Preview of Summer 2014 Revision of Corn N Recommendations and N Issues

Dave Franzen, PhD
Extension Soil Specialist
North Dakota State University, Fargo, ND
Crop Circle V6 Red NDVI Before S Application, Oakes

\[ y = -1E^{-0.05} x + 0.1891 \]
\[ R^2 = 0.0012 \]

GreenSeeker Red Edge NDVI vs Total Known Available N V12 After S Application, Oakes

\[ y = 1E^{-0.07} x^2 + 0.0002 x + 0.2156 \]
\[ R^2 = 0.126 \]
GreenSeeker Red NDVI Arthur, 2013
Before S Application, V6

\[ y = 2E^{-06}x^2 - 0.0007x + 0.3895 \]
\[ R^2 = 0.1065 \]

GreenSeeker Red NDVI 3 Weeks After S Application V12, Arthur

\[ y = -3E^{-06}x^2 + 0.0012x + 0.6254 \]
\[ R^2 = 0.6029 \]
Current published N recommendation for corn-

\[ \text{N Rate (pounds N per acre)} = \text{Yield Potential (bushels per acre)} \times 1.2 \]

less soil test nitrate-N to 2 foot depth
less previous crop credit
Why I dislike the current N recommendations for corn-

Yield Potential

N Rate

200

240
Began to accumulate modern corn N rate data in 2010.

Sites- 2010- 16 eastern, 2 western
- 2011- 14 eastern- western sites lost
-2012- 22 eastern – 4 western
- 2013- 15 eastern- 4 western

Also- 9 sites from southern Manitoba
- 21 sites from NW Minnesota
- 7 northern South Dakota

Total of 117 sites within the past 12 years.
North Dakota, NW Minnesota and Southern Manitoba
Corn N Rate Trials 2001-2013
N Rate Only vs Yield - ALL SITES

Corn Yield, bushels per acre

y = -0.001x^2 + 0.3676x + 129.81
R^2 = 0.0952
North Dakota, NW Minnesota, northern South Dakota, Southern Manitoba N Rate Trials, Total Known Available N vs Corn Yield, All Sites 2001-2013

\[ y = -0.0008x^2 + 0.5026x + 89.834 \]

\[ R^2 = 0.1857 \]

\[ y = -0.0003x^2 + 0.2228x + 71.727 \]

\[ R^2 = 0.3524 \]
All Eastern Sites Including North Dakota, NW Minnesota, Southern Manitoba and Northern South Dakota

\[ y = -0.0008x^2 + 0.4909x + 95.347 \]

\[ R^2 = 0.1603 \]
Eastern Long-Term No-Till Sites

Soil Test Nitrate-N, Previous Crop Credit

\[ y = -0.0009x^2 + 0.4467x + 91.029 \]

\[ R^2 = 0.3282 \]
Total Available N vs Corn Yield, High Clay Soils, North Dakota, NW Minnesota and Southern Manitoba, 2001-2013

\[ y = -0.0009x^2 + 0.5301x + 91.271 \]

\[ R^2 = 0.1226 \]
High Clay Sites that Exceeded 160 bushels per acre, North Dakota, NW Minnesota and Southern Manitoba, 2001-2013

\[ y = -0.0009x^2 + 0.5354x + 114.01 \]

\[ R^2 = 0.2199 \]
High Clay Sites Yielding Under 160 bushels per acre, North Dakota, NW Minnesota, and Southern Manitoba, 2001-2013

\[ y = -0.0005x^2 + 0.3666x + 64.644 \]

\[ R^2 = 0.2991 \]
Eastern Medium Textured Sites Including NW Minnesota, Southern Manitoba, and Northern South Dakota

\[ y = -0.0008x^2 + 0.5134x + 97.21 \]

\[ R^2 = 0.2092 \]
Eastern North Dakota, southern Manitoba, northwest Minnesota and northern South Dakota medium texture conventional tillage with yields greater than 160 bushels per acre

\[ y = -0.0012x^2 + 0.6329x + 104.58 \]

\[ R^2 = 0.2856 \]
Medium Textured Sites, North Dakota, NW Minnesota and Southern Manitoba with High Yields Less than 160 Bushels Per Acre

\[ y = -0.0002x^2 + 0.2498x + 83.064 \]

\[ R^2 = 0.3468 \]
The “Return to N” model -


This model is used in several corn-belt states, including Iowa, Illinois, Wisconsin, Minnesota, Ohio, and Michigan
West River MERN

$3 corn, 40 cent N = 167 lb N/acre
$4 corn, 40 cent N = 200 lb N/acre
$5 corn, 40 cent N = 219 lb N/acre
Long term no-till sites, Return to N $3 (bottom) to $5 corn price 20 cent to $1 N costs

MERN-
$3 corn 40 cent N 174 lb N/acre
$4 corn at 40 cent N 192 lb N/acre
$5 corn at 40 cent N 204 lb N/acre
High Clay Yields
Greater than 160 bushels per acre

MERN

$3 corn, 40 cent N
= 223 lb N per acre

$4 corn, 40 cent N
= 242 lb N per acre

$5 corn, 40 cent N
= 253 lb N per acre
High Clay with Yields Less than 160 bushels per Acre.

MERN

$3$ corn, 40 cent N = 233 lb N/acre
$4$ corn, 40 cent N = 266 lb N/acre
$5$ corn, 40 cent N = 287 lb N/acre
Medium Texture Eastern Sites Yields Greater than 160 Bushels per Acre

MERN

$3 corn, 40 cent N
= 208 lb N/acre
(185 bu/acre)

$4 corn, 40 cent N
= 222 pounds N/acre
(185 bu/acre)

= 232 pounds N/acre
(187 bu/acre)

Range for $1 return
+- 20 lb N/acre
Eastern Medium Texture sites yields < 160 bu/acre

MERN
$3 corn, 40 cent N
= 292 lb N/acre
$4 corn, 40 cent N
= 312 lb N/acre
$5 corn, 40 cent N
= > 355 lb N/acre
High Clay Sites Yielding Under 160 bushels per acre, North Dakota, NW Minnesota, and Southern Manitoba, 2001-2013

The equation of the best fit line is:

\[ y = -0.0005x^2 + 0.3666x + 64.644 \]

with an R² value of 0.2991.
Corn N timeline

Day 1       Day 45        Day 80                    Day 120

Application

Period of greatest uptake
In high clay soils, leaching is not an issue. Downward movement of water in a Fargo soil series is about 0.015 inches per hour, or about 1/3 inch per day.
Clay soils have a denitrification issue.

Denitrification -

$\text{NO}_3^-$ under anaerobic conditions enables a suite of bacteria to convert $\text{NO}_3^-$ to NOx and $\text{N}_2$ gas

Any of the gases are plant unavailable.
Range of values for loss of nitrate per day when soil is saturated range from 1-3% per day.

In May, 2010, soils in the Valley were saturated for about 30 days. Losses of N were estimated at about 80 lb/acre that is about 40% available N over 30 days, or about 1.3% per day.

In 2011, soils were saturated for about 45 days. Losses were estimated at about 150 lb N, or about 1.7% per day.
Total Rainfall
(2013-05-29 - 2013-10-03)
North Dakota Agricultural Weather Network (NDAWN)

Date

inch

2013-05-28
2013-06-04
2013-06-11
2013-06-18
2013-06-25
2013-07-02
2013-07-09
2013-07-16
2013-07-23
2013-07-30
2013-08-06
2013-08-13
2013-08-20
2013-08-27
2013-09-03
2013-09-10
2013-09-17
2013-09-24
2013-10-01

Fargo
Image taken June 28, 3 days after area was covered by 6 inches of water
Yield and quality of sugar beets with tillage treatment and N timing.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield, tons per acre</th>
<th>Per cent net sucrose</th>
<th>Recoverable sugar per ton</th>
<th>Recoverable sugar per acre</th>
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</thead>
<tbody>
<tr>
<td>Conventional till</td>
<td>20.7</td>
<td>15.1</td>
<td>303</td>
<td>6274 b</td>
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<tr>
<td>Strip Till</td>
<td>20.6</td>
<td>15.6</td>
<td>312</td>
<td>6420 ab</td>
</tr>
<tr>
<td>No Till</td>
<td>21.9</td>
<td>15.6</td>
<td>312</td>
<td>6827 a</td>
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<td>NS</td>
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<td>NS</td>
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<tr>
<td>LSD 5% 513</td>
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<tr>
<td>All N Early</td>
<td>21.3 ab</td>
<td>16.1 a</td>
<td>322 a</td>
<td>6848 a</td>
</tr>
<tr>
<td>Split N Timing</td>
<td>22.2 a</td>
<td>15.4 b</td>
<td>309 b</td>
<td>6835 a</td>
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<tr>
<td>All N Late</td>
<td>19.8 b</td>
<td>14.7 c</td>
<td>295 c</td>
<td>5838 b</td>
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<tr>
<td>LSD 5% 1.6</td>
<td>LSD 5% 0.6</td>
<td>LSD 5% 12</td>
<td>LSD 5% 513</td>
<td></td>
</tr>
</tbody>
</table>
Medium Textured Sites, North Dakota, NW Minnesota and Southern Manitoba with High Yields Less than 160 Bushels Per Acre

\[ y = -0.0002x^2 + 0.2498x + 83.064 \]

\[ R^2 = 0.3468 \]
These are soils with issues, often leaching related.

Leaching is easier to understand compared to gas loss after denitrification.

Splitting N application is also a solution to some of these soil problems.
• Incubation study, 10 g soil treated with 200 ppm urea-N and 0, 0.2, 1, 5, and 25 ppm of nitrapyrin as N-Serve emulsifiable, nitrapyrin as Instinct, DCD, sulfur as ATS, or maleic-itaconic polymer as NSN-QDO

• Four soils
  – Renshaw (slow nitrification)
  – Glyndon, Ulysses, Bearden (rapid nitrification)

• 1, 2, 3, 4 week sampling

• Paper submitted to SSSAJ
One soil with slow nitrification, Renshaw, 4-week incubation, initial N application 200 ppm as urea.
Three soils with rapid nitrification (Glyndon, Ulysses, Bearden), 4 week incubation. Initial N level 200 ppm as urea.
• Conclusion
  – Instinct less effective than N-Serve at equal rates of nitrapyrin
  – No effect of Nutrisphere-N with three soils with rapid nitrification
    • Nutrisphere-N less effective than ATS with the soil with slow nitrification
Active optical sensors have been identified as a tool to increase nitrogen-use efficiency.

Greenseeker (Trimble)

Holland Crop Circle Sensor (Holland Scientific)
2011-2012 All Eastern Conventional Till Sites
Greenseeker 5-6 Leaf INSEY vs Corn Yield

\[ y = 84.013e^{650.61x} \]
\[ R^2 = 0.2666 \]

2011-2012 All Eastern Conventional Till Sites
Greenseeker 10-12 Leaf INSEY vs Corn Yield

\[ y = 66.433e^{890.67x} \]
\[ R^2 = 0.2316 \]
Example field - 160 acres

Use zone sampling to direct the initial N-rate to field.

Apply about 200 lb N to a small reference area.
When applicator enters the field to apply side-dress application, the reference area serves as the INSEY that is the maximum supported by an application, less an INSEY of 5%.

Reference area previously highly fertilized with N
INSEY

Yield

Reference

INSEY in field

Field Yield estimate

Reference Yield

INSEY

Yield

Reference INSEY

INSEY
INSEY in field

Field Yield estimate

Reference Yield

Reference INSEY

INSEY

Yield
Corn yield difference in pounds per acre.
X 1.25 % N in corn grain
divided by efficiency factor 0.6
= N rate
Example-

Reference yield predicted- 220 bushels

In-field yield estimated- 160 bushels

difference = 60 bushels X 56 lb N/bushel
= 3360 pounds
X 0.0125 = 42 lb N
42 /0.6 efficiency factor = 70 lb N
at that location.
New Corn N Recommendations will be out Summer 2014.

Print and web-based

West River
Eastern Long-term No-till, diverse rotation
Eastern High Clay, yield > 160 bu/a
Eastern High Clay, yield < 160 bu/a
Eastern Medium textures, yield > 160 bu/a
Eastern Medium textures, yield < 160 bu/a