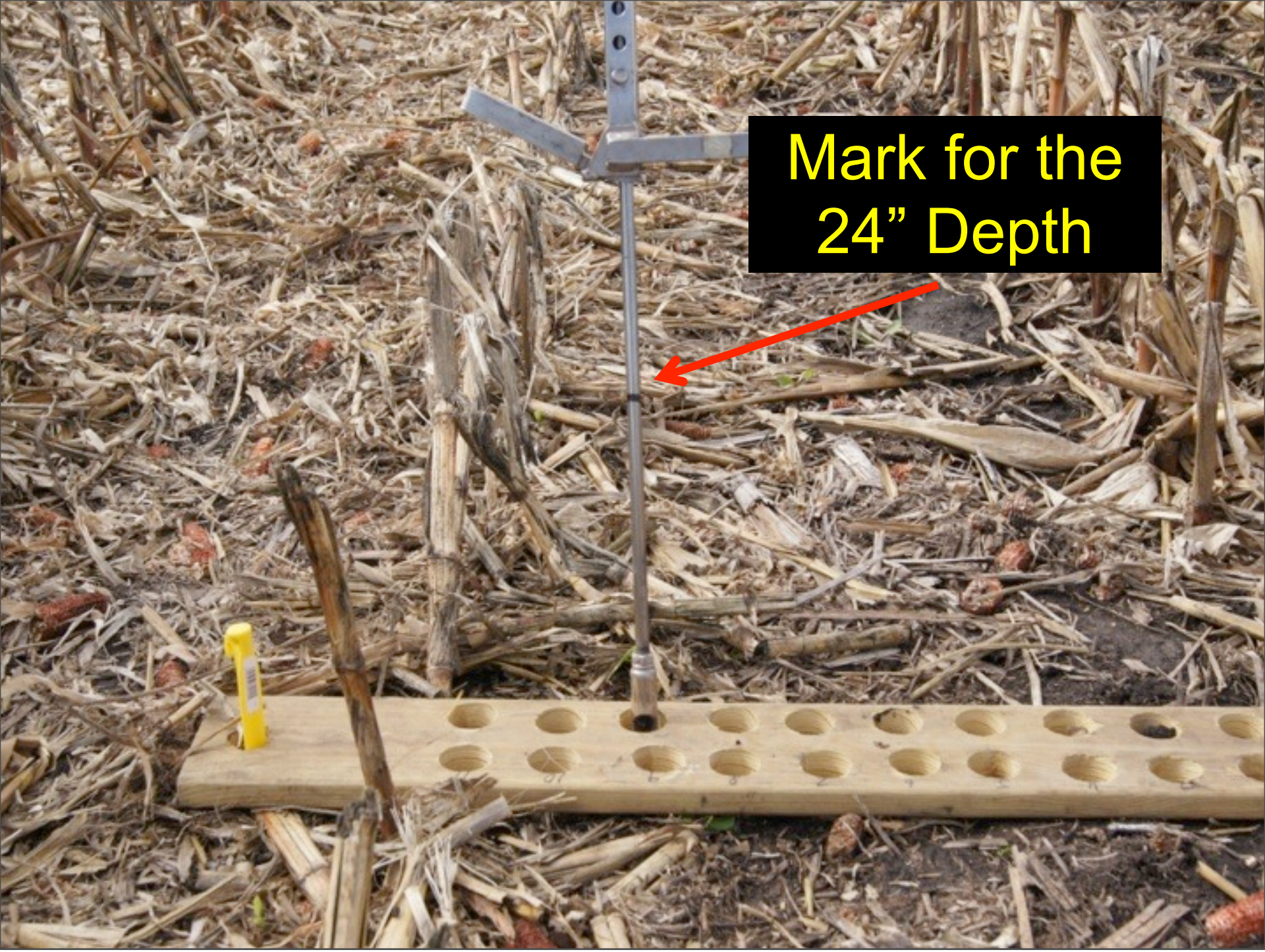



Nitrate Sampling Results

			NO_3-N	
County	N Rate	Corn YLD	0-12”	12-24”
Champ.	173	113	10	8
Macon	214	113	24	13
Sang.	182	132	12	8
Vermil.	166	97	21	16
Livingston	226	105	25	14



So we know nitrate levels now but what about next summer?


Mark for the
24” Depth

N-Watch 2012
N Inventory Report

Sampling Date:	10/5/2012
Customer:	Actual Field Examp.
Farm/Field Name:	U of I Nitrogen Trial
Latitude:	39.67045
Longitude:	-88.1394

NE HIGH

Company:	ICBMP
Submitted By:	Daniel Schaefer
Nearest Town:	KEMP
County:	Douglas

AVAILABLE N	0-12"	12-24"
NO3-N (ppm)	39.2	7.1
NH4-N ((ppm)	2.2	1.9
Tot. Available N	41.4	9.0
% N as NO_3:	95%	79%
% N as NH_4:	5%	21%

0 to 12-inch Sampling Depth

Position (inches)	NO_3-N (ppm)	NH_4-N (ppm)
0	16	3
3	9	2
6	10	1
9	23	2
12	116	2
15	160	2
18	41	1
21	17	3
24	11	2
27	16	4
30	12	2

12 to 24-inch Sampling Depth

Position (inches)	NO_3-N (ppm)	NH_4-N (ppm)
0	6	2
3	5	2
6	6	2
9	8	4
12	8	1
15	8	2
18	7	2
21	6	2
24	7	2
27	9	2
30	8	0

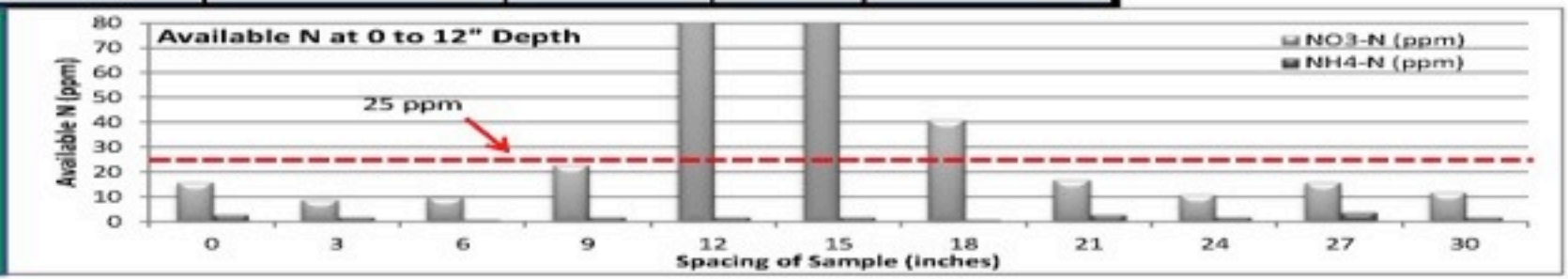
2011-2012 N MANAGEMENT

Crop:	Corn
Yield	100

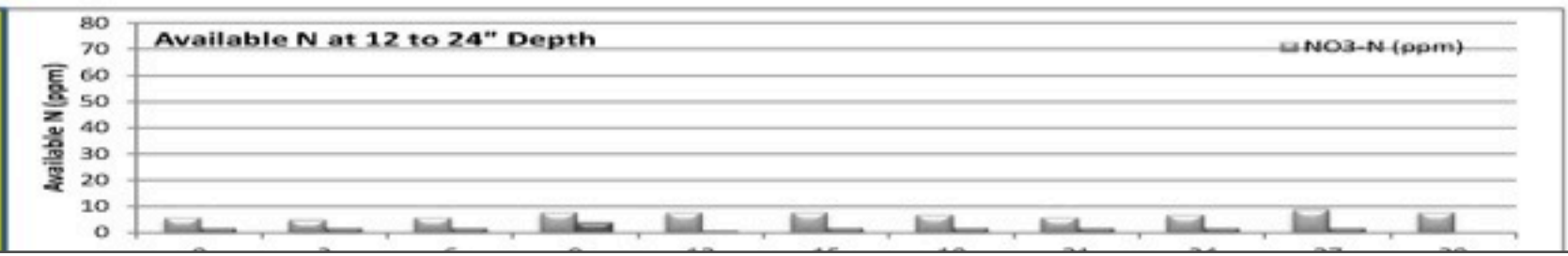
N Source	Application Date	Placement	Rate (N)	Stabilizer Used
NH3	Mar-12	Preplant	190	None

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

Surface

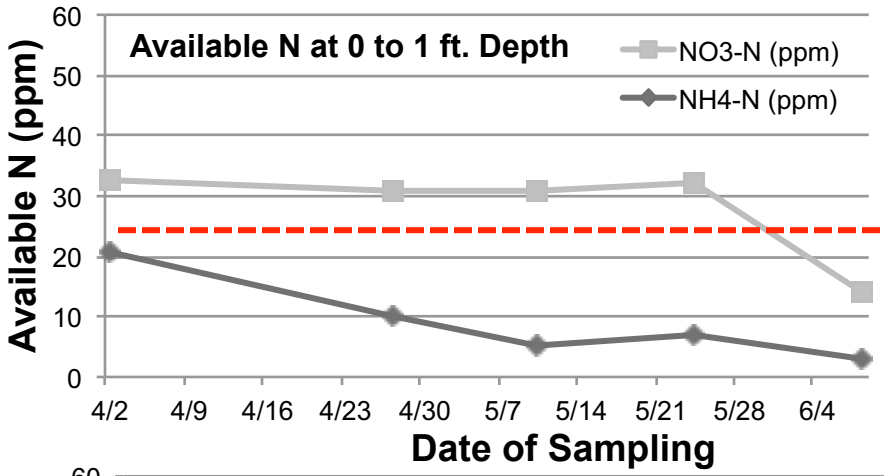


Subsurface

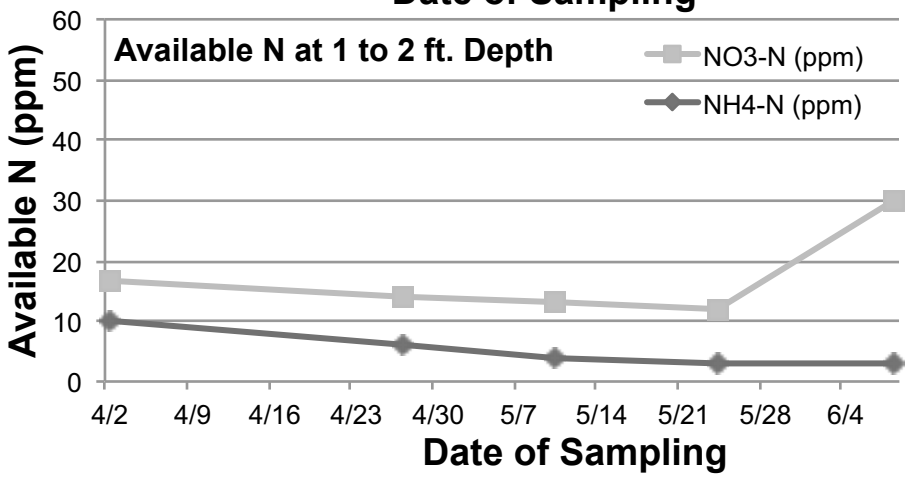


Tracking Report

Surface



Subsurface

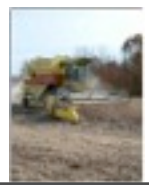


0 to 12-Inch Sampling

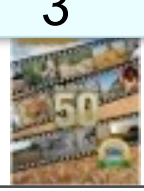
Date of Sampling	NO_3-N (ppm)	NH_4-N (ppm)
4/2	32.5	20.6
4/27	31	10
5/10	31	5
5/24	32	7
6/8	14	3

12 to 24-Inch Sampling

Date of Sampling	NO_3-N (ppm)	NH_4-N (ppm)
4/2	16.9	10.2
4/27	14	6
5/10	13	4
5/24	12	3
6/8	30	3

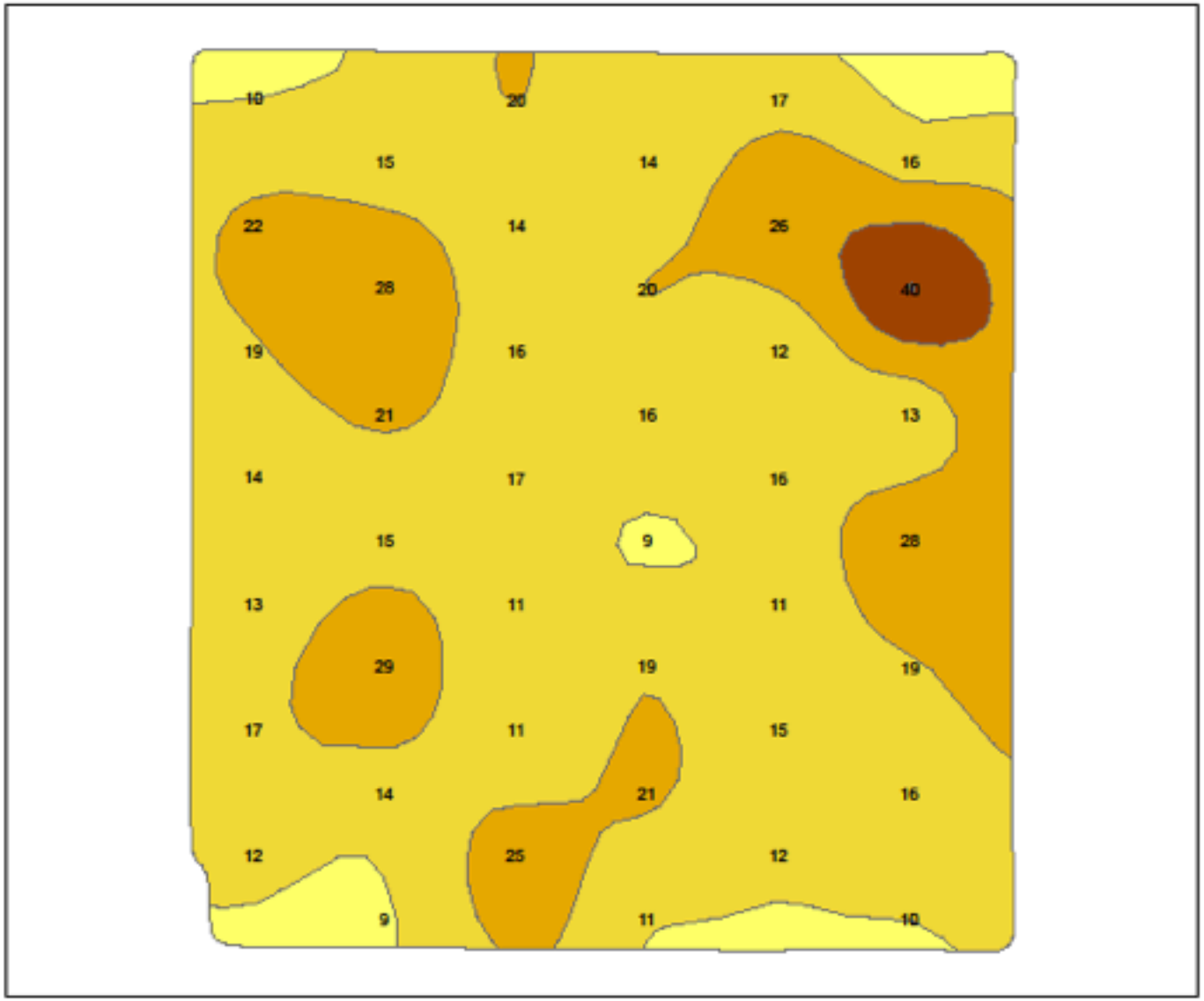






[redacted] South 40 0" - 12"

Nitrate Test Results



NO3N ppm

- < 10
- 10
- 20
- 30
- 40

Total Acres: 44.4

0 385 770 1,540 Feet

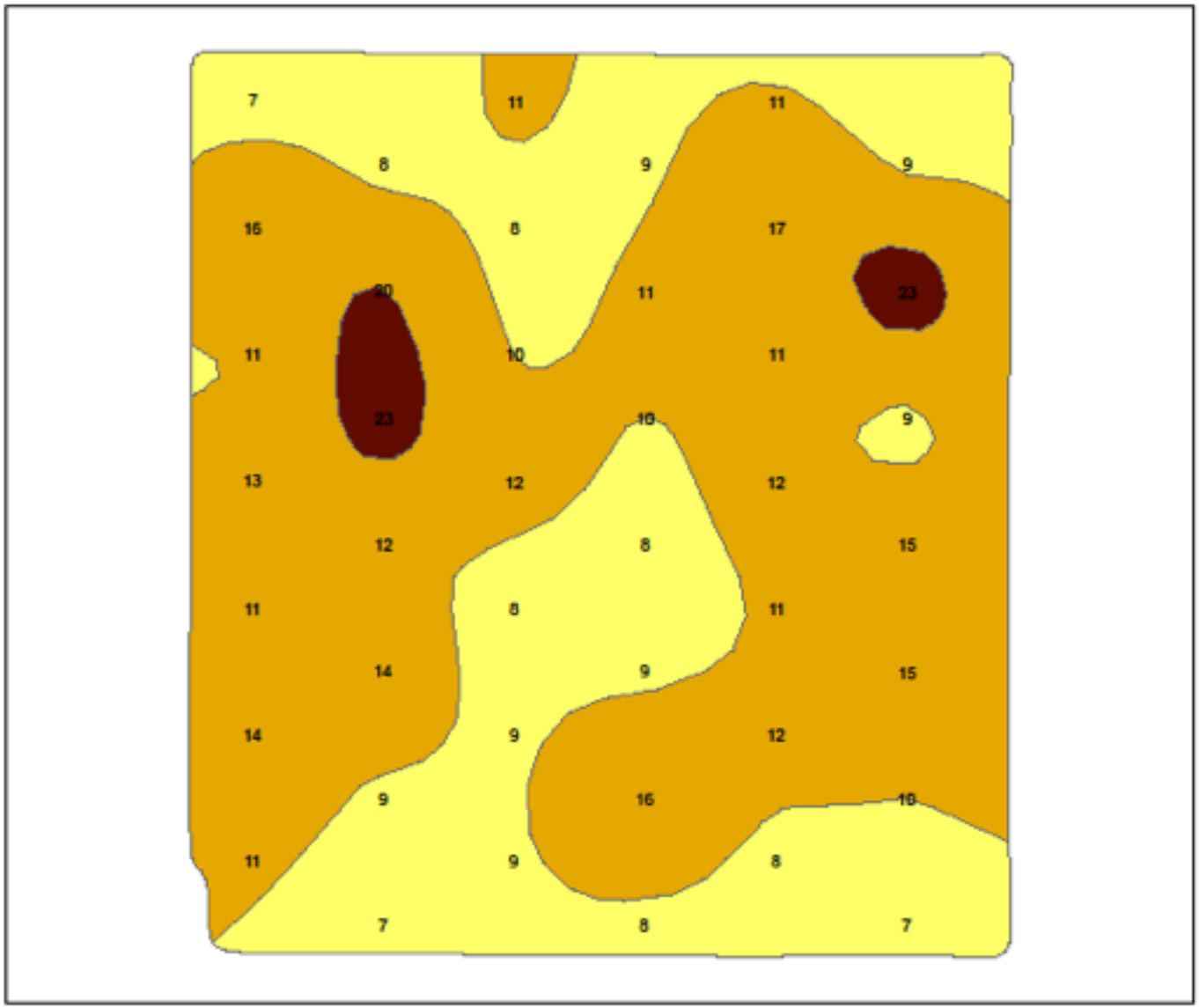
N W E S

Cropsmith, Inc. (217) 621-6117
www.cropsmith.com

Map Produced November 16 2012

[redacted] South 40 12" - 24"

Nitrate Test Results



NO3N ppm

- < 10
- 10
- 20

Total Acres: 44.4

0 385 770 1,540 Feet

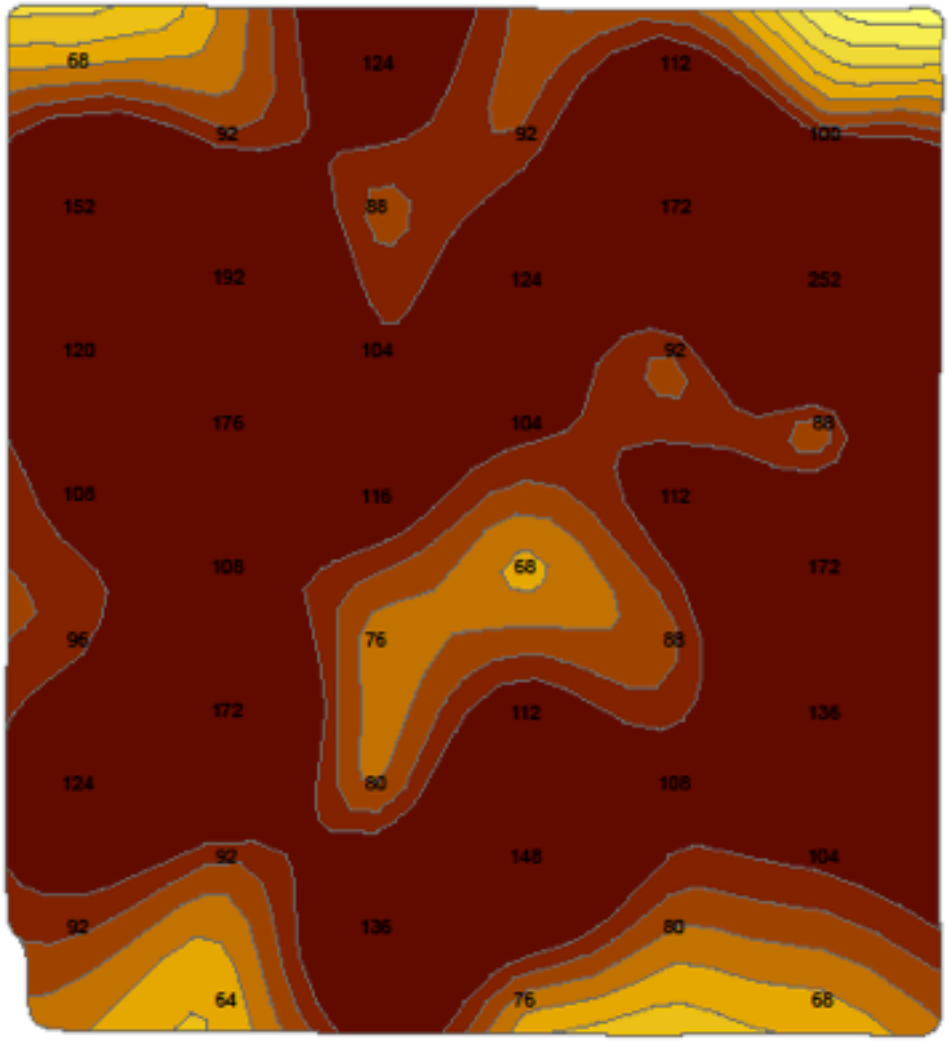
N W E S

Cropsmith, Inc. (217) 621-6117
www.cropsmith.com

Map Produced November 16 2012

[redacted] South 40

Nitrate Test Analysis



Lbs / Acre

- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100

Total Acres: 44.4

0 385 770 1,540 Feet

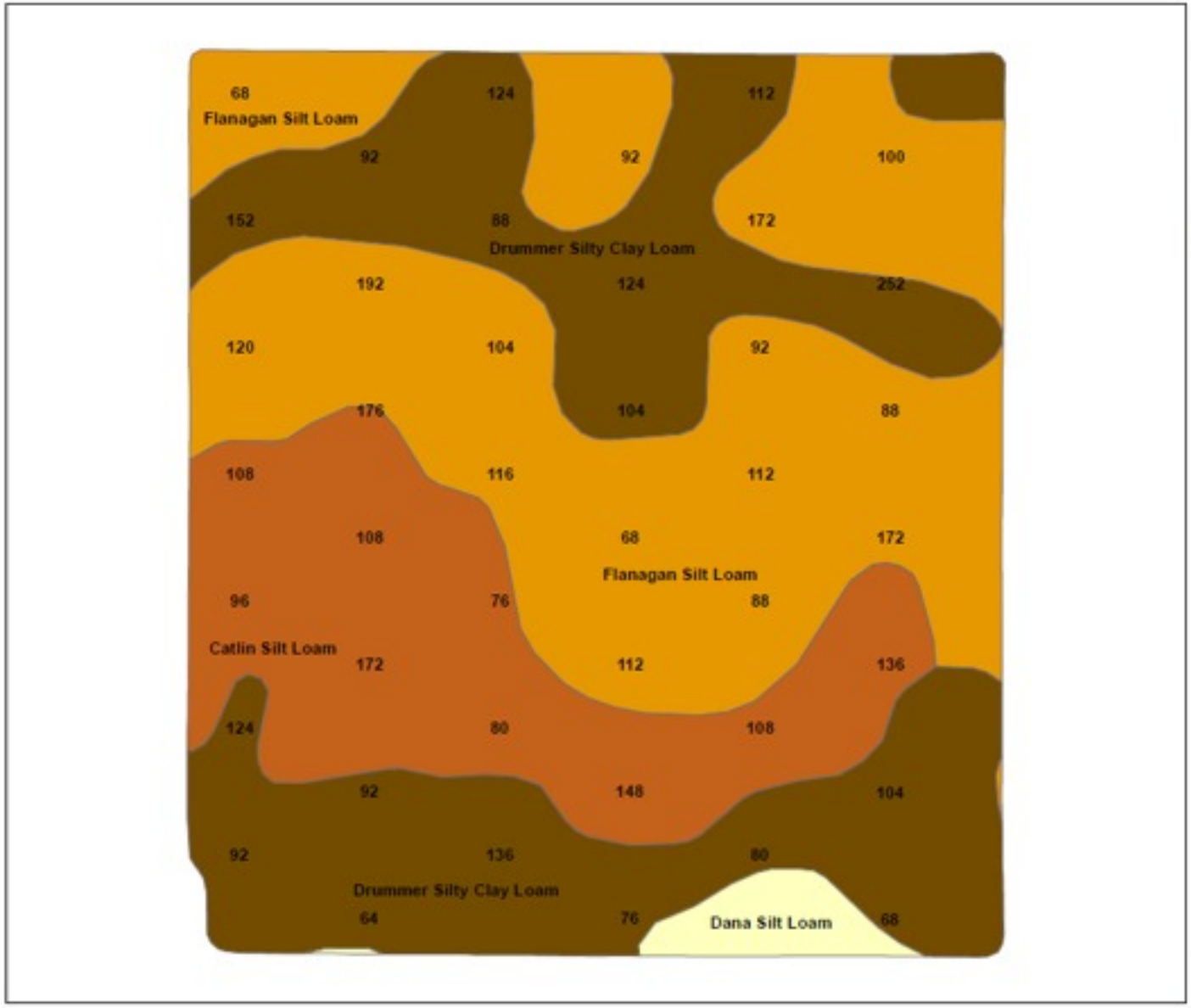
N W E S

Cropsmith, Inc. (217) 621-6117
www.cropsmith.com

Map Produced November 14 2012

[redacted] South 40

Total Nitrate Soil Analysis



[redacted]_S40_Soils

SoilName

- Catlin Silt Loam
- Dana Silt Loam
- Drummer Silty Clay Loam
- Flanagan Silt Loam

Total Acres: 44.4

0 385 770 1,540 Feet

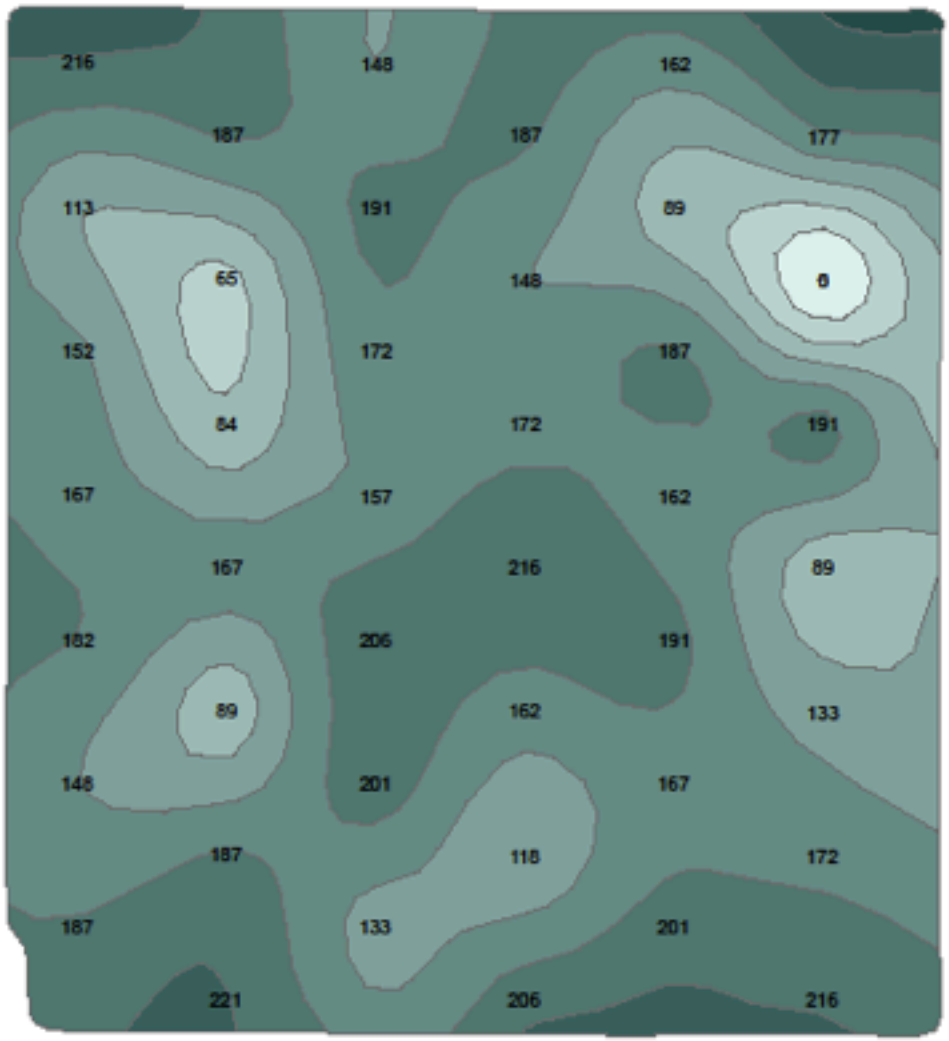
N W E S

Map produced by PAQ Interactive
www.paqinteractive.com

Map Produced January 3 2013

[redacted] South 40

N Recommendation



Lbs_NH3

- 18.29
- 54.87
- 91.46
- 128.04
- 164.63
- 201.21
- 237.8
- 274.39

Total Acres: 44.4
Total N: 5,822 Lbs
Average N: 131.1 Lbs/Acre

0 385 770 1,540 Feet

N W E S

Cropsmith, Inc. (217) 621-6117
www.cropsmith.com
Map Produced December 10 2012

Optimum N Rates for Specific Field?

Same each year?

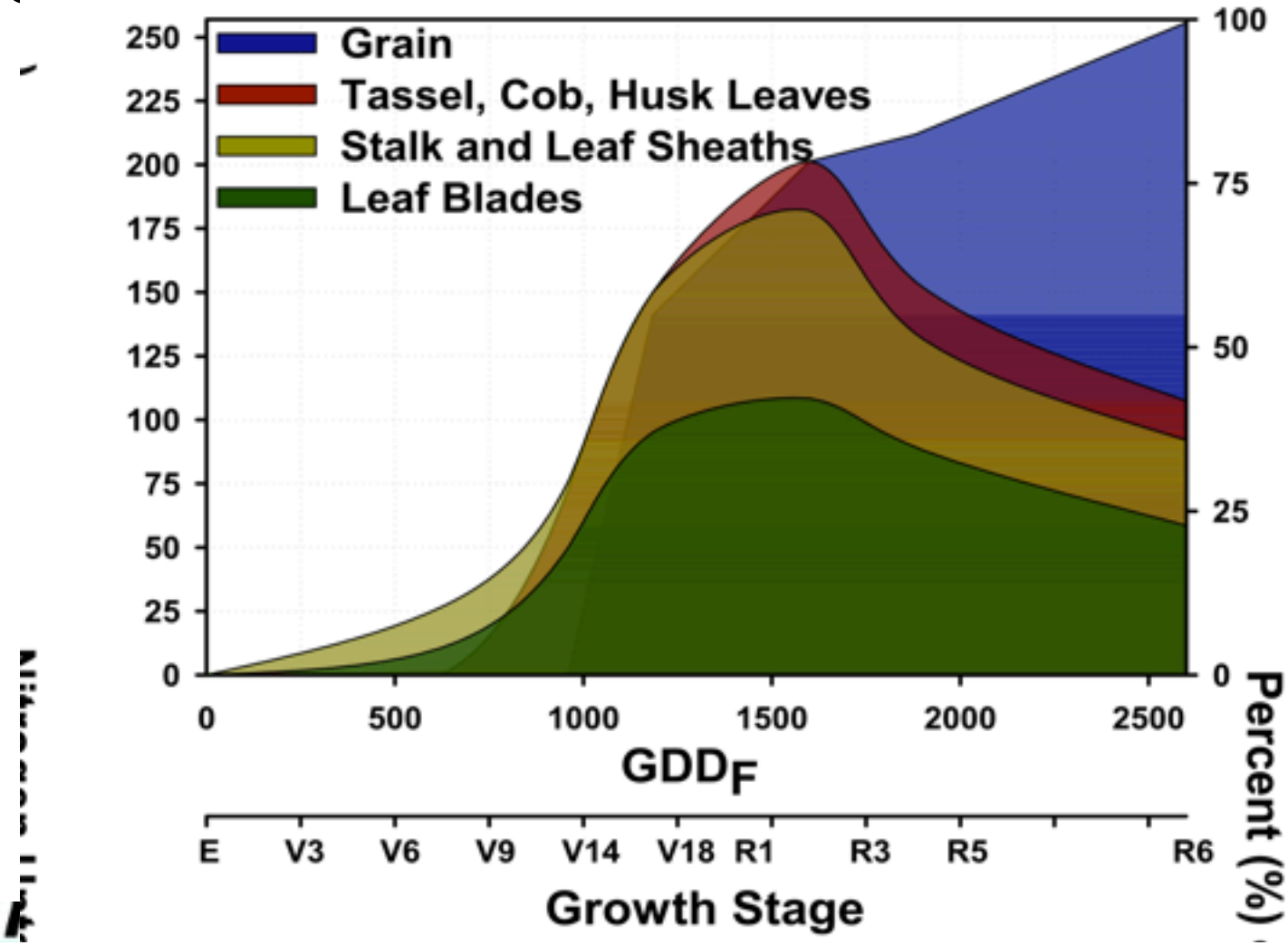




What do I know <u>before</u> I plant the crop?

- Soil type
  - Texture
  - Drainage
  - Organic matter content
- Previous crop, yield and residue management
- Organic N applications – Manures or biosolids
- Precipitation and temperatures to that point in the crop year
- Tillage method
- Time of maximum corn N need relative to growth stage

Seasonal N Uptake and Partitioning



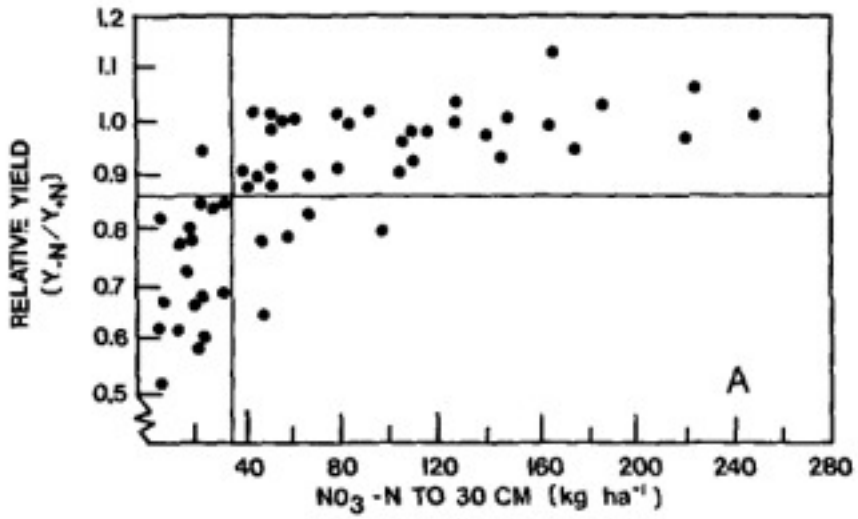
Mean for 6 hybrids – Dekalb and Champaign, IL. F. Below, U. Of IL

N Management Challenge

- Develop N management programs for specific fields and farms
- Factors to consider in developing programs
  - Soils information
  - Cropping systems – biological N fixation and residues
  - Tillage
  - Organic N applications
  - Temperatures during the preceding fall, winter and spring
  - Precipitation
  - Application options available
    - Not what has always been done, but what can be done!
  - Flexibility to respond to weather conditions

In-season Soil Nitrate Measurements
Pre-Sidedress Soil Nitrate Test

In-season application adjusted by in-season measurements of soil nitrate to a 1 ft. depth

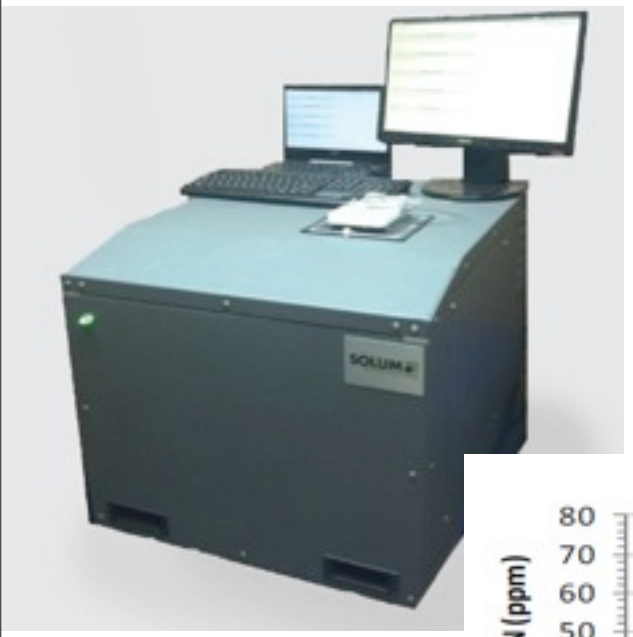


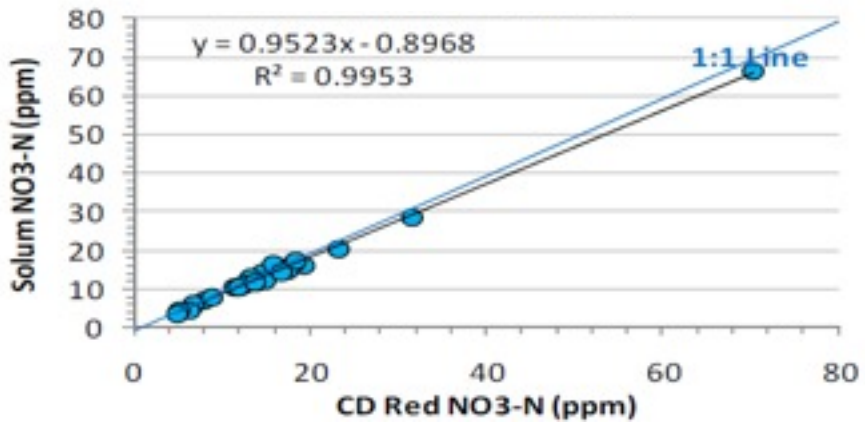
Widely viewed as useful BMP

BUT

Logistically challenging

Immediate (minutes) In-field Soil Nitrate Values





N Management Challenge

- **Factors to consider**
  - **Sources of N fertilizers available**
  - **Logistics of getting applications made at selected times during the season**
  - **Risk tolerance of grower**
  - **Economics**
  - **Other farmer specific factors?**

N Fertilizer Management

What happened during the fall, winter and early spring?

What happened since the crop was planted?

Year-Round N Management

- **Soil characteristics**
  - **Drainage**
    - **Coarse textured – Potential leaching is high in fall and after spring thaw**
    - **Fine-textured – Low potential for leaching loss in fall, higher potential for denitrification losses in late spring, early summer**





Year-Round N Management

- Previous crop yields, N applications and removals
  - Potential residual N in soil profile
  - Crop residues returned to soil
  - C:N ratio of residues and time of likely release of N from residues, i.e. continuous corn, corn-soybean
  - Temperatures and rainfall since crop harvest
    - Potential loss with leaching of residual N in soil profile

PLANT NUTRITION IS ONE PART OF A **TOTAL CROP PRODUCTION PROGRAM**