Presentation Topics

A. N.A. Fertilization History

B. Plant Nutrition Today

C. Opportunities

- Farmer economics
- High yield systems
- 4 R’s
- 16+ essential elements
- Weeds
- Decreasing soil nutrient levels
Fertilizer History 1940-50’s

Low rates /AC

NPK’s – all nutrients in same drop or granule

Limited bulk handling

Farmer applied with planters

Smaller applications
Fertilizer History 1960-70’s

Fertilizer’s Time

Fertilizer’s golden years
Numbers of retailers expands
Quality clear liquids and suspensions
Bulk blends
Increase of broadcast application
Floaters/tenders
Fertilizer grower meetings
Industry marketed fertilizer and soil fertility concepts
Fertilizer History 1980-90’s

New Weed Control Times

- Fertilizer application rates for P/K level out
- Weed/feed
- Farmers come to grower meeting for a free lunch and new chemical stories
- Fertilizer becoming a commodity
- Precision ag
- Variable rate application – fall 1986
- Crop consulting and services grow
- G.P.S. systems
- Yield monitors
Bio –tech
Rapid adoption of G.P.S.
New high yield hybrids
Roundup
Information surplus
Rapid good/bad cycles
U.S. and Iowa Corn Yields - 1950-2009

Iowa Yield = 2.03 x 3918
$R^2 = 0.88$

U.S. Yield = 1.98 x -3829
$R^2 = 0.94$
Increasing Corn Yields

1970’s - 2000: 1.9 bu/A/yr
2000-2009: 3 bu/A/yr
2030 goal: 250-300bu/A/yr or
6bu/A/yr for next 20 years
### Appleton, MN

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield (bu/ac)</th>
<th>p-value</th>
<th>LSD (0.1)</th>
<th>CV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55K-250LB/AC</td>
<td>301.2</td>
<td>&lt;0.0001</td>
<td>28.0</td>
<td>6.4</td>
</tr>
<tr>
<td>45K-250LB/AC</td>
<td>294.7</td>
<td></td>
<td></td>
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<tr>
<td>55K-125LB/AC</td>
<td>264.0</td>
<td></td>
<td></td>
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<tr>
<td>45K-125LB/AC</td>
<td>263.8</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>35K-125LB/AC</td>
<td>261.1</td>
<td></td>
<td></td>
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<tr>
<td>35K-250LB/AC</td>
<td>252.1</td>
<td></td>
<td></td>
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<tr>
<td>45K-0LB/AC</td>
<td>243.0</td>
<td></td>
<td></td>
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<tr>
<td>35K-0LB/AC</td>
<td>232.6</td>
<td></td>
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<tr>
<td>55K-0LB/AC</td>
<td>221.9</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Means followed by a different letter are statistically significant (p<0.1)
Farmer Dollars
Gross/acre

1990’s
150 bu/ac
Price/bu $1.90
LDP $.15
Gross/ac $307.50/ac
1,000 acres - $307,500

2010
205/bu/ac
Price/bu $4.60
Gross/ac $943/ac
2000 acres  $1,886,000

Different economic world today – higher gross, higher expenses, cash flows, risk, equipment size, etc.
• Opportunity  - Soil test levels are dropping
Labels represent the net budget of DAP in Tons and P2O5 in pounds per acre, remaining from inputs after removal by harvested crops, assuming crop yield 20% higher than the average yield.

Table below is a summary of all counties labeled on this map.

Total
Harvested Acres
6,979,239

Net
Tons of DAP
-242,487

Net Lbs of P2O5 / Harvested Acre
-30

Legend:
- Green: Removal less than nutrient replacement
- Yellow: Removal approx. equal to replacement
- Red: Removal exceeds nutrient replacement

Map Code: 9000061_5011043_11
Sources: IPN and PAQ Interactive - NuGIS Project

Oct 26, 2009
Labels represent the net budget of Potash in Tons and $\text{K}_2\text{O}$ in pounds per acre, remaining from inputs after removal by harvested crops, assuming crop yield 20% higher than the average yield.

Table below is a summary of all counties labeled on this map.

**Total**

**Harvested Acres**

6,979,239

**Net**

**Tons of Potash**

-60,906

**Net Lbs of $\text{K}_2\text{O}$/Harvested Acre**

-1
# U.S. Corn Yield and Nutrient Applications

- Three Year Averages 1983-85 vs. 2003-05

<table>
<thead>
<tr>
<th>Years</th>
<th>U.S. Corn Yield</th>
<th>Nutrient Application Rates</th>
<th>Rates per Bushel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bu / A</td>
<td>N</td>
<td>P₂O₅</td>
</tr>
<tr>
<td>1983-85</td>
<td>101.9</td>
<td>138</td>
<td>63</td>
</tr>
<tr>
<td>2003-05</td>
<td>150.1</td>
<td>137</td>
<td>59</td>
</tr>
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</table>

Sources: Compiled from ERS, TVA, AAPFCO, TFI data.
<table>
<thead>
<tr>
<th></th>
<th>Low STP</th>
<th>VH STP</th>
<th>Yield Diff</th>
<th>Economies of high-P</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_2O_5 ) Prior to corn</td>
<td>50 lbs/a</td>
<td>50 lbs/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn yields (3 yr av)</td>
<td>167 bu</td>
<td>193 bu</td>
<td>26 bu</td>
<td>$117.00**</td>
</tr>
<tr>
<td>Soybean yields (3 yr av)</td>
<td>39 bu</td>
<td>49 bu</td>
<td>10 bu</td>
<td>$97.50**</td>
</tr>
</tbody>
</table>

* Source: Randall, University of Minnesota

**Corn $4.50/bu, Soy $9.75/bu
Fertilizer Solutions for Lower Soil Fertility Trends

1. Combine systemic soil testing and yield MAPS to create nutrient balance MAPS by field for customers.

2. Tell the story
   - Farm call topic
   - Newsletters
   - E-mail alerts
   - On-farm plots
   - Training and equipping sales/marketing staff

3. Tools for objection of cost of soil build decision, land tenure issue

4. Not an agronomy issue but marketing and economics
Opportunity – More Weeds!

Rapid trend back to preplant/preemerge weed control to supplement Roundup programs

Weed/feed with UAN
Weed/feed with NPK suspensions
Opportunity – High Yield Systems

Interactions
Rates
Placement
Timing
Source

4 R’s
Interactions/Rates

Higher nutrient levels required for population returns*

<table>
<thead>
<tr>
<th>Plant Population</th>
<th>Traditional 230+0+0</th>
<th>Enhanced 230+100+80+40S</th>
<th>Fertility Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>28,000</td>
<td>202</td>
<td>225</td>
<td>23</td>
</tr>
<tr>
<td>42,000</td>
<td>196</td>
<td>262</td>
<td>66</td>
</tr>
<tr>
<td>Population Response</td>
<td>-6</td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

*Kansas State University
Soil test for P and K - high
Liquids and High Yields

Placement and timing become very important + liquids

Need to go beyond N-P-K + liquids

Stalk yields with high population + liquids

Starters with big planters + liquids

Late season applications + liquids

Increase total nutrient uptake and amounts/day + liquids
Nutrient Uptake For High Yield Corn
(R. Flannery - 308 Bu/A)

- **N** (blue line)
  - 4-leaf: 
  - 8-leaf: 
  - 12-leaf: 
  - Early Tassel:
- **P2O5** (red line)
  - 11.0 lb N/a/day
  - 2.85 lb P2O5/a/day
- **K2O** (green line)
  - 15.3 lb K2O/a/day

**Nutrient Uptake (Lb/A)** vs **Days After Planting**
Beyond N-P-K

16+ essential nutrients

Sulfur
1. More low S soil test
2. High yields
3. N/S, P/S interactions
4. Sulfate/elemental issue
5. Stalks and immobilization issues

Zinc
37% of soil samples in IPNI survey below critical level in zinc

Boron, Mn – Soybeans?
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Corn Yields bu/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>137</td>
</tr>
<tr>
<td>N</td>
<td>187</td>
</tr>
<tr>
<td>N +P</td>
<td>243</td>
</tr>
<tr>
<td>N+P+K</td>
<td>256</td>
</tr>
<tr>
<td>N+P+K+S</td>
<td>265</td>
</tr>
</tbody>
</table>

*Kansas State University*
Liquids and Micro’s

Coverage /ft\(^2\)

Placement

Timing

Response maybe in parts of field vs. general

Yield increases 5-10 bu – hard to see without plots and yield measurements

Carrier for micro’s
1. Dad was well trained in 70’s on fertility so new farm decision makers already understand soil fertility and fertilization

2. Soil testing for field average is fine

3. It’s too hot in growing corn to collect plant tissue samples
Reinforcing a Commodity Fertilizer Program

4. My customer are fine with 180-200 bu corn yields

5. High yields clubs are for 80-90’s

6. All fertilizer sources are the same “if applied correctly”.

7. Farmers will not pay for helping transform information and data into crop production decision.

Etc.