Best Soil Fertility Practices for No-Till

Advanced Crop Advisors Workshop

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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

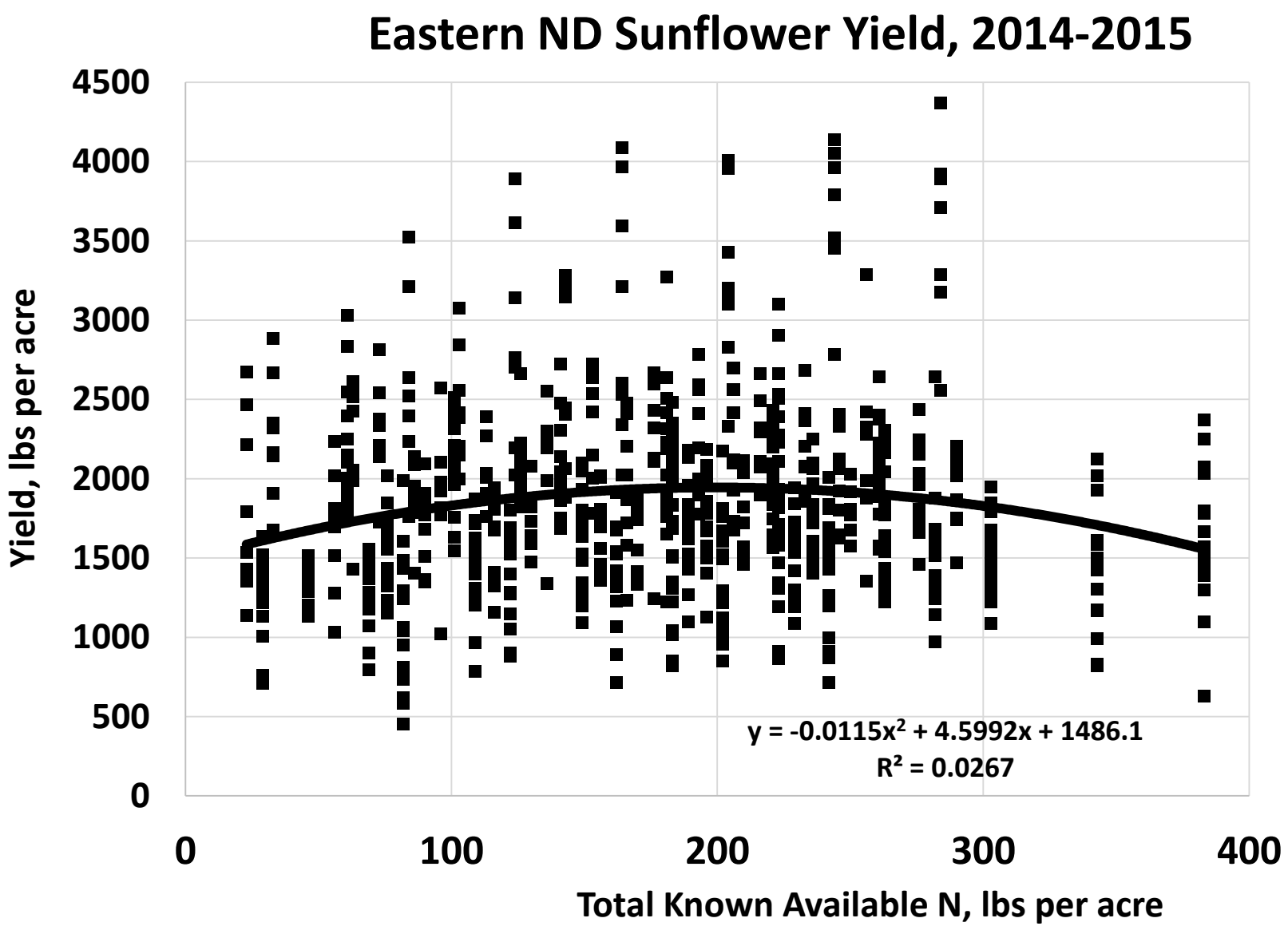
Select Nearest Wheat Price ($/bushel) $5.00

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)

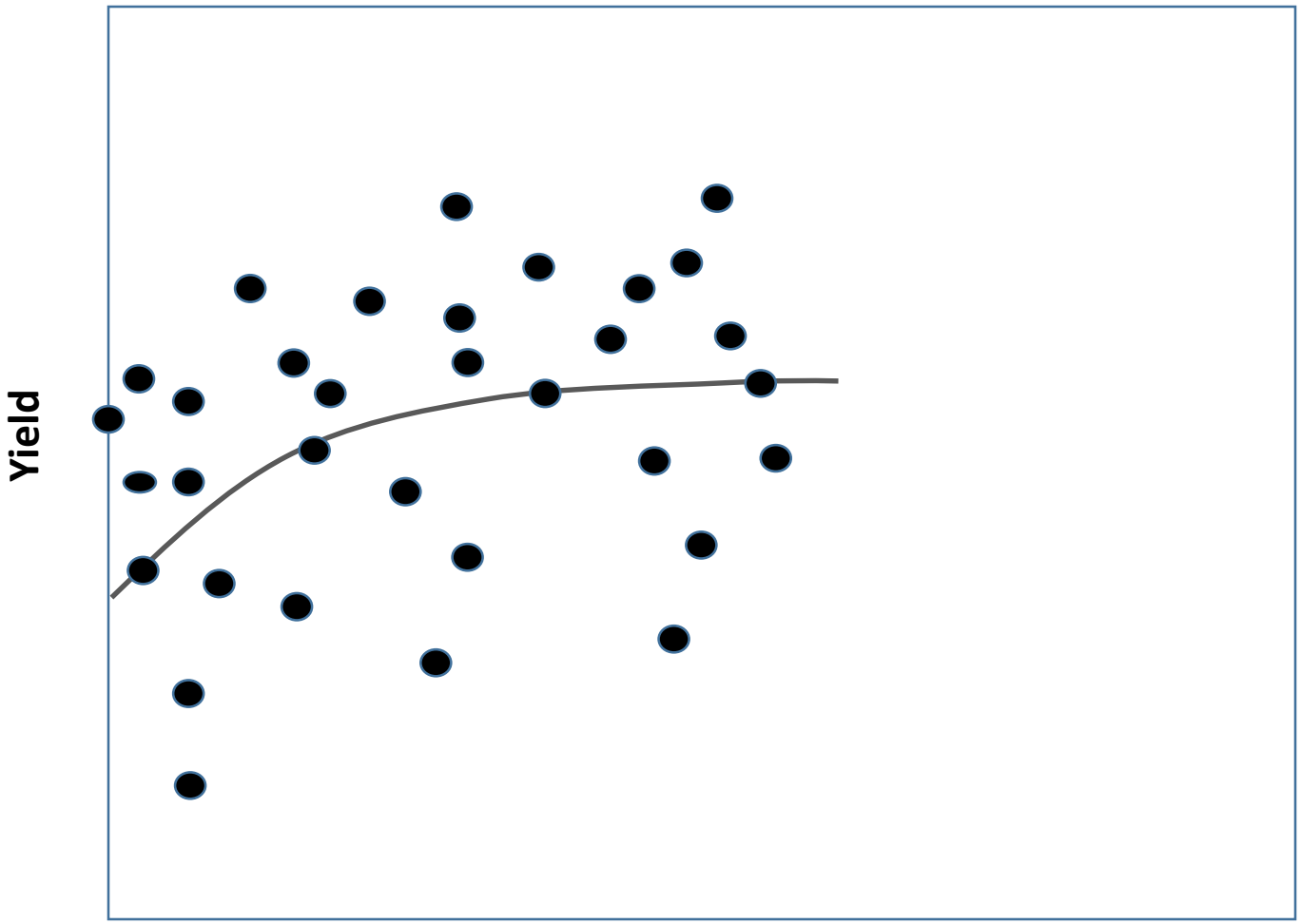
Nitrogen provided by previous crops: 0

Please indicate the previous tilling method used in the field.

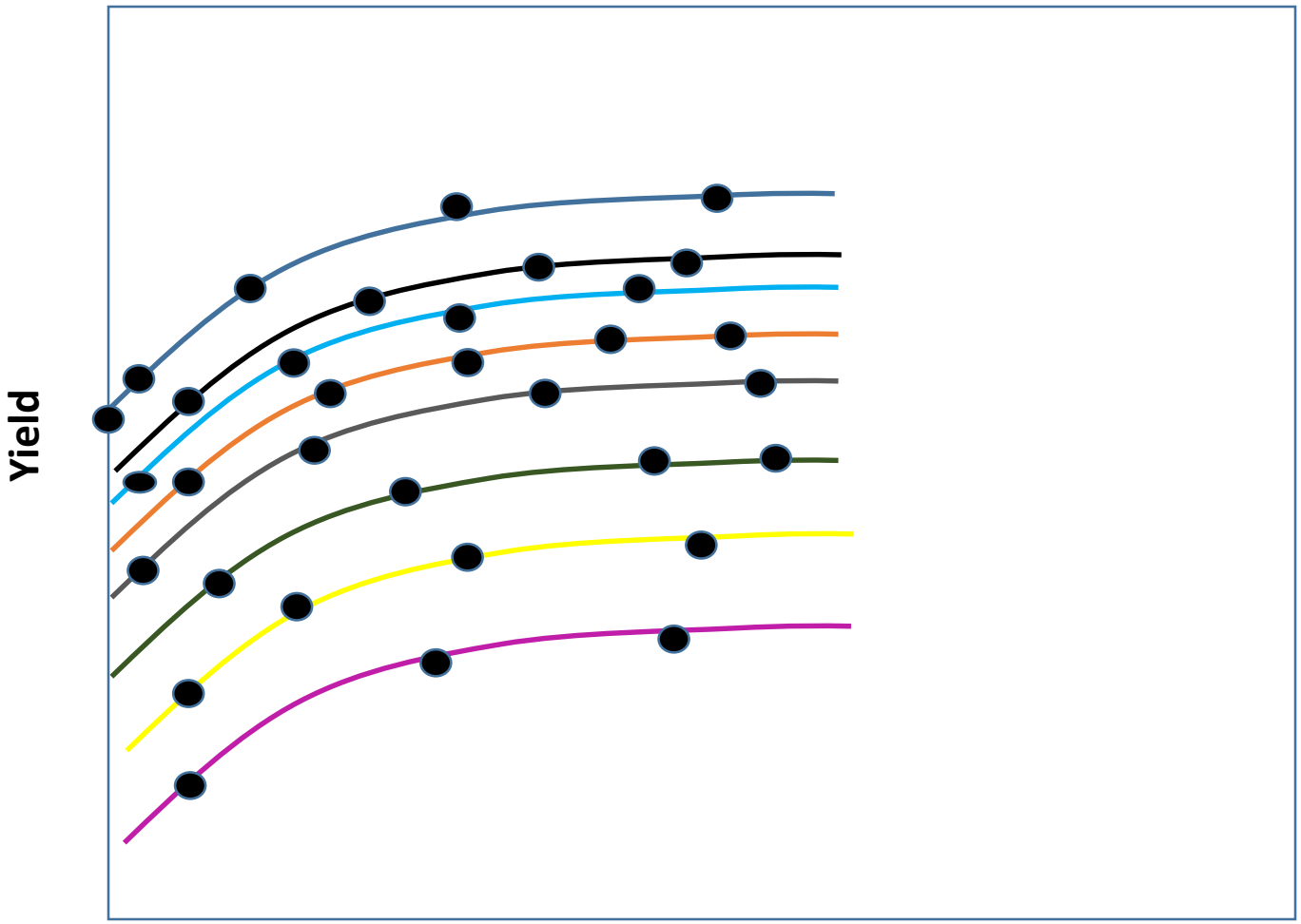

Eastern ND Sunflower Yield, 2014-2015
Yield, lbs per acre
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
100
200
300
400
Total Known Available N, lbs per acre
y = -0.0115x² + 4.5992x + 1486.1
R² = 0.0267

Why is the aggregated relationship of yield and available N so ‘diffuse’, when the relationships within sites are so highly related?

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

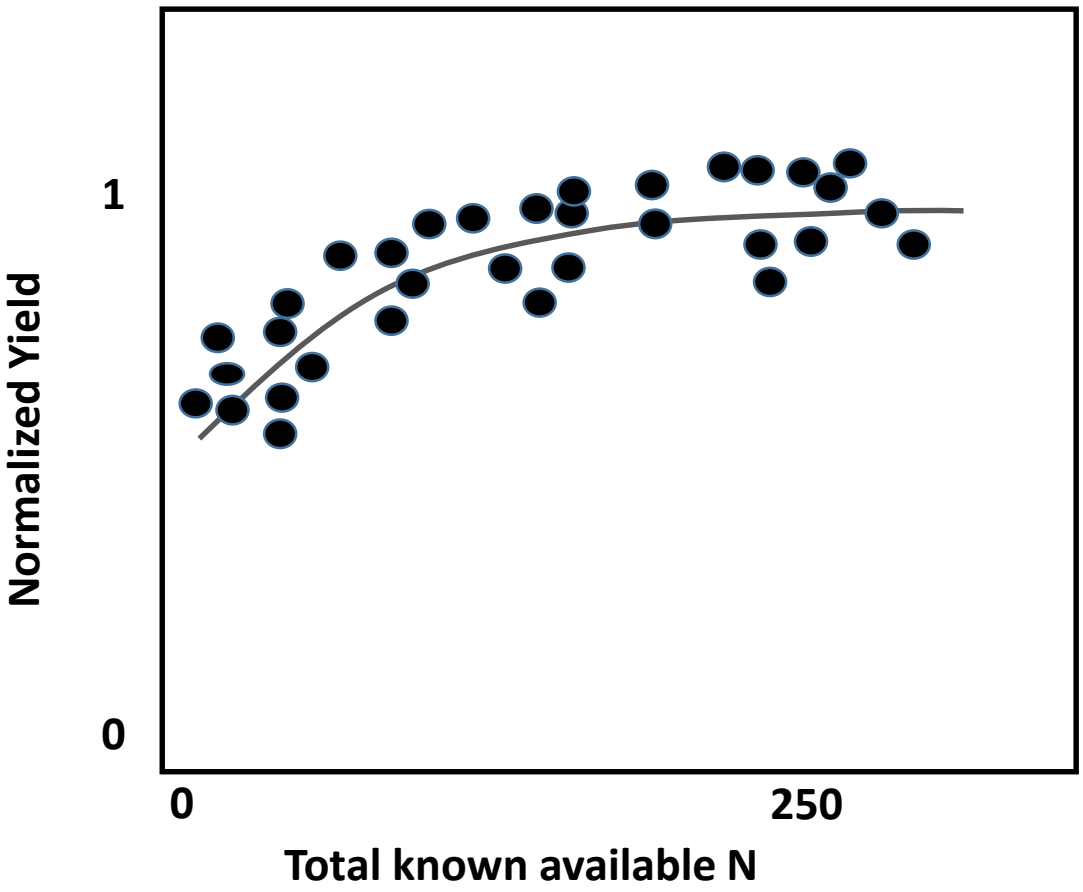
For example-

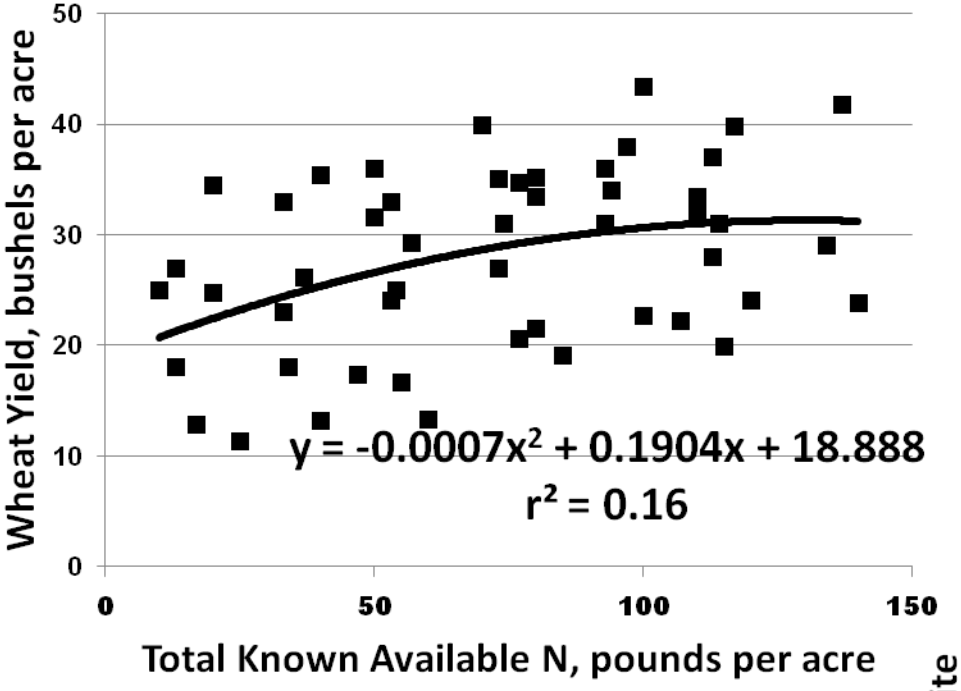
A spring wheat site with high yield 100 bu/acre, divide all yields by 100, and we end up with values from 0 to 1

A spring wheat site with high yield 30 bu/acre, divide all yields by 30, and we end up with values from 0 to 1

A spring wheat site with high yield 60 bu/acre, divide all yields by 60, and we end up with values from 0 to 1

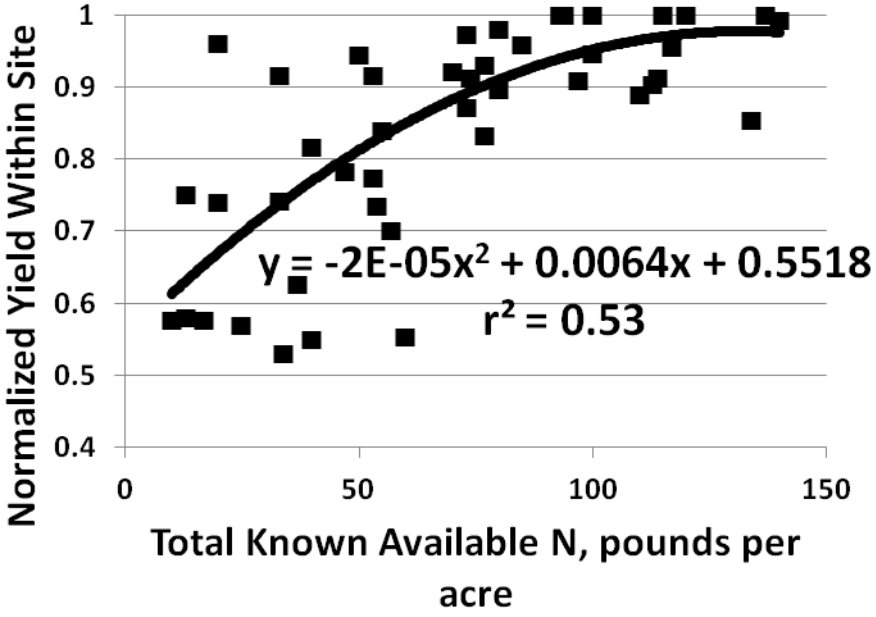
Standarding yields at all sites ends up looking like this-



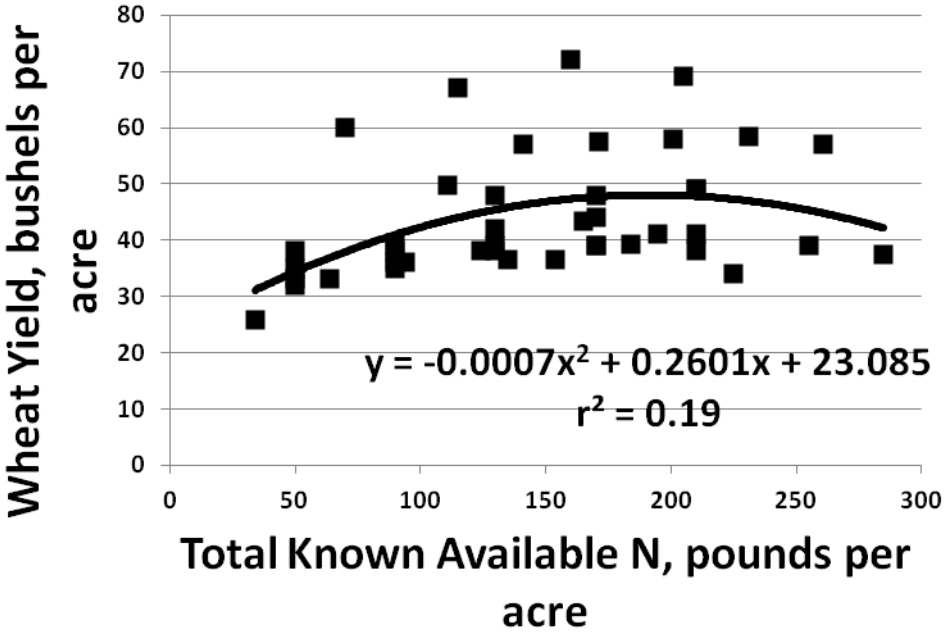


Western ND Conventional Till wheat sites raw yields

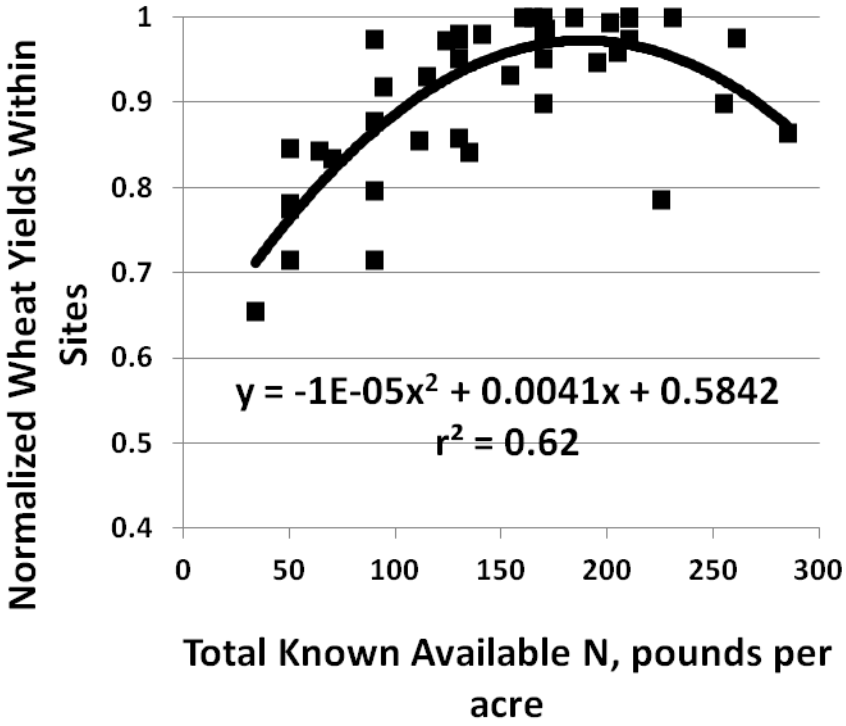
Western ND Conventional Till wheat sites, normalized yields



Western ND No-Till wheat sites raw yields



Western ND No-Till wheat sites normalized yields



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.

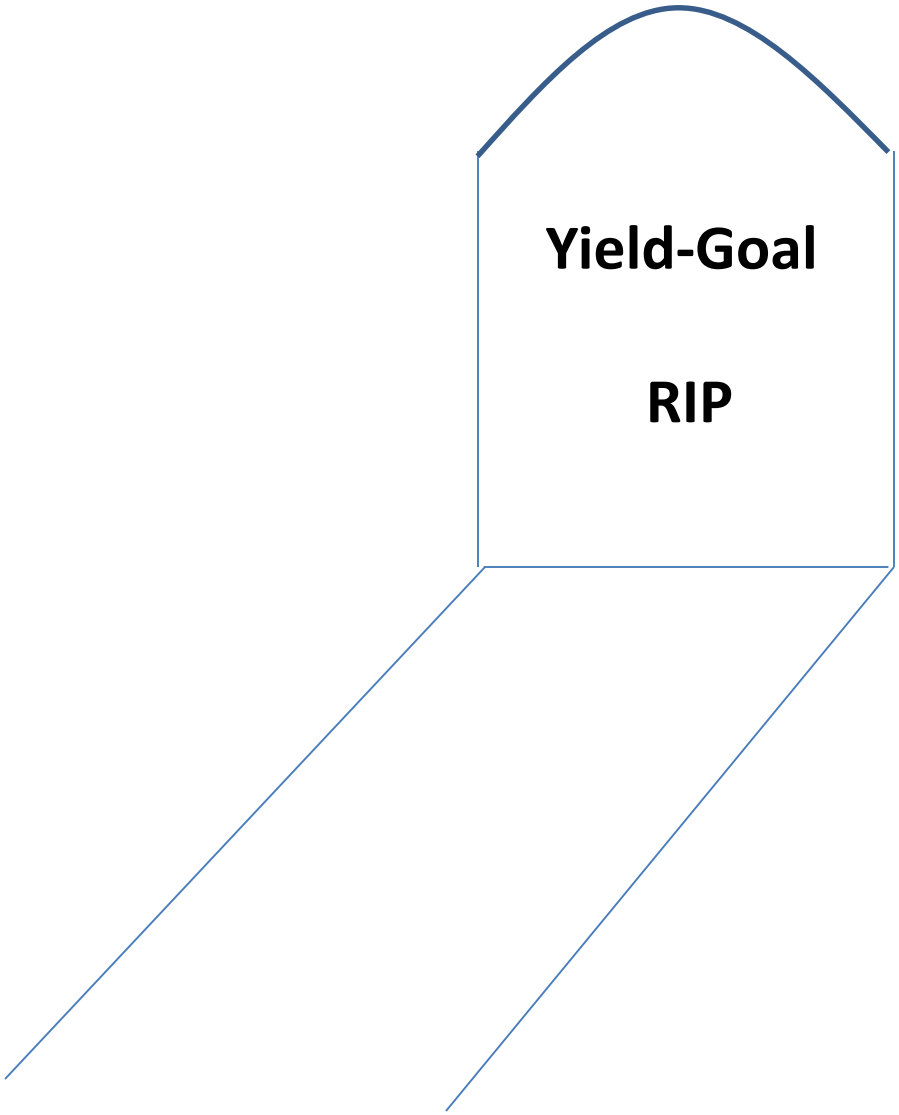
There is a new phone app for Android phones for the 3 N calculators.

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.


Yield-Goal
RIP

Conventional Till

Most N lingers in the soil and is susceptible to

leaching/denitrification

No-Till

N is taken up by microorganisms. Microorganism life cycle is measured in days and weeks. Nutrient cycling is continuous and rapid.

N credit likely comes from increased efficiency of N use compared to conventional till

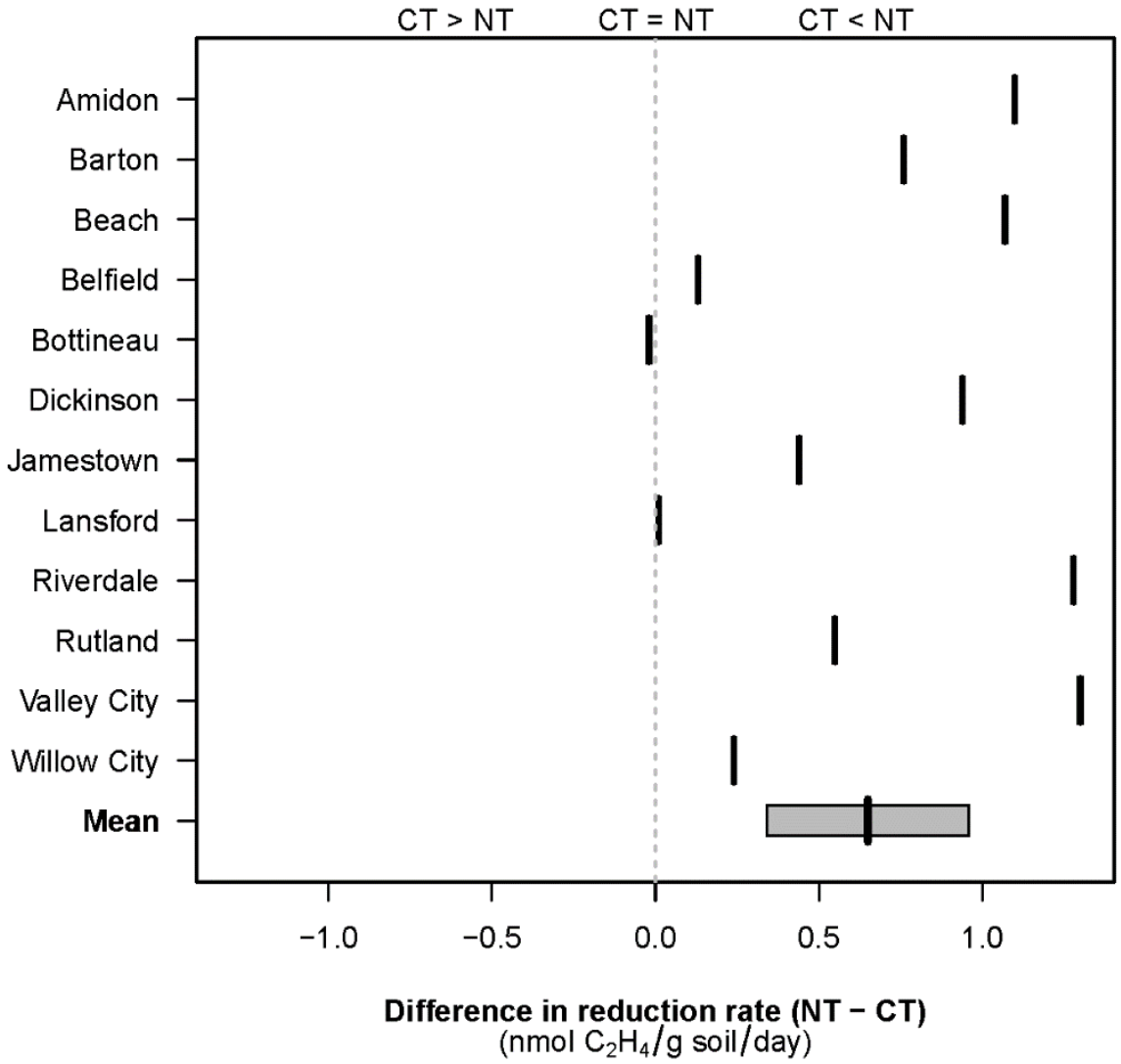
Conventional Till

Most N lingers in the soil and is Susceptible to

leaching/denitrification

No-Till

Also, 2018 spring paired soil sampling and incubation analysis by colleague at University of Florida showed much greater asymbiotic N-fixing activity in long-term no-till.


CT > NT
CT = NT
CT < NT
Amidon
Barton
Beach
Belfield
Bottineau
Dickinson
Jamestown
Lansford
Riverdale
Rutland
Valley City
Willow City
Mean
−1.0
−0.5
0.0
0.5
1.0
Difference in reduction rate (NT − CT)
(nmol C_2H_4/g soil/day)

Challenges of N application in no-tillage-

No-till in the fall?

Fall ammonia application not an option in SE Minnesota

Fall ammonia with N-Serve® is an option for NW Minnesota, North Dakota and South Dakota.

Coulters necessary to cut residue

No-till options preplant or at planting

Ammonia? Separation of at least 3 lateral inches in ammonia band and seed band.

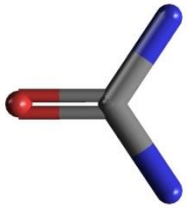
At an angle? If residue allows.
Mid-row band for ammonia also works well. In dry years, no as much for urea.

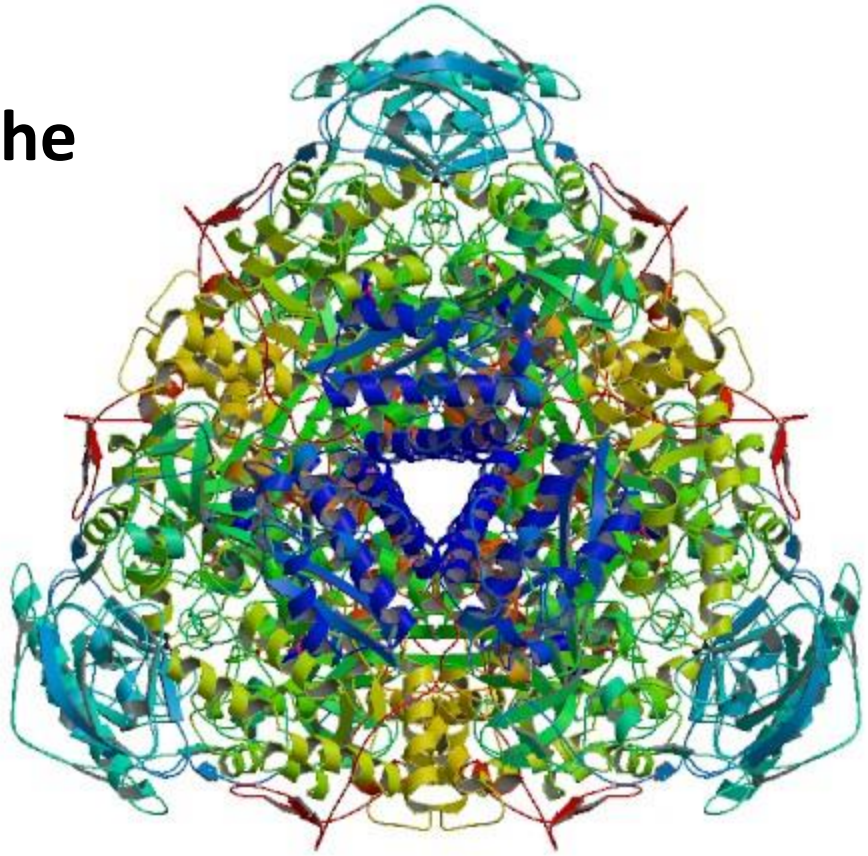
Other no-till preplant options-

Urea with NBPT (Agrotain)?

UAN with NBPT (Agrotain)?

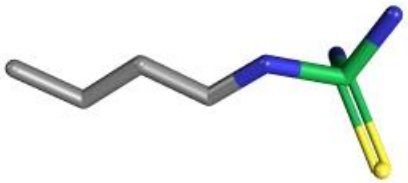
Urea is acted on in the ‘keyhole’ structure of the urease enzyme

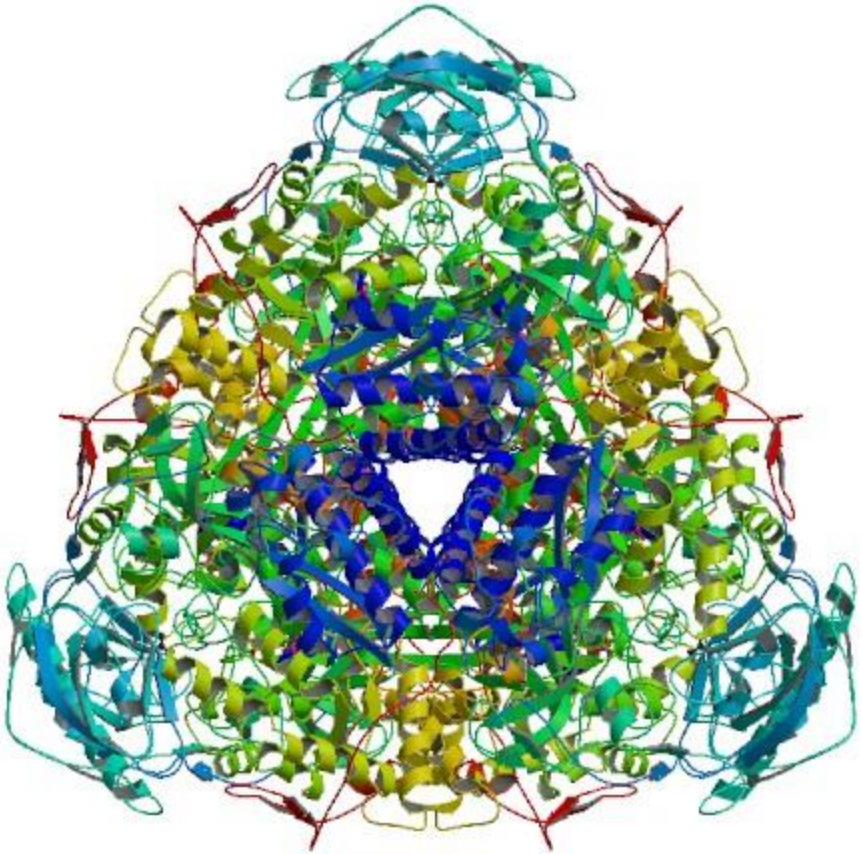




N-(N-Butyl)thiophosphoric triamide

Has same tri-atom configuration as urea

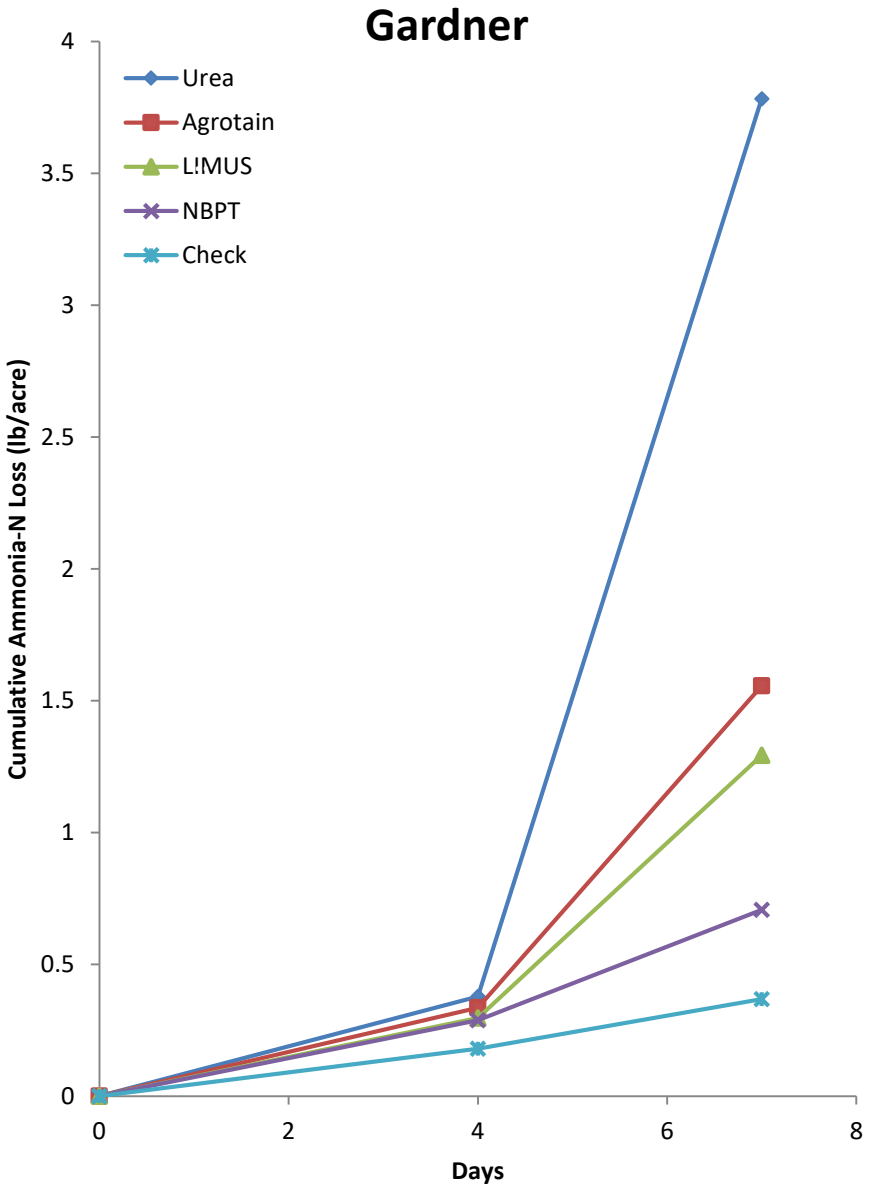


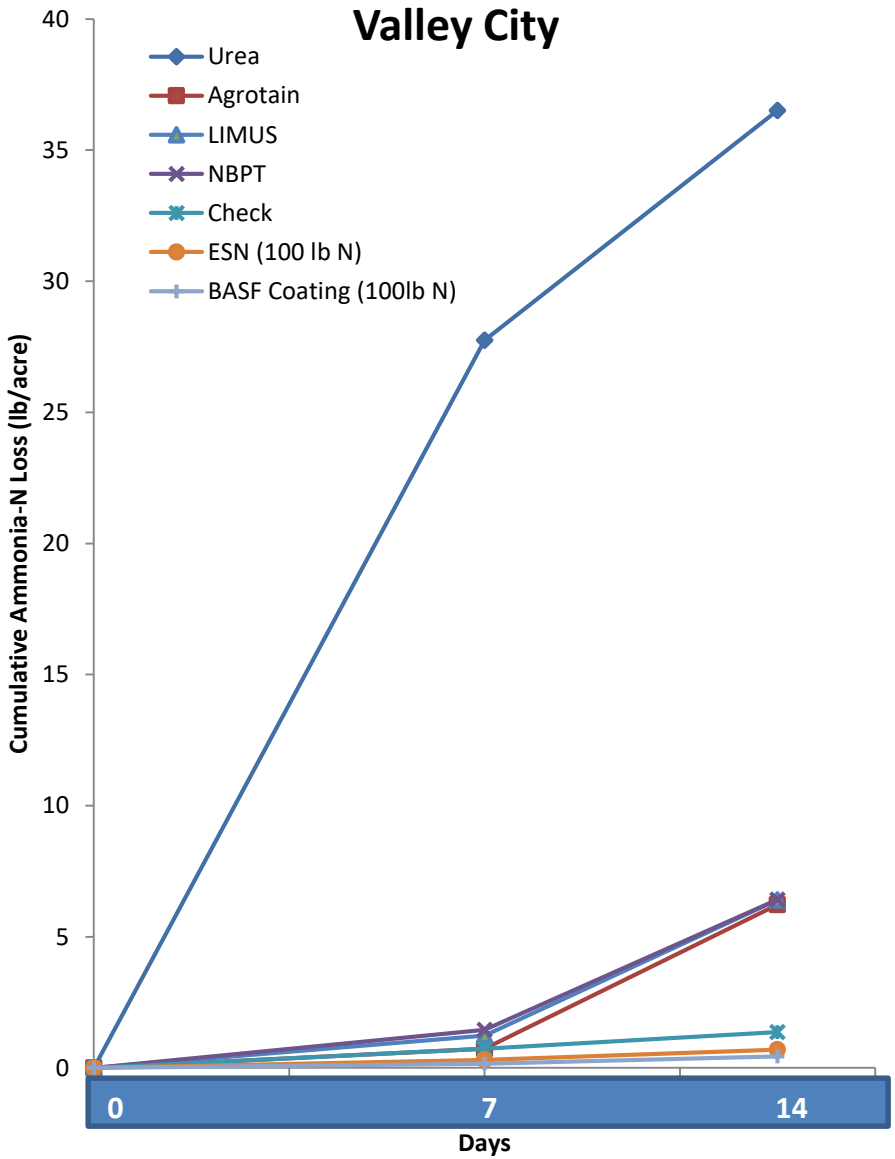


NPPT has same tri-atom structure, but tail has an additional C group.

Yield for side-dressed no-till corn in Hardin County, KY. (From Schwab and Murdock, 2009)

Treatment	Yield, bushels per acre
Check (50 lb N/acre preplant N only)	117d*
Urea	158c
Urea + Agrotain	201b
SuperU	201b
UAN	150c
UAN + Agrotain	179bc
UAN + Agrotain Plus	175bc
Ammonium nitrate	239a


Gardner
Urea
Agrotain
L!MUS
NBPT
Check
Cumulative Ammonia-N Loss (lb/acre)
Days
0
0.5
1
1.5
2
2.5
3
3.5
4
0
2
4
6
8


Valley City
Urea
Agrotain
LIMUS
NBPT
Check
ESN (100 lb N)
BASF Coating (100lb N)
Cumulative Ammonia-N Loss (lb/acre)
Days
0
5
10
15
20
25
30
35
40
0
7
14

Ammonia volatilization from surface and incorporated urea at various depths-

Rochette et al., 2014, J. Env. Q.

Period-hours	Surface (% loss)	1 inch (% loss)	2 inch (% loss)	3 inch (% loss)
0- 1 week	2.2	18.4	2.6	0.0
1-2 weeks	29.5	15.2	3.2	0.1
2-3 weeks	15.2	3.8	1.8	0.5
3-4 weeks	3.4	1.0	1.0	0.0
Total	50.3	38.4	8.6	0.4

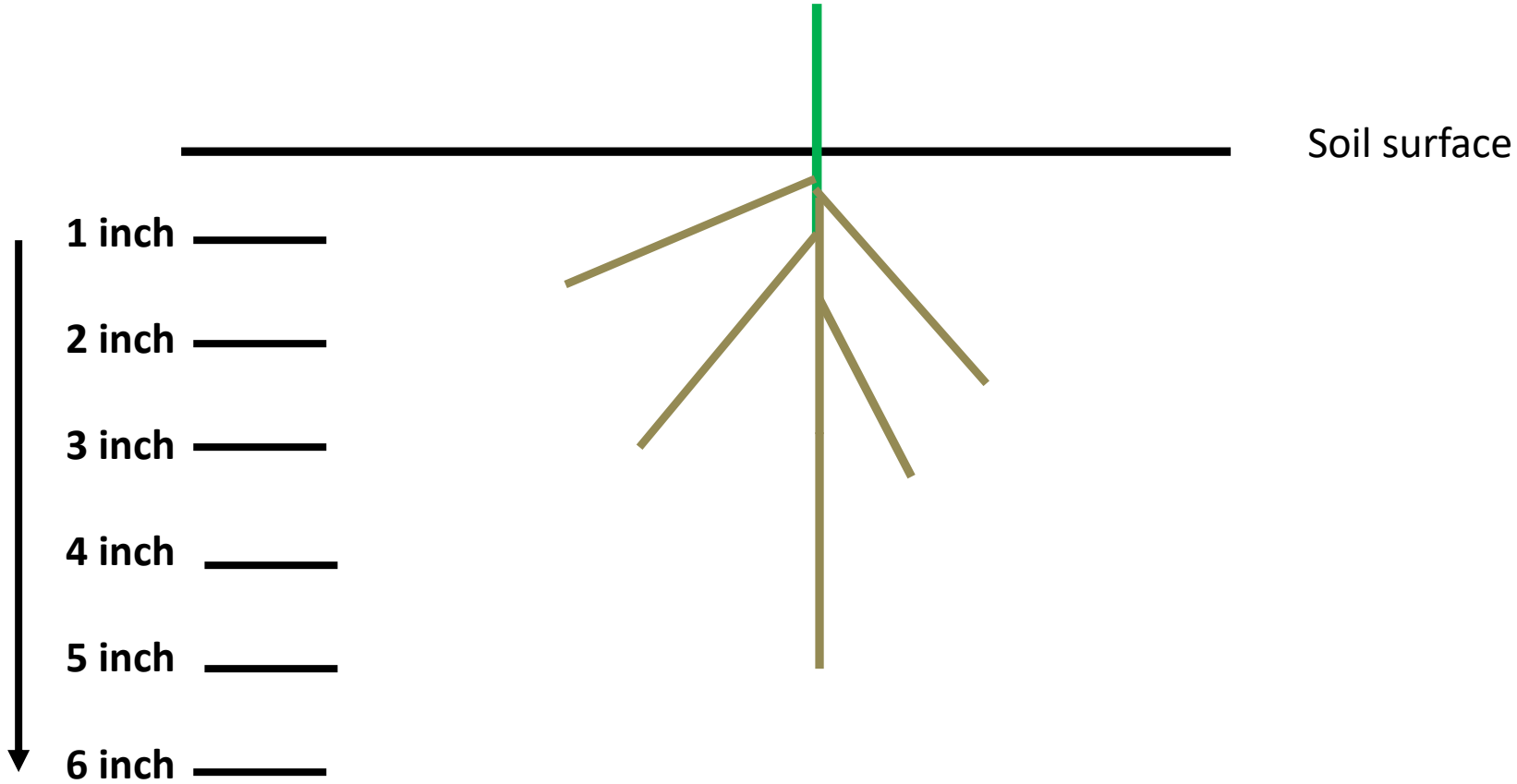
Slightly acid silt loam soil

Intensive crop growth, application of any ammonia-based fertilizer, including manure, results in surface soil acidification.

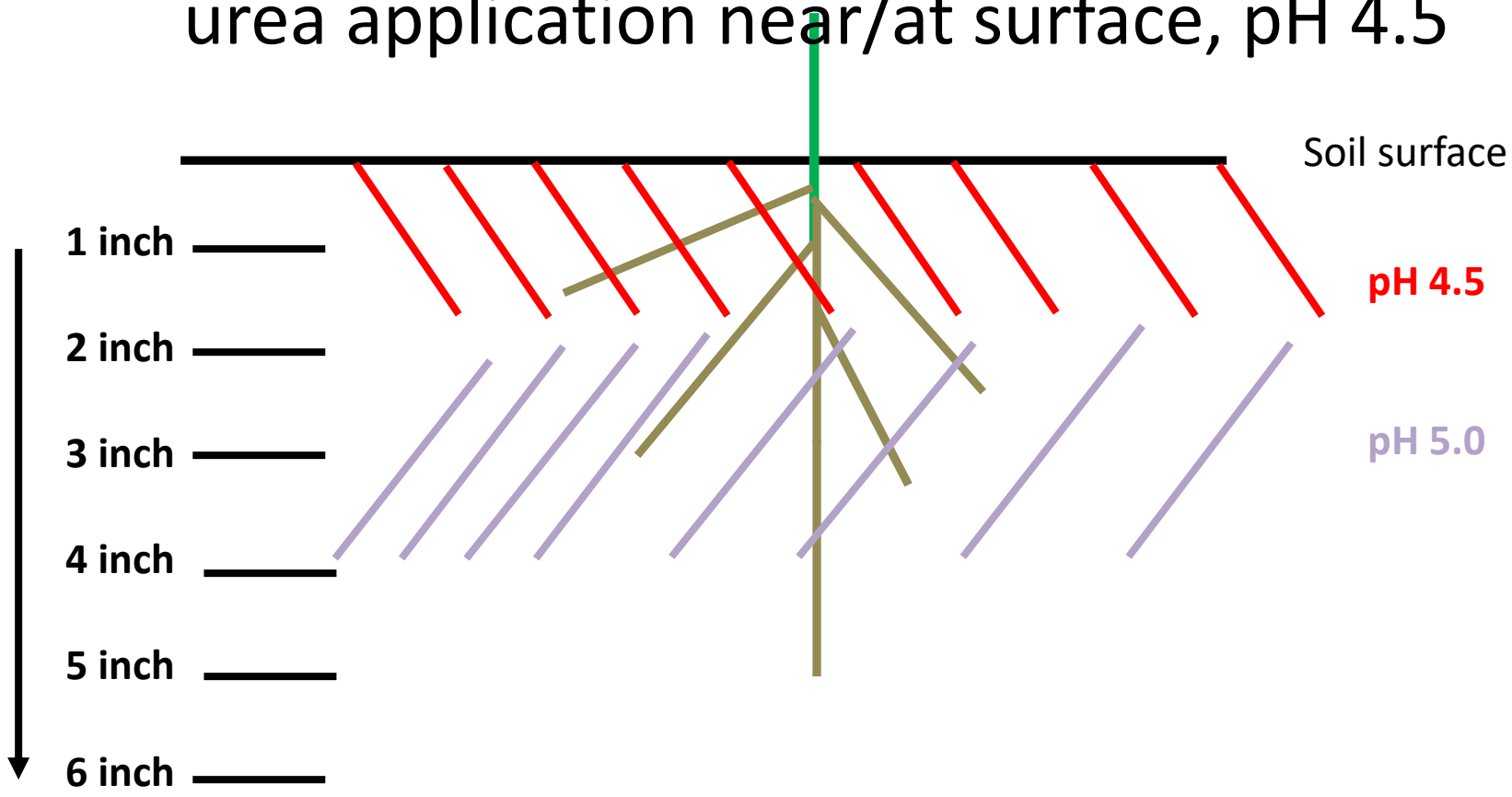
The remedy is 'liming', which is the application of any amendment that reacts with H^+ ions to form CO_2 and water.

In conventional till systems, the liming material is incorporated into the soil during tillage passes.

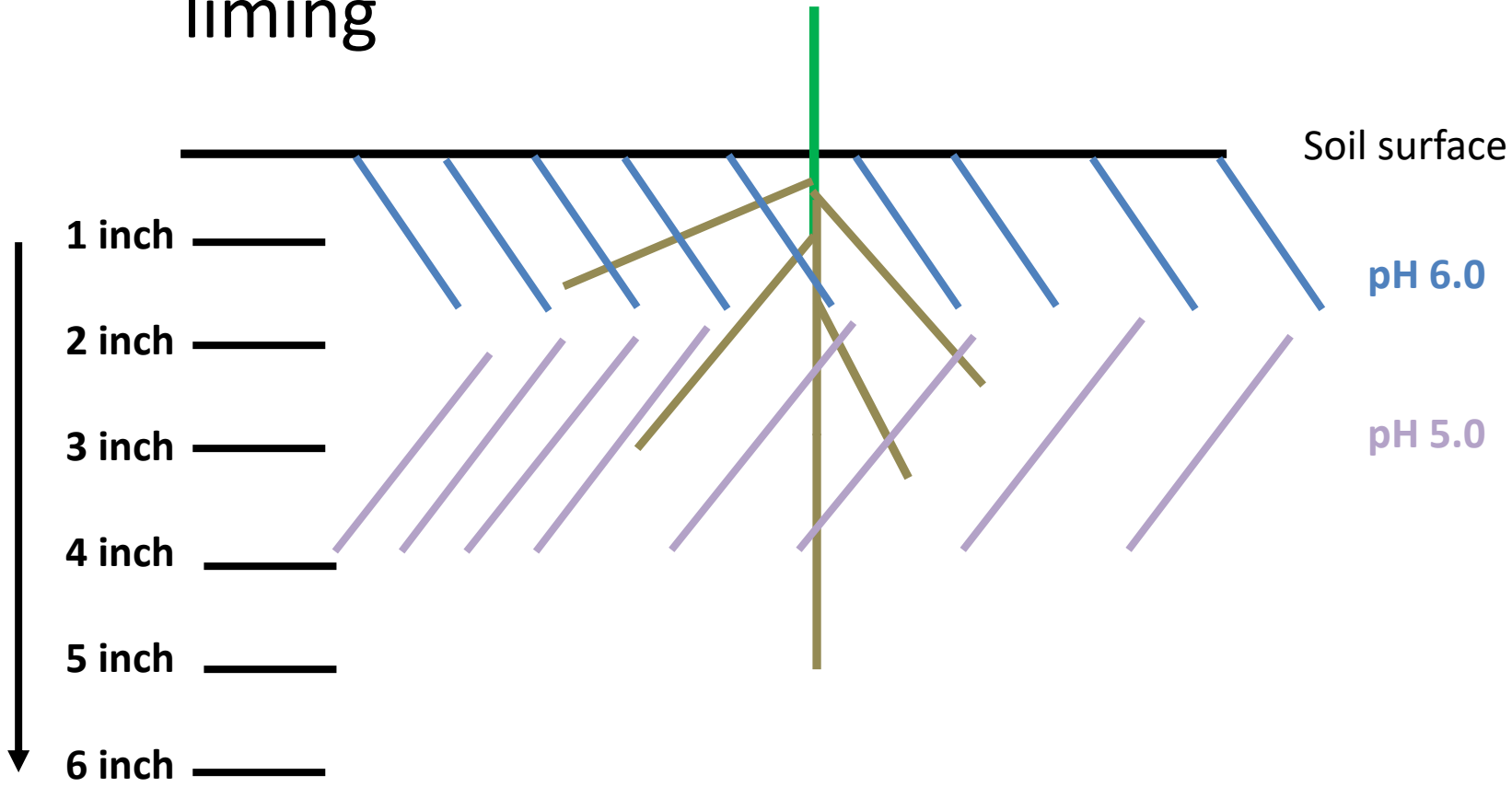
Wheat growing in pH > 5.2



Wheat growing in soil after 20 years urea application near/at surface, pH 4.5



Wheat growing in soil after 1 year surface liming



Equipment is available to apply N/P/K/other in no-till

Make every effort to apply fertilizer under the soil surface.

Make full use of banding and use planters that enable banding

Lime effects, no-till surface application, after 4 years

Kansas Agronomy Journal Godsey et al., 2007

Depth inch	pH	0.5tP	2T	4T
0-1	5.8	6.1	6.7	7.3
1-2	5.5	5.8	6.1	6.6
2-3	5.7	5.8	6.0	6.2
3-4	5.8	5.8	6.0	6.1
4-5	5.9	5.9	5.9	6.0
5-6	5.9	5.9	6.0	6.0

Pennsylvania- Beegle

Initial pH 0-6 inches was 5.1
Initial pH 0-2 inches was 4.5

3 T/acre CCE lime increased pH in 0-2 in 2 months to 6.2 2-4 and 4-6 inch depths also increased.

Winter wheat yield increased from 52 bu/a to 71 bu/a in first year.

Washington State, Palouse Region

Brown et al. 2008

Depth, inches	pH	Ext Al ppm
0-2	5.1 ± 0.8	28
2-4	4.7 ± 0.5	55
4-6	5.5 ± 0.3	7
6-8	5.9 ± 0.3	5

Washington State, Palouse Region

Brown et al. 2008 2 years after broadcast lime 3 T/a CCE lime

Depth, inches	pH w/lime	Al activity after lime	Al in check
0-2	7.0	10^{-14}	10^{-7}
2-4	5.2	10^{-8}	10^{-7}
4-6	5.7	10^{-10}	10^{-8}
6-8	5.9	10^{-11}	10^{-11}

Cyril Hopkins- “Wheat from Stones” about 1910, Illinois Exp Sta Bull.

Summary-

Use N calculator
Apply N below soil surface when possible
Always use some starter P

If urea applied to the surface, use NBPT/NPPT and leave it alone.

Check surface acidity, 0-2 inches, 2-6 inches
Lime if necessary.