UPDATING TRI-STATE FERTILIZER RECOMMENDATIONS

March 10, 2017

Steve Culman
School of Environment and Natural Resources
The Ohio State University, OARDC
culman.2@osu.edu, 330-822-3787
Tri-State Recommendations

- Originally Published in 1995
- Unified N, P, K recommendations for corn, soybean, wheat and alfalfa across Ohio, Michigan and Indiana
- Served as a cornerstone of fertilizer management in this region
Tri-State Recommendations

- Phosphorus and Potassium based on build up and maintenance philosophy
Tri-State Recommendations

• Farming has changed in 20 years
  • Increased yields
  • Increased conservation tillage
  • Adoption of round-up and Bt genetics
  • Reduced rotations
  • New pests and diseases

• In OH-IN-MI, majority of farmland is rented
  • Implications for management?

• Water quality issues has put a spotlight on nutrient management and agriculture
Tri-State Recommendations

• Call to revise fertilizer recommendations

  • Do Tri-State recs still apply to my highly productive fields?

  • I’m renting and don’t know how long I will farm this ground. What’s the minimum amount of fertilizer I can apply to get a good yield?

  • I am concerned about water quality and want to show that I’m doing an even better job managing nutrients on my farm.

  • We’ve moved to variable rate technology and want to dial in multiple rates within a field.
Before we know where we are going, we should probably know where we have been...
Jay Johnson – OSU Fertility Specialist

• 68 P trials (site-years) conducted
• 92 K trials conducted
Ohio Data from Tri-State

P & K trials were conducted at 9 total sites

<table>
<thead>
<tr>
<th></th>
<th>Phosphorus</th>
<th>Potassium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corn</td>
<td>Soybean</td>
</tr>
<tr>
<td>Responsive</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Non-responsive</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>26</td>
</tr>
</tbody>
</table>
At what soil test level should fertilizer be applied to see a yield response?

- **Phosphorus**
  - Soil Test P (Bray P1 ppm)
  - Relative Yield (%)
  - Responsive: No, Yes

- **Potassium**
  - Soil Test K (AA ppm)
  - Relative Yield (%)
  - Responsive: No, Yes
More recently from Ohio...
Long-term P & K Plots

- Clark County
- Wayne County
- Wood County

- 2006 – 2014
  (9 years of corn-soybean)

- Fertilizer rate
  - P: 3 rates (0, 1x, 2x estimated removal rates)
  - K: 3 rates (0, 1x, 2x estimated removal rates)
# Baseline Soil Data

<table>
<thead>
<tr>
<th>Soil Property</th>
<th>Clark</th>
<th>Wayne</th>
<th>Wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.8</td>
<td>5.9</td>
<td>6.1</td>
</tr>
<tr>
<td>CEC (meq/100g)</td>
<td>13</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>OM (%)</td>
<td>1.7</td>
<td>1.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Bray P (ppm)</td>
<td>29</td>
<td>28</td>
<td>22</td>
</tr>
<tr>
<td>K (ppm)</td>
<td>113</td>
<td>113</td>
<td>198</td>
</tr>
</tbody>
</table>

**Tri-State Rec Corn and Soybean Maintenance Range**
- Phosphorous: 15-30 ppm Bray P
- Potassium: 100-155 ppm AA
Grain Yields (2006-2014)

42 total comparisons of fertilized vs. unfertilized

*How many comparisons responded to fertilization?*
Yield Responses to Fertilizer

- 10 out of 42 responded to fertilization

Responses greater over time?

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorus</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>6 out of 42</td>
</tr>
<tr>
<td>Potassium</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4 out of 42</td>
</tr>
</tbody>
</table>

Fulford et al., 2016, Better Crops
Soil Test P & K Trends

![Graph showing trends in Soil Test P and K at Clark, Wayne, and Wood locations over years.]
What about current on-farm work?
Overview – Fertilizer Trials

- Funding from Ohio Corn and Small Grain Marketing Programs, Ohio Soybean Council & USDA

- Majority are on-farm trials, some OSU-farms

- Many sites over diversity of soil types and regions in Ohio

- Working directly with growers, but also with crop consultants, agronomists to help facilitate strip trials

- Corn, Soybean, Wheat
  - N, P, K, S
Ohio Data in Tri-State Fertilizer Recommendations
Old Model vs. New Model

P & K trials were conducted at 9 total sites

N trials were conducted at 15 total sites

25 years of data

Distribution of on-farm fertilizer trials (2014-2016)

Red and blue points = fert trials
3 years of data
Approach

1) Soil sampling
2) R1 Tissue Nutrient Analysis
3) Yield & Grain Nutrient Analysis
Two Trial Types

1) N trials for corn and wheat:
   • Multiple rates to develop yield response curve
   • MRTN (economic model)

2) P, K, S trials for corn, soybean, wheat
   • Single rate of +/- fertilizer
   • Relate to soil test levels and tissue test levels (P, K, S)
Where are we now?
2014 – 2016 Field Seasons – 151 total trials

<table>
<thead>
<tr>
<th>Year</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
<th>Potassium</th>
<th>Total Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soybean</td>
<td>14</td>
<td>15</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>19</td>
<td>12</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>Soybean</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>38</td>
<td>22</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>Soybean</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Wheat</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>
Where are we headed?

- IN-MI-OH State Specialists met in Fort Wayne and discussed issues with revising Tri-State Recommendations

- Intention to continue to maintain as 3-state document

- Hope to have more dynamic, living document, than a static work revisited every 20 years

- More questions than answers at this point

- Hopefully first chapters will emerge in 2018
Thank You

Steve Culman
Soil Fertility
Ohio State University
Wooster, Ohio

culman.2@osu.edu
330-822-3787
go.osu.edu/fert-trials