Soil test phosphorus pools and phosphorus trends in Ohio

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Updated Tri-State Fertilizer Recommendations

Mehlich-3 Now Default Extractant

Phosphorus

Multiply by 1.35

Divide by 1.35

Bray-P

Mehlich-3 P

New Recommended STP Levels

<table>
<thead>
<tr>
<th>Crop</th>
<th>Mehlich-3 P</th>
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</thead>
<tbody>
<tr>
<td>Corn, Soybean</td>
<td>20 – 40 ppm</td>
</tr>
<tr>
<td>Wheat, Alfalfa</td>
<td>30 – 50 ppm</td>
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</tbody>
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go.osu.edu/mehlich

go.osu.edu/fert-recs
Phosphorus Cycling – Organic and Inorganic

- Stable
- Accessible
- Organic P
- Available P
- Biological processes
- Chemical processes
- Clay-bound
- Secondary minerals
- Primary minerals
- Inorganic P
- Leaching/runoff into surface or groundwater
How does P fertilization impact soil P pools?
Long-term P & K Plots

- Clark County (Western)
- Wayne County (Wooster)
- Wood County (Northwest)

- Started in 2006
  - P & K Fertilization
    - 3 rates (0, 1x, 2-3x)
  - Corn-soybean rotation
Soil Test P Trends
(red dashed lines = maintenance range: 20-40 ppm M3-P)

Culman, 2020, Tri-State Fert Recs
Pools of P in Soil After 12 years of P fertilization

Soil P Distribution by Fertilization Rate (lbs P\textsubscript{2}O\textsubscript{5}/ac)

- **Clark**
  - 0x grain removal: 66 lbs
  - 1x grain removal: 62 lbs
  - 2-3x grain removal: 60 lbs
- **Wayne**
  - 0x grain removal: 92 lbs
  - 1x grain removal: 54 lbs
  - 2-3x grain removal: 74 lbs
- **Wood**
  - 0x grain removal: 146 lbs
  - 1x grain removal: 180 lbs
  - 2-3x grain removal: 172 lbs

Legend:
- \(\text{M3-P}\)
- \(\text{Organic P}\)
- \(\text{Total P remaining}\)

Wade, 2019, unpublished
Grain Yield Response to P Fertilization

P fertilization increased yields:
- Corn: 20% of obs
- Soybean: 8% of obs
Soil Test Pools in Ohio

- Mehlich-3 P represents a small fraction of total soil P (<10%)

- Soil P fractionations show continuous cropping without fertilizing P for 12 years
  - Reduces Mehlich-3 P
  - Leads to slight increases in organic P
  - Has little impact on total soil P

- Ohio soils are highly buffered with regard to P
  - Can supply P to crops for some time (??) when soils are above critical levels
What are Ohio soil test P and P balance trends over the past 20-25 years?

- Requested soil test data from three major soil testing labs that service Ohio
  - Spectrum Analytic, Brookside, A&L Great Lakes

- Compiled data from 1993 – 2015

- >2 million soil samples; aggregated by zipcode and then into counties

- Quantile regression analysis – trends over time via quantiles

- Also used NuGIS database (IPNI, 2014) for county P balance trends

- Many limitations and assumptions made with these data!

96% of counties in STP maintenance range or below @ 50th percentile

Dayton et al, 2020
Agronomy Journal, 112:1617–1624

50th percentile

Numbers indicate Mehlich-3 STP levels in 2015 (ppm)

50th percentile

90th percentile

Numbers indicate Mehlich-3 STP levels in 2015 (ppm)

Dayton et al, 2020
Agronomy Journal, 112:1617–1624
84% of counties have a negative P balance

Numbers indicate significant trend (in Mg P/yr) between 1987 and 2014.


Dayton et al, 2020
*Agronomy Journal, 112:1617–1624*
Ohio Soil Test Trends

• Over the past 2 decades soil test P has trended down in many Ohio counties

• 96% of counties are in maintenance range or below @ median levels

• 84% of counties have negative P trends

• Why are soil test P and P balances be trending down?
  • Farmers applying less P fertilizer?
  • Greater P removal rates?
  • Less P retention in soil?

• Many questions remain!