1) Improving Soil Sampling Consistency

- Keys to Successful Soil Sampling

2) Early Summer Topsoil Sampling

- Early Summer vs October Comparison Project

Richard Jenny
Agronomist
AGVISE Labs, Benson, MN

Early Summer Topsoil Sampling

Early Summer vs October Comparison Project

Increasing trend in 2.5 acre grid sampling
Shift from post-harvest sampling to early summer (late-May to early-July) sampling
In-crop sampling in unfertilized soybeans
Corn/soybean rotation
Topsoil samples only
Primarily test for: P, K, pH, OM, Zn, CEC
4-year project with > 300 GPS sample points
Sampled in growers fields

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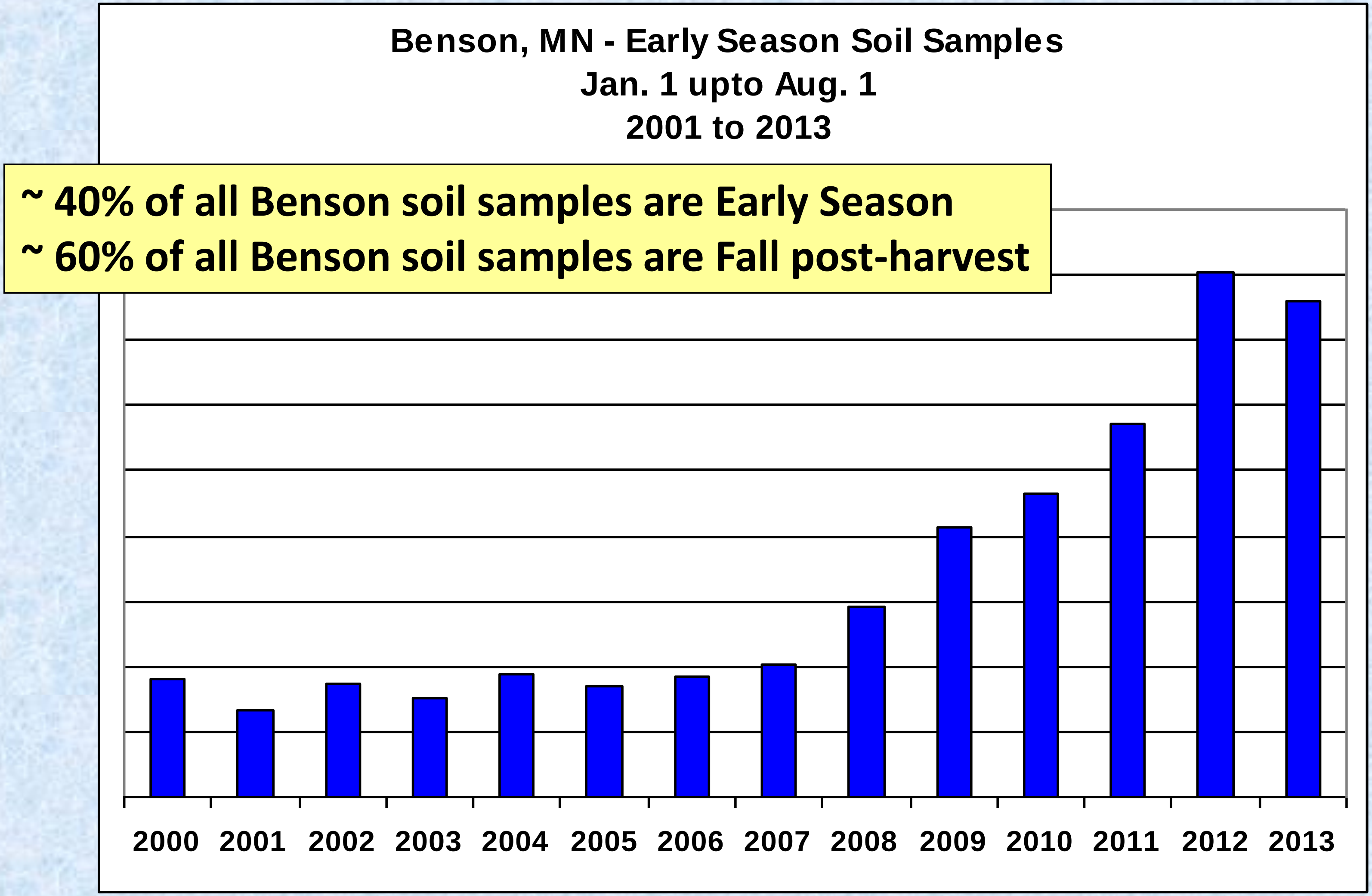
Early Summer Sampling

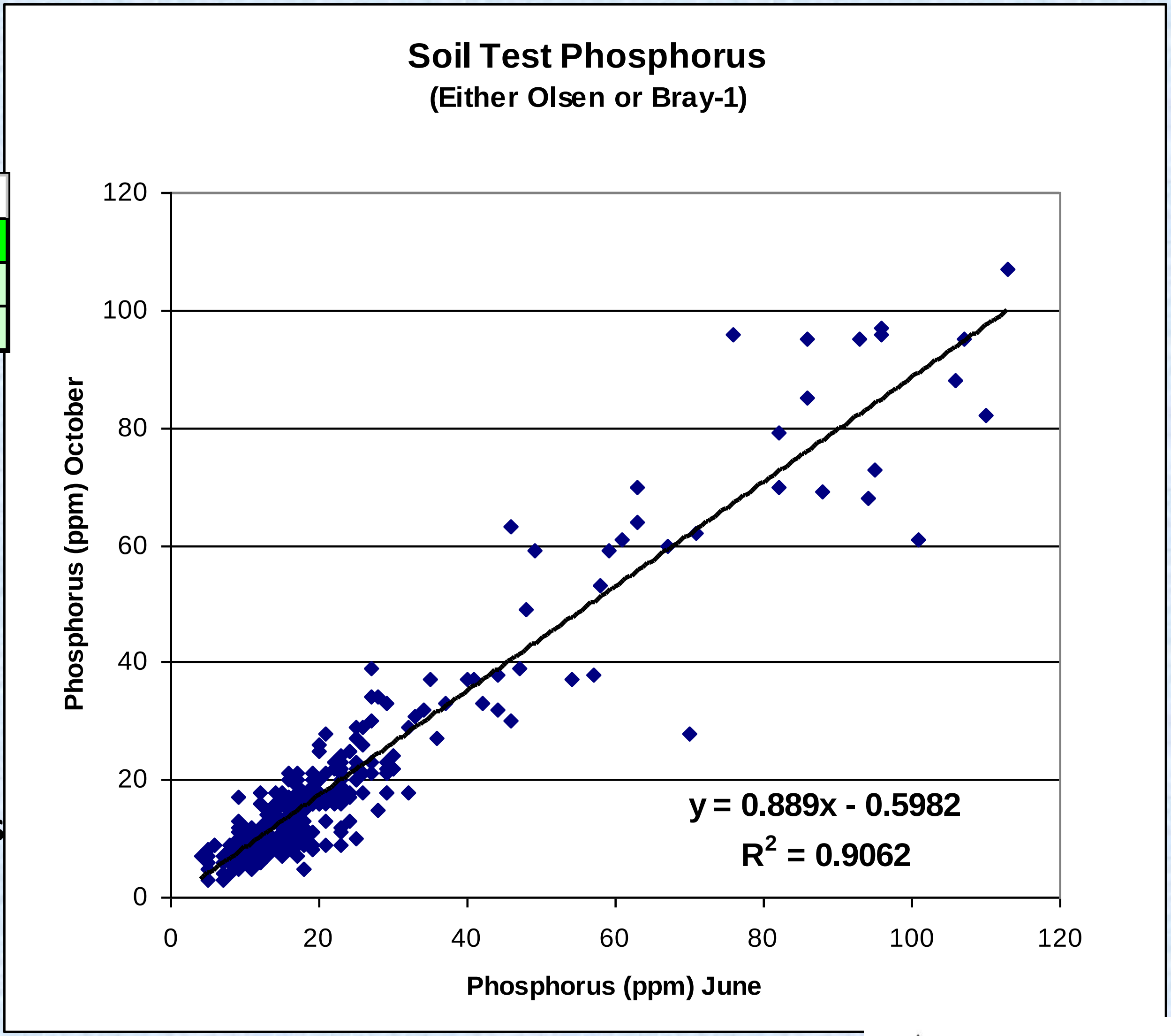
2001 – 2013: Benson Lab



Time of Soil Sampling Project

Early Summer vs October Comparison

Averages: June vs October		
	Time of Sampling	
	Early	October
P (ppm)	23	20



4 year and > 300 sample points

Corn/Soybean Rotation

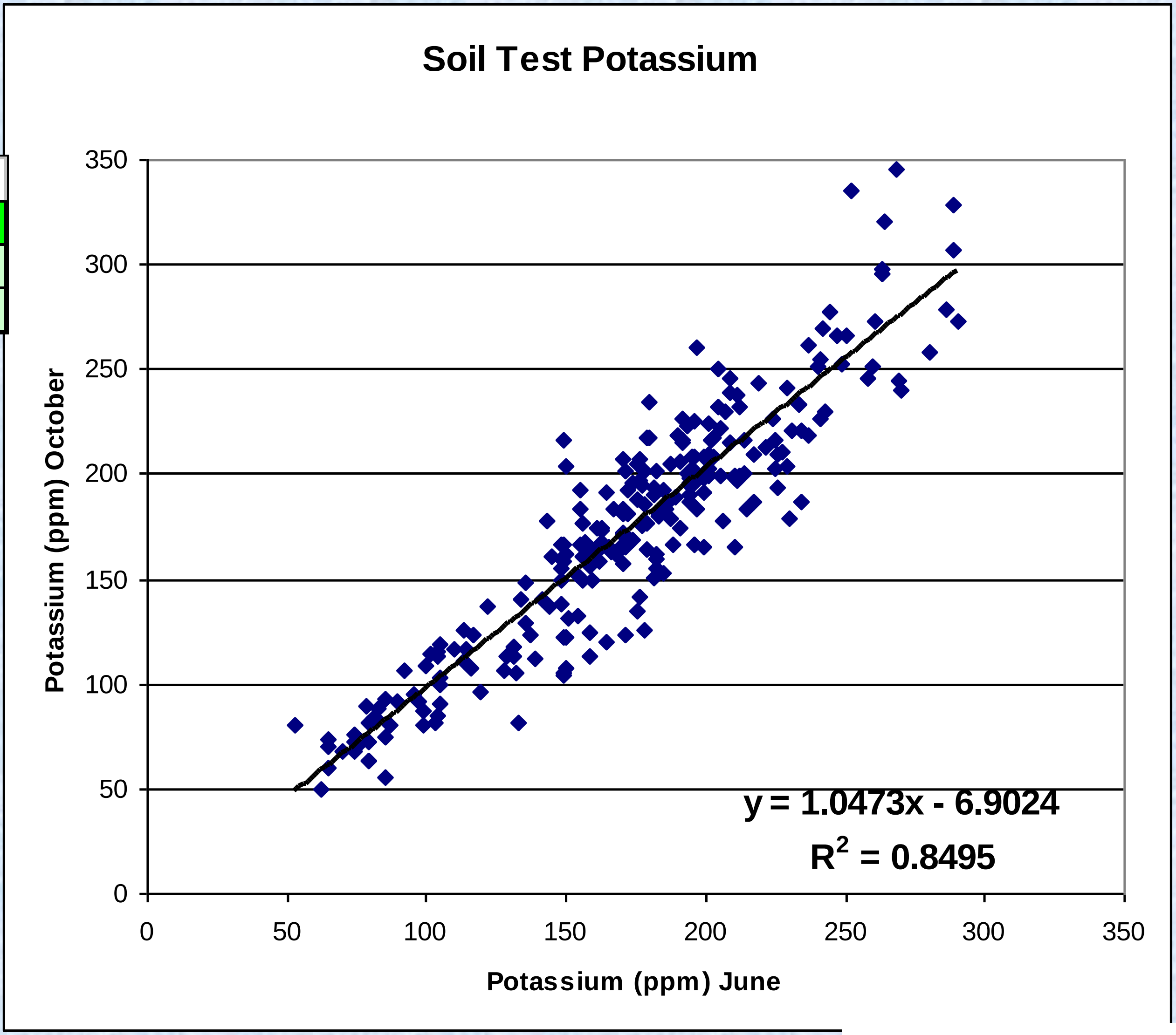
Unfertilized soybean

Topsoil samples

Time of Soil Sampling Project

Early Summer vs October Comparison

Averages: June vs October		
	Time of Sampling	
	Early	October
K (ppm)	190	197



4 year and > 300 sample points
Corn/Soybean Rotation
Unfertilized soybean
Topsoil samples

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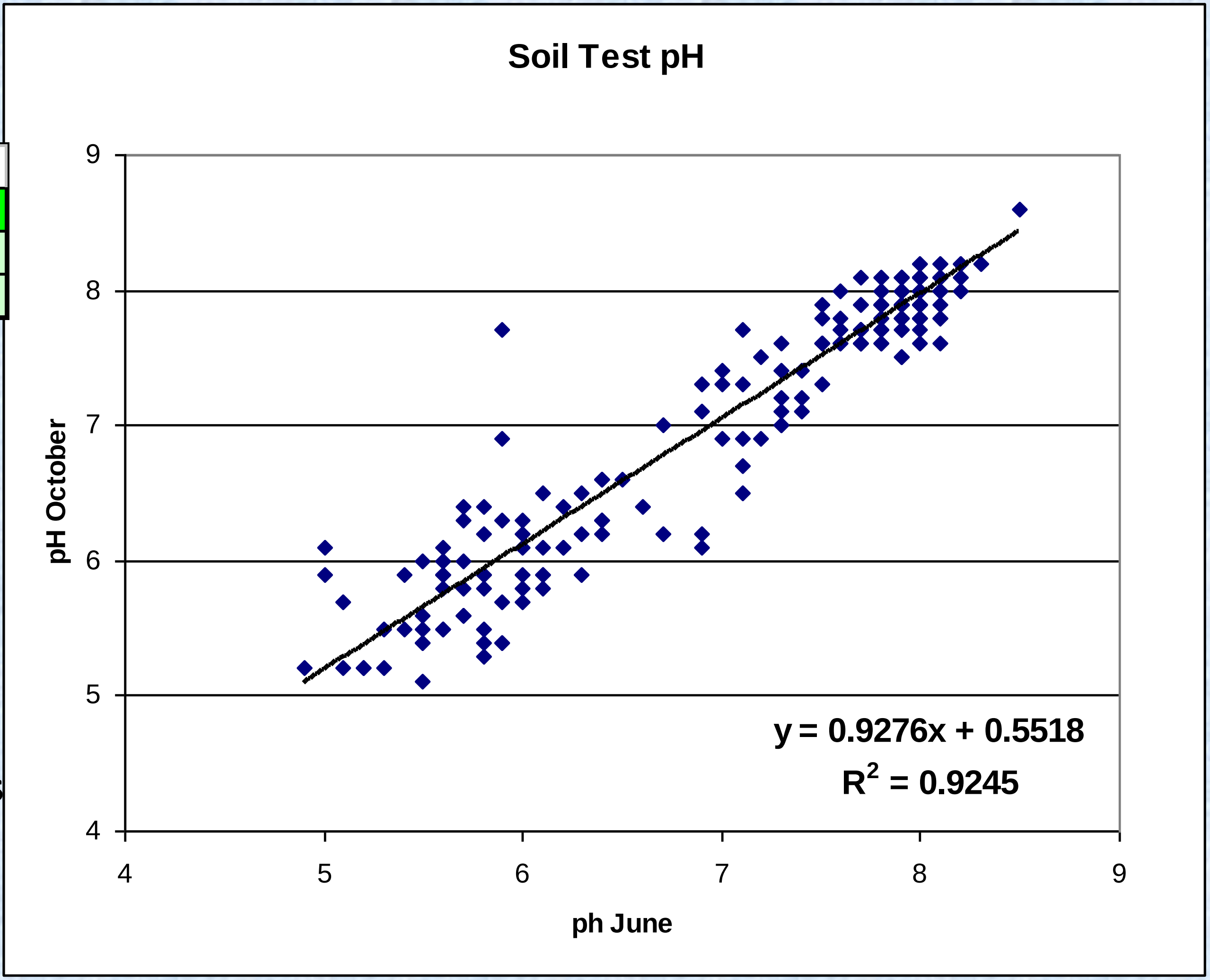
Time of Soil Sampling Project

Early Summer vs October Comparison

Averages: June vs October		
	Time of Sampling	
	Early	October
pH	7.4	7.4



4 year and > 300 sample points

Corn/Soybean Rotation

Unfertilized soybean

Topsoil samples

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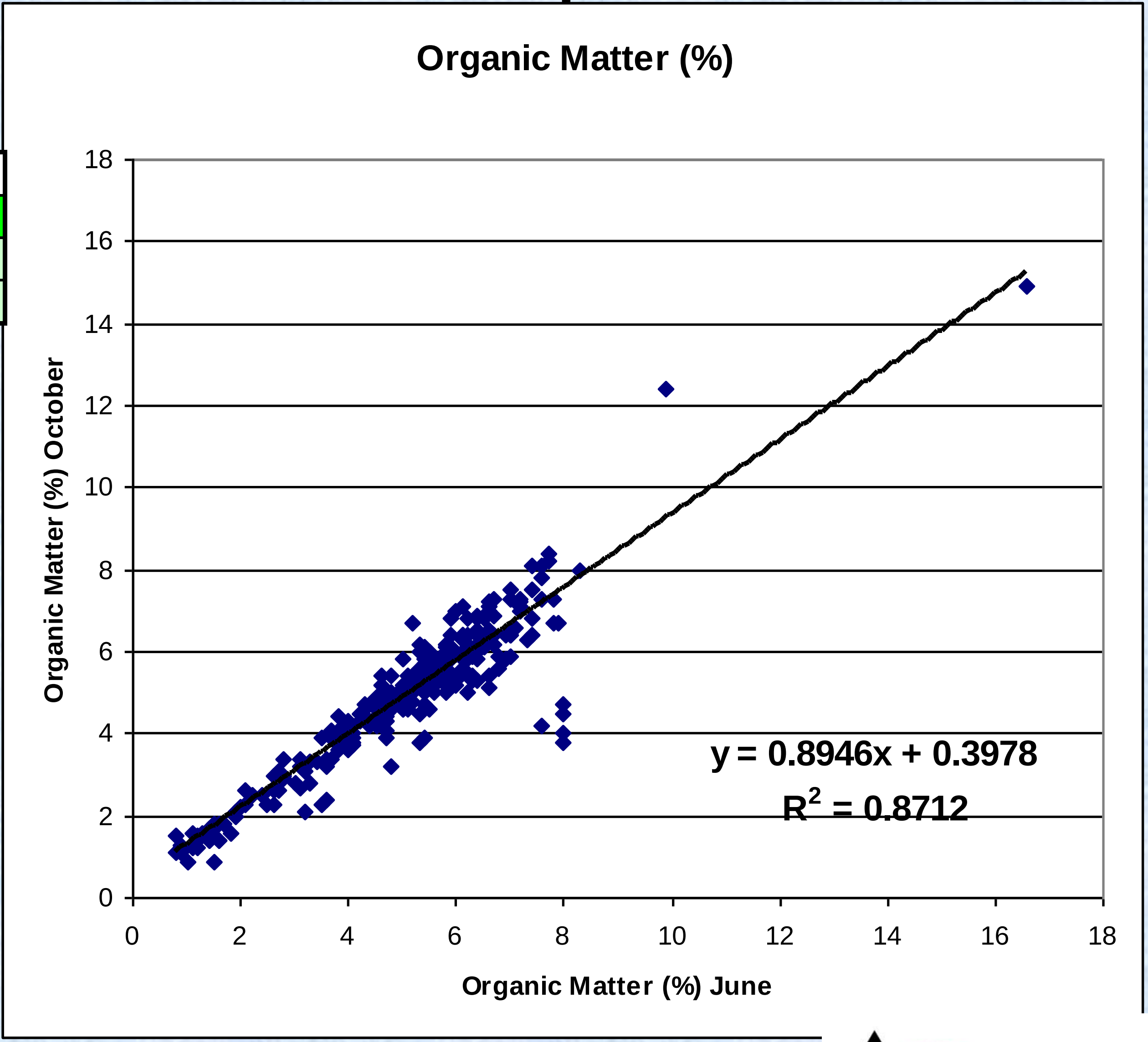
Time of Soil Sampling Project

Early Summer vs October Comparison

Averages: June vs October		
	Time of Sampling	
	Early	October
OM (%)	5	4.8



4 year and > 300 sample points
Corn/Soybean Rotation
Unfertilized soybean
Topsoil samples

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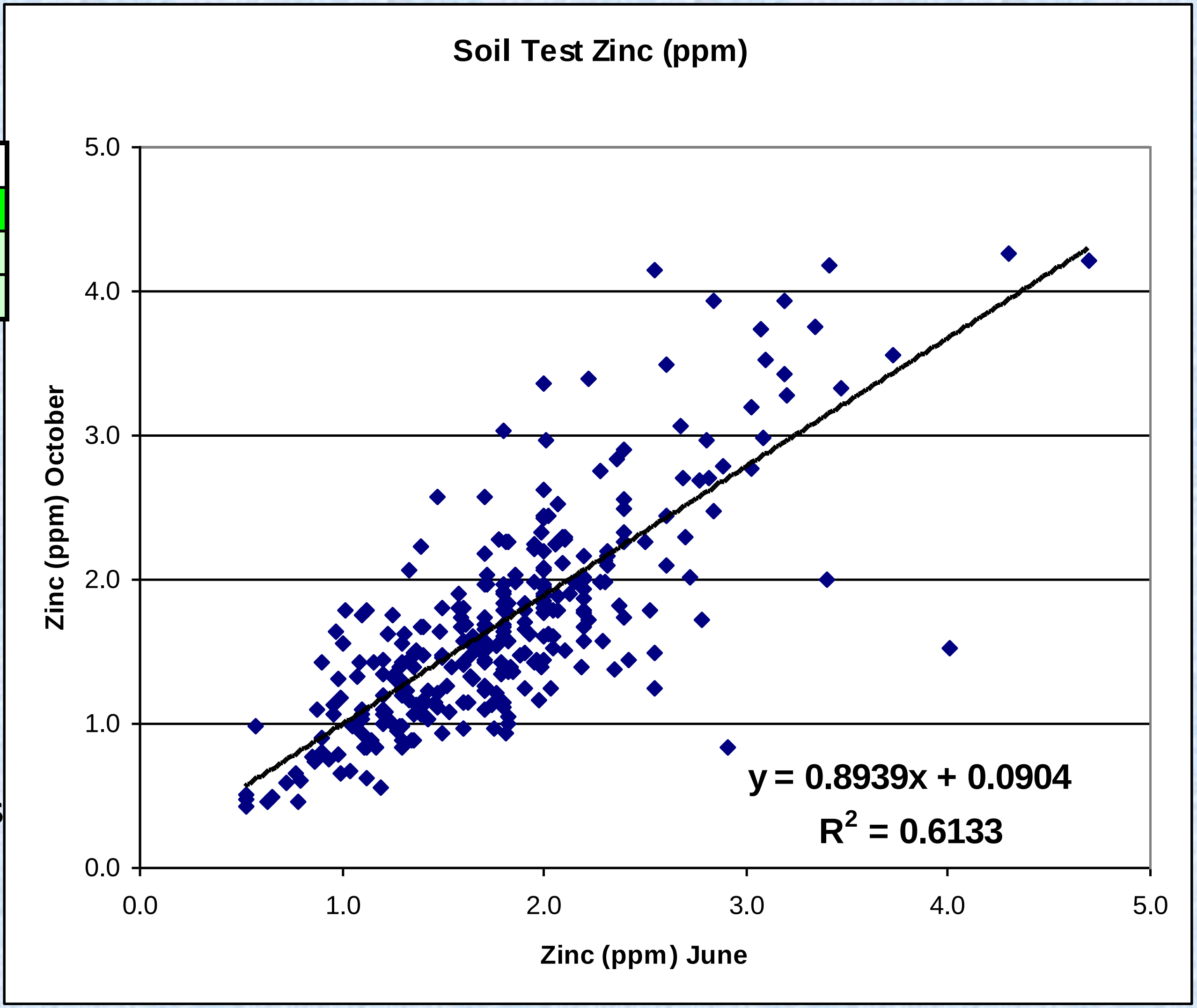
Time of Soil Sampling Project

Early Summer vs October Comparison

Averages: June vs October		
	Time of Sampling	
	Early	October
Zn (ppm)	1.8	1.7



4 year and > 300 sample points
Corn/Soybean Rotation
Unfertilized soybean
Topsoil samples

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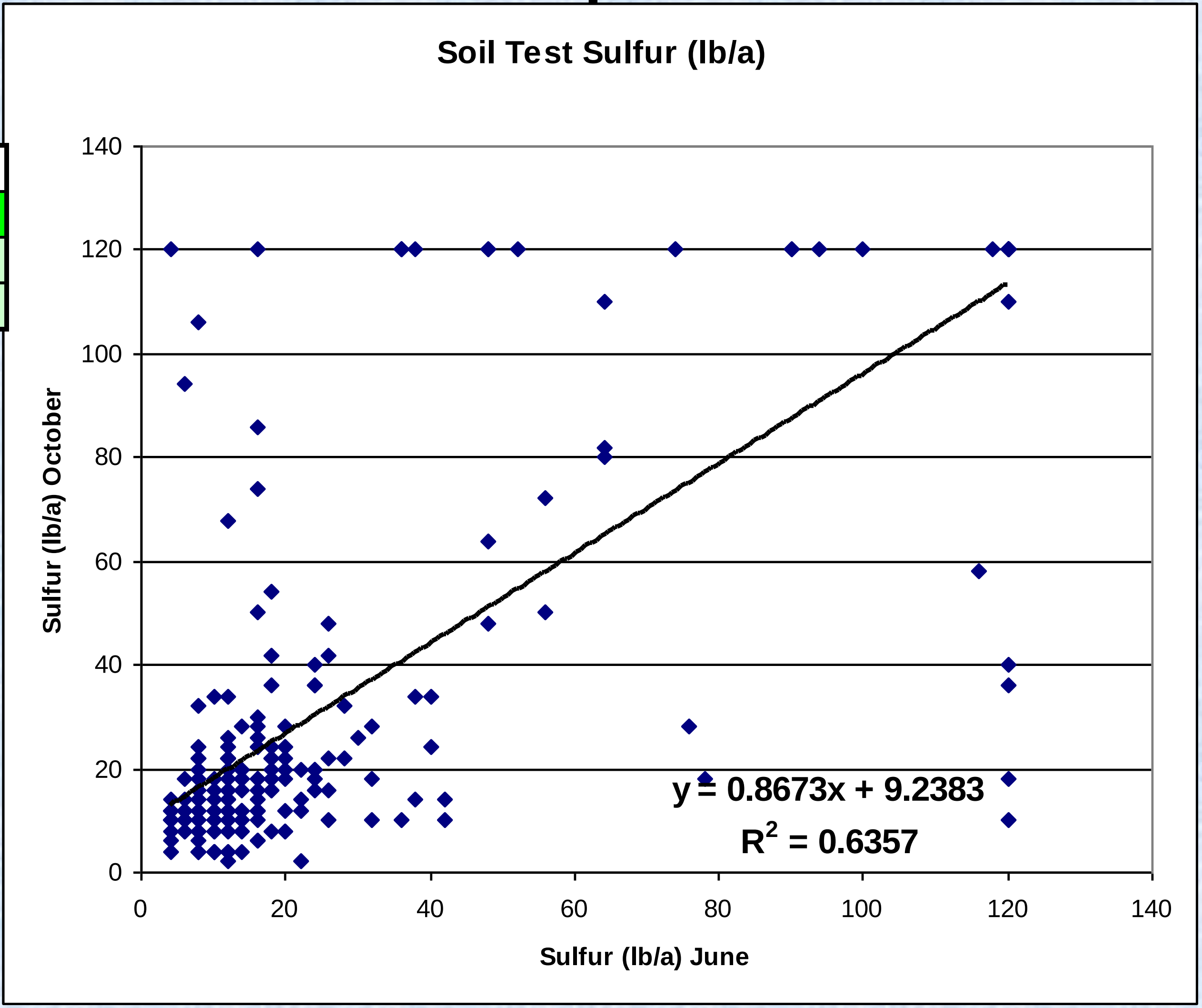
Time of Soil Sampling Project

Early Summer vs October Comparison

Averages: June vs October		
	Time of Sampling	
	Early	October
S (lb/a)	32	37



4 year and > 300 sample points
Corn/Soybean Rotation
Unfertilized soybean
Topsoil samples

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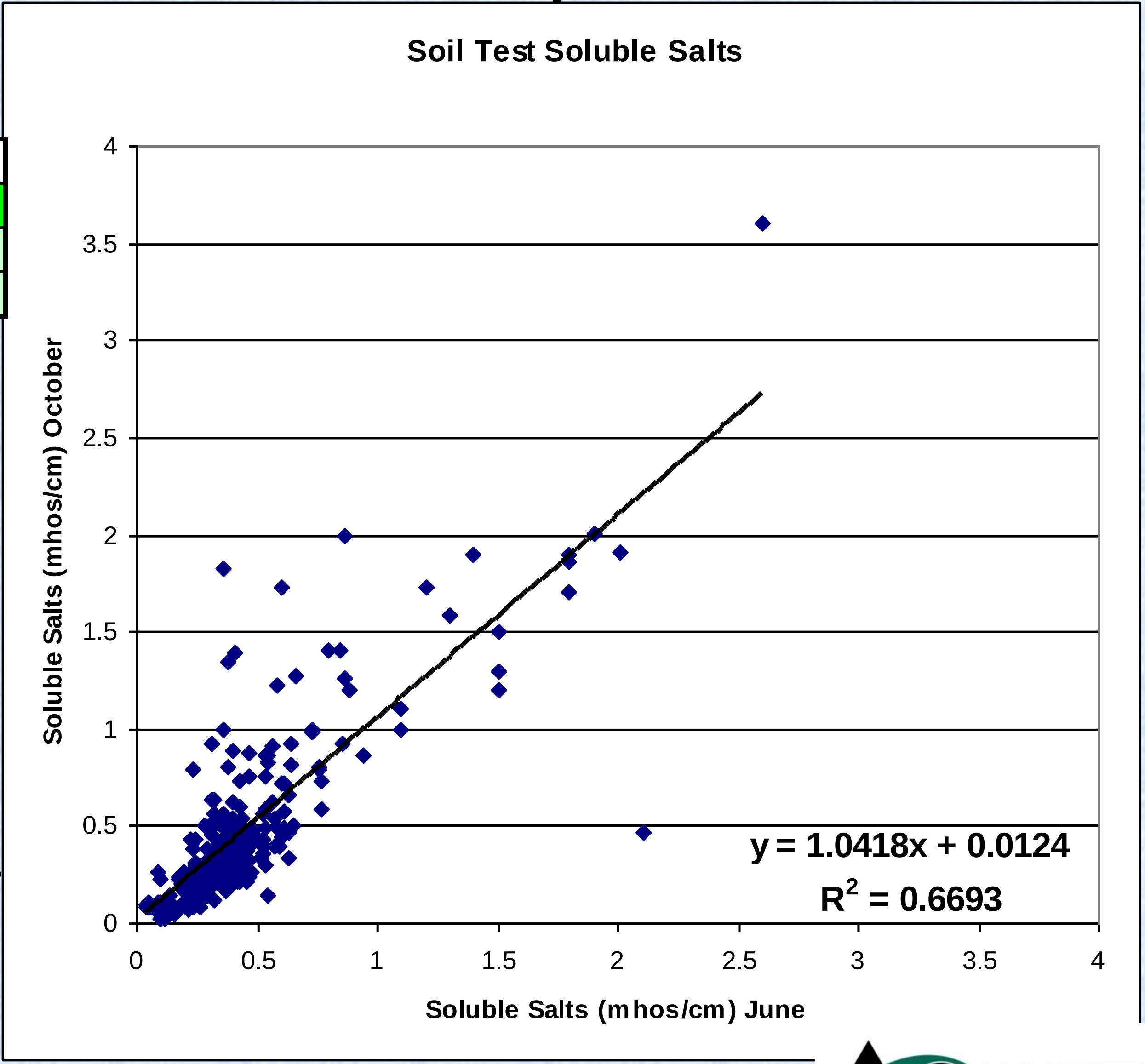
Time of Soil Sampling Project

Early Summer vs October Comparison

Averages: June vs October		
	Time of Sampling	
	Early	October
Salts	0.43	0.47



4 year and > 300 sample points
Corn/Soybean Rotation
Unfertilized soybean
Topsoil samples

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Time of Soil Sampling Project

Early Summer vs October Comparison

Averages: June vs October

	Time of Sampling	
	Early	October
P (ppm)	23	20
K (ppm)	190	197
pH	7.4	7.4
OM (%)	5	4.8
Zn (ppm)	1.8	1.7
S (lb/a)	32	37
Salts	0.43	0.47

R-square value

Time of Sampling	
P (ppm)	0.906
K (ppm)	0.85
pH	0.925
OM (%)	0.871
Zn (ppm)	0.613
S (lb/a)	0.636
Salts	0.669

4 year and > 300 sample points
Corn/Soybean Rotation
Unfertilized soybean
Topsoil samples

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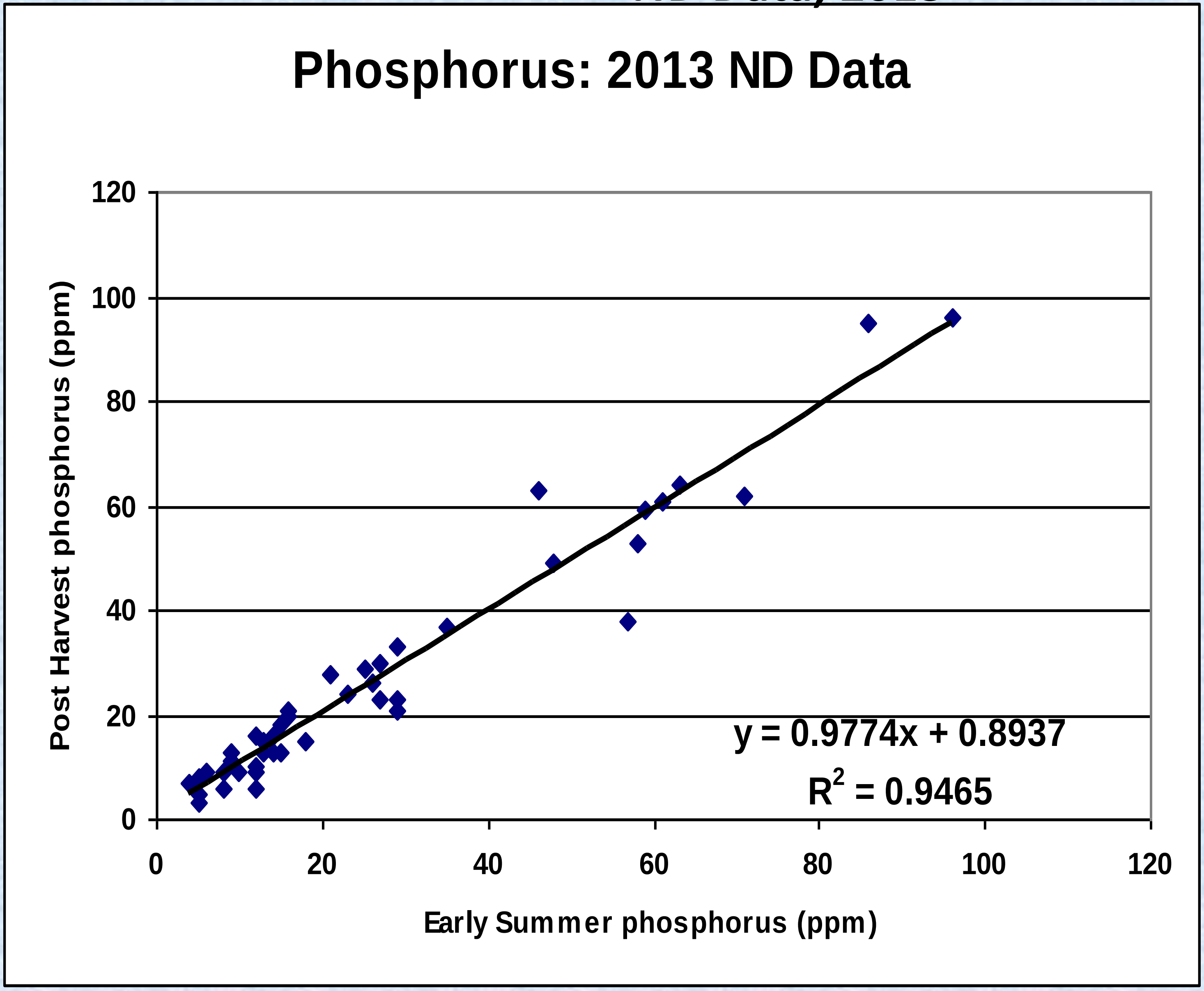
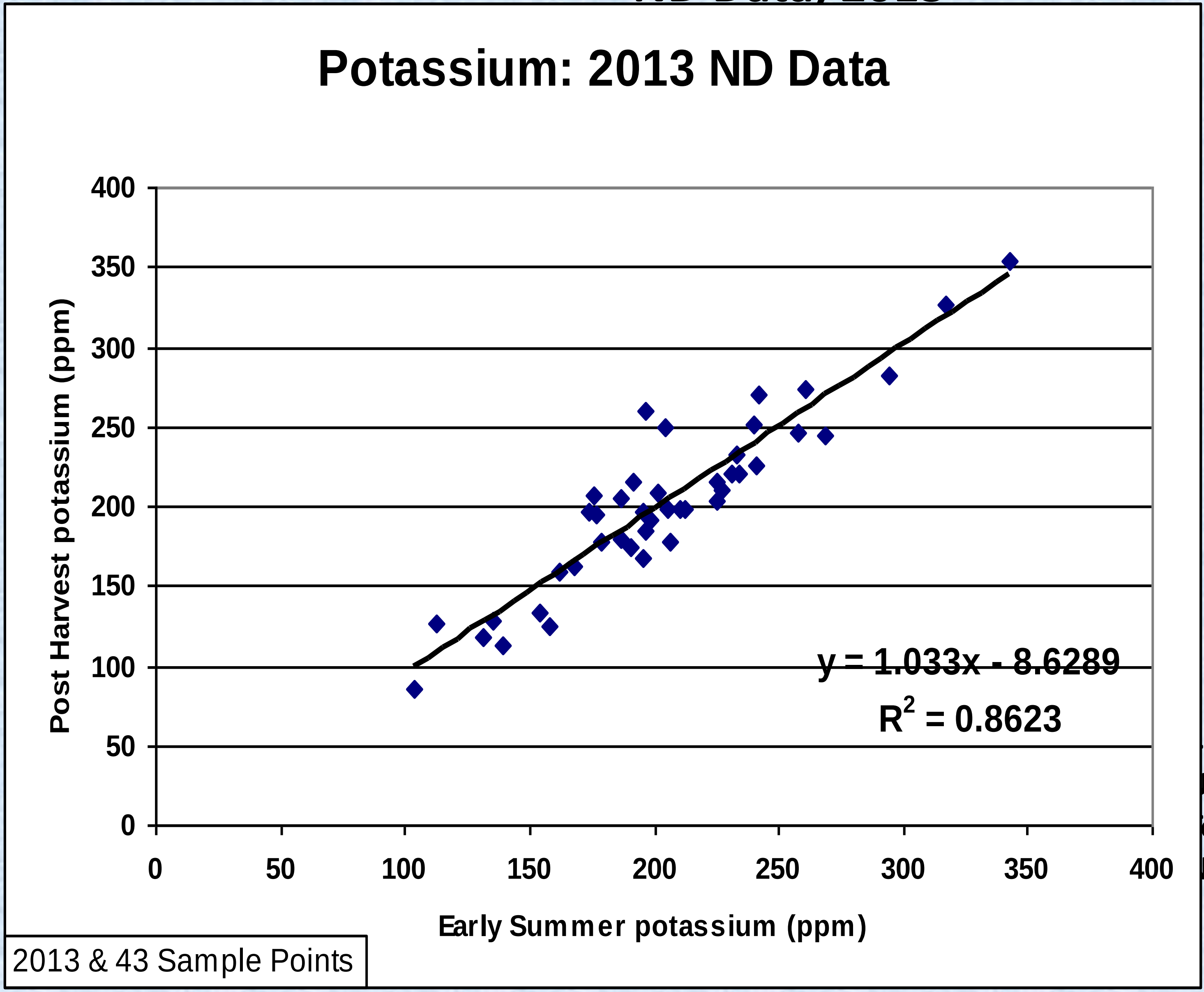
Time of Soil Sampling Project
Early Summer vs October Comparison
ND Data, 2013



43 sample points, 5 fields
Unfertilized soybeans
Topsoil samples
Northwood, ND - 2013

Time of Soil Sampling Project
Early Summer vs October Comparison
ND Data, 2013



- 3 sample points, 5 fields
- Jnfertilized soybeans
- opsoil samples
- Jorthwood, ND - 2013

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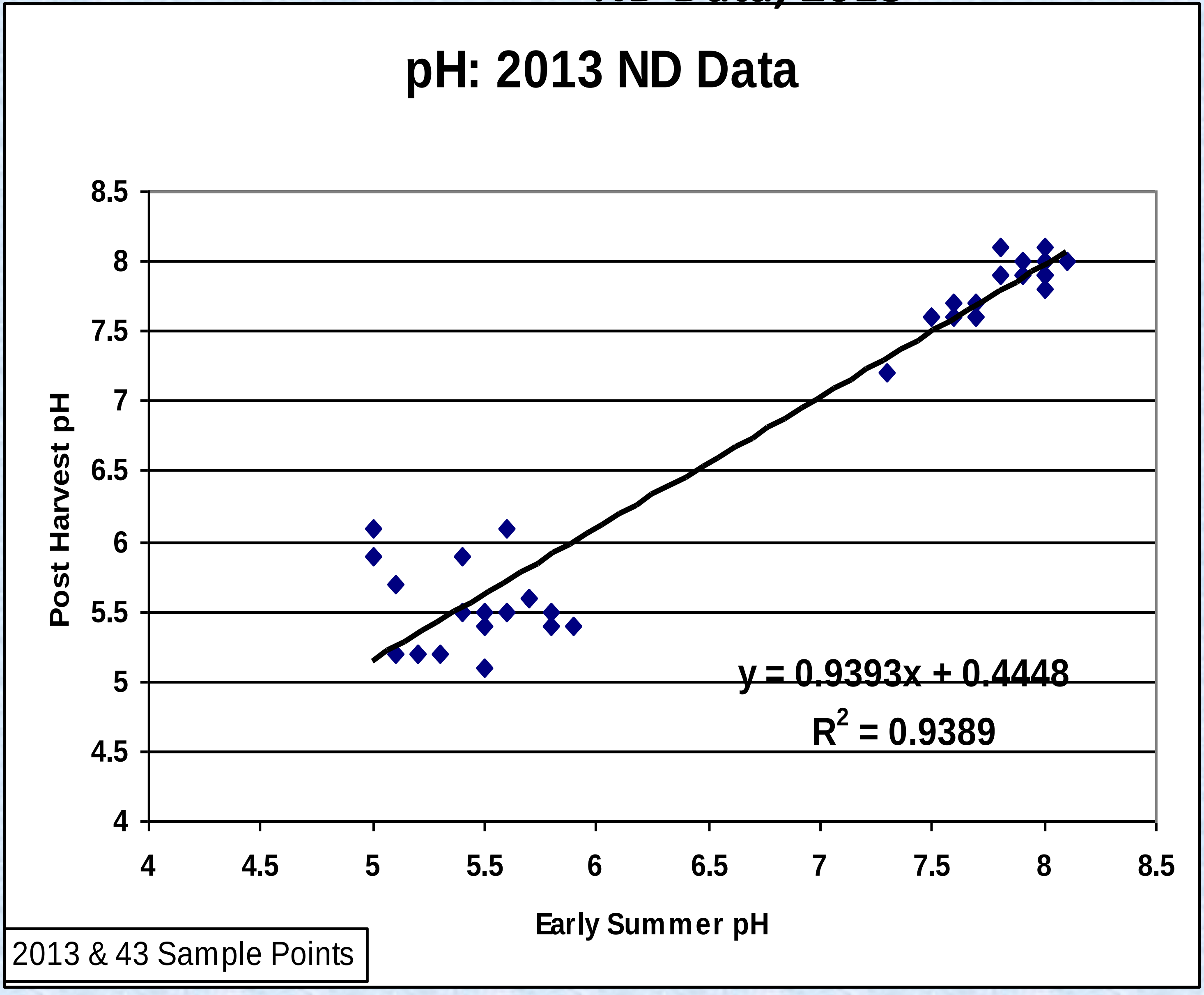
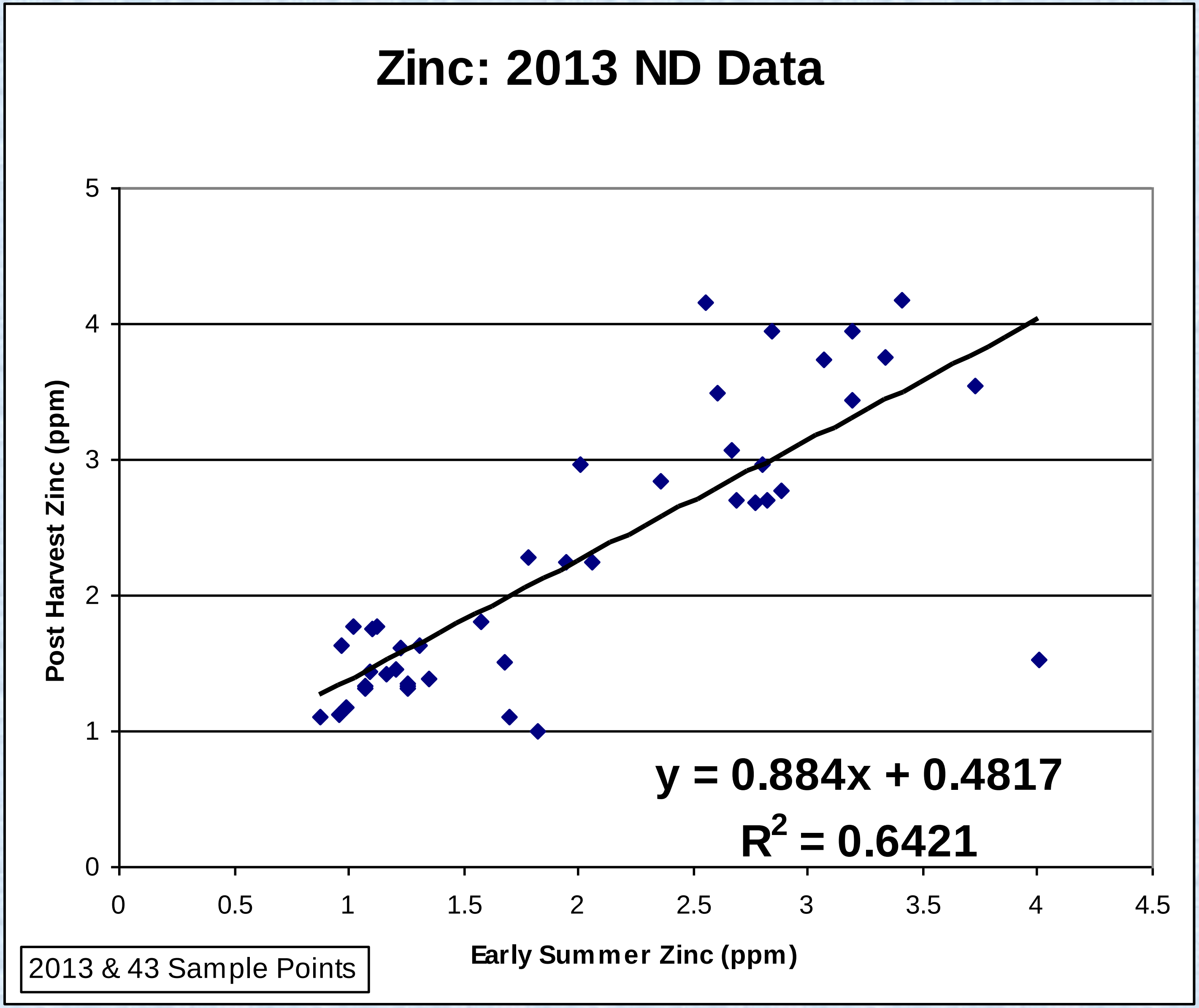
Time of Soil Sampling Project
Early Summer vs October Comparison
ND Data, 2013



43 sample points, 5 fields
Unfertilized soybeans
Topsoil samples
Northwood, ND - 2013

Time of Soil Sampling Project
Early Summer vs October Comparison
ND Data, 2013



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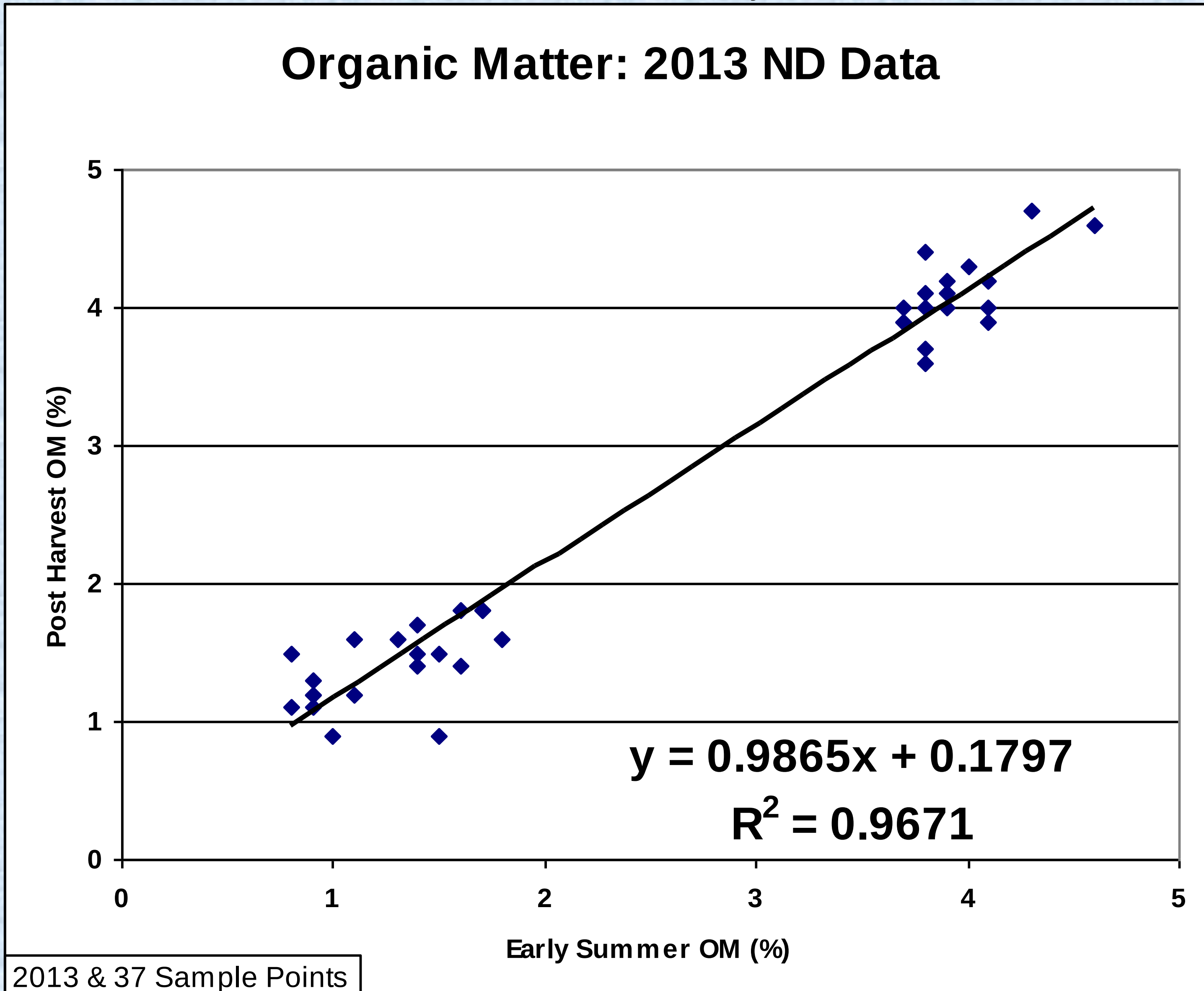
Time of Soil Sampling Project
Early Summer vs October Comparison
ND Data, 2013



43 sample points, 5 fields
Unfertilized soybeans
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Early Summer vs October Comparison
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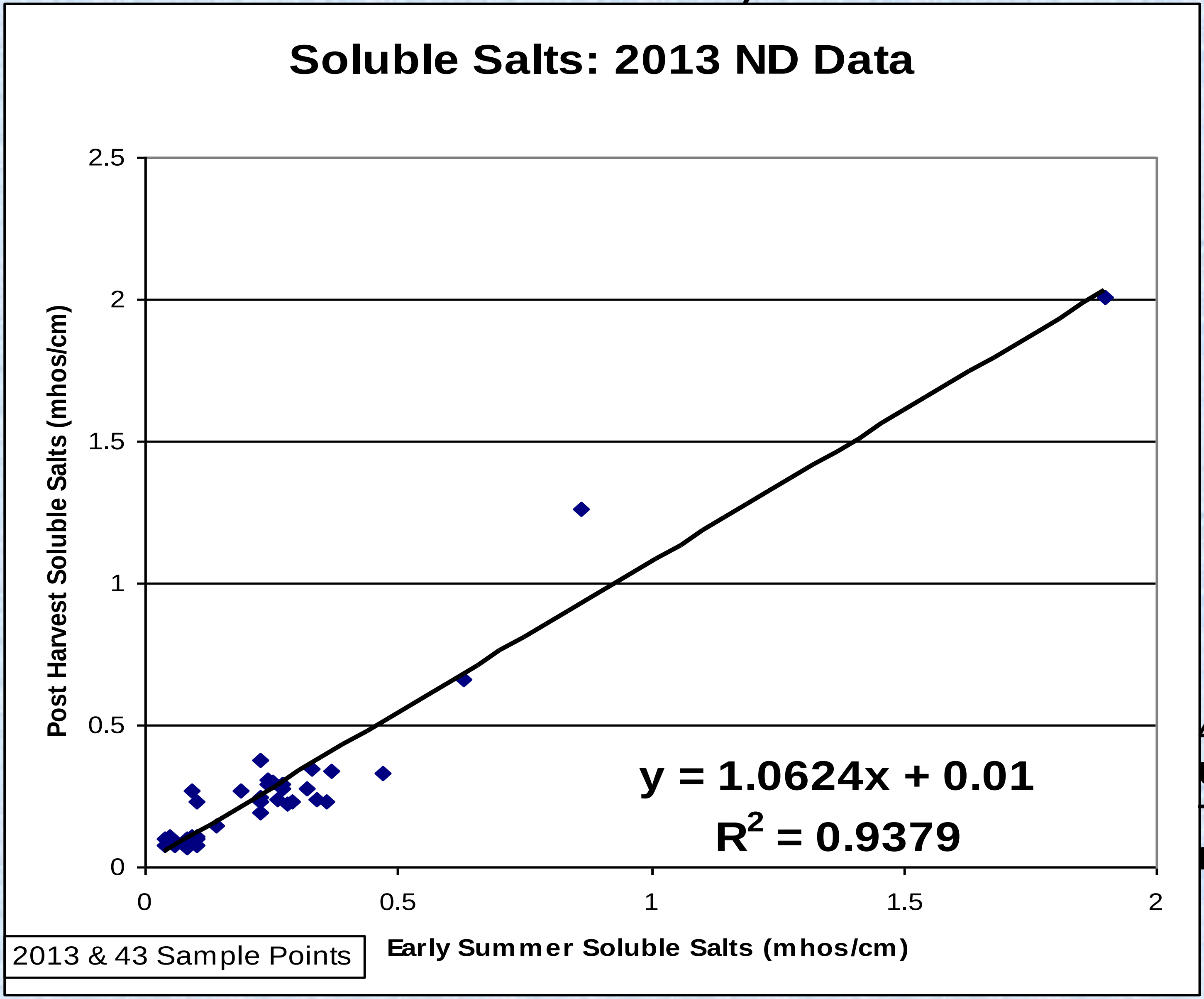

43 sample points, 5 fields
Unfertilized soybeans
Topsoil samples
Northwood, ND - 2013

Early Summer Topsoil Sampling

Early Summer vs October Comparison Project

Benefits all involved:

Growers

Retailers

Consultants

Samplers

Applicators

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

The Goal and Purpose of Soil Sampling

To collect a "**representative**" soil sample that reflects the "true" average value for the "grid" or "zone" or "field" that is cost effective, useful for nutrient management and maximizes yield.

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Goal is to obtain a sample(s) that accurately represents the field:

A. **Accuracy**: “Hit the bulls-eye”
- How close to the “true” average value.

B. **Precision**: “Continuously hitting the bulls-eye”
- Being able to reproduce the soil test values after resampling it numerous times.
- Repeatability

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Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Goal is to obtain a sample(s) that accurately represents the field:

<u>Accuracy and Precision</u>

Ex. Accuracy of +/- 15% and precision level of 80% means:
    If you resample a field 10 times, then 8 out of 10 times
    the soil test values will be within 15% of the average.

"***Accuracy increases with the increase of cores."***

"Nitrogen and phosphorus more variable than potassium."

"N and P need more cores to be accurate as compared to K."

"20 well taken cores, will give you +/-15% accuracy at 80% precision."

Dr. W.C. Danke, NDSU Soil Scientist

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Improving Soil Sampling Consistency
Keys to Successful Soil Sampling
Largest Source of Inconsistency

The **largest source of inconsistency** in soil testing comes from the actual soil sample collection process.

A. Not enough cores
B. Field Size: Field/Zone/Grid too large in size
C. Depth consistency – Too deep or too shallow
D. Core Quality: Tillage vs standing stubble conditions
E. Sampling after manure or fertilizer application
F. Contaminated bucket or soil bag
G. Field anomalies
H. Strip-Till

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Improving Soil Sampling Consistency
Keys to Successful Soil Sampling
Number of Cores to Collect

- **Conventional Composite Samples**
  - Minimum 15 cores, 20 is better
- **Zone Samples**
  - Minimum 10-12 cores, 15 is better
- **Grid Samples**
  - Minimum 8-10 cores, 12 is better

If followed, then you should get the correct value (+ or – 15%) at least 80% of the time

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Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Number of cores necessary to provide various levels of Accuracy and Precision.

(Field size ~ 80 acres, conventional tillage and composite soil sample.)

	Accuracy Level								
	(+/-) 5%			(+/-) 15%			(+/-) 25%		
Precision Level	N	P	K	N	P	K	N	P	K
	(number of cores)								
90%	227	298	59	25	34	7	10	12	3
80%	137	181	36	18	31	5	6	8	2
70%	90	117	24	10	14	2	4	5	2

Dr. W.C. Danke, NDSU Soil Scientist

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling
Strip-Till Sampling

Methods to Collect the Cores

1. **6” off the side of the strip-till band**
2. **1 core in the strip-till band**
   and 3 cores between the strip-till bands
3. **Random**

The problem:

If you collect cores between the bands, then more than likely it will result in over-fertilization.

If you collect cores in the bands, then more than likely it will result in under-fertilization.

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Improving Soil Sampling Consistency

Keys to Successful Soil Sampling

Avoid or Sample Separately

Field anomalies

A. Saline or sodic areas of a field
B. Headlands or field margins
C. Old farmsteads
D. Old feedlots
E. Drowned out areas
F. Combining smaller fields into one field
G. Eroded knolls or exposed subsoil
H. Drainage ditches

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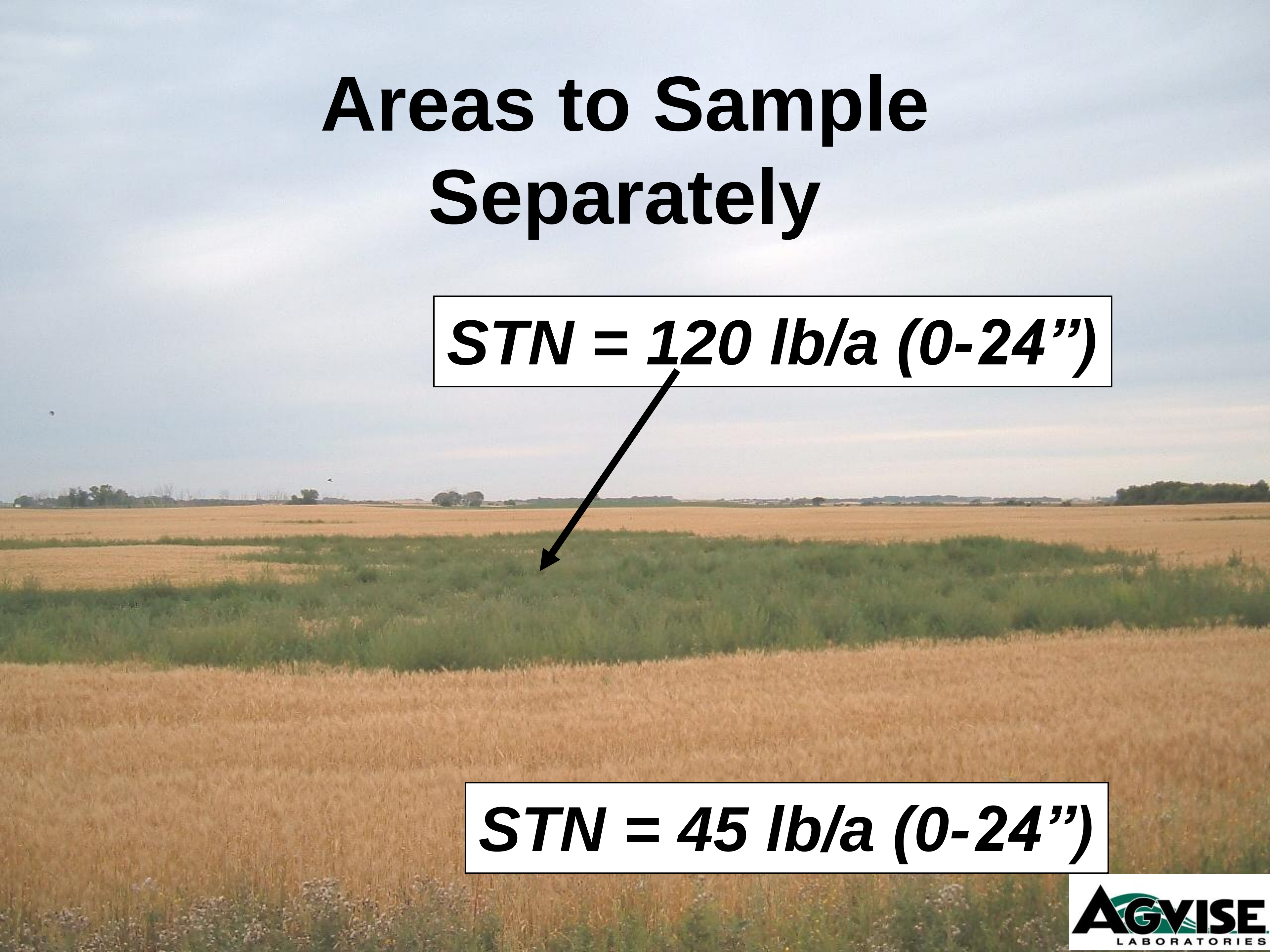
Areas to Sample Separately



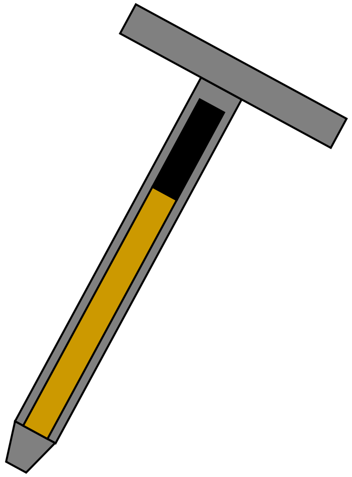
Areas to Sample Separately or Avoid

- ✓Higher nitrogen
- ✓Higher sulfur
- ✓Higher phosphorus
- ✓Higher potassium

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Saline Soils

- High concentration of dissolved salts
  - Calcium sulfate (gypsum)
  - Magnesium sulfate (Epson salts)
  - Sodium sulfate
  - Calcium Chloride
  - Magnesium Chloride
  - Sodium Chloride



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Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Tillage

Tillage:

Major impact on soil test variability.

Conventional vs Conservation Tillage

Conventional tillage = **less variability**

No-till/Strip-till = **more variability**

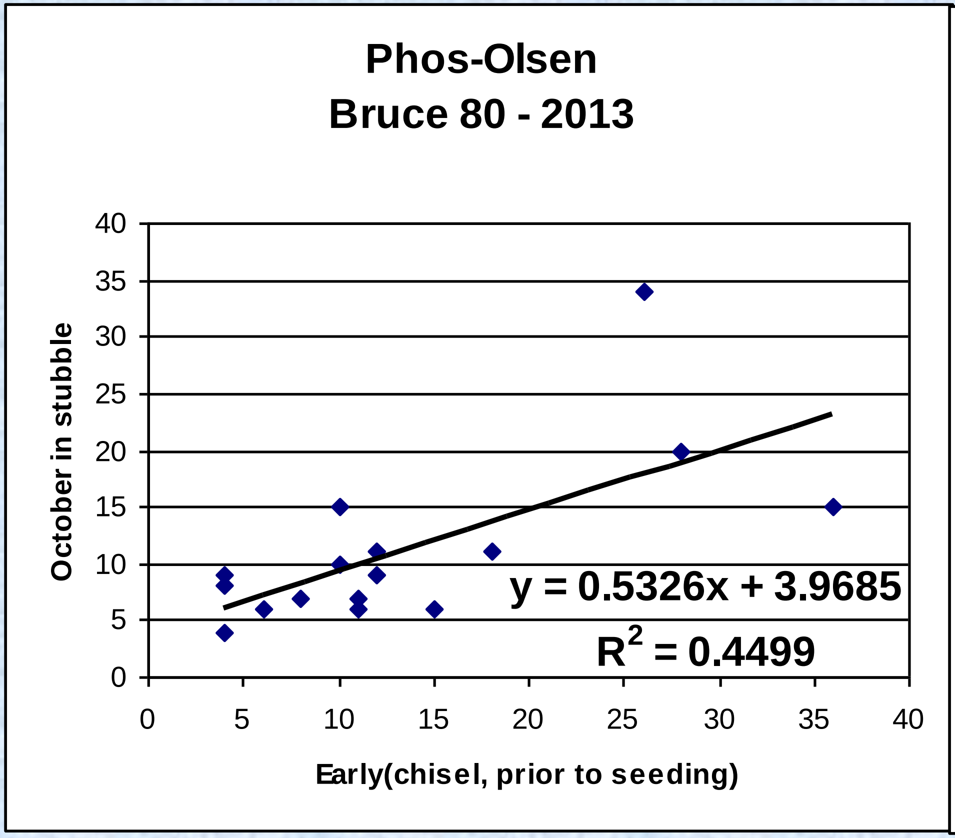
Stubble field vs Tilled Field

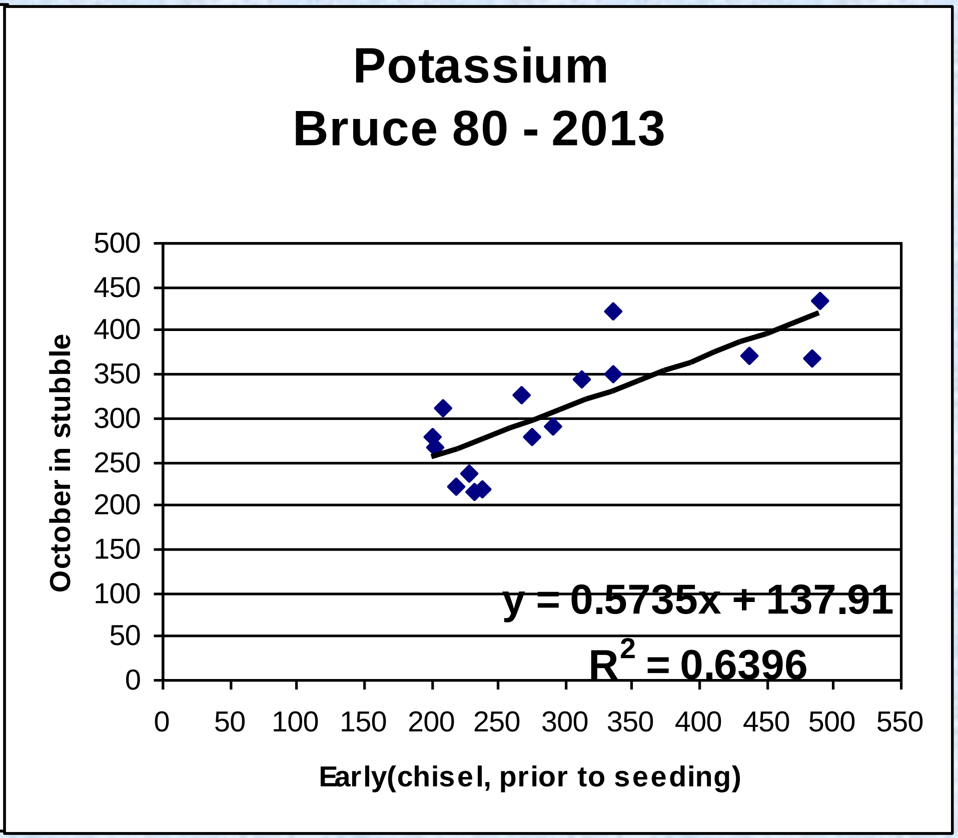
Tilled field = **more variability**

Stubble field = **less variability**

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

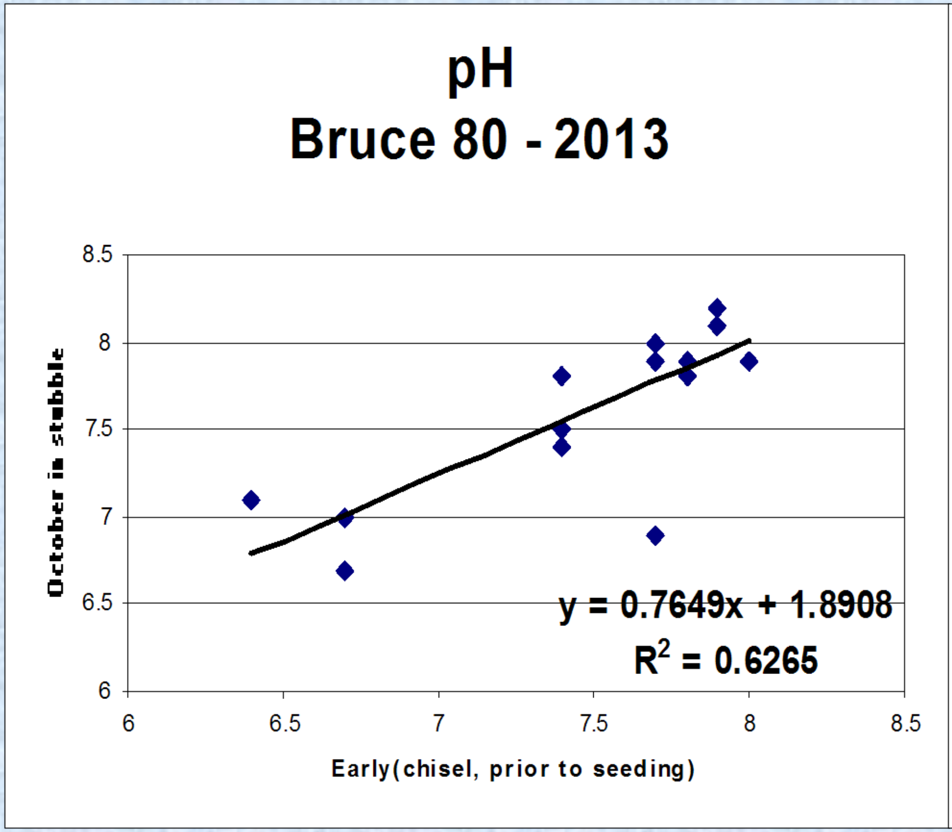
Tillage Affects

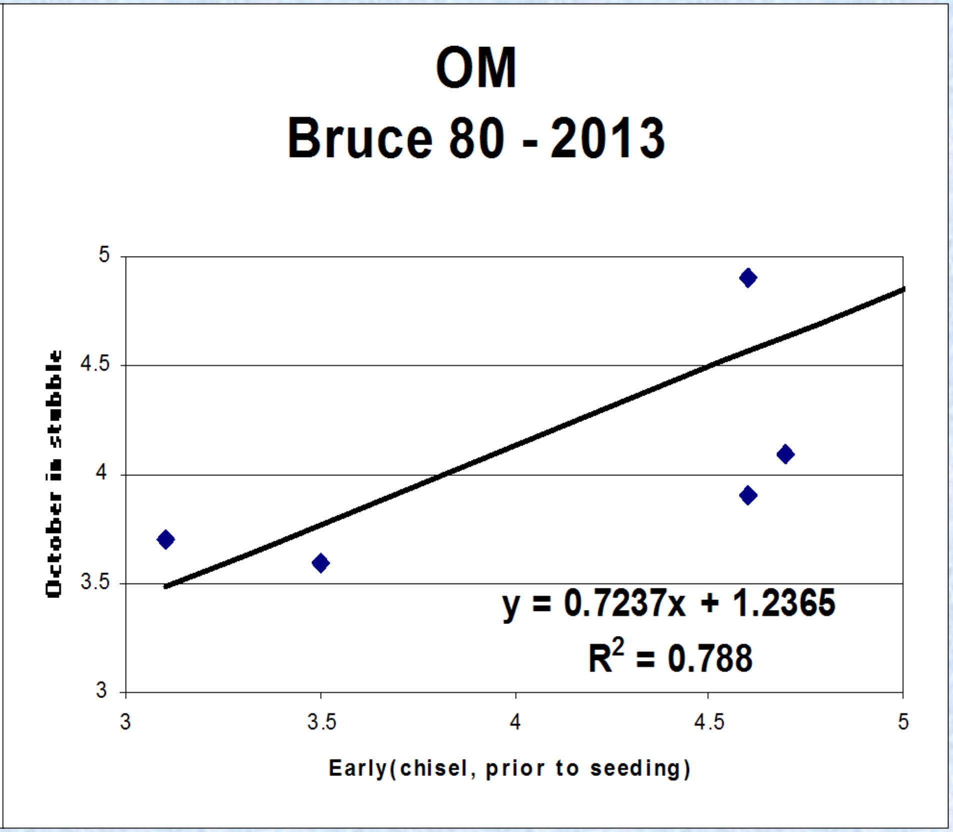




Early vs Late sample comparison.
Early sampled in May on fall-chisel plow prior to spring tillage vs Late stubble

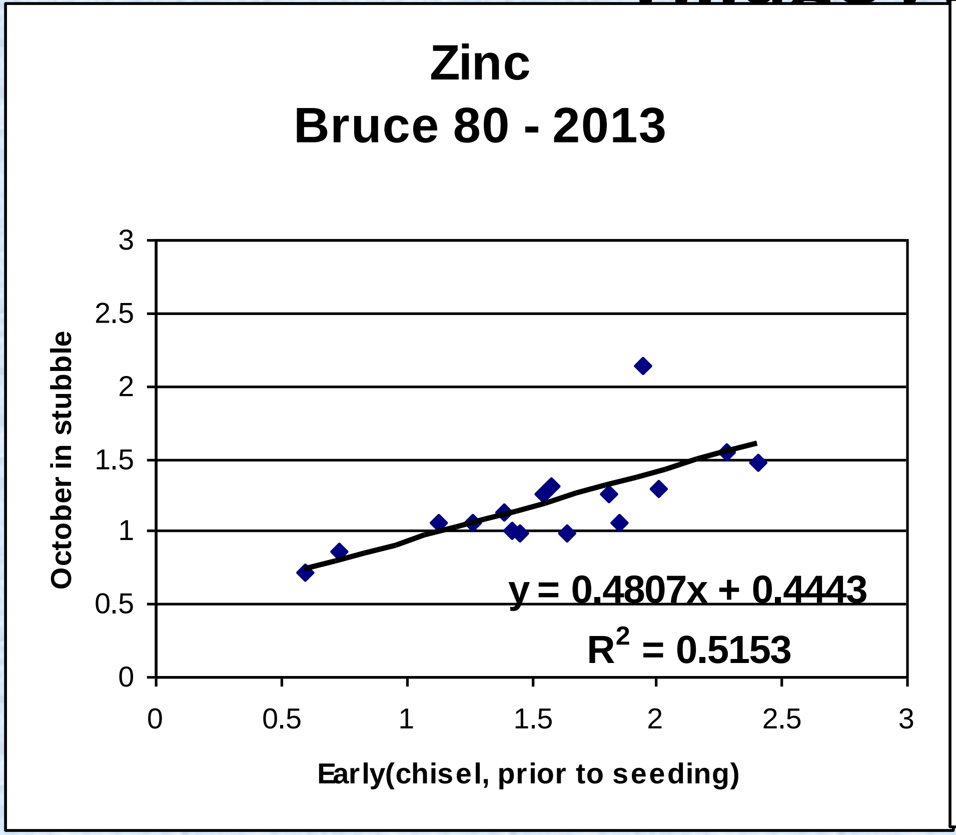
Improving Soil Sampling Consistency
Keys to Successful Soil Sampling
Tillage Affects

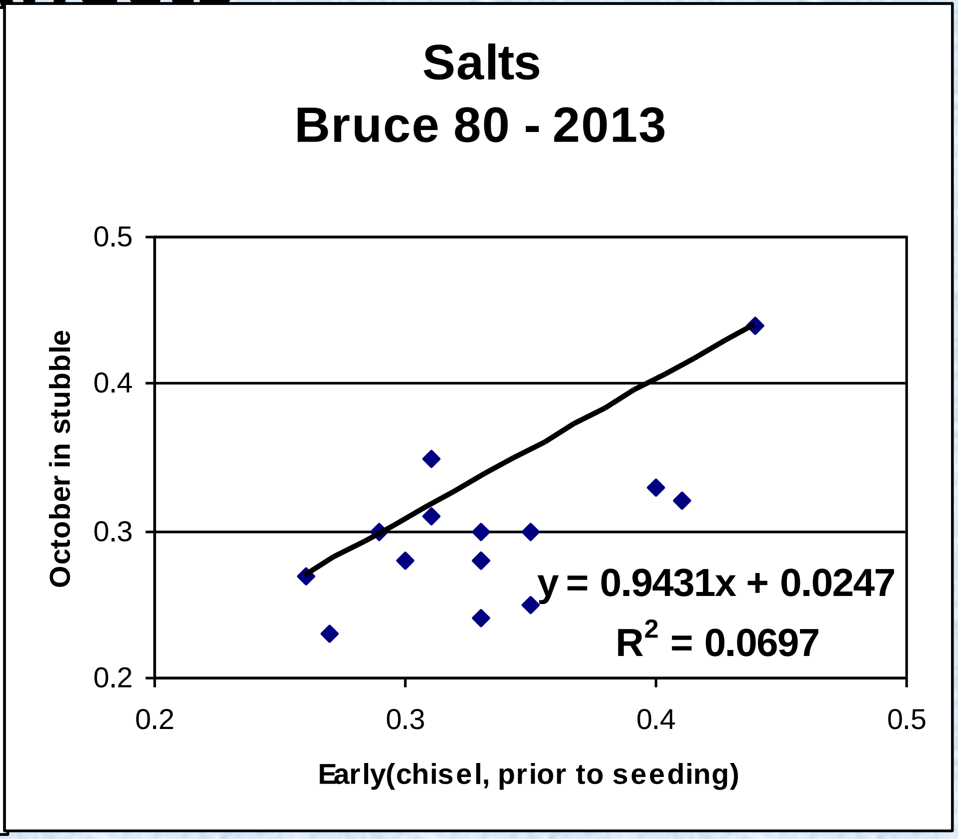




Early vs Late sample comparison.
Early sampled in May on fall-chisel plow prior to spring tillage vs Late stubble

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling
Tillage Affects





Early vs Late sample comparison.
Early sampled in May on fall-chisel plow prior to spring tillage vs Late stubble

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Tillage:

Major impact on soil test variability.

Phosphorus: Affects of tillage on soil test variability.			
	Tillage		
	No-till	Min-till	Conv. Till
Sites	26	17	17
Variability	41%	26%	16%
Dr. R. O. Miller, CSU, 65 fields across 10 States.			

Potassium, pH and OM:

Much less variation than phosphorus.

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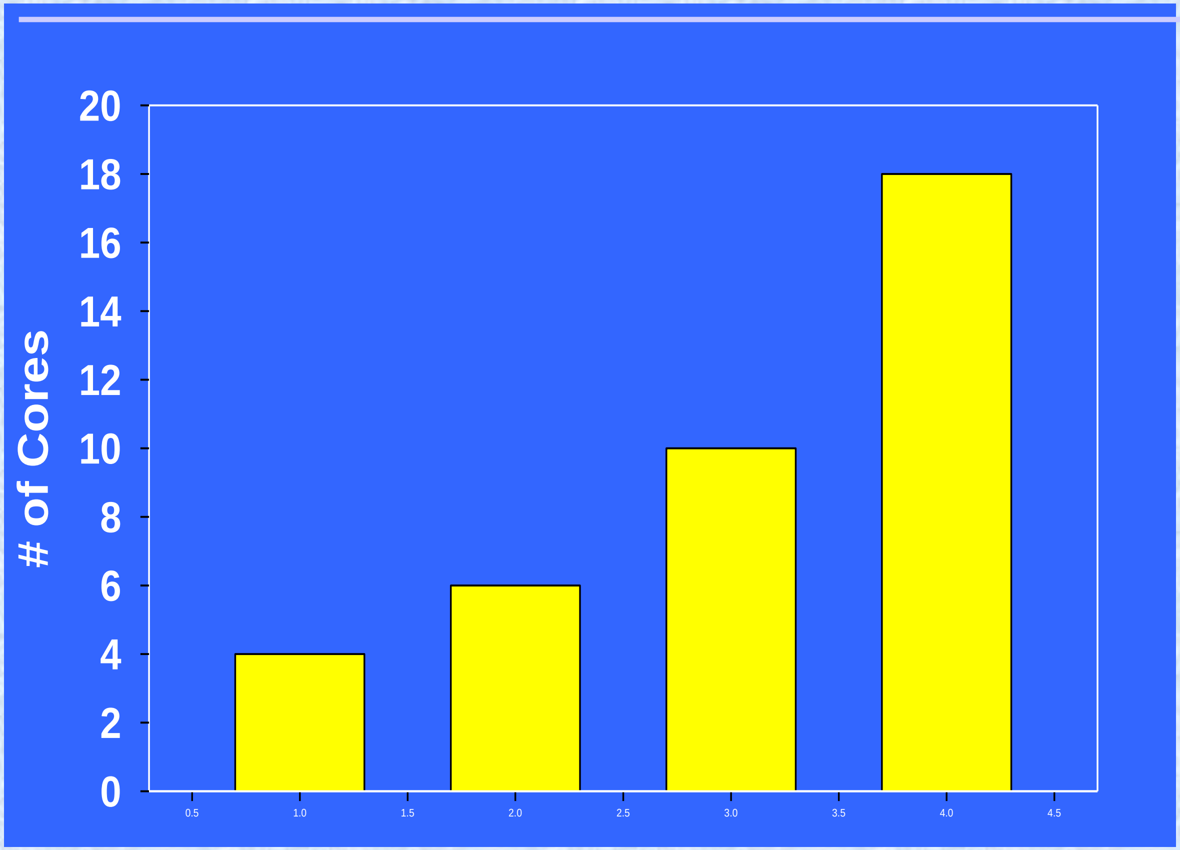
Improving Soil Sampling Consistency
Keys to Successful Soil Sampling



With decreased tillage, increased variation both vertically and horizontal.

Accuracy improves with increased sampling intensity.

Conventional → **No-Till**

Decreased Tillage

R. O. Miller, 2010

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Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

<u>Depth and Stratification:</u>

3 inch increments

0-3”, 3-6”, 6-9” & 9-12”

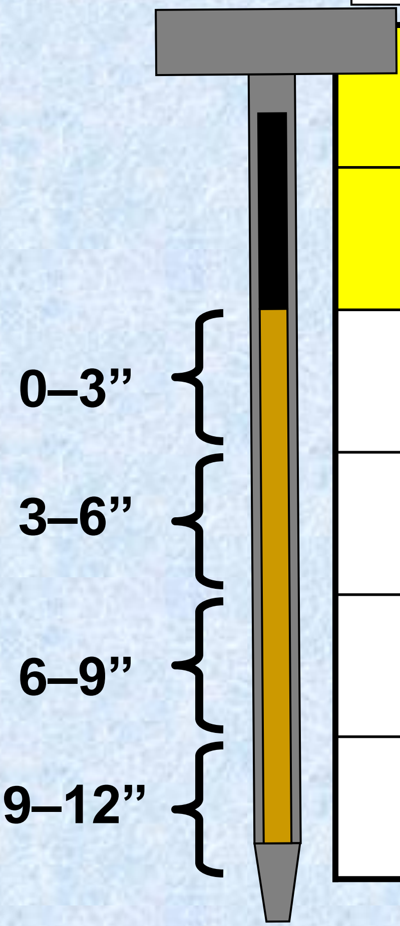
<u>Sample Info</u>

1) Sampled July 2, 2013
2) Unfertilized soybean field
3) 2 sample points
4) ~ 300 yards apart
5) Corn/soybean rotation
6) Conventional tillage
7) ~ 5” of rainfall since May 20

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Depth and Stratification:

Major impact on soil test variability.



Organic Matter	
Sample 1	Sample 2
4.4	5.8
4	5.7
3.8	5.5
2.8	5.2

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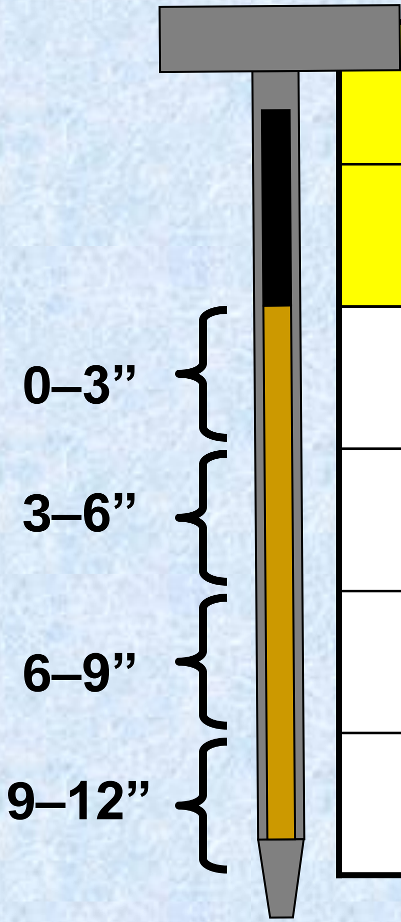
Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

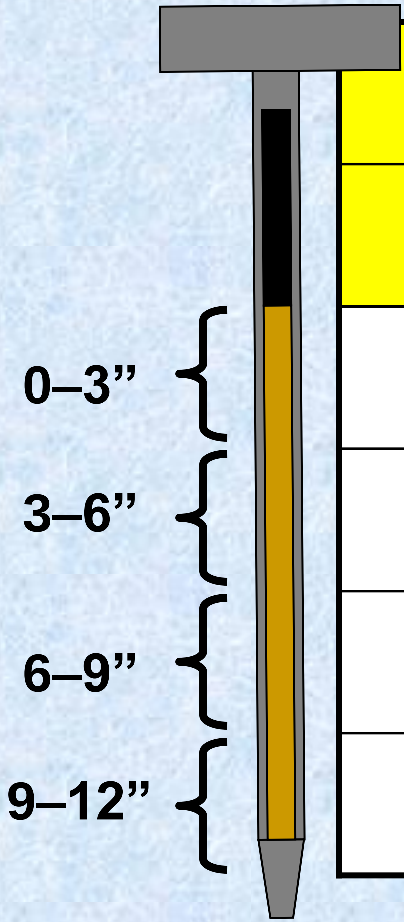
<u>Depth and Stratification</u>:
Major impact on soil test variability.



pH	
Sample 1	Sample 2
6.8	8
7.2	8.1
7.7	8.1
7.9	8.2

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Depth and Stratification:
Major impact on soil test variability.



Phosphorus-Olsen	
Sample 1	Sample 2
14	12
4	7
2	2
2	2

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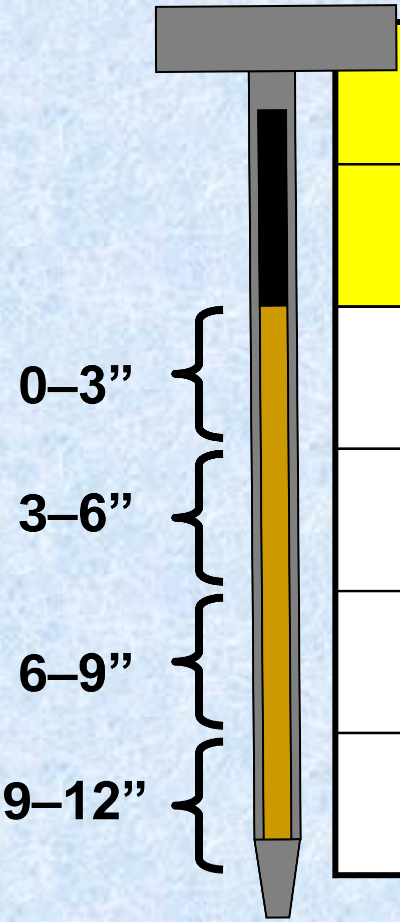
Keys to Successful Soil Sampling

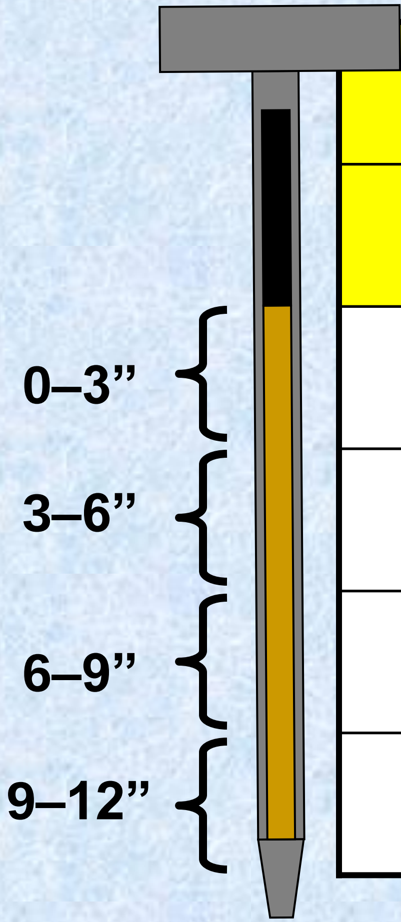
<u>Depth and Stratification</u>:
Major impact on soil test variability.



Potassium	
Sample 1	Sample 2
154	141
107	97
99	83
93	69

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Depth and Stratification:
Major impact on soil test variability.



Zinc	
Sample 1	Sample 2
1.8	1.7
2.1	1.3
0.7	0.8
0.7	0.4

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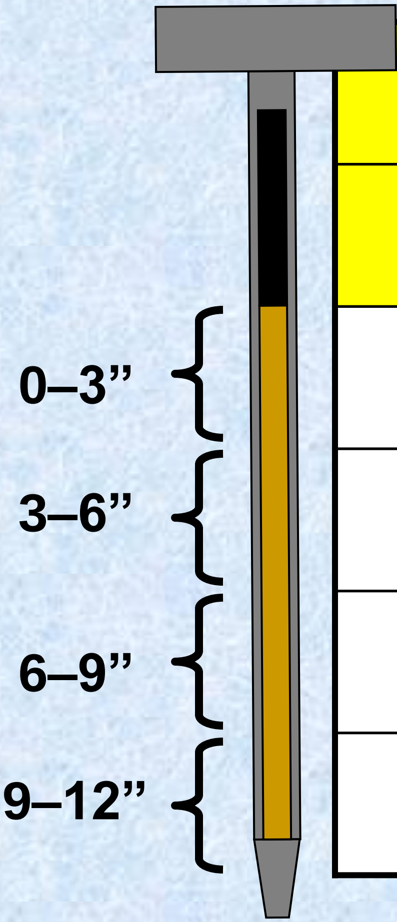
Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Depth and Stratification:

Major impact on soil test variability.



Carbonate	
Sample 1	Sample 2
0	4.1
0	4.3
0	6.4
3.1	12.6

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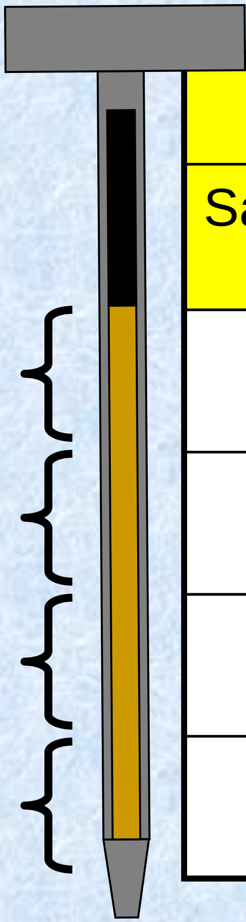
Depth and Stratification:

Major impact on soil test variability.

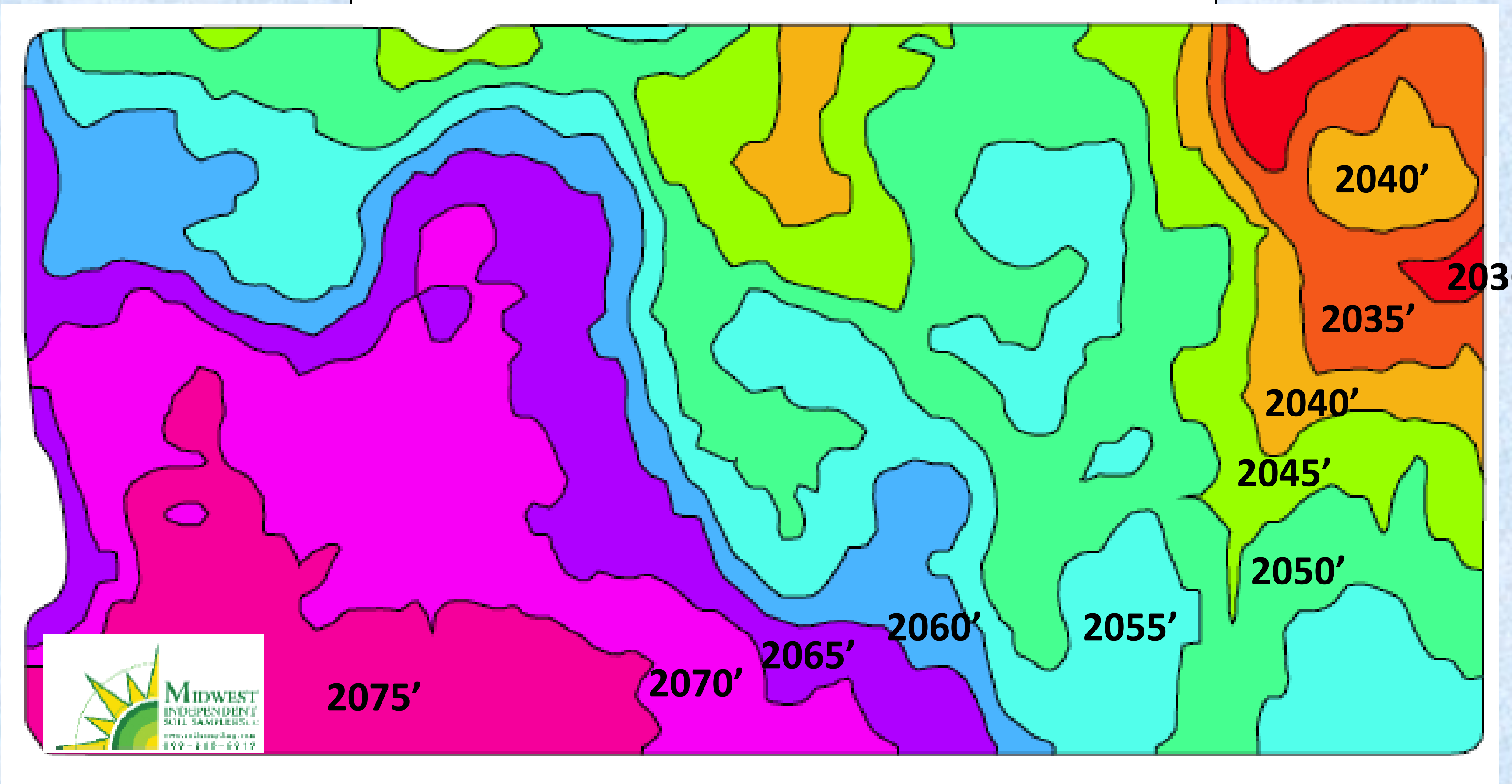


	Nitrogen		Sulfur	
	Sample 1	Sample 2	Sample 1	Sample 2
0–3”	8	10	3	4
3–6”	8	8	3	3
6–9”	8	8	3	3
9–12”	7	9	2	5

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

<u>Field size too large</u>:

Major impact on soil test variability.



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Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Grid – Zone Comparisons

- **Grid:**
  - **0-6" (topsoil) sample**
  - Best for manure mgmt. and lime
  - Easy system to implement
  - More intensive sampling than zone
  - **P,K,pH,OM,Zn,S,CEC**
  - Corn/Soybean rotation

- **Zone:**
  - **0-6" + 6-24" sample**
  - Change yield goal per zone
  - Main nutrient: **Nitrogen**
  - Secondary nutrients: P,K….
  - Poor on manure mgmt. and lime
  - Use remote sensing, Veris, topography, yield maps, others…

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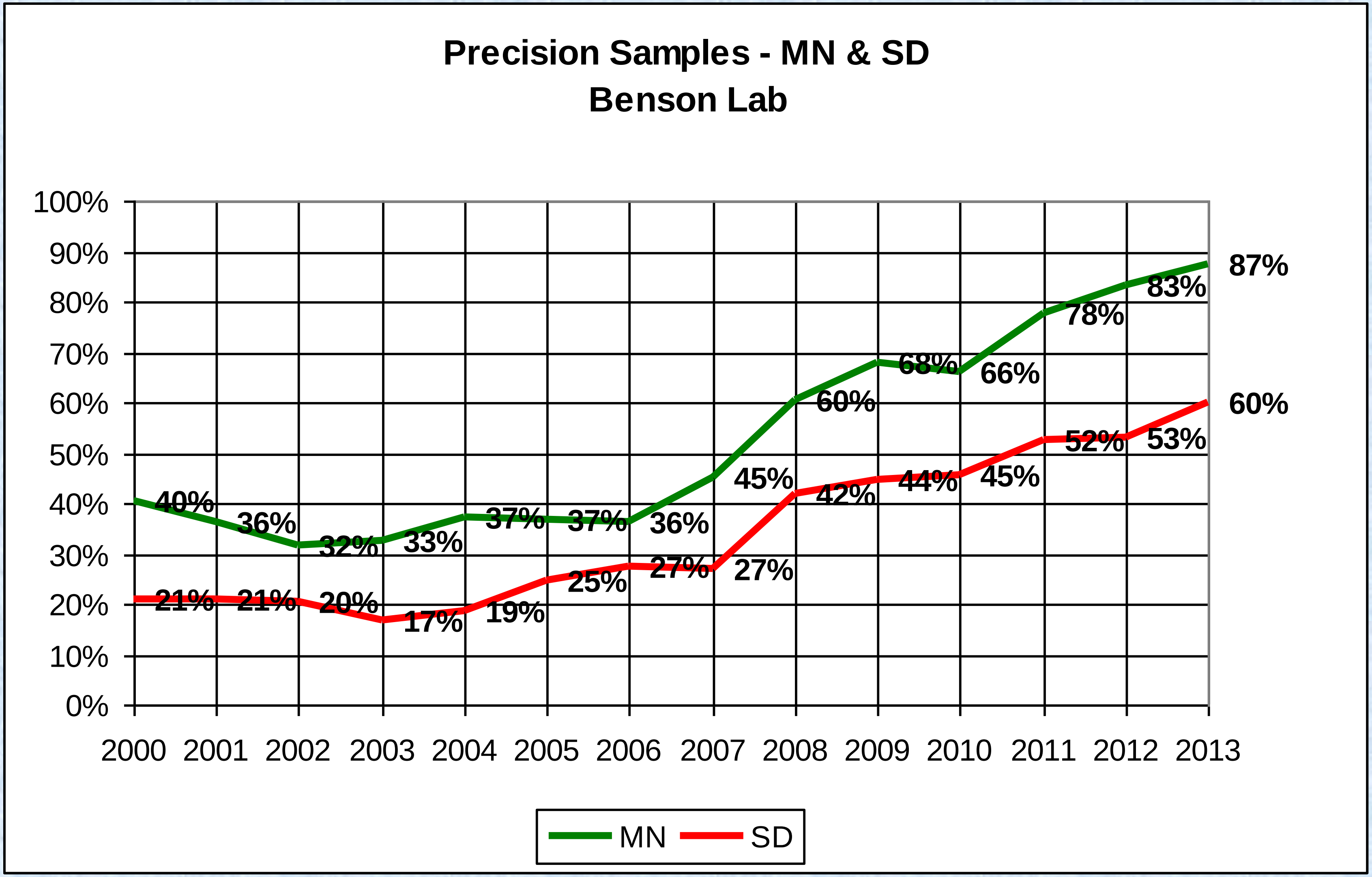
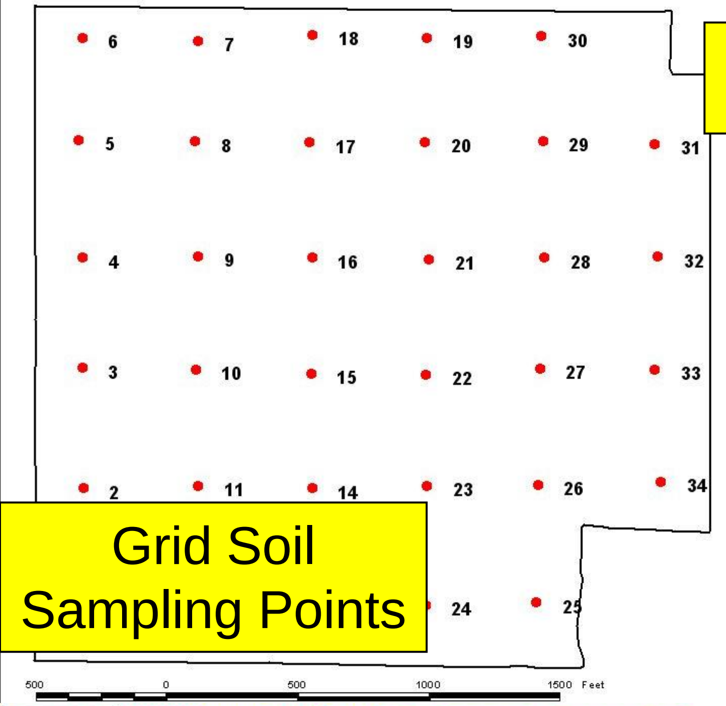
Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

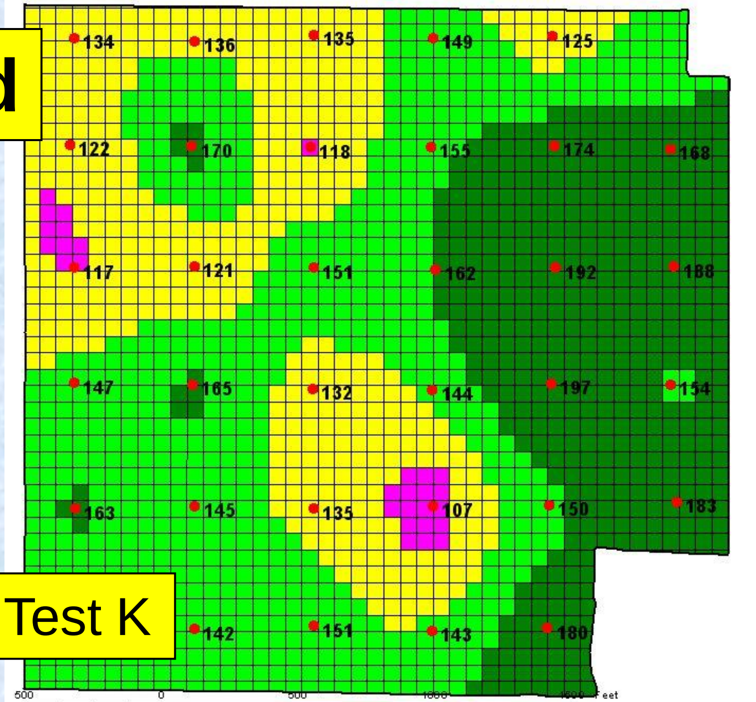


Ex.Grid Field

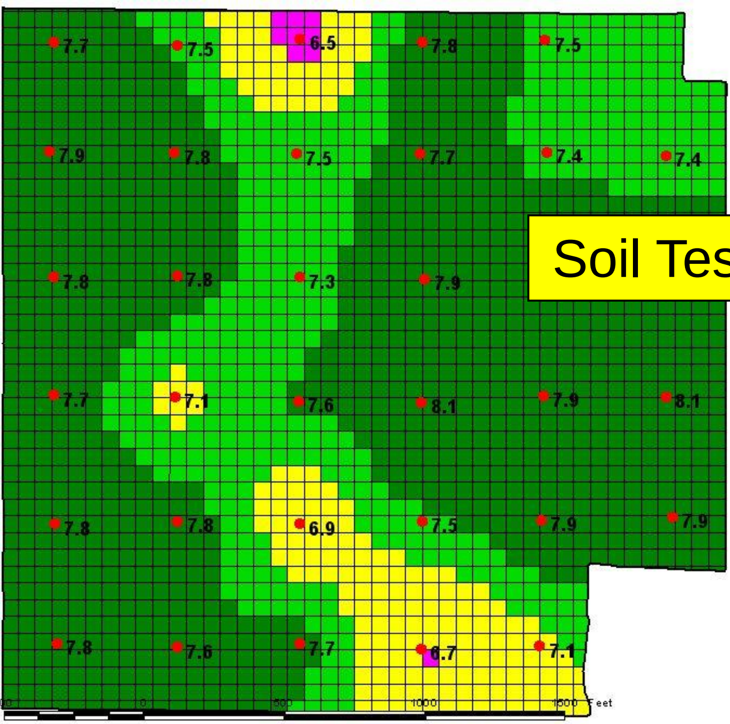
140 acre field



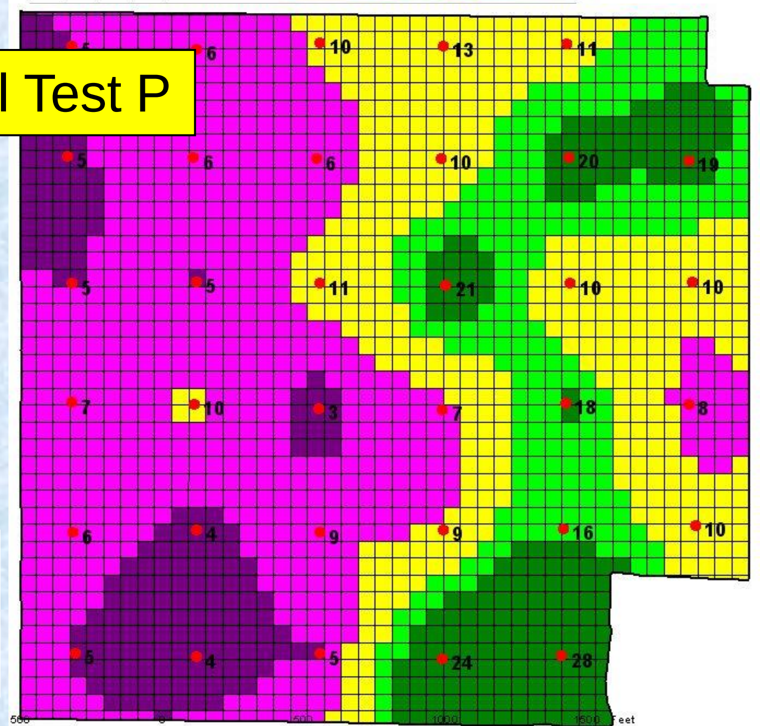
Grid Soil Sampling Points



Soil Test K



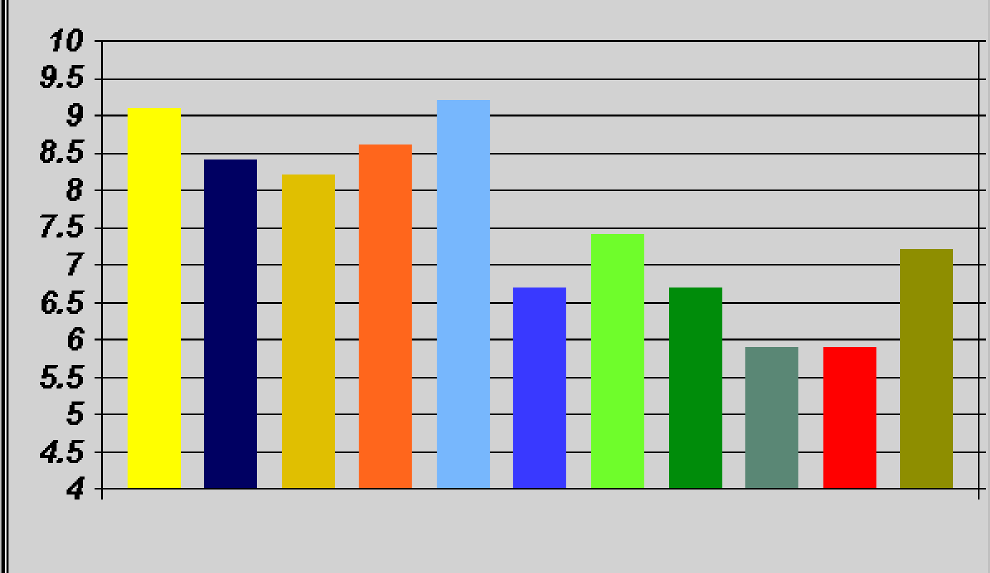
Soil Test pH

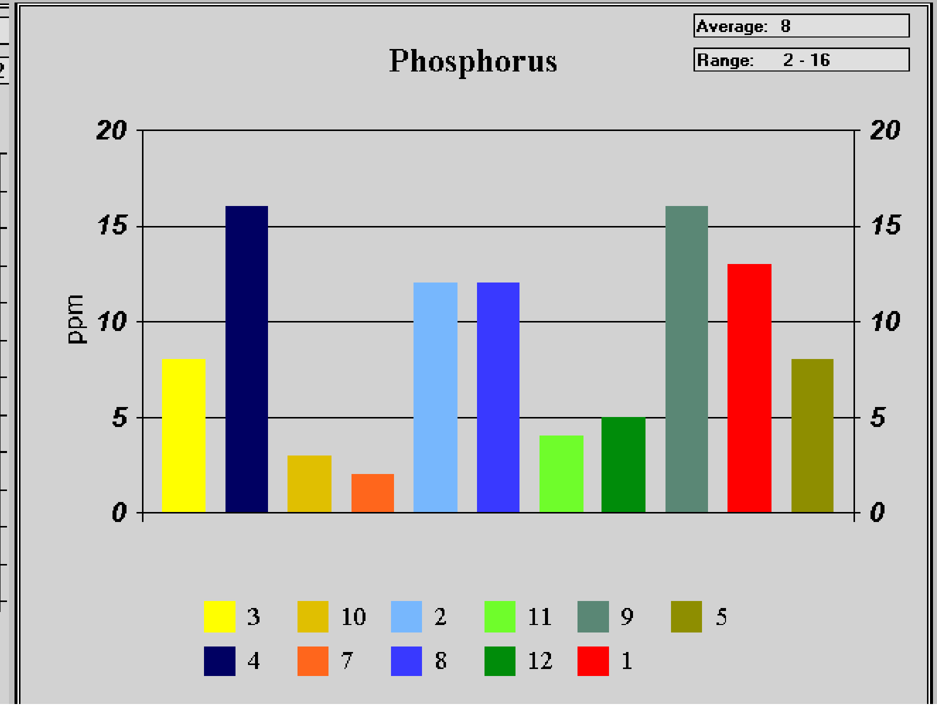


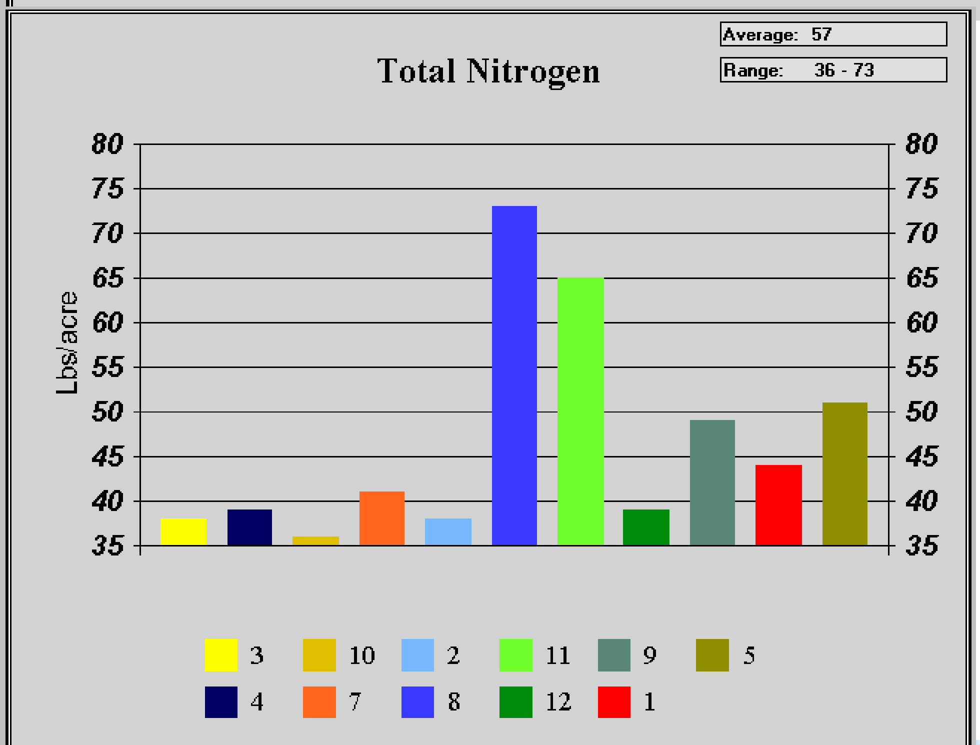
Soil Test P

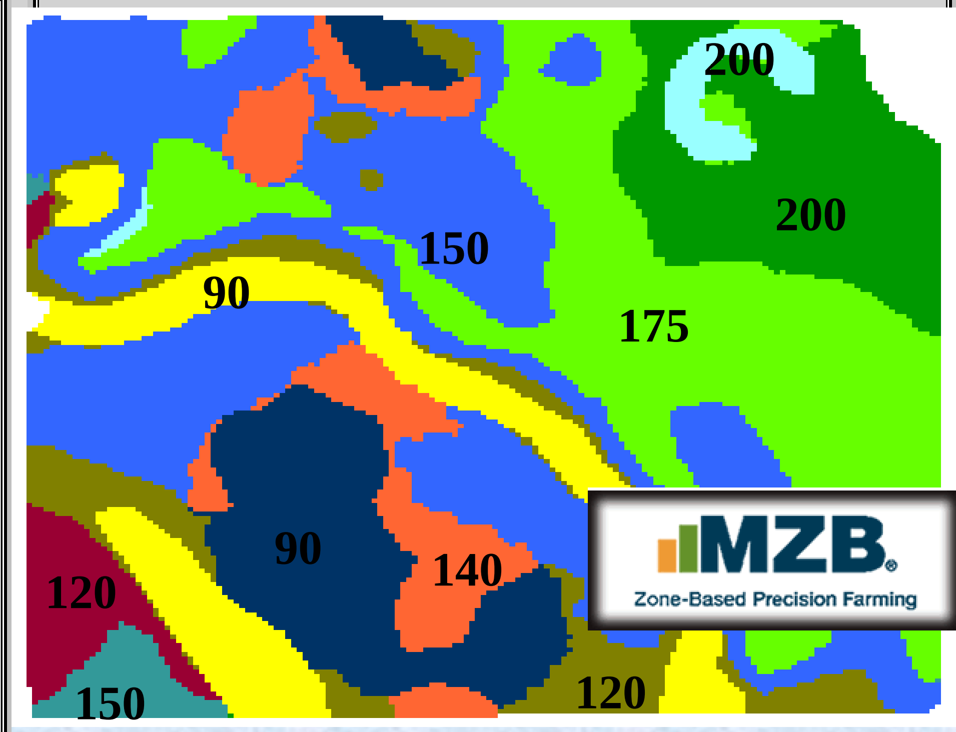
AgroTech Consulting

Ex.12 Zone


pH
Average: 7.1
Range: 5.9 - 9.2
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4


Phosphorus
Average: 8
Range: 2 - 16
ppm
20
15
10
5
0
3
10
2
11
9
5
4
7
8
12
1


Total Nitrogen
Average: 57
Range: 36 - 73
Lbs/acre
80
75
70
65
60
55
50
45
40
35
3
10
2
11
9
5
4
7
8
12
1


200
200
150
90
175
90
140
120
150
120
MZB
Zone-Based Precision Farming

3 Zone Map (NIR)

Improving Soil Sampling Consistency
Keys to Successful Soil Sampling

Conclusions

The **largest source of inconsistency** in soil testing comes from the actual soil sample collection process.

A. Not enough cores
B. Field Size: Field/Zone/Grid too large in size
C. Depth consistency – Too deep or too shallow
D. Tillage vs standing stubble conditions
E. Sampling after manure or fertilizer application
F. Contaminated bucket or soil bag
G. Field anomalies
H. Strip-Till

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Thank you!!!
Have a Great 2014

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