Variability in Soil Moisture and Crop Nutrient Variability Within Farm Fields

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Points to make-

Variability in soils is natural and oftentimes enhanced by people

In non-irrigated fields (98% of North Dakota farmland) moisture is most limiting factor to yield.

Variation in soil properties make variable rate moisture a huge factor in years with moisture stress.

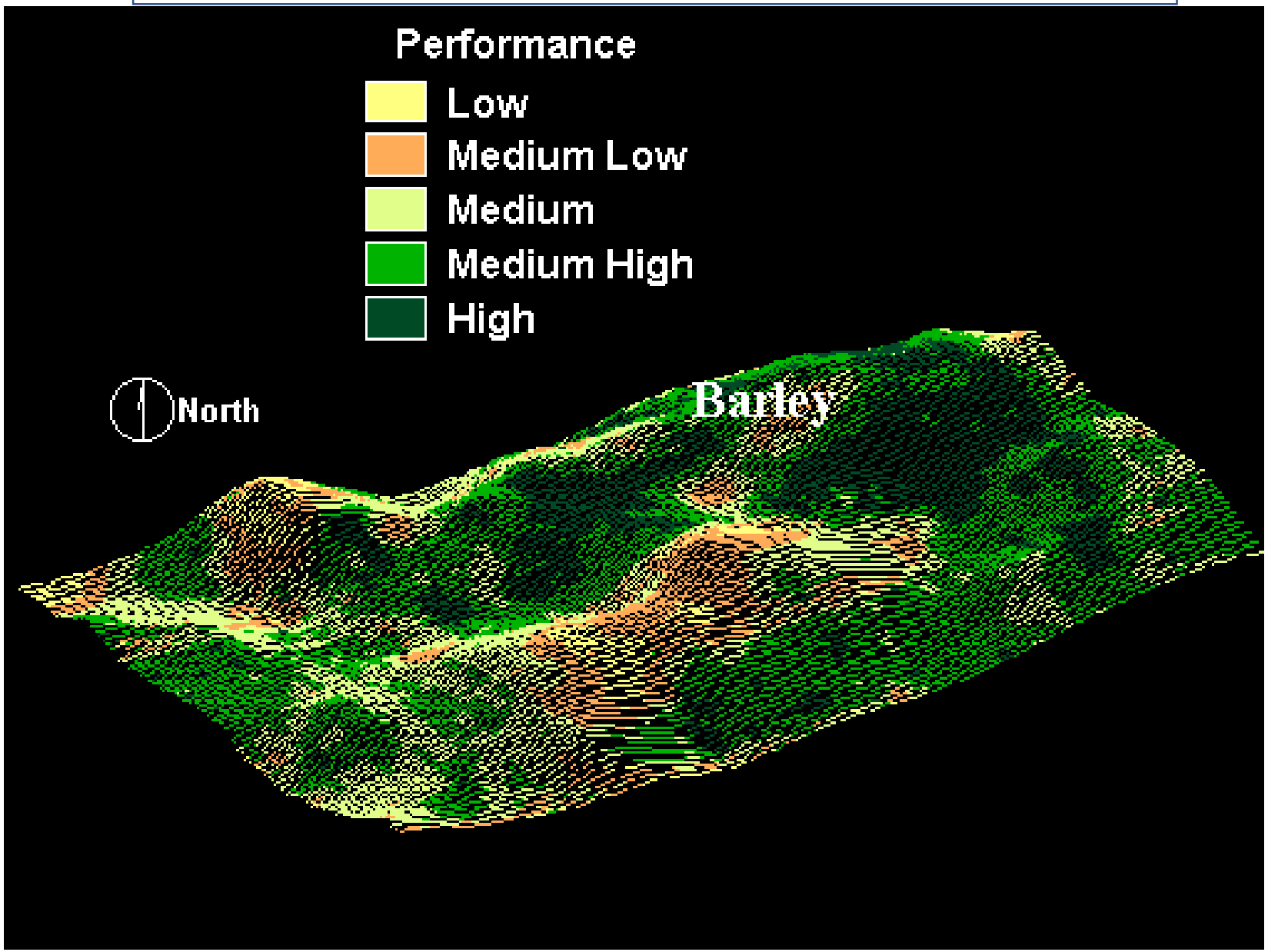
Other Points to make-

Variability can be greatly addressed through zone soil sampling.

Differences in productivity within the field should generally not be a reason to modify nutrient recommendations with few exceptions.

However, variability in soil test are definitely reasons to modify nutrient recommendations, with no exceptions.

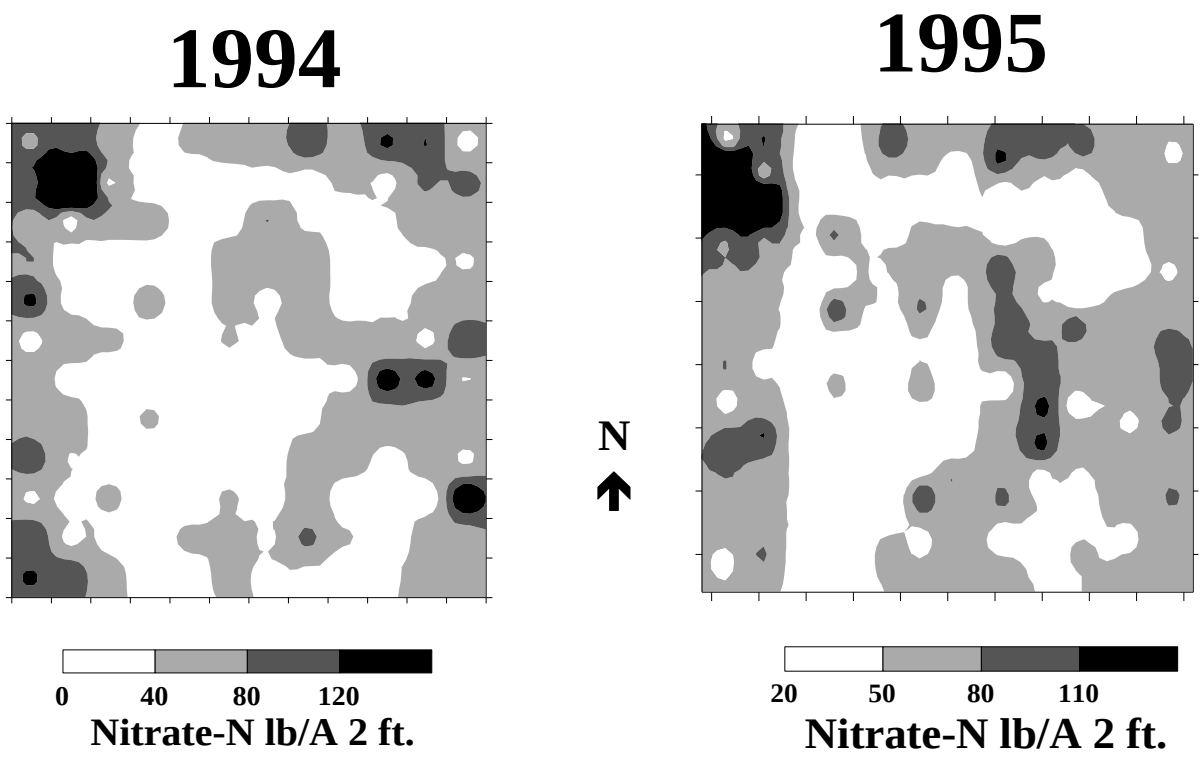
Barley yield differences with landscape



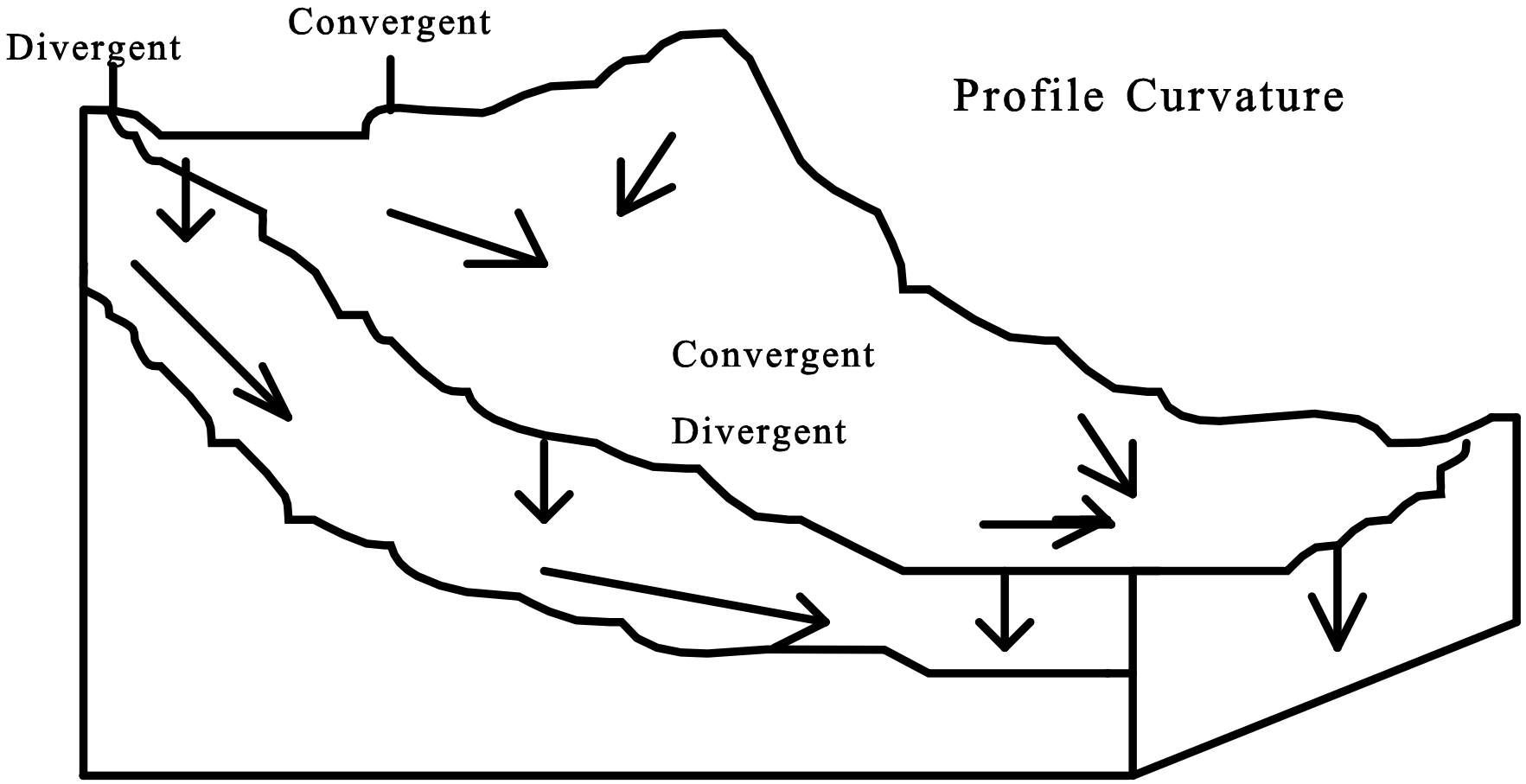
In many fields, growers and their consultants report that their residual soil nitrate values are high compared to ‘normal’ values.

Are these high values ‘real’?

Patterns of mobile nutrients tend to be stable between years.

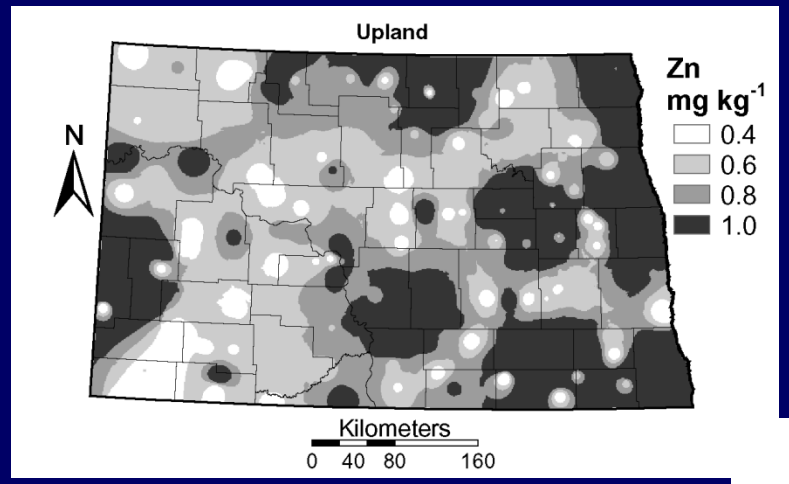


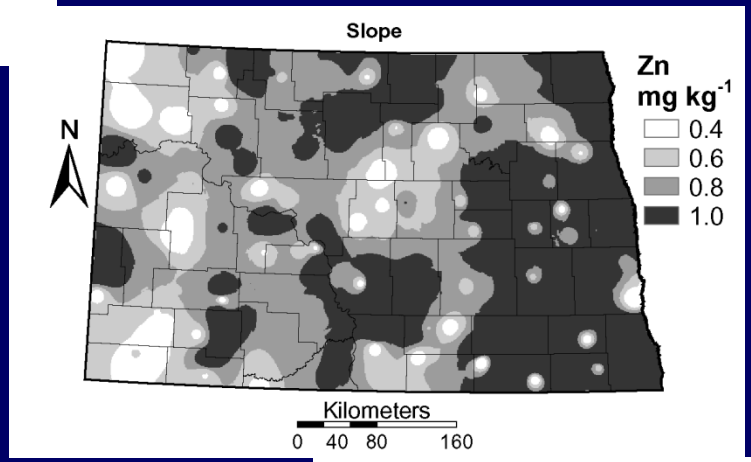
Mobile Nutrients Move, But They Tend To Move To The Same Places.

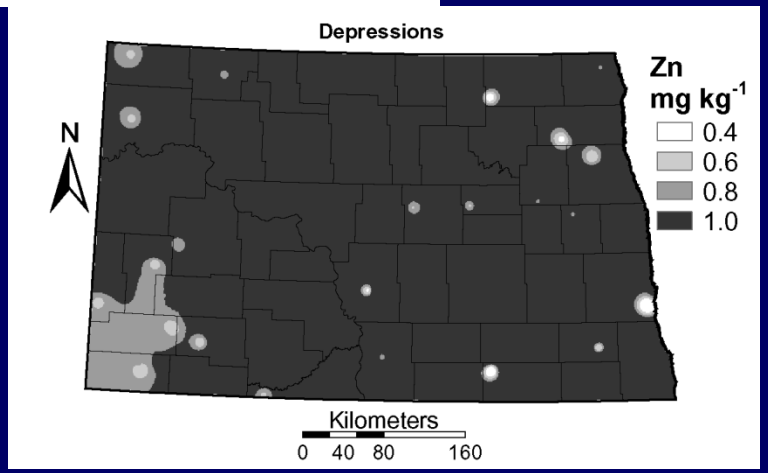


Patterns of erosion

Image Evan Thaler, NPR


Upland
N
Zn
mg kg-1
0.4
0.6
0.8
1.0
Kilometers
0 40 80 160


Slope
N
Zn
mg kg-1
0.4
0.6
0.8
1.0
Kilometers
0 40 80 160


Depressions
N
Zn
mg kg-1
0.4
0.6
0.8
1.0
Kilometers
0 40 80 160

Emerging problems of extreme acidity

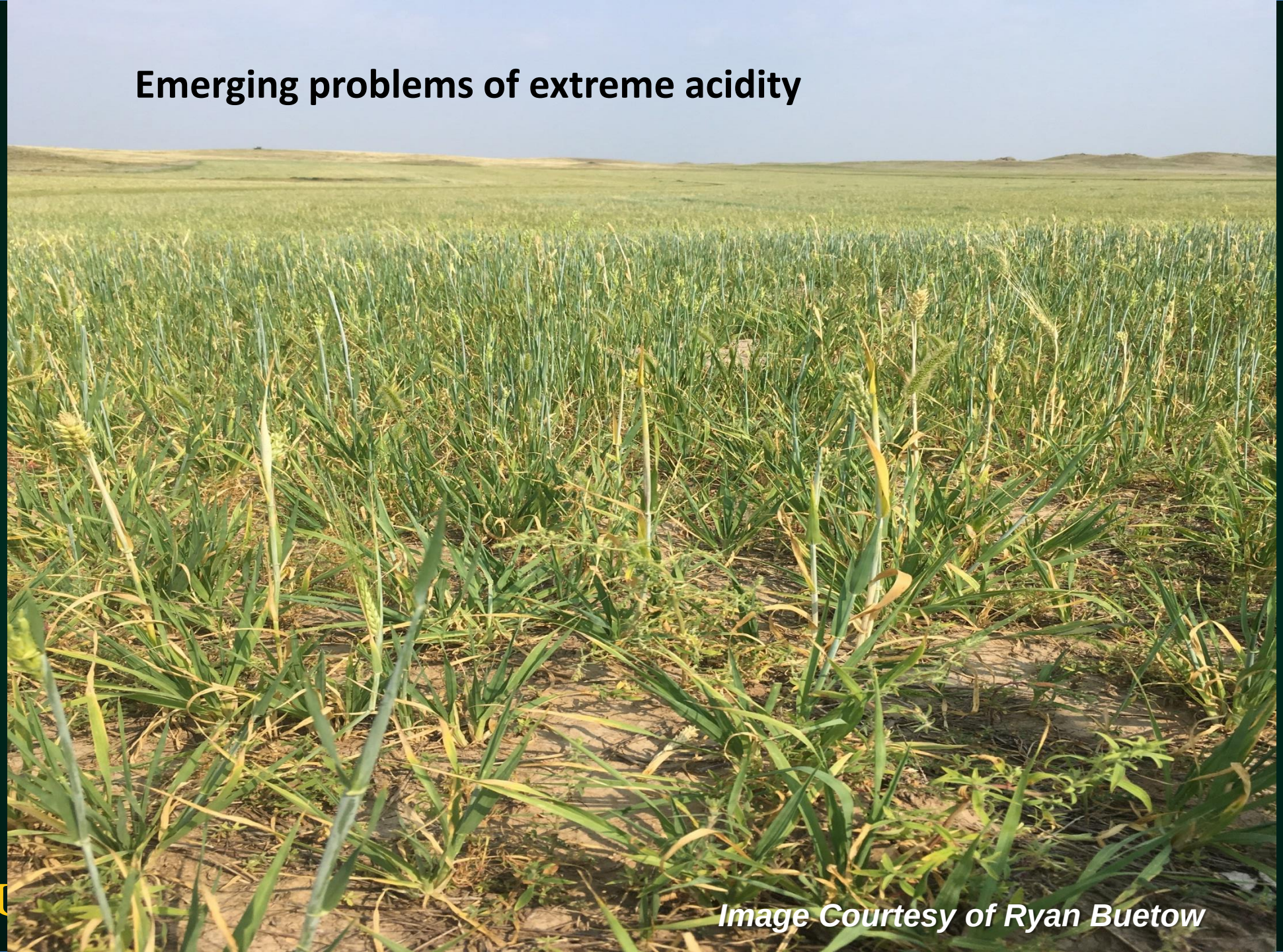


Image Courtesy of Ryan Buetow

NDSU

Veris EC sensor

VerisTech, Salina, KS

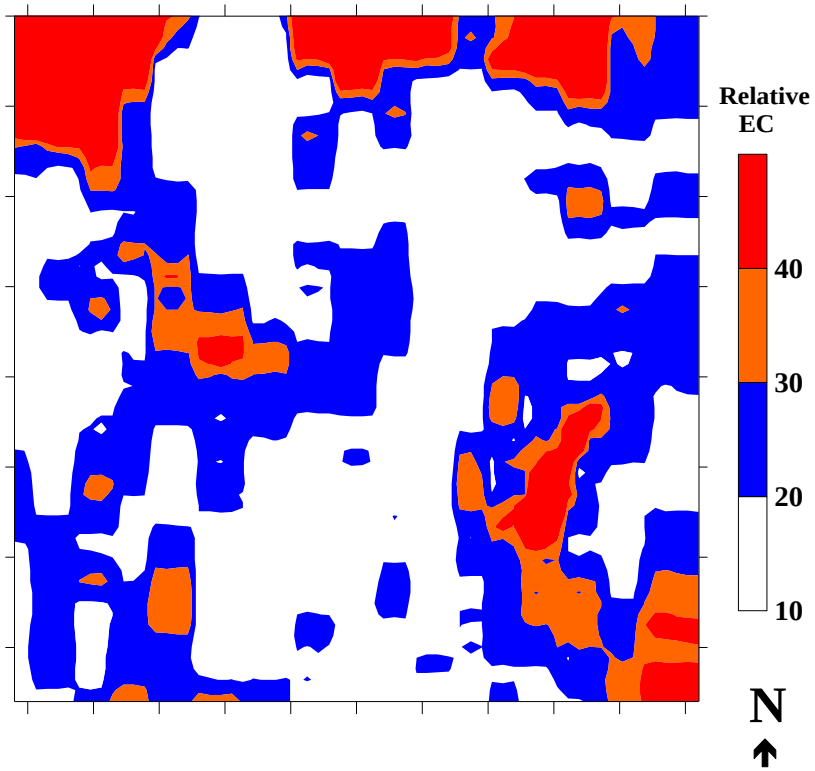
EM-38 and others

Geonics, Ltd

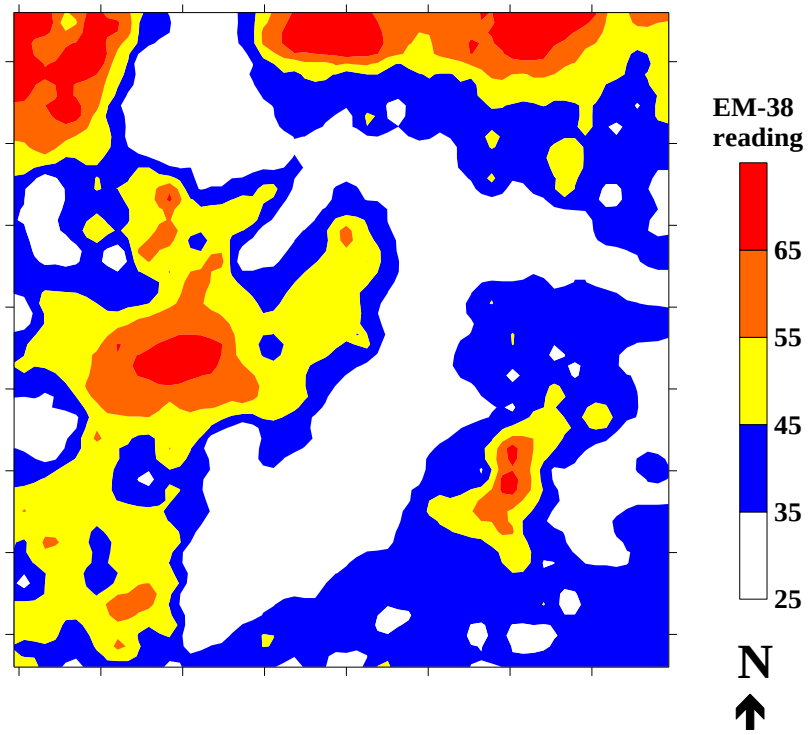
Missassauga, ON

Electrical conductivity

VERIS



EM-38

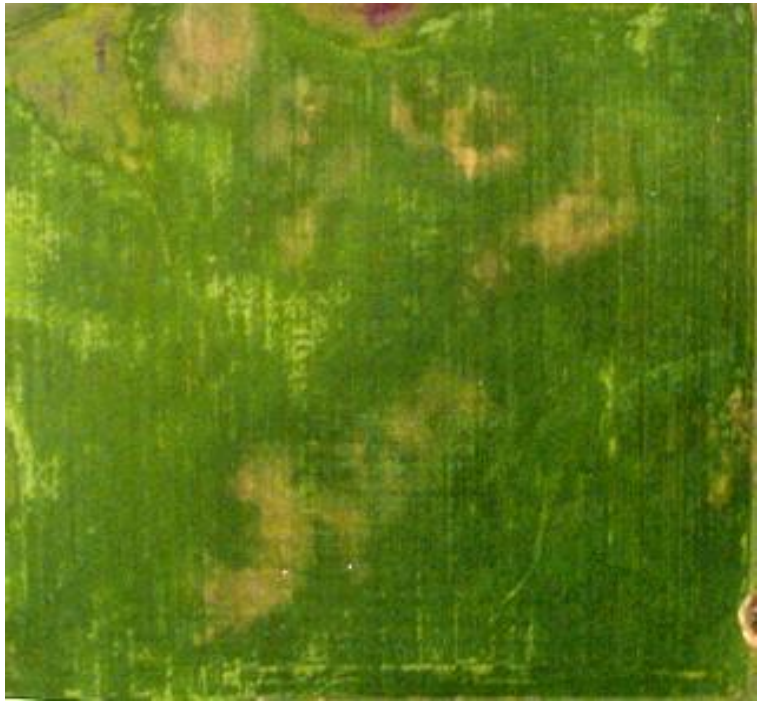


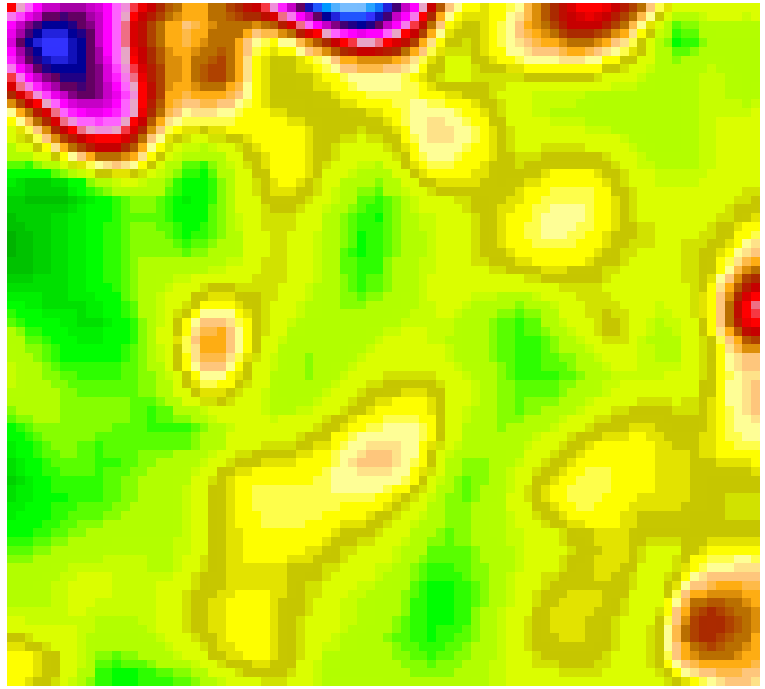
EC and EM sensors are related to:

-Clay content
-Organic matter content
-Soil moisture
-Soluble salts (including fertilizer salts)
-Depth to limiting layer

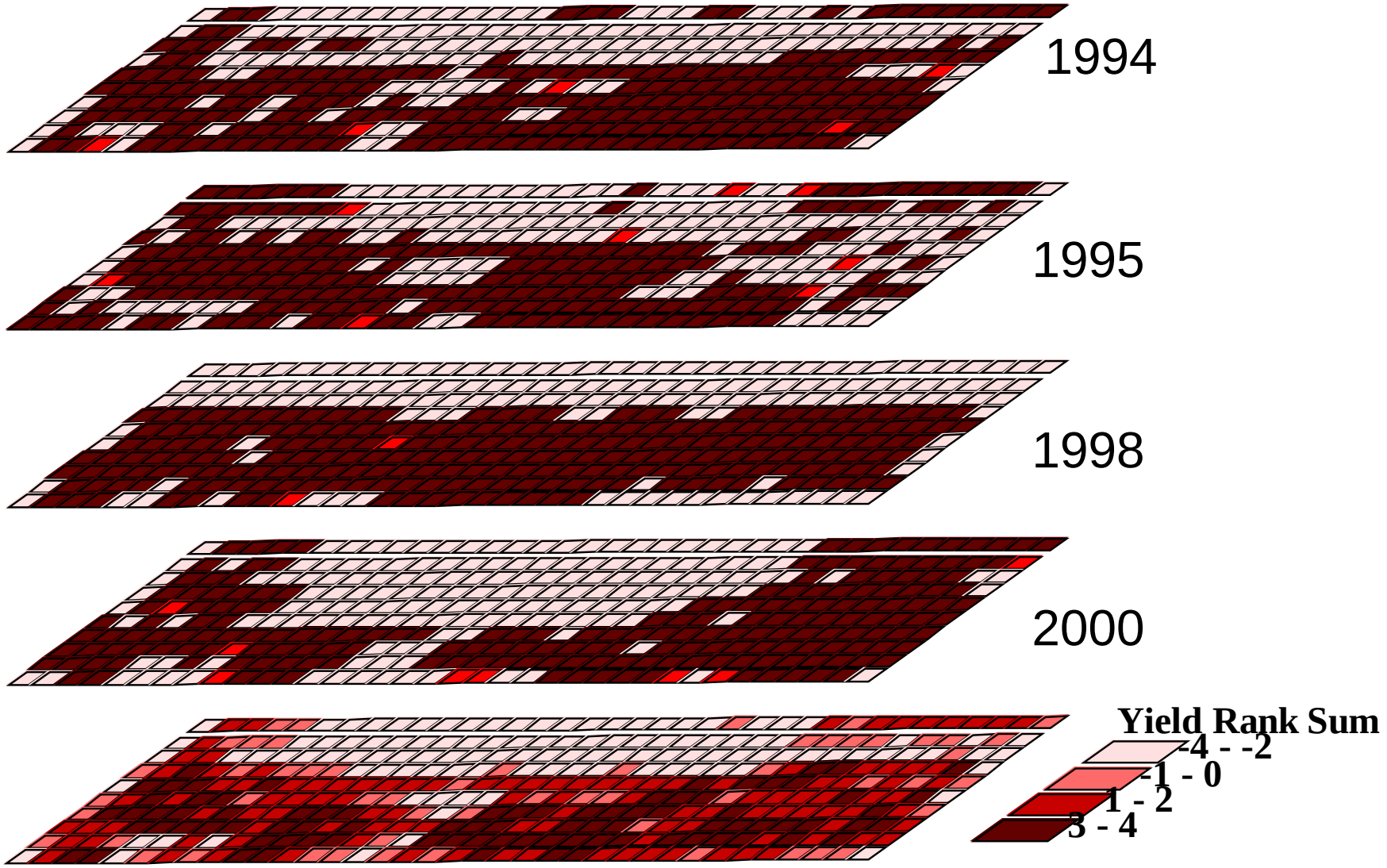
In our region, the EC and EM sensors are usually not related to one thing (Except when soluble salts are high)

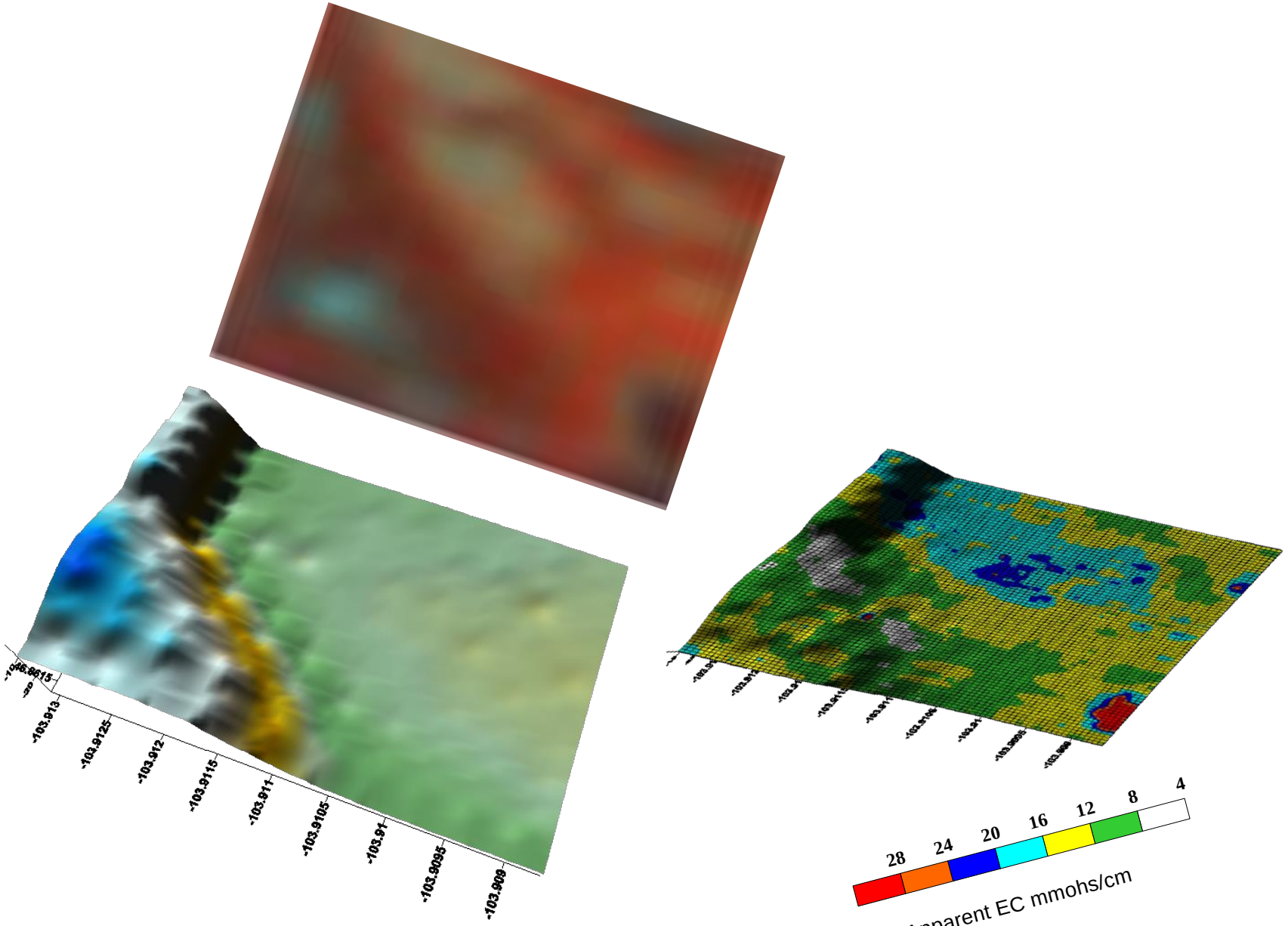
Remote imagery-
Aerial photo, Satellite imagery, Drones





Developing Frequency Map




-103.913
-103.9125
-103.912
-103.9115
-103.911
-103.9105
-103.91
-103.9095
-103.909
28
24
20
16
12
8
4
Apparent EC mmohs/cm

The zone map will identify related areas of similar soil fertility (N, P, K, pH, Zn, EC)

These values will be used directly in fertilizer recommendations spatially if it is possible to vary rates.

North Dakota Wheat Nitrogen Recommendation Calculator - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.soilsci.ndsu.nodak.edu/wheat/

Most Visited Getting Started Latest Headlines

North Dakota Wheat Nitrogen Reco...

Welcome to the

North Dakota Wheat Nitrogen Calculator

You will need to know the location of the farm, the general productivity of the soils, the price you contract for wheat, the cost per pound of N, the soil test nitrate-N to a depth of 2-feet, and the previous crop.

Please select the location of the farm. The map of North Dakota on this site will help you determine the region of the farm. ***Click on the map for a detailed view.***

- (•) Eastern North Dakota
- ( ) Western North Dakota
- ( ) Langdon Region

1

Low productivity is defined in Eastern ND as historical yields below 40 bushels per acre

Medium productivity is defined in Eastern ND as historical yields from 41 to 60 bushels per acre

High productivity is defined in Eastern ND as historical yields over 60 bushels per acre

Please select the historical productivity of the farm from the options below.

- (•) Low Productivity
- ( ) Medium Productivity
- ( ) High Productivity

2

Select Nearest Wheat Price ($/bushel) $5.00

Please indicate the crop previously planted in the field.

- (•) No Nitrogen-supplying crop
- ( ) Soybean, Field Pea, Dry Bean, Lentil, Chickpea, or harvested Sweet Pea
- ( ) Sugarbeet with yellow-green leaves
- ( ) Sugarbeet with green leaves
- ( ) Harvested Alfalfa or unharvested Sweet Clover (&#062 5 plants/sq-ft)
- ( ) Harvested Alfalfa or unharvested Sweet Clover (3-4 plants/sq-ft)
- ( ) Harvested Alfalfa or unharvested Sweet Clover (1-2 plants/sq-ft)
- ( ) Harvested Alfalfa or unharvested Sweet Clover (&#060 1 plants/sq-ft)

Nitrogen provided by previous crops: 0

Please indicate the previous tilling method used in the field.

Done

Start KINGSTON (G:) North Dakota Wheat ... Document1 - Microsoft ... 10:52 AM

North Dakota Wheat Nitrogen Recommendation Calculator - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.soilsci.ndsu.nodak.edu/wheat/

Most Visited Getting Started Latest Headlines

North Dakota Wheat Nitrogen Reco...

- Low Productivity
- Medium Productivity
- High Productivity

Select Nearest Wheat Price ($/bushel) $5.00

3

Select Nearest N Cost (cents/lb) $0.20

4

Nitrogen Recommendation Before Credits: 100

Please indicate the amount of nitrates in the soil. *(Enter the analysis result in the box.)*

Soil test for Nitrogen analysis (lbs/acre 2-ft depth) Input OK

5

- Harvested Alfalfa or unharvested Sweet Clover (&#062 5 plants/sq-ft)
- Harvested Alfalfa or unharvested Sweet Clover (3-4 plants/sq-ft)
- Harvested Alfalfa or unharvested Sweet Clover (1-2 plants/sq-ft)
- Harvested Alfalfa or unharvested Sweet Clover (&#060 1 plants/sq-ft)

6

Nitrogen provided by previous crops: 0

Please indicate the previous tilling method used in the field.

- Is the field/area conventionally tilled (chisel and/or disc, and/or field cultivator or plow)?
- Has the field/area been in No-till for 1 to 5 years?
- Has the field/area been in No-till for more than 5 years?

7

Nitrogen recommendations assume conventional tillage and no adjustment in N rates are made.

Please indicate the percent of organic matter in the soil. *(Enter the percentage in the box.)*
(If soil organic matter exceeds 5.9%, please type in the soil organic matter value. If 5.9% or less, please leave blank.)

Organic matter 0.0 % Input OK

8

Input OK

Nitrogen recommendation: 100 plus/minus 30 lbs. N

The final Nitrogen recommendation is the average optimal rate. Growers may choose to apply up to 30 lb N/acre more or less than the calculated N rates due to protein traits of a variety, special soil conditions such as susceptibility to spring denitrification, application techniques that may not be most efficient or historical experiences from the field or part of a field that may influence N uptake and efficiency. For wheat after small grains, we assume about 2,000 lb/acre of straw residue. For every 2,000 lb/acre straw greater than this, add 30 lb N/acre.

Site designed by Matti Kariluoma for Dr. Dave Franzen, NDSU Department of Soil Science.
Created August 2009. Last revised November 2009.

Done

Start KINGSTON (G:) North Dakota Wheat ... Document1 - Microsoft ... 10:52 AM

North Dakota Sunflower Nitrogen Calculator

Select A Region From The List Below:

- Eastern North Dakota
- Western North Dakota
- Langdon Area

Select Tillage From The List Below:

Conventional Till (Tillage greater than 2 inch depth, thin ammonia shank or striptill shank, does not contribute to conventional till)
- Oil-Seed
- Confection

Long-Term No-Till (6 years or more continuous no-till)
- Oil-Seed
- Confection

Short-Term No-Till (1-5 years of continuous no-till)
- Oil-Seed
- Confection

Select Previous Crop Credits From The List Below:

- No previous crop credits
- Soybean, Dry Bean, Field Pea, Lentils, Chickpea, Sweet Clover
- Alfalfa stand greater than 5 plants per square foot
- Alfalfa stand from 3 to 4.9 plants per square foot
- Alfalfa stand from 1 to 2.9 plants per square foot
- Alfalfa stand less than 1 plant per square foot
- Sugar beet with yellow leaves at harvest
- Sugar beet with yellow-green leaves at harvest
- Sugar beet with dark green leaves at harvest

Sunflower Price:

Price Range From: ($0.09/lb to $0.30/lb)
Price Increments: ($0.03)
0.09

Nitrogen Cost:

Price Range From: ($0.20/lb to $1.00/lb):
Price Increments: ($0.10)
0.20

Percent Organic Matter In The Soil:

If organic matter is greater than 5.9% additional credits are considered.

Organic Matter Percentage: 0.0

Soil Test Nitrate-N (0-2 foot depth):

Whole Numbers: Zero to No-Limit, (No Decimal Values): 0

Nitrogen Recommendation:

Nitrogen Recommendation Preview:
0 plus or minus 20 pound N per acre.

Nitrogen Recommendation After Credits:
0 **plus or minus 20 pound N per acre.**

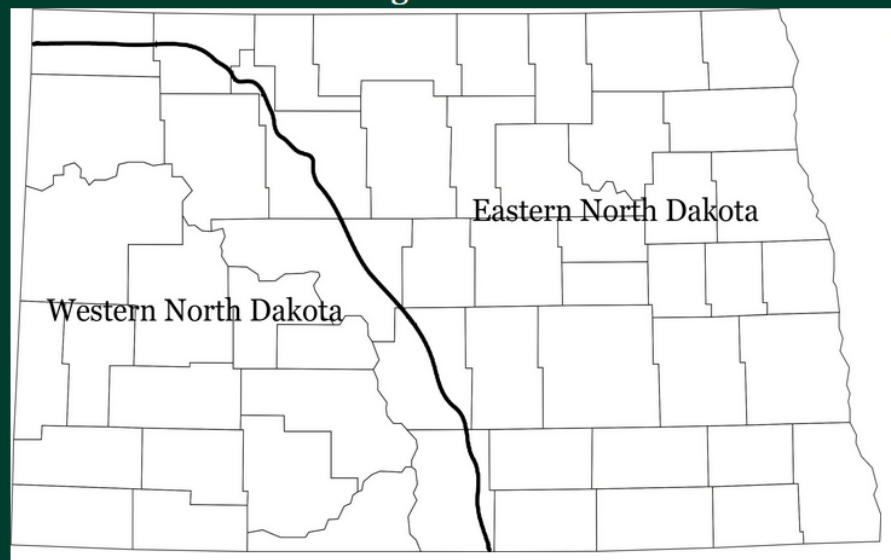
The final N recommendation is an average optimal rate. Your final N rate decision may be plus or minus 20 pounds N per acre from that value depending on individual field situations. The value assumes an optimal N application and timing strategy. If these strategies are not optimal, a greater N rate maybe needed. Suboptimal N application strategies include to early N application the fall prior to seeding, surface urea/UAN application or lightly incorporated urea/UAN, or shallow ammonia application. Fields that are first year sunflower, or sunflower more then 4 years after a deep rooted crop including sunflower may have have deep N, and a minimal N preplant application followed by side-dress application at V5-V8 is recommended.

Site developed by: Max McGrath, Date: Spring 2016
For: Dr. Dave Franzen, NDSU: Department of Soil Science

Conservation Tillage Conf | NDSU Corn Nitrogen Calc

www.ndsu.edu/pubweb/soils/corn/

North Dakota Corn Nitrogen Calculator



Region:
West River:
Eastern ND:

Field Information (If in Eastern ND):
- No-Till for 6+ Years
- Irrigated Corn
- Conventional Till/Minimal No-Till
  - Conventionally-Tilled
  - No-Till for 1-5 years
    - High-Clay Soils
      - Historic Yield > 160 bu/a
      - Historic Yield less than 160 bu/a
    - Medium-Texture Soils
      - Historic Yield > 160 bu/a
      - Historic Yield less than 160 bu/a

Input Nearest Corn Price ($/Bushel): 2.00
Input Nearest Nitrogen Cost ($/Pound): 0.20
Soil Test for Nitrogen Analysis (lbs/acre 2-ft depth): 0.0
Percent Organic Matter In Soil: 0.0

Nitrogen Recommendation: 0
plus/minus 30 lbs.

Previous Crops Planted

- No nitrogen-supplying crop
- Soybean, Field Pea, Dry Bean, Lentil, Chickpea or harvested Sweet Pea
- Sugarbeet with yellow-green leaves
- Sugarbeet with green leaves
- Harvested Alfalfa or unharvested Sweet Clover (>5 plants/sq-ft)
- Harvested Alfalfa or unharvested Sweet Clover (3-4 plants/sq-ft)
- Harvested Alfalfa or unharvested Sweet Clover (1-2 plants/sq-ft)
- Harvested Alfalfa or unharvested Sweet Clover (less than 1 plant/sq-ft)

The data used in development of the North Dakota Corn Nitrogen Calculator was gathered with funding from the North Dakota Corn Council, the International Plant Nutrition Institute, and Pioneer Hi-Bred, Int. Data was gathered by Dr. Dave Franzen, lead investigator, with collaboration from Roger Ashley, Greg Endres, Jasper Teboh, Lakesh Sharma, Honggang Bu, Brad Schmidt and Eric C. Schultz. Dr. John Lamb,

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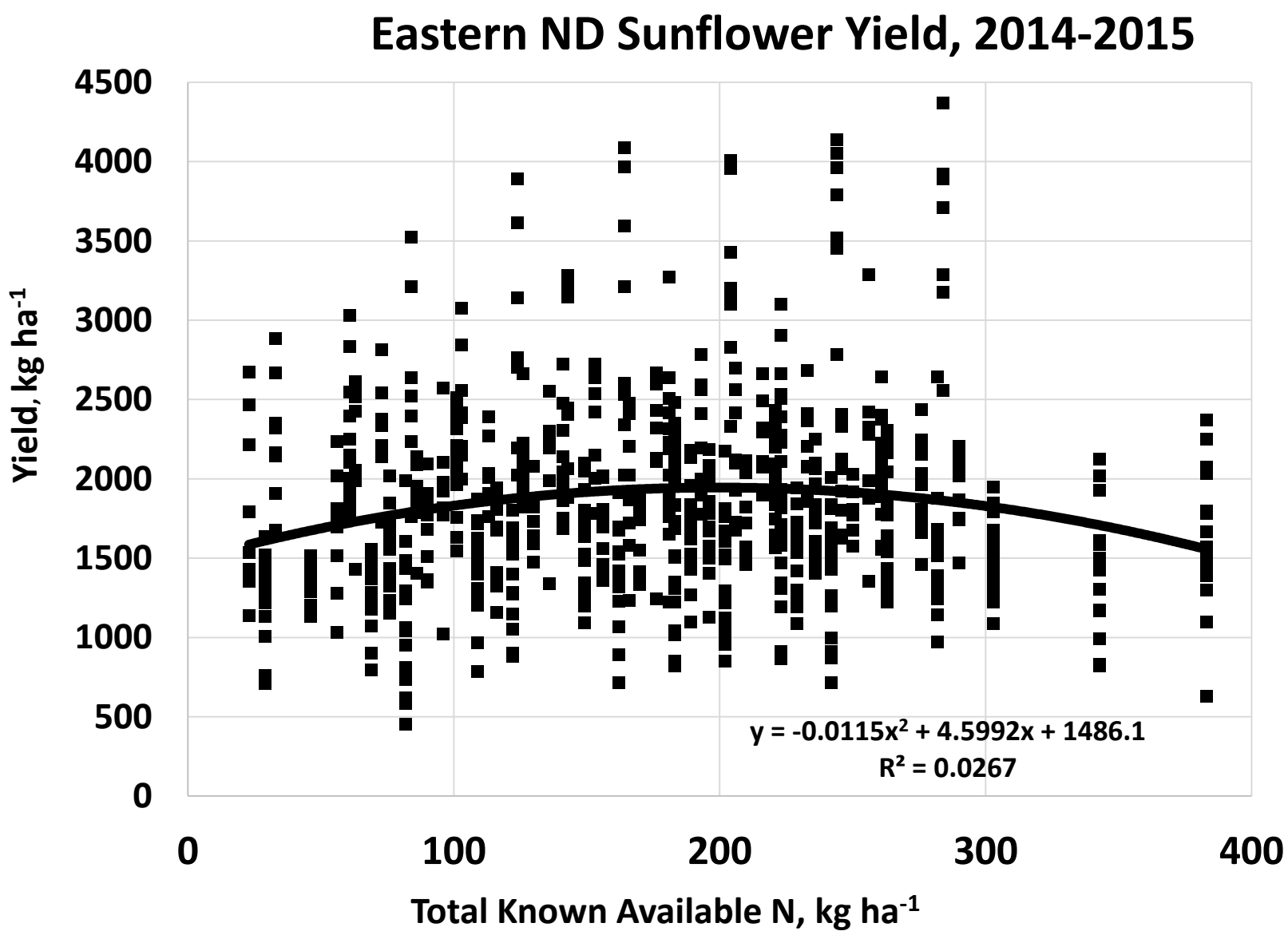
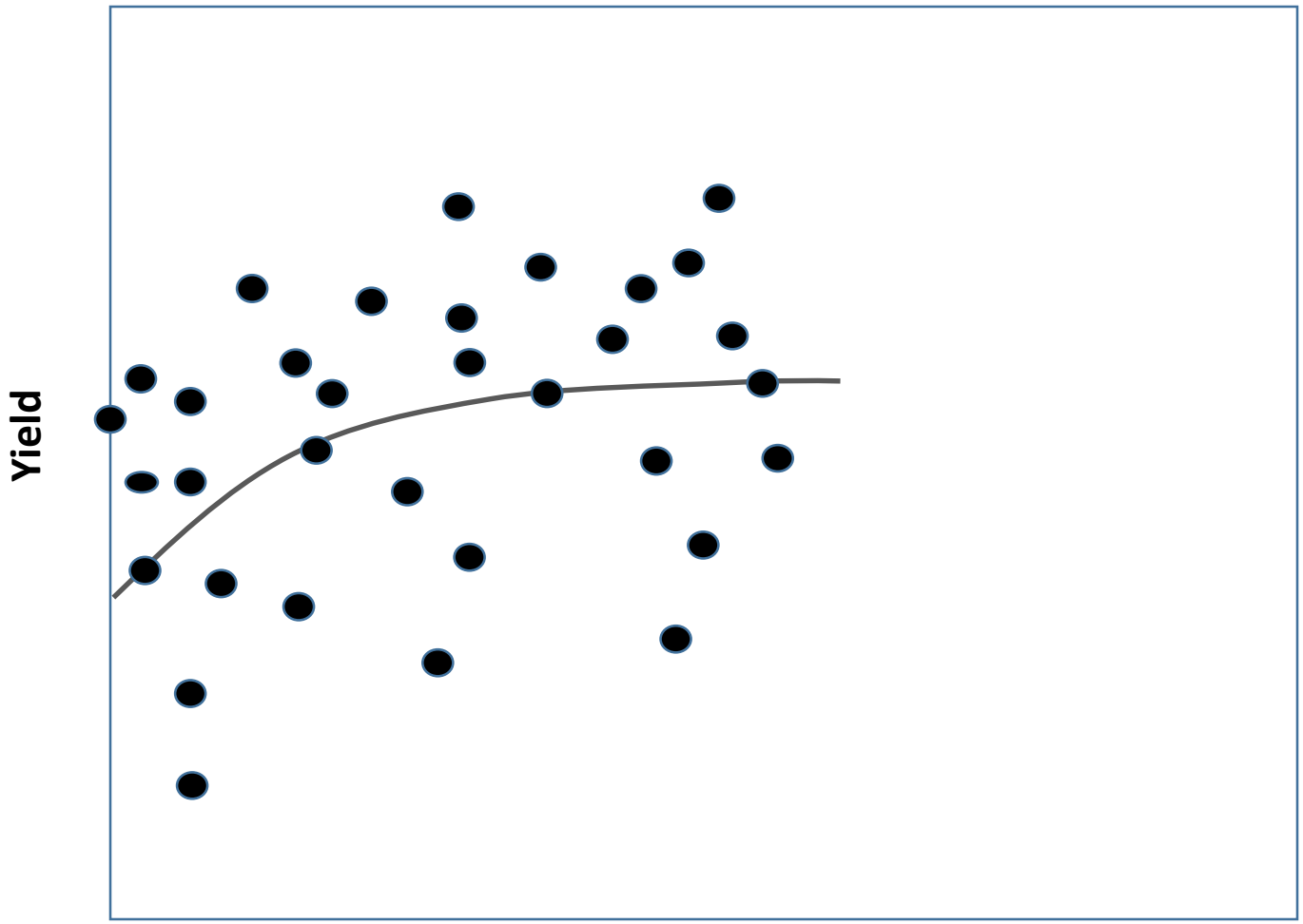
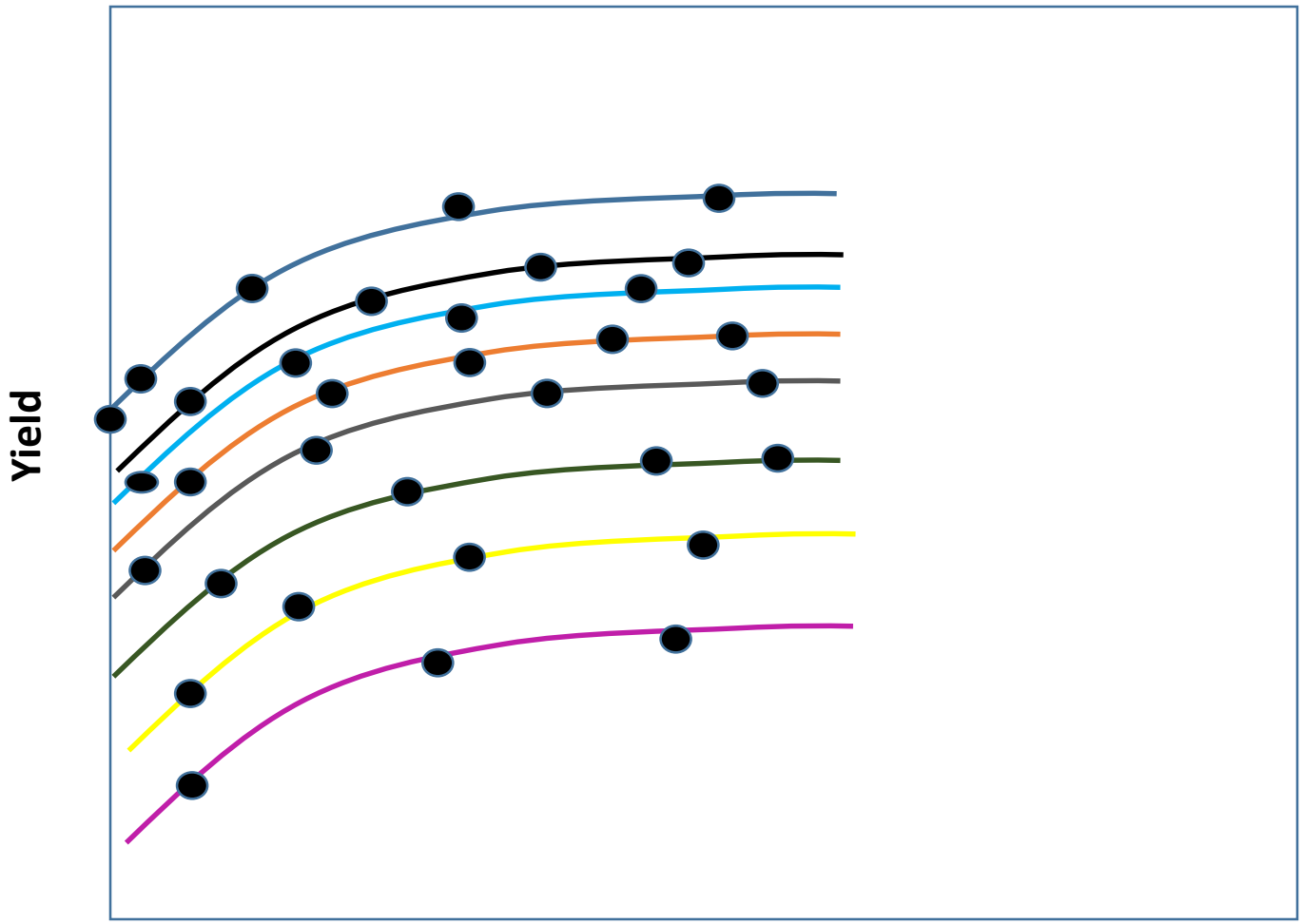
12/14/2014


Eastern ND Sunflower Yield, 2014-2015
Yield, kg ha-1
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
100
200
300
400
Total Known Available N, kg ha-1
y = -0.0115x² + 4.5992x + 1486.1
R² = 0.0267

Example-Combining all sites with actual yield at N rate looks like this



When it really looks like this-



To get a better idea of what the data look like without showing all the curves is to '*Standardize*' the data- putting it all in the same scale

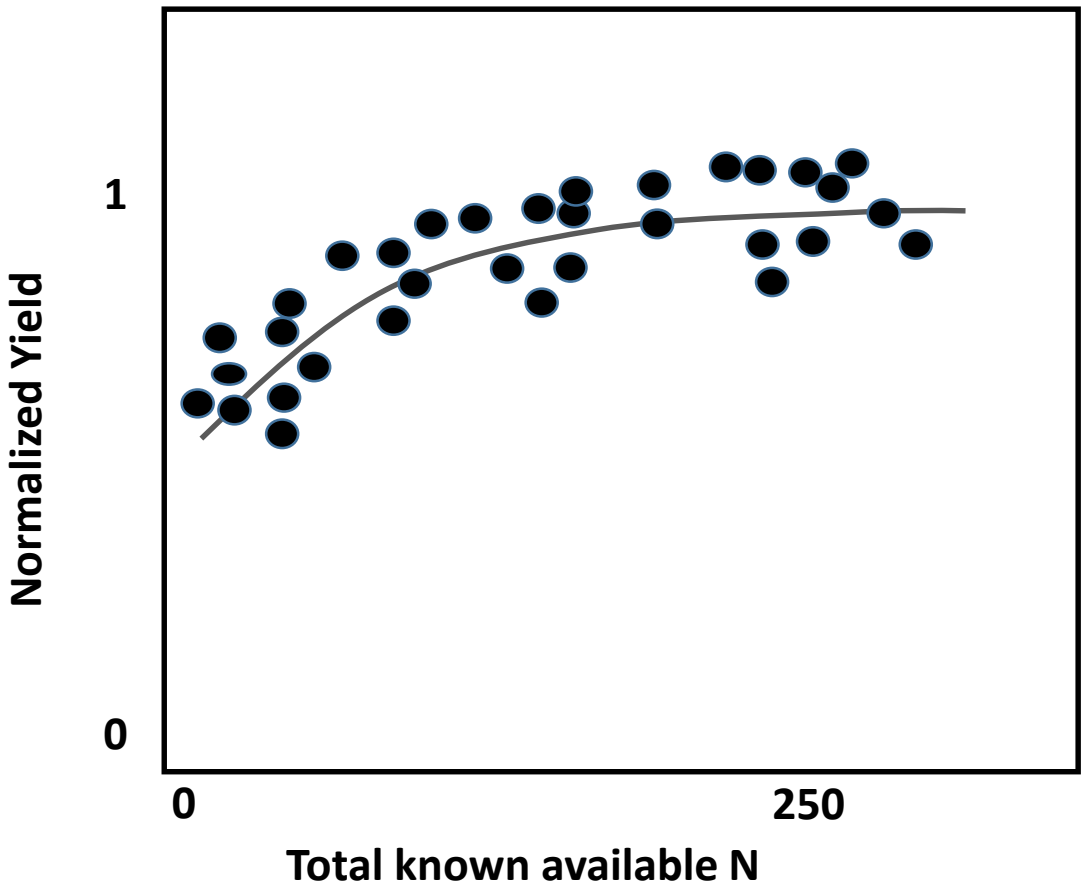
For example-

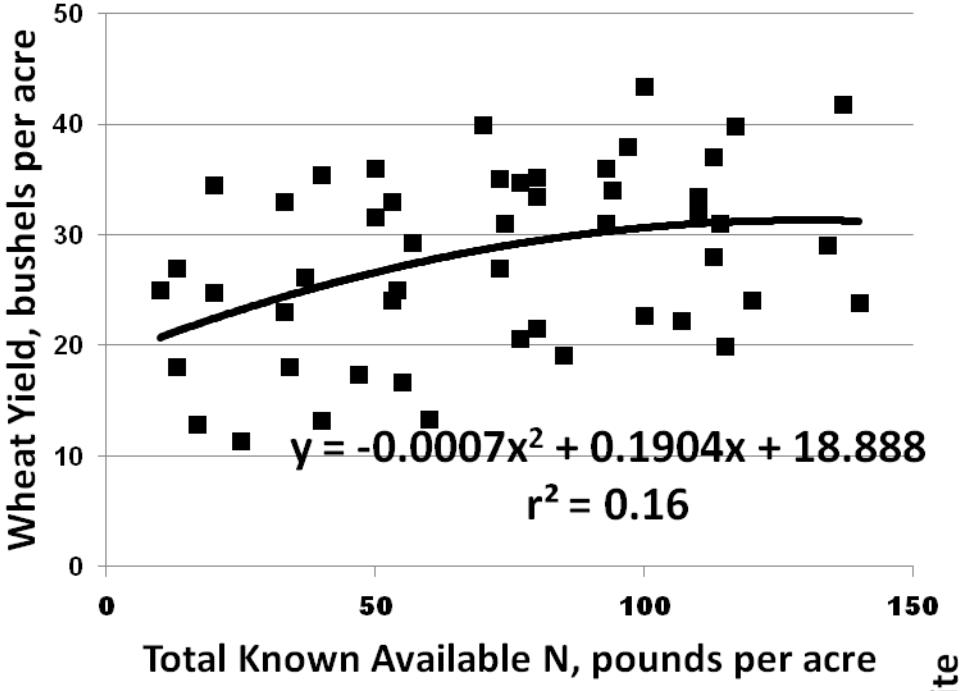
A sunflower site with high yield 4,000 pounds per acre, divide all yields by 4,000, to reach values from 0 to 1

A sunflower site with high yield 1,800 pounds per acre, divide all yields by 1,800, to reach values from 0 to 1

A sunflower site with high yield 2,500 pounds per acre, divide all yields by 2,500, to reach values from 0 to 1

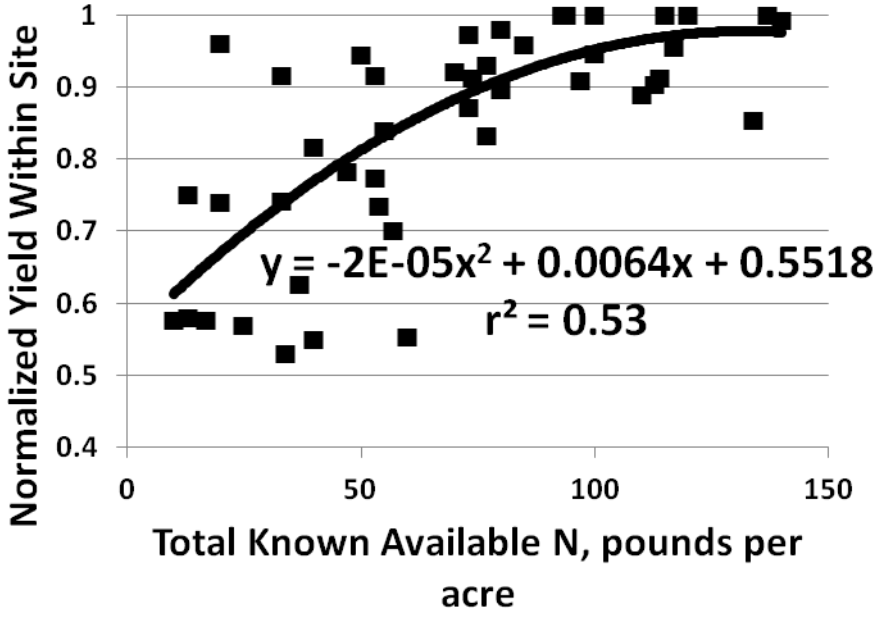
Standardizing yields at all sites ends up looking like this-



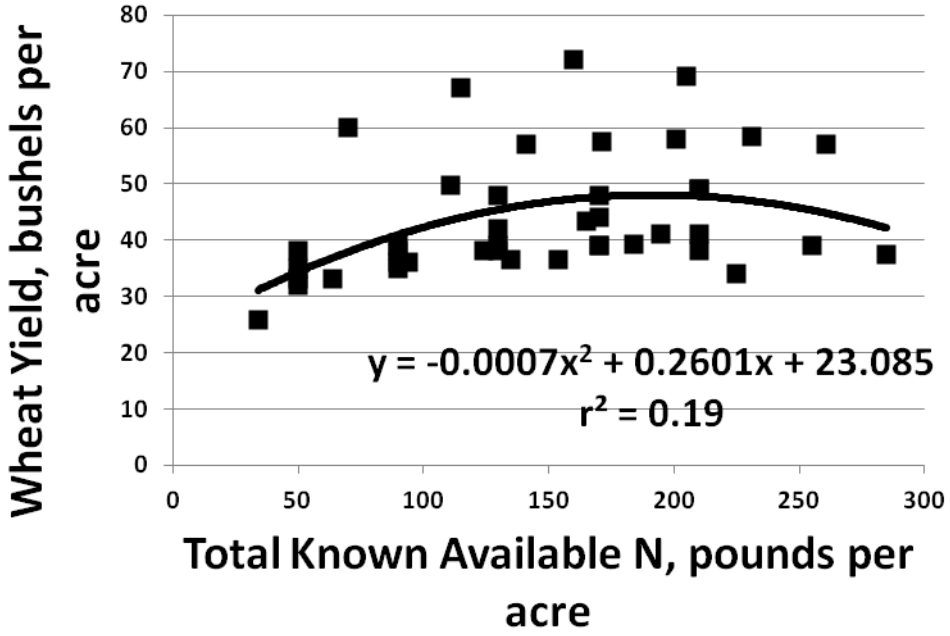


Western ND Conventional Till wheat sites raw yields

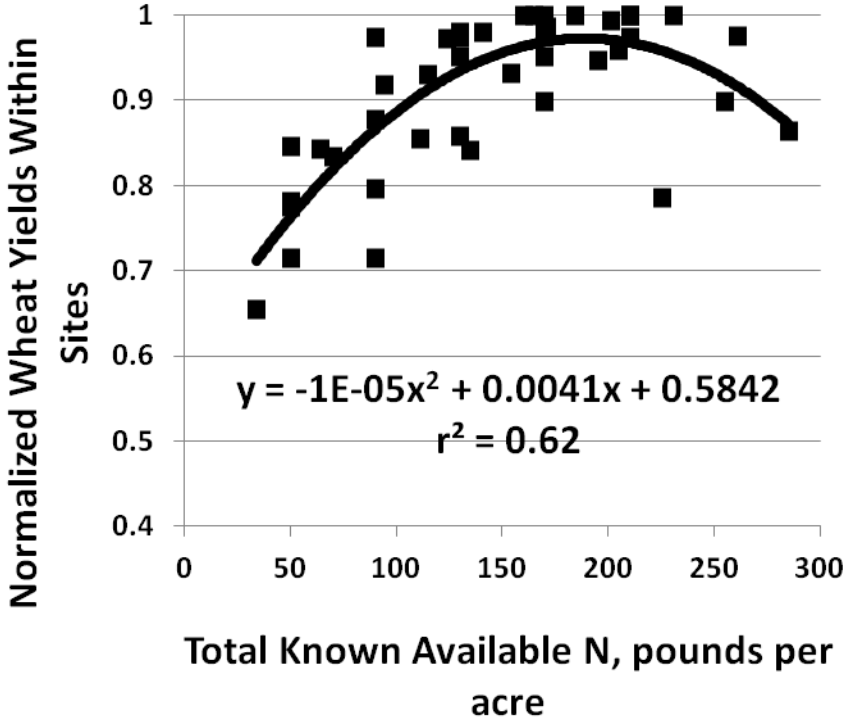
Western ND Conventional Till wheat sites, standardized yields

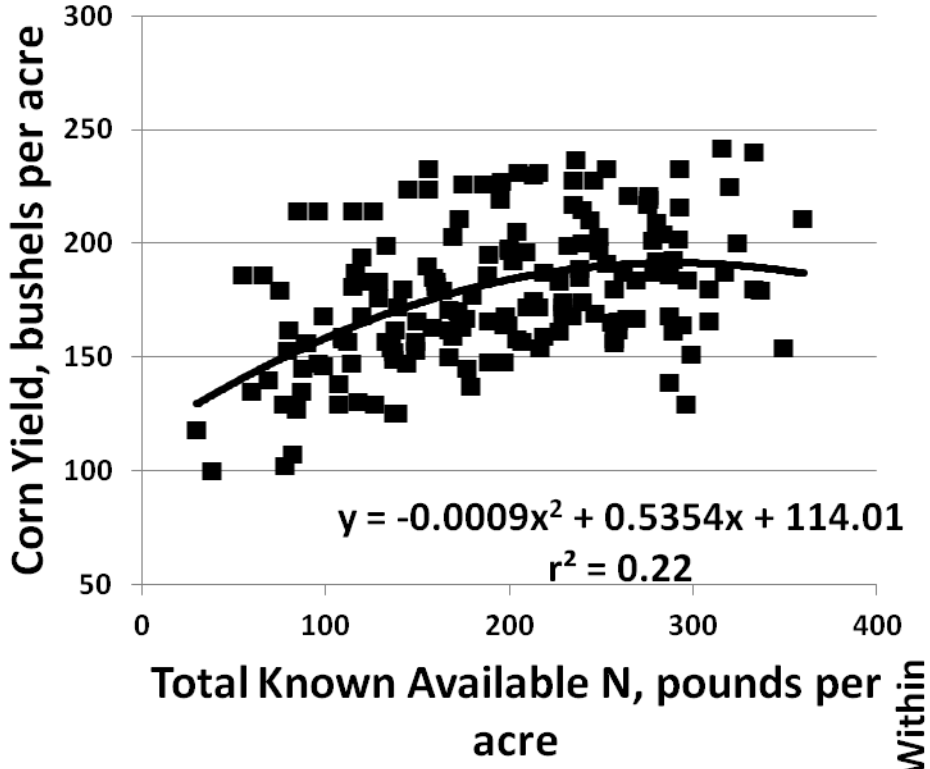


Western ND No-Till wheat sites raw yields



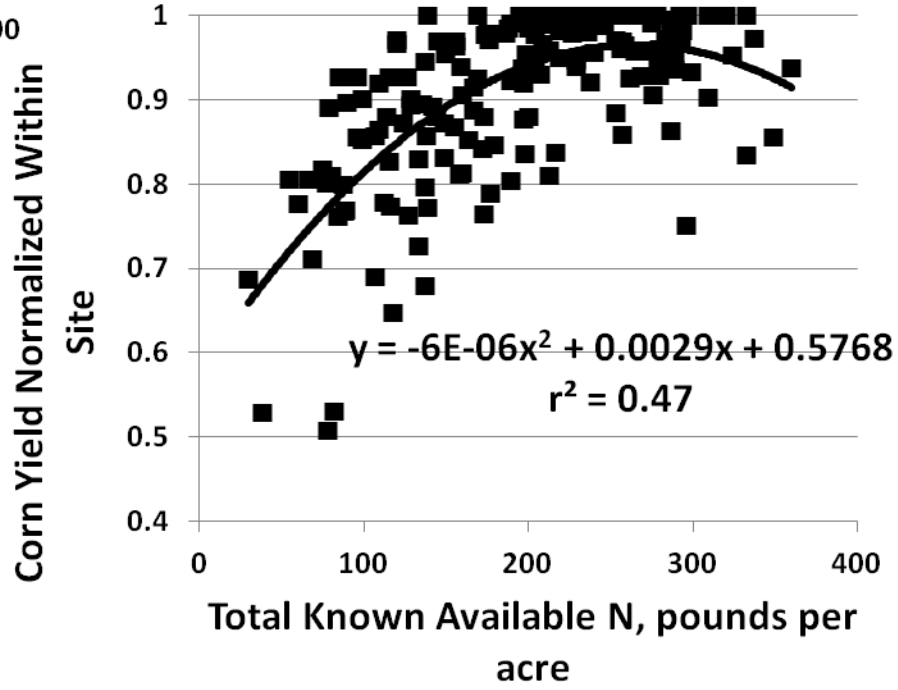
Western ND No-Till wheat sites standardized yields

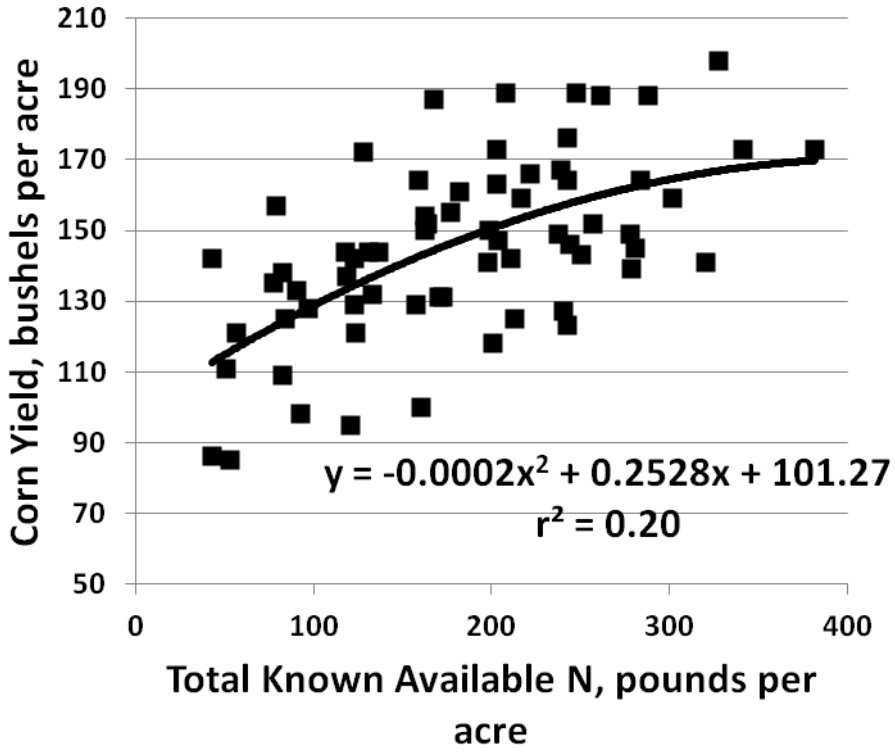




Eastern ND high-clay,
Conventional Till,
corn sites raw yields

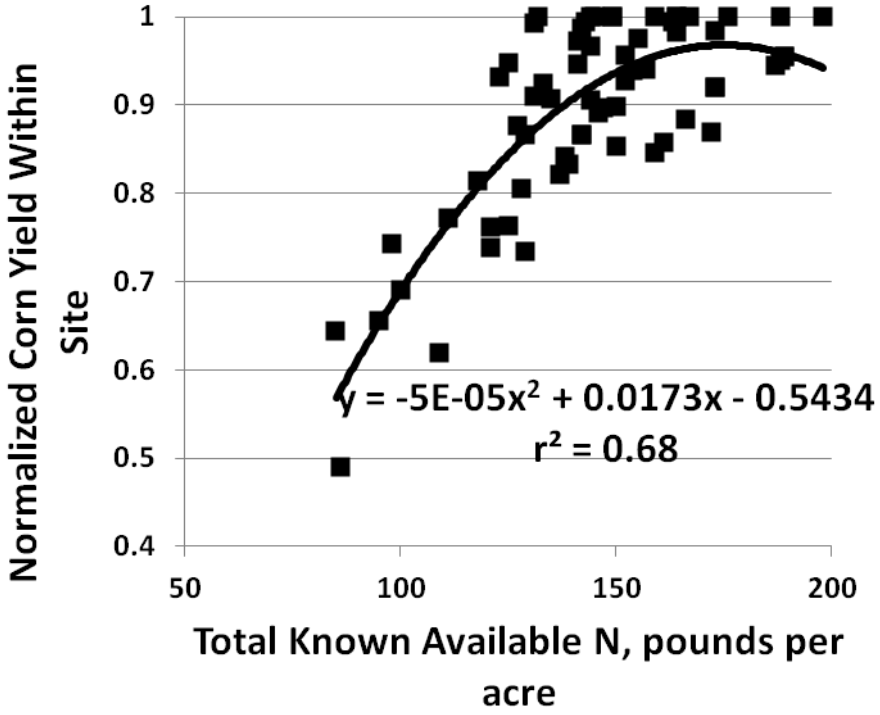
Eastern ND high-clay,
Conventional Till,
corn sites standardized yields

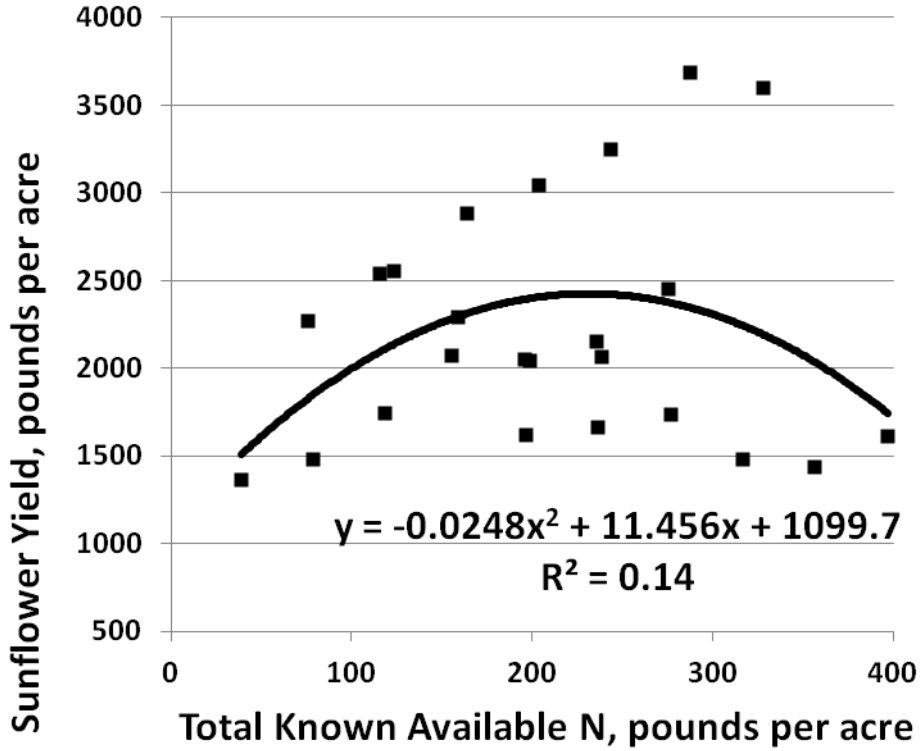




Eastern ND no-till, corn sites raw yields

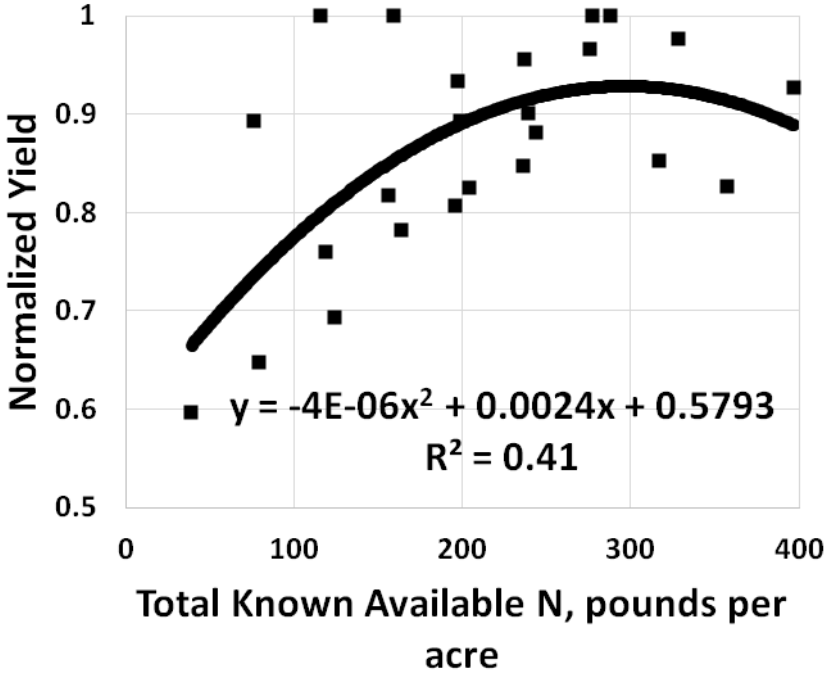
Eastern ND no-till, corn sites standardized yields

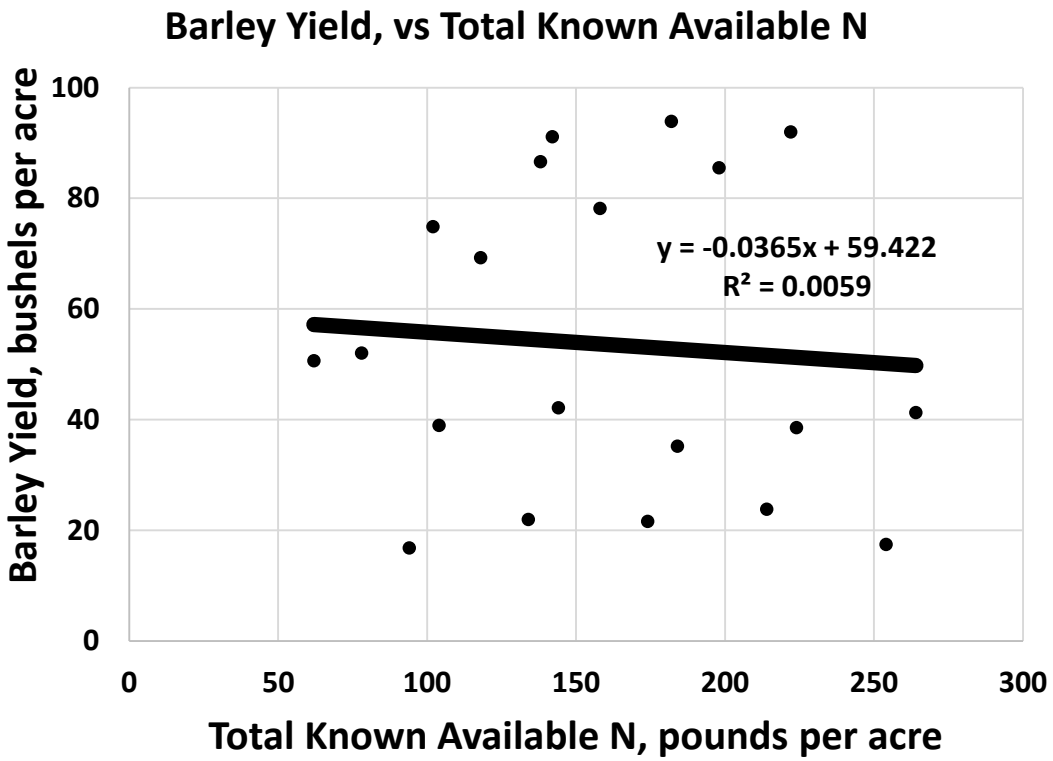




Eastern ND Conventional Till, sunflower sites raw yields

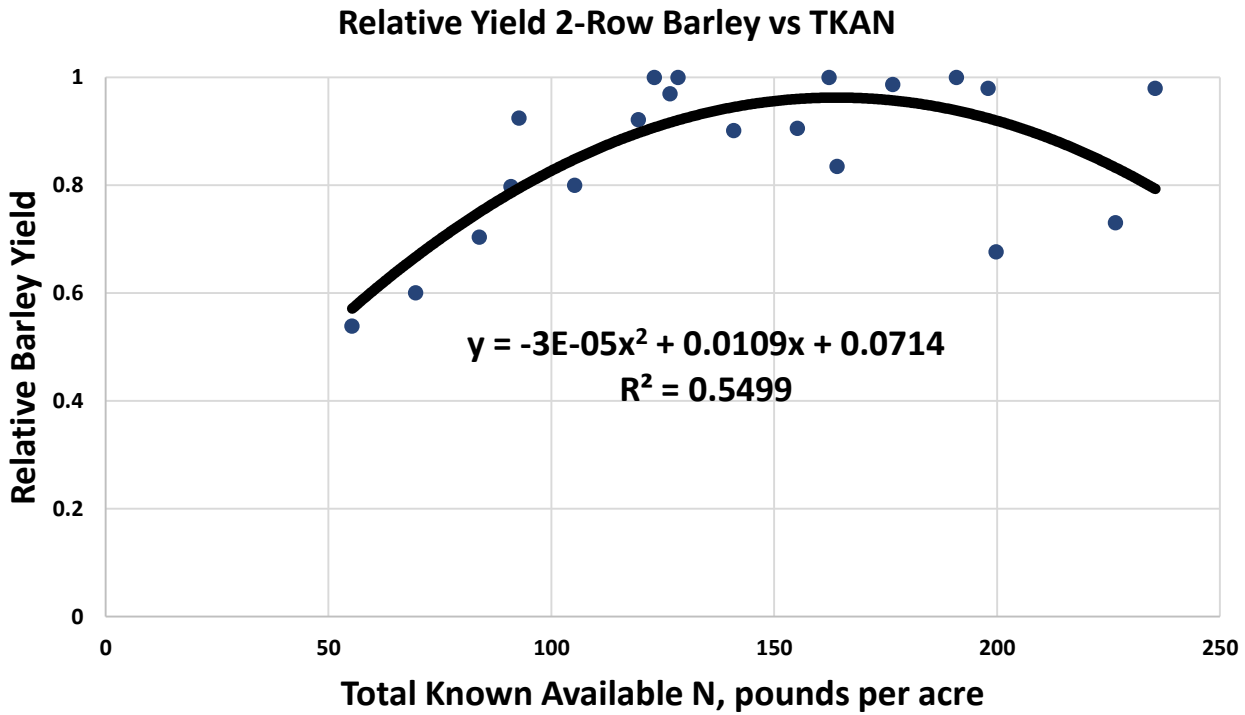
Eastern ND Conventional Till sunflower sites standardized yields





2-Row Barley raw yields, 4 site years

2-Row Barley standardized yields, 4 site years



Low yield environment-

usually drier (sometimes excessive wetness)

Lower N use efficiency and crop uptake

Less N mineralization

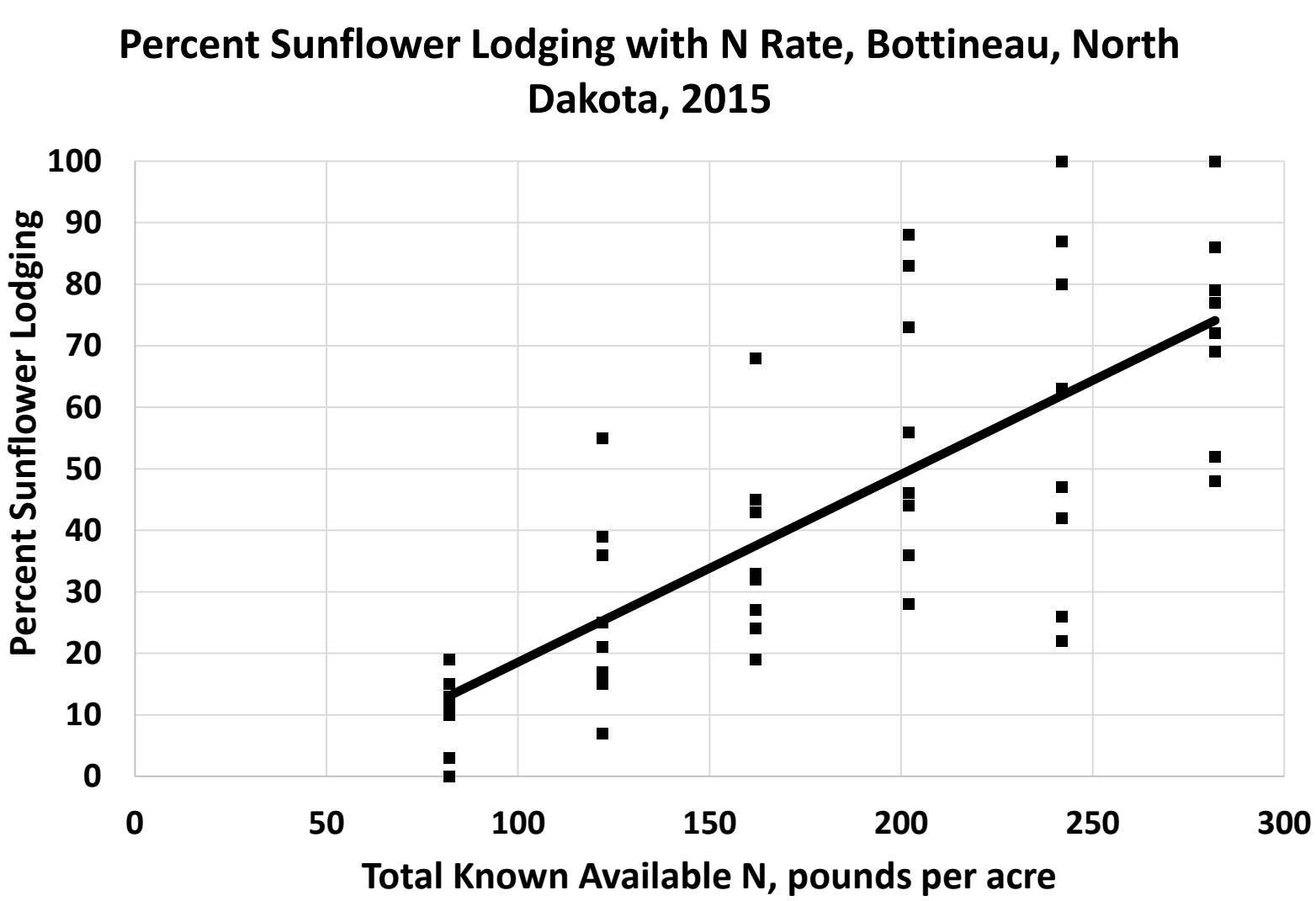
High yield environment-

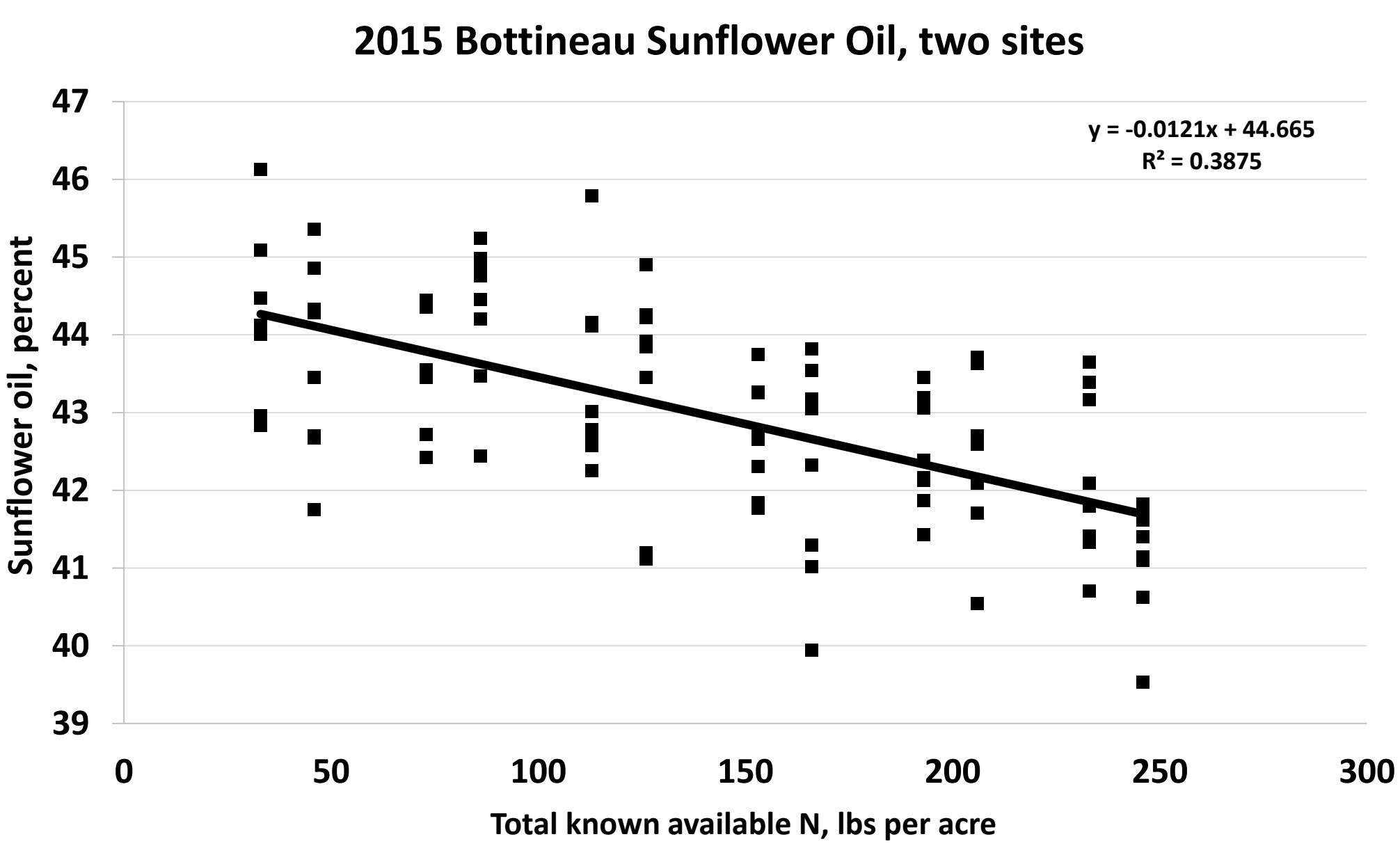
Moisture near ideal- not too wet or too dry

Higher N use efficiency and crop uptake

Greater N mineralization

Net result is that rate to produce economic max yield is similar in both environments.


Percent Sunflower Lodging with N Rate, Bottineau, North Dakota, 2015
Percent Sunflower Lodging
100
90
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250
300
Total Known Available N, pounds per acre


2015 Bottineau Sunflower Oil, two sites
y = -0.0121x + 44.665
R² = 0.3875
Sunflower oil, percent
47
46
45
44
43
42
41
40
39
0
50
100
150
200
250
300
Total known available N, lbs per acre

Sunflower rust severity rating as a result of N rate, Dickinson, ND, 2015.

N rate, lb per acre	Sunflower rust rating
0	0.65 a
40	1.51 ab
80	2.25 b
120	1.53 ab
160	1.25 ab
200	1.63 ab

Ratings made on images obtained by retired plant pathologist Roger Ashley and rated by Dr. Samuel Markel, NDSU Extension Plant Pathologist.

There is a new phone app for Android phones for the 3 N calculators.

Go to app store and search for North Dakota Crop Nitrogen Calculator and follow the instructions.

It’s free to download.

We also have an app for IPhones-

Go to the Iphone app store and look up
North Dakota Crop Nitrogen Calculator,
then follow instructions.

Summary of causes and management for field variability 1

Variation in soil moisture results in tremendous yield variability and crop nutrient availability.

Zone soil sampling helps manage crop nutrient variability.

Variation in crop yield potential is not a consideration in the nutrient recommendation formulas.

Summary of causes and management for field variability 2

-Erosion history

-Areas of excessive acidity

Contact information-

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