Soil Fertility in a Wheat/Soybean/Corn Rotation

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Road Map

- General soil testing and fertility concepts
- Wheat specific issues
  - Yield goals
  - Sulfur
  - Burning or bailing stubble
All Soil Test Recommendations for P & K Include:

- Critical Level
  - Yield loss below this level
- Crop removal
  - How much goes out with the crop
- Build-up
  - Extra added to keep soil testing above target level.
- Rotation?
Critical Level:

Critical level: 320 lbs K/acre

% Relative Yield

Lbs. K/acre
Critical Levels for Missouri Crops

- **P**
  - Row crops except for rice: 45 lbs/a by Bray 1
  - Rice: 35 lbs/a by Bray 1

- **K**
  - Row crops except for rice: 220 + (5XCEC) lbs/a by Ammonium acetate
  - Rice: 125 + (5XCEC) lbs/a by Ammonium acetate
The cost of being below the critical level for K:

Based on $5.00/bu rice
Crop Removal for P & K

<table>
<thead>
<tr>
<th>Crop</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Soybean</td>
<td>0.9</td>
<td>1.5</td>
</tr>
<tr>
<td>Corn</td>
<td>0.35</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Given in lb of P or K per bu
# Crop Uptake and Removal for Phosphorus

<table>
<thead>
<tr>
<th>Crop</th>
<th>Uptake</th>
<th>Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat 70 bu</td>
<td>50 lb</td>
<td>42 lb</td>
</tr>
<tr>
<td>Soybean 60 bu</td>
<td>72 lb</td>
<td>54 lb</td>
</tr>
<tr>
<td>Corn 200 bu</td>
<td>120 lb</td>
<td>70 lb</td>
</tr>
</tbody>
</table>

**2-Year total** 166 lb
Crop Uptake and Removal for Potash

<table>
<thead>
<tr>
<th>Crop</th>
<th>Uptake</th>
<th>Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat 70 bu</td>
<td>140 lb</td>
<td>28 lb</td>
</tr>
<tr>
<td>Soybean 60 bu</td>
<td>144 lb</td>
<td>90 lb</td>
</tr>
<tr>
<td>Corn 200 bu</td>
<td>260 lb</td>
<td>50 lb</td>
</tr>
<tr>
<td><strong>2-Year total</strong></td>
<td><strong>168 lb</strong></td>
<td></td>
</tr>
</tbody>
</table>
Grain Removal:

Wheat: 70 bu
Corn: 200 bu
Soybeans: 50 bu
Value of P & K removed

Based on P @ $1.05/unit & K @ $0.60/unit

2-year rotation removes $250+ of P & K!
Build Up:

• Fertilizer added above target level + crop removal to keep soils testing in optimum range

• Select from 1-8 years
  – 1 year, add more in a good year?
  – 8 year, limit inputs in bad years?

• MU default is 8 years, A&L is 4
P & K Build up

- For the average soil it takes:
  - 5 lb of applied $K_2O$ = to raise soil test 1 lb/a K
  - 7 lb of applied $P_2O_5$ = to raise soil test 1 lb/a P

- Removal: same numbers apply in reverse

- Do you farm the average soil?

- Our system works for silt loams but not for sands
P & K build up on Sands

Leaching of K thwarted our build up system. Suggest treating K as a yearly input with no plans for build up.
Yield Goals

• Average yield VRS best year ever?
  – If you fertilize for the average yield that’s all you will ever get!
  – Best decisions flow from the most information
  – Split applications for N

• MU soil test recommendations for wheat/beans
  – You get to pick your wheat goal, but the system says 40 bu for your beans
  – It all goes back to the critical level and crop removal
Sulfur in Soils

• Organic matter (OM) is 3% Sulfur
  – 600 lb S for each % of OM not available to plants in OM
• Sulfur becomes available as OM is decomposed
  – Rate dependent on temperature
• Sulfur very water soluble, leaches as fast at it is made available

• Bottom line:
  Cool, wet spring weather = Sulfur deficiencies
Free Sulfur or Acid Rain?

1986

1 inch rain = 1.5 lb S/acre

2003

1 inch rain = 0.75 lb S/acre
Sulfur & Wheat Yields

• State wide study 2000-2003
  – Soil test called for no Sulfur but yield increase found at 2 of 8 sites, Portageville and Mount Vernon.
  – 10 lbs S added an average of 6 bu/acre at Portageville
Sulfur & Wheat Yields
2004-2005 Portageville, Silt loam soil

2004
2005
2-Year average

Check
12 lbs S
24 lbs S
Sulfur Recommendations

• MU Soil test recommendations
  – 2 factors
    • CEC above 6.5: No S recommended
    • Soil test below 7.5 ppm SO$_4$-S: 10-20 lbs S/acre

• My Recommendation
  – Add 50 lb AMS at green-up
    • 12 lbs/acre Sulfur & 11 lbs Nitrogen
    • Adds $5.00 per acre to production costs

• Tissue testing at green up is a good guide to sulfur deficiency
Down side to Sulfur: It lowers pH

<table>
<thead>
<tr>
<th>N-Source</th>
<th>lb lime required for 100 lbs N as</th>
</tr>
</thead>
<tbody>
<tr>
<td>Am Nitrate</td>
<td>280</td>
</tr>
<tr>
<td>UAN solution</td>
<td>300</td>
</tr>
<tr>
<td>Urea</td>
<td>320</td>
</tr>
<tr>
<td>Am Sulfate</td>
<td>840</td>
</tr>
<tr>
<td>El Sulfur</td>
<td>210*</td>
</tr>
</tbody>
</table>

*For 20 lbs Sulfur
Burning & Bailing

Wheat straw is 0.25% P and 1% K

• Bailing:
  – 50 lb bail contains 0.125 lb P and 0.5 lb K
  – P & K valued at $0.30 per bail
  – How many bails per acre?

• Burning:
  – N P & K were 70% conserved in my test.
  – Is this what happens in your fields?
Questions?
Suggestions?