Effect of Tillage and K Fertilization on Soybean Yield

Dick Wolkowski
Department of Soil Science
UW-Madison
rpwolkow@wisc.edu
Today’s discussion topics

- Review soybean K fertility
- Fertilizer recs. for soybean
- Summarize 3 year tillage x K fertility study on soybean
Comparison of basic P and K fertility requirements of corn and soybean

<table>
<thead>
<tr>
<th>Crop</th>
<th>Component</th>
<th>Yield</th>
<th>( \text{P}_2\text{O}_5 )</th>
<th>( \text{K}_2\text{O} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>per bu</td>
<td>total</td>
</tr>
<tr>
<td>Corn</td>
<td>Grain</td>
<td>150</td>
<td>0.37</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Crop Need</td>
<td></td>
<td>0.57</td>
<td>86</td>
</tr>
<tr>
<td>Soybean</td>
<td>Grain</td>
<td>50</td>
<td>0.80</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Crop Need</td>
<td></td>
<td>1.07</td>
<td>54</td>
</tr>
</tbody>
</table>

Source: Purdue Corn and Soybean Field Guide, 2005
Soybean K uptake rate is different than corn

- Soybean accumulates K at a slower rate
- Soybean can absorb K at lower soil solution concentrations
- Seed concentrations vary less than plant tissue
### UW soil test recs. reflect soybean K physiology

<table>
<thead>
<tr>
<th>Crop</th>
<th>Subsoil Group</th>
<th>VL</th>
<th>L</th>
<th>O</th>
<th>H</th>
<th>EH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>B</td>
<td>&lt;70</td>
<td>70-90</td>
<td>91-110</td>
<td>111-150</td>
<td>&gt;150</td>
</tr>
<tr>
<td>Soybean</td>
<td>B</td>
<td>&lt;50</td>
<td>50-80</td>
<td>81-100</td>
<td>101-120</td>
<td>&gt;140</td>
</tr>
<tr>
<td>Corn</td>
<td>C</td>
<td>&lt;60</td>
<td>60-70</td>
<td>71-100</td>
<td>101-140</td>
<td>&gt;140</td>
</tr>
<tr>
<td>Soybean</td>
<td>C</td>
<td>&lt;40</td>
<td>40-70</td>
<td>71-90</td>
<td>91-110</td>
<td>&gt;130</td>
</tr>
<tr>
<td>Corn</td>
<td>E</td>
<td>&lt;45</td>
<td>45-65</td>
<td>66-90</td>
<td>91-130</td>
<td>&gt;130</td>
</tr>
<tr>
<td>Soybean</td>
<td>E</td>
<td>--</td>
<td>&lt;60</td>
<td>60-80</td>
<td>81-100</td>
<td>&gt;120</td>
</tr>
</tbody>
</table>

**Source:** UWEX, A2809  
**Note:** VH category for soybean not shown
Effect of soil test on soybean K accumulation by crop component

Fig. 32–3. Accumulation of K in soybean plants during the growing season at high and low levels of K+ availability (Dunphy, 1972; Loberg, 1979).

Soybean K concentration in various crop components

Fig. 32–4. Concentrations of K⁺ in different soybean plant parts during the growing season at high and low levels of K⁺ availability (Dunphy, 1972; Loberg, 1979).
Arlington long-term rotation-tillage-fertilization study

- ROTATION AND TILLAGE TREATMENT SINCE 1997
  - Fertilizer treatments installed 2001
- ROTATION
  - Cont. corn, soybean/corn, corn/soybean
- TILLAGE
  - Chisel/field cultivator, strip-till, no-till
- FERTILIZER PLACEMENT
  - None, fall broadcast, 2 x 2, deep (strip-till only)
  - 18+46+60
- MEASURE STAND, GROWTH, K REMOVAL, YIELD
Strip-till treatment
Note: Pictures taken at Lancaster

Remlinger Strip-till tool

Kinze planter - Pete Wakeman

Note: Soybean planted in 30” rows
Main effect of tillage on crop residue in soybean following corn, Arlington, Wis.

![Bar graph showing the main effect of tillage on crop residue in soybean following corn in Arlington, Wis.](image)

- The graph shows the percentage of crop residue over years (2002, 2003, 2004) for different tillage methods: CH, ST, and NT.
- Significant differences are indicated by ** symbols.
Main effect of tillage on soybean population, Arlington, Wis.

The graph shows the main effect of tillage on soybean population from 2002 to 2004. The bars represent the stand (x 1000) for CH, ST, and NT tillage methods. The years 2002, 2003, and 2004 are plotted on the x-axis, and the stand values are shown on the y-axis. The significance levels are indicated with 'NS' and '*', where NS means non-significant and * indicates a significant difference.
Main effect of fertilizer placement on soybean population, Arlington, Wis.

![Bar chart showing the main effect of fertilizer placement on soybean population from 2002 to 2004. The chart compares four different treatment groups: NONE, BDCT, 2x2, and 2x2. The y-axis represents stand count (x 1000) ranging from 80 to 180, and the x-axis represents years 2002, 2003, and 2004. The chart indicates that the main effect is significant in 2003 (marked with an asterisk) and not significant in 2002 and 2004 (marked with NS).]
Effect of tillage and fertilizer placement on soil test K, Arlington, Wis.

BDCT = 18+46+60/YR
Main effect of tillage on the dry matter accumulation of soybean, Arlington, Wis., 2003

- CH
- ST
- NT

Dry Matter (lb/ha)

Julian Date

0 174 188 205 233 253

** NS
Main effect of fertilizer placement on the dry matter accumulation of soybean, Arlington, Wis., 2003

![Graph showing the dry matter accumulation of soybean over Julian Date with different fertilizer placements: NONE, BDCT, and 2 x 2. The graph indicates NS (not significant) and significant differences marked with * and **.](image-url)
Main effect of tillage on the K concentration of soybean, Arlington, Wis., 2003
Main effect of fertilizer placement on the K concentration of soybean, Arlington, Wis., 2003

![Graph showing the main effect of fertilizer placement on K concentration of soybean. The graph displays a downward trend in tissue K (%) from 2.5 to 0 as Julian Date progresses from 174 to 253. The graph includes data points and lines for different fertilizer treatments: NONE, BDCT, and 2 x 2.](image-url)
Main effect of tillage on soybean yield, Arlington, Wis.

YIELD (bu/a)

2002 2003 2004

CH  ST  NT

NS  *
Main effect of fertilizer placement on soybean yield, Arlington, Wis.

YIELD (bu/a)

- 2002
- 2003
- 2004

- NONE
- BDCT
- NS

NS

2002 2003 2004

YIELD (bu/a)
Summary

- Soybean has the ability to extract K more effectively at low soil test
- Sensitivity to fertilizer application even when fall applied
- Slower growth in high residue, but similar by the end of the season
- Tillage did not affect tissue K
- Fertilization substantially increased vegetative K concentration, but seed similar
- Tillage had a minimal effect on yield
- Slight benefit to annual (recommended) fertilization, with no difference between broadcast and 2 x 2