CROP RESPONSE TO SOIL TEST P & K AND STARTER FERTILIZER

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Introduction

• Frequent reports of K deficiency.
• More often seen in no-till.
• Do current soil test K recommendations need modification?
• Does starter fertilizer containing K prevent deficiencies?
**Procedure**

- Long-term plots with wide range of soil test K (VL to EH, 60 to 265 ppm).
- Response to NPK starter (100/9-23-30) across range of soil test K levels.
- Corn yield responses measured over 4 yr.
# Soil test K interpretation for corn (Group B soils)

<table>
<thead>
<tr>
<th>Category</th>
<th>Soil test K (ppm)</th>
<th>Recommend. (lb K₂O/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V. low (VL)</td>
<td>&lt; 70</td>
<td>100</td>
</tr>
<tr>
<td>Low (L)</td>
<td>70-90</td>
<td>90</td>
</tr>
<tr>
<td>Optimum (O)</td>
<td>91-110</td>
<td>60</td>
</tr>
<tr>
<td>High (H)</td>
<td>111-150</td>
<td>30</td>
</tr>
<tr>
<td>Ex. high (EH)</td>
<td>&gt; 150</td>
<td>0</td>
</tr>
</tbody>
</table>

* 151-170 bu/acre yield goal.
Procedure

• 1993 to 1996.

• P and K broadcast to some plots (1993 & 1995 – spring disked & chisel plowed) to expand the range of soil test levels.

• No-till in 1994 and 1996.
Soil K response relationship relative to current soil test interpretation ranges at Arlington, 1993 to 1996

Soil test K, ppm

Relative yield, %

VL       L       O          H                  EH

69%  77%  93%      98%             100%

Soil K response relationship relative to current soil test interpretation ranges at Arlington, 1993 to 1996
## Growing season characteristics

<table>
<thead>
<tr>
<th>Year</th>
<th>PDRM*</th>
<th>F.F. days</th>
<th>GDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>225</td>
<td>154</td>
<td>2055</td>
</tr>
<tr>
<td>1994</td>
<td>228</td>
<td>189</td>
<td>2293</td>
</tr>
<tr>
<td>1995</td>
<td>227</td>
<td>145</td>
<td>2413</td>
</tr>
<tr>
<td>1996</td>
<td>228</td>
<td>170</td>
<td>2043</td>
</tr>
</tbody>
</table>

* Planting dates: Apr. 30 to May 3; RM=105
**Relationship between soil test K level and yield response to starter fertilizer at Arlington, 1995**

\[y = \begin{cases} 
343 - 6.82x + 0.034x^2 & \text{if } x < 100 \\
0 & \text{if } x > 100 
\end{cases} \]

\[R^2 = 0.52 \quad n = 54\]
Relationship between soil test K level and yield response to starter fertilizer at Arlington, 1996

QRP

\[ y = 145 - 2.04x + 0.0075x^2 \]

if \( x < 136 \)

\[ y = 6 \]

if \( x > 136 \)

\[ R^2 = 0.32 \quad n = 111 \]
Relationship between temperature (GDD and departure – May to September) and maximum soil test K level where yield response to starter fertilizer occurred

\[ y = 1119 - 0.84x + 0.00017x^2 \]

\[ R^2 = 0.97 \]
Relationship between temperature (GDD and departure – May to September) and maximum soil test K level where yield response occurred.
Relationship between soil test K level and soybean grain yield relative to current soil test interpretation ranges at Arlington, 1992

Yield, bu/acre

Soil test K, ppm

L          O        H      VH      EH
(31 bu/a)  (36)    (38)    (38)    (38)

n = 184
Relationship between Bray P1 and Mehlich III extractable soil P (0-2 cm) for southern silty and eastern clayey soils in Wisconsin.

Southern silty soils: $n = 350$, $y = -7 + 1.46x$, $r^2 = 0.96$

Eastern clayey soils: $n = 56$, $y = 8 + 1.32x$, $r^2 = 0.94$
Summary

• Results support the soil test K & P categories used for current fert. recommendations.
• For corn, little response to increasing soil test K above 110 ppm or above 20 ppm for P.
• Frequency and size of response to starter was influenced by GDD accumulation.
• Response to starter occurred at higher soil test K levels in cooler growing seasons.
**Relationship between soil test K level and yield response to starter fertilizer at Arlington, 1993 to 1996**

\[ y = 153 - 2.35x + 0.0092x^2 \]

if \( x < 128 \)

\[ y = 0 \]

if \( x > 128 \)

\[ R^2 = 0.34 \quad n = 309 \]
Relationship between Bray P1 and Mehlich 3 soil tests on Eastern Red Soils in Wisconsin

\[ y = 0.62x + 2.06 \]

\[ R^2 = 0.99 \]
Procedure- Corn P Response

• Results only from plots with soil test K values ≥ 135 ppm and where no broadcast P was applied in the study year.

• Range of soil test P levels (6 – 64 ppm).

• Max. yield to calculate rel. yield was the average of plots with STP>30.
Soil P response relationship relative to current soil test interpretation ranges at Arlington, 1993 to 1996
Relationship between soil test P level and yield response to starter fertilizer at Arlington, 1996

R² = 0.04  n = 52

Soil test P, ppm

Yield response, bu/acre

QRP

Mean yield response

VL  L  O  H  EH

15  9  5  4  10

Mean yield response

R² = 0.04  n = 52
Relationship between soil test P level and yield response to starter fertilizer at Arlington, 1993 to 1996

QRP

\[ R^2 = 0.04 \quad n = 147 \]