Potassium Nutrition and Soil Testing

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Soil View, Paulina, IA

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Columbus, Ohio
My Background

5th Generation farm family in eastern Nebraska – 500 acres corn and soybeans

Affiliate Professor Colorado State University.
- Ph.D. Montana State University,
- Extension Soil Specialist UC Davis.

Conduct Regional Research in Soil Sampling, Soil Fertility, Lab Analysis and Coordinate the Agricultural Laboratory Proficiency (ALP) Program.
Overview

- Potassium Trends: Soil and Tissue
- Corn K Nutrition
- Field K Studies
- STK, Ear Leaf K and Yield
- Fertility Management
Soil Test K Trends

IPNI Report shows STK declining, in Ohio, Indiana and Michigan over the past 15 years.

<table>
<thead>
<tr>
<th>State</th>
<th>STK Decline (ppm)</th>
<th>2005 - 2010</th>
<th>2010 - 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio</td>
<td>- 23</td>
<td>- 20</td>
<td></td>
</tr>
<tr>
<td>Indiana</td>
<td>- 14</td>
<td>- 30</td>
<td></td>
</tr>
<tr>
<td>Michigan</td>
<td>- 18</td>
<td>- 19</td>
<td></td>
</tr>
</tbody>
</table>

Data from LGI Laboratory shows STK declining, Ellsworth Iowa.

<table>
<thead>
<tr>
<th>STK (ppm)</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 130</td>
<td>30 %</td>
<td>35 %</td>
<td>42 %</td>
</tr>
<tr>
<td>&lt; 170</td>
<td>58 %</td>
<td>63 %</td>
<td>68 %</td>
</tr>
</tbody>
</table>

Mean STK Dropping 6-7 ppm/yr

Miller et al, 2017
Soil Test K - Ohio

What Does Plant Analysis Show

<table>
<thead>
<tr>
<th>K ppm</th>
<th>% of samples less than</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 100</td>
<td>26.6</td>
</tr>
<tr>
<td>&lt; 150</td>
<td>65.5</td>
</tr>
<tr>
<td>&lt; 180</td>
<td>80.8</td>
</tr>
</tbody>
</table>

Soil Test K Median 132 ppm

N = 94922 samples

1 Source: Bill Urbanowicz, Spectrum Analytical, 2017.

Miller et al, 2017
# Corn Nutrient Deficiencies - Indiana

Ear Leaf R1-R2, 3670 samples, six years

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Deficiency threshold</th>
<th>Percent of samples deficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
<td>&lt; 2.90</td>
<td>9.7</td>
</tr>
<tr>
<td>P (%)</td>
<td>&lt; 0.30</td>
<td>8.3</td>
</tr>
<tr>
<td>K (%)</td>
<td>&lt; 1.90</td>
<td>41.5</td>
</tr>
<tr>
<td>S (%)</td>
<td>&lt; 0.16</td>
<td>0.5</td>
</tr>
<tr>
<td>Zn (ppm)</td>
<td>&lt; 20</td>
<td>6.9</td>
</tr>
</tbody>
</table>


2 Corn ear leaf GS R1-R2.

Source: Betsy Bower, Ceres Solutions, Lafayette, IN

Miller et al, 2017
You can’t resolve a problem unless you know its cause.

Robert Lustig UCSF, CA
Plant Potassium Nutrition

Crop Demand

• Plant Nutrition
• Phenology of Uptake
• Plant Population

Soil Supply

• Soil Chemistry
• Nutrient Transport
• Stratification

Miller et al, 2017
Potassium Accumulation: Karlen et. al. 1988

Corn Yield: 308 bu/ac

*K above ground


Miller et al, 2017
Corn Potassium Accumulation Rate

K Uptake improves stalk height (Gelderman, 2002)

### Corn Population and Nutrient Uptake

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Aerial Uptake grams per plant (g)</th>
<th>Estimated Uptake per 1000 plts/ac (lbs/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>3.8 ± 0.4</td>
<td>8.4 ± 1.0</td>
</tr>
<tr>
<td>P</td>
<td>0.8 ± 0.2</td>
<td>1.7 ± 0.9</td>
</tr>
<tr>
<td>K</td>
<td>3.1 ± 0.5</td>
<td>6.8 ± 1.0</td>
</tr>
</tbody>
</table>

1 Source: Data review of published literature for corn populations ranging from 10,000 to 44,000 plant per acre: Sayre, 1948; Jordan et al 1950; Hanway, 1962; Rhoades and Stanley 1981; Karlen et al 1987, 1988; and Doberman, 2003.

Increasing corn population from 24,000 to 32,000 requires another 55 lbs/ac of K uptake.
Plant Potassium Nutrition

Crop Demand

- Plant Nutrition
- Plant Population
- Phenology of Uptake

Soil Supply

- Soil Chemistry
- Nutrient Transport
- Stratification

Miller et al, 2017
Soil Potassium Transport

**Root Interception**
Direct root contact with soil K, 1-2% of total uptake.

**Mass Flow**
Soil solution K acquired through mass flow of soil water to plant root, 10-20% of total.

**Diffusion**
K movement down ion concentration gradient from bulk soil to root surface, 70-80% of uptake. Impacted by moisture.

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1 Jungk and Claassen, 1986. Z. Pflanzenernähr. Bodenk

Miller et al, 2017
STK Stratification – Five Sites 2014

STK consistently elevated at surface levels (> 3x subsoil) across 94% of KRx locations across four states.

Specific sites the 0-2” depth was 5X the content of the 6-8” depth. All sub soils had STK < 90 ppm.

1 2014 KRx Project, SD, MN, IA, IL.
Soil Testing

Lab Analysis

Calibration Data

Root Cause Analysis

Corn Nutrition

Soil Fertility

Grain Yield

Application

Miller et al, 2017
Nutrient Management

Soil Testing

An evaluation of nutrient availability based on the probability of crop response utilizing a laboratory chemical extraction method. It has little to do with crop uptake or requirements.

Tissue Testing

Is an assessment of leaf/plant nutrient concentration based on a standard norm and historical observations.

Gerwing, Gelderman and Bly, 2003


Miller, 2011
Miller et al, 2017
KRx Project

KRx project was launched in 2011 to evaluate grain yield response to applied K across six states based on the 4Rs approach.

Assess STK, ear leaf nutrient and K fertilizer on grain yield.

K Deficiency Winchester, Indiana, 2012 - Dave Taylor
KR$_X$ Corn Yield Response

KR$_x$ Project Yield Results 2012
six Illinois, Indiana and Nebraska sites.

<table>
<thead>
<tr>
<th>Site</th>
<th>STK</th>
<th>Check</th>
<th>+K</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cty / State</td>
<td>ppm</td>
<td>bu/ac</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merrick, NE</td>
<td>151</td>
<td>169</td>
<td>170</td>
<td>+ 1</td>
</tr>
<tr>
<td>Vermillion, IL</td>
<td>131</td>
<td>174</td>
<td>176</td>
<td>+ 2</td>
</tr>
<tr>
<td>Livingston, IL</td>
<td>142</td>
<td>89</td>
<td>88</td>
<td>- 1</td>
</tr>
<tr>
<td>Piatt, IL</td>
<td>305</td>
<td>141</td>
<td>154</td>
<td>+ 13*</td>
</tr>
<tr>
<td>Sullivan, IN</td>
<td>116</td>
<td>94</td>
<td>110</td>
<td>+ 16</td>
</tr>
<tr>
<td>Warsaw, IN</td>
<td>198</td>
<td>73</td>
<td>67</td>
<td>- 6</td>
</tr>
</tbody>
</table>

* Yield significant at the 0.10 level, corn 15.5% moisture.

STK 0-6” Depth

K increased yield on a soil STK > 300 ppm
## KR<sub>x</sub>: N x K Corn Yield Response

### 2015 Yield Response to N and K

<table>
<thead>
<tr>
<th>Treatment</th>
<th><strong>Iowa Sutherland</strong></th>
<th><strong>Wisconsin Dodgeville</strong></th>
<th><strong>Illinois Farmer City</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STK (ppm)</strong></td>
<td>192</td>
<td>178</td>
<td>154</td>
</tr>
<tr>
<td><strong>Check</strong></td>
<td>194 *</td>
<td>219 *</td>
<td>183 *</td>
</tr>
<tr>
<td><strong>50 K&lt;sub&gt;ac&lt;/sub&gt;</strong></td>
<td>206 *</td>
<td>231 *</td>
<td>187 *</td>
</tr>
<tr>
<td><strong>50 N</strong></td>
<td>217 *</td>
<td>230 *</td>
<td>200 *</td>
</tr>
<tr>
<td><strong>50 N + 50 K&lt;sub&gt;ac&lt;/sub&gt;</strong></td>
<td>212 *</td>
<td>239 *</td>
<td>195 *</td>
</tr>
</tbody>
</table>

1. Treatments in the same column are significant from the check plot at p 0.1 level, 8 reps

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Miller et al, 2017
A K application\(^1\) improved grain yield at 28 of 60 locations.

**Probability of yield response**

- STK 75 to 150 - 62%
- STK 150 to 200 - 56%
- STK 200 to 300 - 38%
- STK 300 to 600 - 8%

**Ave yield increase**

11 bu/ac

\(^1\) Yield increase to application of 50 lbs/ac K at V3-V5.

*Miller et al, 2017*
2011, a K application\(^1\) of 100 lbs/ac only increased ear leaf K significantly at 1 of 18 locations.

Similar results were found in 2012, 2013, 2014, and 2015.

In summary relatively no response in ear leaf K to applied K.

\(^1\) K applied as KCl + KSO\(_4\) at V5 using spoke wheel applicator.
Premise of soil testing, that a lack of crop yield response indicates no nutrient deficiency.

However, just because there is no yield response does not mean that a fertilizer corrected a crop nutrient deficiency.

Questions

- Does soil test K influence yield?  Ear leaf K?
- Does ear leaf K impact yield?
- Due Soil factors (pH, SOM, CEC etc.) effect leaf nutrition?
2011-2015, 81 site studies were conducted in grower corn fields across 7 states. Check plot data: soil analysis (pH, P, K, Ca, Mg NO$_3$-N, P, SOM, CEC - 0-6”); ear leaf GS R1-R2 nutrients$^1$; harvest population, grain yield; eight reps per site.

Sites diverse in: soil types, hybrids, fertility mgt, crop history, irrigated/dryland, and weather.

2016, 50 additional sites in seven states, added data collected on stalk nutrients, 4 reps/site. Cluster analysis and regression modeling.

$^1$ Lab Analysis: LGI, Solum Laboratory and Sure Tech Labs.
Cluster Analysis: STK vs Grain Yield

2014, 16 observation sites, 5 states. Data collected on M3-K, ear leaf nutrients and yield, M3-K sorted low to high.

<table>
<thead>
<tr>
<th>STK (ppm)</th>
<th>Yield (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>161</td>
</tr>
<tr>
<td>100</td>
<td>234</td>
</tr>
<tr>
<td>116</td>
<td>222</td>
</tr>
<tr>
<td>122</td>
<td>162</td>
</tr>
<tr>
<td>126</td>
<td>208</td>
</tr>
<tr>
<td>128</td>
<td>131</td>
</tr>
<tr>
<td>139</td>
<td>174</td>
</tr>
<tr>
<td>141</td>
<td>183</td>
</tr>
<tr>
<td>146</td>
<td>182</td>
</tr>
<tr>
<td>151</td>
<td>188</td>
</tr>
<tr>
<td>158</td>
<td>187</td>
</tr>
<tr>
<td>163</td>
<td>128</td>
</tr>
<tr>
<td>186</td>
<td>199</td>
</tr>
<tr>
<td>187</td>
<td>237</td>
</tr>
<tr>
<td>187</td>
<td>219</td>
</tr>
<tr>
<td>189</td>
<td>235</td>
</tr>
<tr>
<td>Highest</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STK (ppm)</th>
<th>Yield (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>111</td>
</tr>
<tr>
<td>Stdev</td>
<td>16</td>
</tr>
<tr>
<td>Mean</td>
<td>182</td>
</tr>
<tr>
<td>Stdev</td>
<td>11</td>
</tr>
</tbody>
</table>

1 Cluster analysis contrasting five lowest sites and five highest sites for Mehlich 3 K 0-6" response variable grain yield, 8 reps per site.

Miller et al, 2017
Cluster Analysis: STK and Yield

Box Whisker plot STK cluster\(^1\) comparisons variable grain yield, 3 years.

1 2
Yield (bu/ac)
100
120
140
160
180
200
220
240
260

2012 Soil M3-K

130 mg kg\(^{-1}\) 350 mg kg\(^{-1}\)

Low  High

2013 Soil M3-K

160 mg kg\(^{-1}\) 231 mg kg\(^{-1}\)

Low  High

2016 Soil M3-K

102 mg kg\(^{-1}\) 342 mg kg\(^{-1}\)

Low  High

Cluster analysis contrasting five lowest sites and highest sites for Mehlich 3 STK 0-6 in response variable grain yield.

\(^1\) Cluster analysis contrasting five lowest sites and highest sites for Mehlich 3 STK 0-6 in response variable grain yield.

Miller et al, 2017
Cluster Analysis: STK vs Leaf K

Box Whisker plot soil M3-K cluster\(^1\) comparisons for variable ear leaf K for three years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Soil STK Cluster</th>
<th>Leaf STK Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>134 (mg kg(^{-1}))</td>
<td>331 (mg kg(^{-1}))</td>
</tr>
<tr>
<td>2014</td>
<td>111 (mg kg(^{-1}))</td>
<td>182 (mg kg(^{-1}))</td>
</tr>
<tr>
<td>2016</td>
<td>102 (mg kg(^{-1}))</td>
<td>321 (mg kg(^{-1}))</td>
</tr>
</tbody>
</table>

\(^1\) Cluster analysis contrasting five lowest sites and highest sites for Mehlich 3 K 0-6” response variable corn ear leaf K R1-R2.

Miller et al, 2017
Box Whisker plot nutrient cluster\(^1\) comparisons

Variable grain yield – 2014, 16 sites, cluster size 5 sites each

\(^1\) Cluster analysis based on five lowest sites and highest sites for each test parameter (Leaf N, K and K:Mg), response variable grain yield, 8 reps per site.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Low K Cluster</th>
<th>High K Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Stdev</td>
</tr>
<tr>
<td>N %</td>
<td>2.80</td>
<td>0.51</td>
</tr>
<tr>
<td>K %</td>
<td>1.60*</td>
<td>0.16</td>
</tr>
<tr>
<td>Mg %</td>
<td>0.34*</td>
<td>0.04</td>
</tr>
<tr>
<td>K:Mg</td>
<td>4.8*</td>
<td>2.2</td>
</tr>
<tr>
<td>N:Mg</td>
<td>8.4*</td>
<td>1.5</td>
</tr>
<tr>
<td>Yield bu ac⁻¹</td>
<td>160*</td>
<td>21</td>
</tr>
</tbody>
</table>

Low K clusters show significant increases in Mg, and declines in K:Mg and N:Mg ratios associated with lower grain yields.

Leaf diagnostic norms reported by Elwali et al. (1985) show the normal range K:Mg of 10.0 ± 4.2 and N:Mg value 14.1 ± 3.7.

Low leaf K clusters K:Mg and N:Mg are outside normal range.

¹ Sixteen sites, each cluster five sites, differences *significant at 0.05 level.
## Summary: Ear Leaf K Cluster Analysis

132 sites, 2011 – 2016 cluster mean comparisons

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean Ear Leaf Low K cluster ¹</th>
<th>Mean Ear Leaf High K cluster</th>
<th>Yield Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>K %</td>
<td>K: Mg</td>
<td>K %</td>
</tr>
<tr>
<td>2011</td>
<td>1.77</td>
<td>5.9</td>
<td>2.64*</td>
</tr>
<tr>
<td>2012</td>
<td>1.52</td>
<td>3.2</td>
<td>1.91</td>
</tr>
<tr>
<td>2013</td>
<td>1.67</td>
<td>3.0</td>
<td>1.95</td>
</tr>
<tr>
<td>2014</td>
<td>1.60</td>
<td>4.8</td>
<td>2.17*</td>
</tr>
<tr>
<td>2015</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2016</td>
<td>1.47</td>
<td>3.6</td>
<td>2.93*</td>
</tr>
</tbody>
</table>

¹ Clusters comparisons five sites in 2011, 2012 and 2014; four in 2013; and eight 2016. No data 2015. * values are significant at the 0.05 level

² 2016 Data based on 46 sites, seven states.

Cluster comparisons show mean leaf K and K:Mg ratios are different.

Cluster yield differences were consistent.

Five year mean: 45.2

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Miller et al, 2017
Cluster Analysis Soil Properties 2016

Box Whisker plot soil test parameters\(^1\) comparisons
Variable ear leaf K, 2 clusters, size - 8 sites each

<table>
<thead>
<tr>
<th>Variable</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>K Base Sat.</td>
<td>1.2%</td>
<td>6.8%</td>
</tr>
<tr>
<td>CEC</td>
<td>8.0 cmol kg(^{-1})</td>
<td>24.6 cmol kg(^{-1})</td>
</tr>
<tr>
<td>SOM-LOI (^2)</td>
<td>2.01%</td>
<td>4.53%</td>
</tr>
</tbody>
</table>

\(^1\) Cluster analysis contrasting eight lowest sites and highest sites for soil variables 0-20 cm depth, response variable ear leaf K R1-R2. (CEC by summation).

\(^2\) Regression of CEC = 5.6(SOM-LOI) - 1.0, \(R^2 0.864\)
Cluster analysis of soil K Base Sat. shows significant differences for soil CEC, SOM, K:Mg ratio.

Low soil K Base Sat. was associated with low leaf K, stalk K and lower grain yields.

Grain yield, although associated with higher leaf K, is a function of factors (H₂O, N, Pest, etc) that impact grain fill.

---

<table>
<thead>
<tr>
<th>Variable</th>
<th>Soil K Base Saturation (%)</th>
<th>Low Cluster</th>
<th>High Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Stdev</td>
</tr>
<tr>
<td>K Base Sat (%)</td>
<td>1.2</td>
<td>0.2</td>
<td>6.8 *</td>
</tr>
<tr>
<td>CEC (cmol kg⁻¹)</td>
<td>23.4</td>
<td>3.5</td>
<td>11.7 *</td>
</tr>
<tr>
<td>SOM (%)</td>
<td>4.28</td>
<td>0.58</td>
<td>2.40 *</td>
</tr>
<tr>
<td>M3 K/Mg (meq)</td>
<td>0.05</td>
<td>0.01</td>
<td>0.43 *</td>
</tr>
<tr>
<td>Leaf K (%)</td>
<td>1.50</td>
<td>0.20</td>
<td>2.62 *</td>
</tr>
<tr>
<td>Stalk K (%)</td>
<td>0.97</td>
<td>0.55</td>
<td>2.51 *</td>
</tr>
<tr>
<td>Grain (bu/ac)</td>
<td>202</td>
<td>26</td>
<td>240</td>
</tr>
</tbody>
</table>

1 Forty-six sites across seven states, K base sat cluster size eight sites each.
2 * Mean values are significant at the 0.05 level.

Miller et al, 2017
Regression analysis\(^1\) shows ear leaf K is associated with K Base Sat, SOM and M3 K/Mg ratio.

\[
K \text{ Leaf} = 2.6 - 0.24 \times (\text{SOM}) + 0.022 \times (\text{K Base Sat}) + 1.05 \times (\text{M3 K:Mg})
\]

\[ R^2 = 0.652 \]

Inter collinearity is noted between SOM and K Base Sat.

Although positive correlation of K base saturation and M3 K/Mg ratio with leaf K has a rational basis, the negative correlation of SOM is confounding.

\(^1\) Forty-six sites 2016 across seven Midwestern states.
Linear model for M3-K for Leaf K \(R^2 = 0.242\)

Miller et al, 2017
Cluster analysis of soil K Base Sat. shows significant impact on leaf K concentration and overall average grain yield.

Note data is diverse as it represents 46 observations collected across seven states ranging in soil types, management and hybrids.

1 2016, each K base sat range had 7-9 observation sites, soil sample 0-6” depth collected spring 2016, ear leaves collected at R1-R2 growth stage.
Summary of Field Observations

- M3-K minor association with grain yield and corn leaf K.

- Corn ear leaf K clusters > 1.9% and K:Mg > 8 are associated with higher grain yields, averaging 45.2 bu ac⁻¹ over 5 yrs.

- Soil K Base saturation is positively correlated with ear leaf and stalk K, whereas CEC, SOM and M3-Mg levels are negatively correlated with ear leaf and stalk K.

- Low ear leaf K:Mg associated with 70% lower stalk K and 15% lower grain yields, 2016.

Additional Research planned for 2018 in IA, SD, IL, MN, and NE.

Miller et al, 2017
• Ear leaf N explained 48% of grain yield across 46 sites with highest yields with leaf N of 2.9 -3.3 %, growth stage R1-R2.

• Cluster analysis of ear leaf Zn showed a yield difference of 48 bu/ac with highest yields with Zn concentrations of 35-45 ppm.

• Ear leaf N and Zn accounted for 58% of grain yield variation in a multiple linear regression model.
Addressing K Deficiencies

Soil Factors Impacting Ear Leaf K

• Soil K base saturation, < 3%.
• Stratification, low sub soil M3-K, < 125 ppm.
• High soil M3-Mg, > 500 ppm.
• Soil Moisture V5-V10. A 50% decrease in soil moisture decreases K diffusion >80%, facilitating Mg uptake.

Miller et al, 2017
Recommendations

Assess K Base Sat levels. K Base < 3% indicate possible response. Assess sub soil K at 10-20% of grid points.

Plant Analysis. Confirm fertility, ear leaf (VT-R1) K < 1.9%, K:Mg ratios < 8 and N:Mg ratios < 10 are indicative of K deficiencies. Track five grid points/field, assess K management.

Corn Stalk Analysis. Low stalk K < 1.5% indicates low plant K uptake.

Focus K fertilizer on subsoil applications. Surface broadcast applications do little - side dress. Don’t expect K Base Sat or leaf K to change in 1 year, longer term 2-4 yrs.

### Management Tool

<table>
<thead>
<tr>
<th>Management Tool</th>
<th>Recommendation</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium Soil Test</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Sub Soil K Test</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Tissue Test</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Potassium Soil Test

Sub Soil K Test

Tissue Test
**Recommendations**

No Till - avoid surface K broadcast.

Reduce till systems, pre-plant in the row of dry K or liquid materials applied 2x2 or 2x4. 100 lbs/ac K applied 6” wide band over row pre-plant achieves 500 lbs/ac.

Side dress banding of liquid products (KCl, K$_2$SO$_4$ or K acetate) at V2-V5 is an option. Adding small amount of N is advised.

Zone of K enrichment. Focus on increasing K base saturation in V3-V6 root zone.

Miller et al, 2017
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2017 – Soil, tissue, stalk and yield data has been collected on an additional 23 sites and is being compiled.

2018 – Research will target Midwest sites based on soil K base sat, SOM and K/Mg ratio to verify predicted leaf K and yield results.

Evaluation of alternative methods of K application, products and timing.

\(^1\) Lab Analysis: LGI, Solum Laboratory and Sure Tech Labs.
Thank you for your time and attention