Why more midwest K problems in 2003? (And what can I do?)

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Some possibilities to be discussed

- K application vs crop removal
- Soil test K levels and trends
- Factors influencing soil test K measurement and interpretation
K fertilizer consumption in WI

K<sub>2</sub>O, 1000 short tons

Percent of total area planted that is in a corn-soybean rotation

Padgitt et al., 2000
Historical corn and soybean acreage in WI

Year

Harvested acres, x1000

Corn

Soybean

NASS, 2003
Historical K removal by corn/soybean rotation in WI

Total K removed by rotation, lb K$_2$O/A

End of soybean year in corn/soybean rotation

NASS, 2003; PPI, 2003
Percent of major field crop area where hay or pasture was a previous crop

Padgitt et al., 2000
Historical alfalfa and corn silage acreage

NASS, 2003
Historical K removal by forage crops in WI

K removal, lb K$_2$O/A/Yr

Year

1900 1920 1940 1960 1980 2000 2020

Alfalfa
Corn silage

NASS, 2003; PPI, 2003
Wisconsin K Removal by Major Crops

- Alfalfa: 47%
- Corn (grain): 15%
- Corn (silage): 13%
- Soybeans: 11%
- Other hay: 6%
- Other: 8%
## Wisconsin partial K budget

<table>
<thead>
<tr>
<th>Component</th>
<th>Million lb K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop removal ($R$)</td>
<td>739.0</td>
</tr>
<tr>
<td>Applied fertilizer ($F$)</td>
<td>567</td>
</tr>
<tr>
<td>Recoverable manure ($M$)</td>
<td>222</td>
</tr>
<tr>
<td>Balance: $F - R$</td>
<td>-172.0</td>
</tr>
<tr>
<td>Balance: $(F + M) - R$</td>
<td>50.0</td>
</tr>
<tr>
<td>Ratio: $R / F$</td>
<td>1.30</td>
</tr>
<tr>
<td>Ratio: $R / (F + M)$</td>
<td>0.94</td>
</tr>
</tbody>
</table>
What can I do? Check K budgets.

- Calculations can be
  - Done by hand
  - Performed in a spreadsheet
  - Performed by PKalc
    - Calculator that facilitates balance calculations
    - Minimizes calculation errors
Use a recent soil test to evaluate budgets

- **Low soil test, but levels are expected to increase**
- **Low soil test, and levels are expected to decline further**
- **High soil test, but levels are expected to decline**
- **High soil test, and levels are expected to increase further**

**Difference from target soil test level**

$(\text{Actual soil test level} - \text{target soil test level})$
Combs and Peters
Wisconsin has the highest frequency of soils below 160 ppm in the central Corn Belt.

Distribution of soil K levels in WI

Central Corn Belt soils testing <160 ppm, %

% of samples

<table>
<thead>
<tr>
<th>Ammonium acetate equivalent K, ppm</th>
<th>0-40</th>
<th>41-80</th>
<th>81-120</th>
<th>121-160</th>
<th>161-200</th>
<th>201-240</th>
<th>241-280</th>
<th>281-320</th>
<th>&gt;320</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>2</td>
<td>24</td>
<td>31</td>
<td>20</td>
<td>11</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
How soil test levels change depends on many factors

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Not fertilized</th>
<th>1080 lb K₂O/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moist</td>
<td>Dry</td>
</tr>
<tr>
<td>Antigo sil</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>Carrington sil</td>
<td>69</td>
<td>109</td>
</tr>
<tr>
<td>Miami sil</td>
<td>75</td>
<td>142</td>
</tr>
<tr>
<td>Plainfield s</td>
<td>61</td>
<td>63</td>
</tr>
<tr>
<td>Spencer sil</td>
<td>38</td>
<td>51</td>
</tr>
<tr>
<td>Superior cl</td>
<td>64</td>
<td>72</td>
</tr>
</tbody>
</table>

Attoe, 1947 (WI)
Laboratory drying temperature can affect soil test K differently for various soils

Mallarino et al., 2003 (IA)
Soil clay mineralogy can impact K variability

- Montmorillonite clays
  - Fix K under reducing (wet) conditions
    - Soil test levels may decrease

- Illite clays
  - Release K under reducing (wet) conditions
    - Soil test levels may increase

Stucki, 1996 (IL)
Response to K may depend upon soil series

Soil series
- Canisteo, Colo, Ely, Nicollet, Tama, Webster. All with low subsoil K and poor permeability.
- Many others

Mallarino et al., 2003 (IA)
Depth and location of cores impacts variability

Robbins and Voss, 1991 (IA)

No-till field with 10-yr history
Tama silt loam
Core number impacts variability

True average

5 cores per sample

20 cores per sample

Soil test P category upper limit (ppm)

Frequency (50 total)
What can I do? Monitor K status of crops and record metadata.

- Watch for visual symptoms of K deficiency
- Test plant tissue
  - Plants with and without visual deficiency symptoms
  - Consult “Using Plant Analysis as a Diagnostic Tool”, Kelling et al.
- Test soils properly and consistently
  - Note soil moisture conditions at sampling
  - Record soil series, landscape position, past cropping history, and nutrient applications
Strive for improved K management

- K management may require more vigilance
- Consider making more intensive K measurements part of an initiative at the retail outlet or consulting business
  - Let farmers know there is uncertainty in soil test K data and provide options
    - Tissue testing
    - Establishing monitoring areas for soil test K under different moisture conditions, soil series, and fertilization practices
  - Share findings during meetings to create awareness of your efforts and any results