Fertilizing for $8 Soybeans

Considerations for rational adjustments to fertilizer and lime rates when soybean prices are low

Dorivar Ruiz Diaz, PhD

Associate Professor of Soil Fertility
Soybean versus fertilizer prices

USDA and Farm Futures, 2016
Soybean versus $P_2O_5$ fertilizer prices

<table>
<thead>
<tr>
<th>A bu of soybean buys:</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19</td>
<td>20</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>lbs of P2O5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Common limiting nutrients for soybean in Kansas

• In Kansas the greatest potential return to fertilizer dollars is from P, K, and some micros depending on the region (i.e. Fe).
• Optimum soil pH is essential.
• pH, P and K have reliable soil tests to measure nutrient availability and predict fertilizer/lime needs.
# Nutrient Removal in the field

<table>
<thead>
<tr>
<th>Crop</th>
<th>Unit</th>
<th>P2O5 (lb)</th>
<th>K2O (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>bushel</td>
<td>0.33</td>
<td>0.26</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>bushel</td>
<td>0.40</td>
<td>0.26</td>
</tr>
<tr>
<td>Wheat</td>
<td>bushel</td>
<td>0.50</td>
<td>0.30</td>
</tr>
<tr>
<td>Sunflowers</td>
<td>pound</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Oats</td>
<td>bushel</td>
<td>0.25</td>
<td>0.20</td>
</tr>
<tr>
<td>Soybeans</td>
<td>bushel</td>
<td>0.80</td>
<td>1.40</td>
</tr>
</tbody>
</table>
Soil test P change in 30 years corn and soybean

Ruiz Diaz, 2014
Economic return to P fertilization (using values of 2015)

Ruiz Diaz, 2014
Net return to 46 lb of P$_2$O$_5$

$\$3.8/bu Corn
$\$0.6/lb P$_2$O$_5$

Mallarino, ISU
Lime using flat rate vs Variable Rate

Cost Saving ($/acre) @ 50 ECC for 30 locations

Source: Eric Preston, MFA
Variable rate application?

• Identify parts of a field that could respond to higher rates of fertilizer.

• Savings from reduced fertilizer application: only if non-responsive areas of a field are identified.

• Benefits can only be determined on a field-by-field basis.

• The challenge is to identify opportunities for increased net income with sufficient precision without excessive cost.
Soil pH and lime application

• Soybean require good soil pH levels, however, may not be the year for full lime rate application.
  – Consider lime application of no more than 2 tons ECCE and test again in 2 years.

• Don’t lime with pH of 6.4 or higher. Values <5.5 can reduce yields significantly.

• Consider variable rate lime application.
Micronutrients soybean – Average yield (2013-2014)

Soybean yield (bu/acre)

<table>
<thead>
<tr>
<th>Fertilizer treatment</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>37</td>
</tr>
<tr>
<td>Mix-B</td>
<td>40</td>
</tr>
<tr>
<td>Control</td>
<td>40</td>
</tr>
<tr>
<td>Zn</td>
<td>40</td>
</tr>
<tr>
<td>Cu</td>
<td>40</td>
</tr>
<tr>
<td>Mix-Band</td>
<td>40</td>
</tr>
<tr>
<td>Mn</td>
<td>40</td>
</tr>
<tr>
<td>B</td>
<td>40</td>
</tr>
</tbody>
</table>

P=0.351
Micronutrients soybean – High yield

Soil Fertility Research and Extension

Fertilizer treatment
Zn Mn Control S Cu Mix-Band Mix-B B

Soybean yield (bu/acre)

Winchester

Fertilizer treatment

Zn Mn Control S Cu Mix-Band Mix-B B

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Micronutrients soybean – Responsive site

Rossville

Soybean yield (bu/acre)

Control  | Cu    | Mn     | S      | Zn  | B     | Mix-Band | Mix-B

56       | 56    | 56     | 56     | 62  | 62    | 62       | 62

Fertilizer treatment

Sandy soils, low CEC

P=0.084
## Micronutrients soybean - Rossville

<table>
<thead>
<tr>
<th>Soil parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.8</td>
</tr>
<tr>
<td>Soil test P (ppm)</td>
<td>24</td>
</tr>
<tr>
<td>Soil test K (ppm)</td>
<td>114</td>
</tr>
<tr>
<td>CEC (meq/100g)</td>
<td>4.5</td>
</tr>
<tr>
<td>OM (%)</td>
<td>0.9</td>
</tr>
<tr>
<td>Sand (%)</td>
<td>80</td>
</tr>
<tr>
<td>Clay (%)</td>
<td>5</td>
</tr>
</tbody>
</table>
Soybean response to P placed before corn - Ottawa

80 lbs/acre P2O5 total, (60+20 lbs/acre starter)

Soybean yield

Average of 9 years
Soybean response to P placed before corn - Scandia

80 lbs/acre P2O5 total, (60+20 lbs/acre starter)

Average of 9 years

Soybean yield

<table>
<thead>
<tr>
<th></th>
<th>No starter</th>
<th>Starter</th>
<th>No starter</th>
<th>Starter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcast</td>
<td>ab</td>
<td>ab</td>
<td>c</td>
<td>bc</td>
</tr>
<tr>
<td>Deep band</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average of 9 years
Additional P application to soybean

Average of 9 years

Soybean Yield (bu ac$^{-1}$)

Fertilizer application before planting soybean (lb P$_2$O$_5$ ac$^{-1}$)

<table>
<thead>
<tr>
<th>Scandia</th>
<th>Ottawa</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 lbs Broadcast + 20 lbs starter before corn</td>
<td>20 lbs Broadcast + 20 lbs starter before corn</td>
</tr>
<tr>
<td>60 lbs Broadcast + 20 lbs starter before corn</td>
<td>60 lbs Broadcast + 20 lbs starter before corn</td>
</tr>
</tbody>
</table>

Soil Fertility Research and Extension
Banding versus Broadcast

- Banding is generally similar to broadcast, including for “long term” placement.
- Starter P fertilizer under some soil conditions can be beneficial, typically more for corn than soybean.
- Subsurface P application reduce P loss with runoff.
Soil Sampling

• Soil test is very useful, especially during unfavorable prices.
• Use good sampling methods for good quality information.
  – Use the right sampling depth for right recommendations.
  – Good number of subsamples
  – One sample should represent the field variability.
Returns to soil sampling are greater when crop prices are lower.

Only fields with a greater potential yield increase per unit of N or P would be fertilized when crop prices are low.

T. Kastens and K. Dhuyvetter, 2004
Soil Sampling

• How often? Should we sample every 2 years?
  – Could be best for P and K.
  – Is a good investment as we avoid guessing.
  – There is significant temporal variability due to removal with yield and soils- weather conditions.

• Trends over time can provide better information.
Cut what, when and how much?

- Previous research show that soybean don’t respond to nitrogen fertilizer (with very few exceptions).
- Phosphorus, potassium and micros can be provided by the soil – use soil test.
- Don’t cut P, K or lime across all conditions or fields.
Summary

• Use good soil test information to make the right decision.
  – Don’t reduce P or K in low testing fields, profits are very likely.
  – Return to fertilizer in high testing soils may be limited with current conditions (use “reserve soil nutrients”).
  – Soybean is considered more responsive to “soil fertility” than fertilizer.

• Low grain prices may require more soil sampling.
• Consider variable rate application.
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  – Kansas Soybean Commission
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Questions?

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Education
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B.S. 2000 Pan-American School of Agriculture, Zamorano, Honduras
Agronomy

Professional Positions Held:
2013 - present: Associate Professor, Soil Fertility and Nutrient Management. Department of Agronomy, Kansas State University.
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2002 - 2004: Graduate Research Assistant. Department of Natural Resources and Environmental Science, University of Illinois at Urbana-Champaign.
2001 - 2002: Assistant Scientist, Illinois Natural History Survey, University of Illinois at Urbana-Champaign.

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• Associate Editor for Agronomy Journal (2009-2012).
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• Secretary for the NCERA 103 regional committee. 2013-2014

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• Outstanding Associate Editor. Agronomy Journal. 2012.
• North Central Extension-Industry Soil Fertility Graduate Student Award, 2005
• North Central Branch ASA Outstanding Graduate Student Paper, 2004
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- The International Biometric Society
- Kansas Academy of Science
- Gamma Sigma Delta

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