Nvision:
Remote sensing to visualize AND CORRECT nitrogen (N) deficiency in corn

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Uses:

- Rescue N decisions
- Variable-rate N to manage soil variability
There was widespread N deficiency 2008-2011 across the Corn Belt.
I estimate that we lost 2 billion bushels of potential yield 2008-2011
In a wet year, N must be applied in-season.

Planned in-season N
Rescue N in-season
No in-season N

Central Iowa, August 2008
Central Missouri 2008: in-season N kicks butt

180 N at planting

110 N sidedress knee-high

+ 44 bu/ac
Central Missouri 2009: in-season N kicks butt again

+ 68 bu/acre

153 N sidedress knee-high at planting

180 N at planting
Central Missouri 2010: Can you believe a 3-peat?

80 bu difference
# Central Missouri 2013: In-season N wins big

<table>
<thead>
<tr>
<th>N timing</th>
<th>N rate</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee-high</td>
<td>160 (chlorophyll meter)</td>
<td>213</td>
</tr>
<tr>
<td>Knee-high</td>
<td>144 (crop sensor, VR 67 to 191)</td>
<td>207</td>
</tr>
<tr>
<td>Knee-high</td>
<td>116 (soil nitrate test)</td>
<td>196</td>
</tr>
<tr>
<td>Preplant</td>
<td>180</td>
<td>126</td>
</tr>
<tr>
<td>Preplant</td>
<td>140</td>
<td>101</td>
</tr>
<tr>
<td>Preplant</td>
<td>140 (soil nitrate test)</td>
<td>94</td>
</tr>
<tr>
<td>Preplant</td>
<td>100</td>
<td>72</td>
</tr>
<tr>
<td>Preplant</td>
<td>0</td>
<td>51</td>
</tr>
</tbody>
</table>
In-season N benefit in this experiment 2007-2013 totals about 265 bushels/acre

With 120 lb less N/acre

2013: Largest wet spring in history

- My rule of thumb: more than 16” of rain April-June = high risk of N deficiency
- Areas that wet in 2013 are shown in crosshatch
- We made maps like this one going back to 1900
More wet area in the central U.S.

Area with $\geq 16$ inches of rainfall, April-June

99.97% chance that this is real
Yield map: yellow corn yields poorly

\[ y = -3.01x + 514 \]

\[ R^2 = 0.52 \]

170 bushels
Yield map: yellow corn yields poorly

- Y = -3.01x + 514
- $R^2 = 0.52$
- Darkest corn around 170 bushels
- Lightest corn around 80 bushels
- Average yield 125 bushels
- 45 bushels less than dark green corn
N Deficiency costs a lot!

Average yield loss = 45 bu/acre
Total yield loss = 11,925 bu
(45 bu/ac x 265 acres)
Total economic loss = $44,720
(11,925 bu x $3.75/bu)
Yellow corn can be rescued

- Fully fertilized fields but producers concerned
- N applied anywhere from thigh-high to tassel
Rescue N outcomes

- Average yield response 34 bu/acre (11 fields)

- Yield response depended on visible stress
  - High stress: 57 bushels (2 tests)
  - Medium stress: 41 bushels (5 tests)
  - Low stress: 14 bushels (4 tests)
Rescue N timing

• How late is too late?
  – Six tests in 2010, all applied at tasseling, ave 34 bu response

  • Tasseling is NOT too late
  – Give up by 2 weeks after tassel?
How do I know whether I need to apply rescue N?
NVision: quantitative decision support

aerial photo

yield loss map (ave 74)

N rate map: fix the problem
Is there any reason I’d use NVision in a normal year?
What happens when you apply 150 lb N/acre to the whole field?

Yes: Minnesota, Kansas, Missouri, Pennsylvania

No: Wisconsin

We studied eight fields this way—seven were as variable as this one.

In one field, average best rate was 65;
In another field it was 200.

Yes: Minnesota, Kansas, Missouri, Pennsylvania

No: Wisconsin
Color predicts N rate better than soil tests or yield data from 64 fields, 7 states.

- Optimal N rate with pre-plant soil nitrate to 2’, ppm, predictive ability: 9%
- Optimal N rate with pre-sidedress soil nitrate to 1’, ppm, predictive ability: 16%
- Optimal N rate with Relative Chlorophyll Meter Reading V5 to V9 (30cm to hip high), $r^2 = 0.54$, predictive ability: 4%
Color predicts N rate better than soil tests or yield data from 64 fields, 7 states.

54% predictive ability
2013: Far more in-season N than ever before

- Pioneer agronomist webinar June (mainly IA/MO)
  - On average expected 50% of acres to get in-season N
- Phone calls July: a dozen consultants, extension agronomists, and retailers in MO/IA/IL
  - On average thought 45% of acres had received in-season N
- Field day wagons northwest MO in August
  - 22/63 = 35% of corn producers had applied in-season N
- I don’t think it had ever been above 5% before
Questions?
Comments?
Near Craig, Missouri
August 2, 2008
Can we get by with applying all N pre-plant?

- I’ve had this question several times from producers & advisors in the delta region
- If we use N sources resistant to loss?
  - Anhydrous ammonia
  - ESN
Highest yields:
1) ammonium nitrate on knee-high corn
2) urea + agrotain on waist-high corn

March/April ESN or anhydrous: 20 to 45 bushels less

But still the best-yielding N sources at those times

2009:
• 30 bushel response to ESN
• 60 bushel response to sidedress
ESN and anhydrous ammonia are the best preplant N sources in a wet year...
...but not as good as sidedress