Managing soil fertility during record high fertilizer prices

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Overview

• Nitrogen: return to Nitrogen fertilizer
  – Fertilizer management
  – The role of additives

• Phosphorus: sufficiency vs draw down options
  – $$ return to P fertilizer across soil test levels
  – Value of starter fertilizers and no-till

• Manure as nutrient source
Corn economic optimum N vs maximum agronomic N?

118 trials in Kansas

\[ y = 78 + 0.89x - 0.0019x^2 \]
Should I cut back on N rates with current prices? How much?

The graph shows the relationship between the net return to N ($/acre) and the N rate (lbs N/acre) for corn. The max return to N is indicated on the graph. At very low N rates, the return is less than 10%. The graph suggests that cutting back on N rates would be beneficial at current prices.
Can we improve N fertilizer efficiency in corn?

UAN coulter injected at planting

Urea broadcast at planting

Compared to broadcast urea

<table>
<thead>
<tr>
<th>Placement</th>
<th>Source</th>
<th>Time</th>
<th>“Efficiency”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streamed</td>
<td>UAN</td>
<td>planting</td>
<td>=</td>
</tr>
<tr>
<td>Coulter</td>
<td>UAN</td>
<td>planting</td>
<td>+</td>
</tr>
<tr>
<td>2x2</td>
<td>UAN</td>
<td>planting</td>
<td>+</td>
</tr>
<tr>
<td>Broadcast</td>
<td>ESN</td>
<td>planting</td>
<td>-</td>
</tr>
<tr>
<td>Broadcast</td>
<td>Urea+NBPT</td>
<td>planting</td>
<td>=</td>
</tr>
<tr>
<td>Streamed</td>
<td>UAN</td>
<td>V6-V8</td>
<td>-</td>
</tr>
<tr>
<td>Broadcast</td>
<td>Super-U</td>
<td>V6-V8</td>
<td>-</td>
</tr>
</tbody>
</table>

$y = 140 + x - 0.0027 \times x^2 \quad \text{R}^2_{\text{adj}} = 0.95$

120 lbs N/acre
Nitrogen additives?
Urease inhibitors for side-dress urea

Benefit under conditions with high risk for volatilization
- Source: urea!
  Urea $\rightarrow$ NH$_3$ $\rightarrow$ NH$_4$
- Temperature
- Wind
- Moisture
- Soil pH
- Urease in the soil (residue)
Use of nitrification inhibitor (N-serve) with NH3 (150 lbs/a)

Soils/environment prone to leaching or denitrification
Corn response to N applied with and without PivotBio-Proven

**Plant N uptake**

**Grain yield**
$ return to 60 lbs of P$_2$O$_5$ in the year of application in corn

12 locations in 2021

Corn: $5.25/bu
P$_2$O$_5$: $0.86/ lb
Yield response and opportunities for starters?

12 locations in 2021

Optimum range and use of starters?

Use of starters and fertilizer placement particularly for no-till

\[ y = 40 - 2.1x + 0.028x^2 \]

\[ R^2_{adj} = 0.76 \]
Soybean response and soil test phosphorus

Mehlich-3 soil test P

![Graph showing the relationship between Mehlich-3 extractable P and relative yield with critical value at 16.9 ppm.]

Critical value: 17 ppm

Haney H3A- soil test P

![Graph showing the relationship between H3A-4 P and relative yield with critical value at 13 ppm.]

Critical value: 13 ppm

18 locations 2019-2021
$ return to 45 lbs of \( \text{P}_2\text{O}_5 \) in the year of application in soybean

Soybean: $13/bu
\( \text{P}_2\text{O}_5 \): $0.90/lb

\[
y = 140 - 10x + 0.12x^2 \quad R^2_{\text{adj}} = 0.54
\]
Can I skip a year of P application?

Assuming ~18 lbs of $P_2O_5 = \text{change } 1 \text{ ppm soil test P}$

<table>
<thead>
<tr>
<th>Crop</th>
<th>$P_2O_5$ (lb)/bu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>0.33</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>0.40</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.50</td>
</tr>
<tr>
<td>Soybeans</td>
<td>0.80</td>
</tr>
</tbody>
</table>

200 bu corn = 66 lbs of $P_2O_5 = \text{change } \sim 3.5 \text{ ppm STP}$

Soil test every 2-4 years!
Potassium fertilization in high soil testing
K – soybean

Soil test K = 364 ppm
K tissue test @ V4: > 1.6%
Critical Soil test K value = 130 ppm
Wheat nitrogen deficiency: effect on yield and protein (average of 21 sites in Kansas)

21 trials (2019-2020)

Average yield increase to N ~ 16 bu = ~$120 from grain
Grain protein content as an indicator of N sufficiency

- 21 trials (2019-2020)
- 134 trials (last ~15 years)
Evaluation of yield response to sulfur across 24 sites in Kansas

4-11 bu response (average= 6.5 bu)

7 responsive sites

17 non-responsive sites

2019-2021
Wheat yield response with in-season sulfur application
Wheat yield response with in-season sulfur application

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Yield (bu/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>b</td>
</tr>
<tr>
<td>Urea</td>
<td>b</td>
</tr>
<tr>
<td>Urea+S</td>
<td>b</td>
</tr>
<tr>
<td>AMS</td>
<td>a</td>
</tr>
<tr>
<td>Gypsum</td>
<td>a</td>
</tr>
</tbody>
</table>
Response to sulfur fertilizer

- Sulfur accumulation in the subsoil can be significant – profile S test.
  - Need profile sampling (ideally 24 in)

- Responsive to S typically in soils with sand content > ~35% combined with profile soil test S < 2 ppm

- Need sulfate fertilizer form for topdressing application time
Soil sampling

• Soil test especially useful 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.
Summary

- Improve N use with proper application, and avoid excessive cut in rates
- Phosphorus, and other immobile nutrients can be provided by the soil – use soil test
- Don’t cut P across all conditions or fields
- Identify limiting factors (such as pH or other soil factors)
Thank you!

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