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Pesticide Safety 2008 - Nutrient Management BMPs Phosphorus

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Nutrient Management BMPs
Phosphorus

Carolyn DeMoranville
UMass Amherst Cranberry Station
Topics to be covered

- Phosphorus reduction
  - Monitoring tissue levels

- Water quality
  - Data from P reduction
  - Flood handling BMP
Background – why P reduction?

- Nationally, cranberry farmers, like all farmers, are being pressured to develop nutrient management plans.

- P management has become the primary issue for cranberry planning on the environmental side.

- Cranberry farming involves discharging surface water into streams, pond, and lakes – most of these are P limited.
Background

Since growers apply based on N requirements, P applications may be in excess.

Actual P requirement based on plant composition/ growth is low:
- “trash” plus 200 bbl crop removes 4.2 lb P/acre.

Soil testing is problematic for planning due to lack of calibration ability – acid soils.
Background

- Tissue testing should be a better tool (established standard value of 0.1 to 0.2%)

- For best planning, a target P application range should also be established

- If growers are exceeding the target range - the nutrient management plan would call for a reduction strategy
Recommended target

- No more than 20 lb P/acre

- This is ~45 lb/a $\text{P}_2\text{O}_5$ (what’s on the bag)
Calculations

The number on the bag is not actual P!!

\[ P \times 2.29 \rightarrow P_2O_5 \]

\[ P_2O_5 \times 0.44 \rightarrow P \]

What’s on the bag!
No difference among P rates, all > 0 rate

DeMoranville and Davenport, 1997
Yield comparisons – field scale P reduction

<table>
<thead>
<tr>
<th>Year</th>
<th>P rate</th>
<th>Yield</th>
<th>P rate</th>
<th>Yield</th>
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</thead>
<tbody>
<tr>
<td>2002</td>
<td>17.8</td>
<td>117</td>
<td>24.8</td>
<td>117</td>
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<tr>
<td>2003</td>
<td>14.3</td>
<td>119</td>
<td>22.3</td>
<td>119</td>
</tr>
<tr>
<td>2004</td>
<td>5.6</td>
<td>172</td>
<td>17.3</td>
<td>195</td>
</tr>
<tr>
<td>2005</td>
<td>16.5</td>
<td>190</td>
<td>24.0</td>
<td>121</td>
</tr>
<tr>
<td>2006</td>
<td>6.4</td>
<td>162</td>
<td>5.7</td>
<td>244</td>
</tr>
<tr>
<td>pre-reduction</td>
<td>17.8</td>
<td>117</td>
<td>22.1</td>
<td>138</td>
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<tr>
<td>post-reduction</td>
<td>10.7</td>
<td>161</td>
<td>5.7</td>
<td>244</td>
</tr>
</tbody>
</table>
Compare formulations

- High P ratio
  - 5-15-30
  - 3-13-26
  - 12-24-12

- Low P ratio
  - 15-15-15
  - 10-12-24
  - 18-8-12 (custom)
  - 18-8-18 (custom)

Advantage of 18-8-18:
- Fewer pounds to apply (based on N requirement)
- Lower application cost
Environmental benefit to P reduction

P concentration in outlet water decreased with fertilizer reduction and was lower on mineral sites

<table>
<thead>
<tr>
<th>Bog</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
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</thead>
<tbody>
<tr>
<td>EH</td>
<td>0.377</td>
<td>0.424</td>
<td>0.237</td>
<td>0.097</td>
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<tr>
<td>PV</td>
<td>0.384</td>
<td>0.439</td>
<td>0.528</td>
<td>0.408</td>
</tr>
<tr>
<td>M-K</td>
<td>0.100</td>
<td>0.170</td>
<td>0.118</td>
<td></td>
</tr>
<tr>
<td>ASH</td>
<td>0.109</td>
<td>0.127</td>
<td>0.147</td>
<td></td>
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</table>

Mean mg/L TP in flood discharges
## Net P loading from bog systems (organic soil)

### lb/a/yr

<table>
<thead>
<tr>
<th>Bog/year</th>
<th>PO4</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in discharge</td>
<td>minus incoming</td>
</tr>
<tr>
<td>EH 2002</td>
<td>1.11</td>
<td>1.02</td>
</tr>
<tr>
<td>EH 2003</td>
<td>1.82</td>
<td>1.78</td>
</tr>
<tr>
<td>EH 2004</td>
<td>0.82</td>
<td>0.74</td>
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<tr>
<td>PV 2002</td>
<td>3.53</td>
<td>2.67</td>
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<tr>
<td>PV 2003</td>
<td>3.68</td>
<td>2.99</td>
</tr>
<tr>
<td>PV 2004</td>
<td>3.20</td>
<td>2.62</td>
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</table>
## Net P loading from bog systems (mineral soil)

<table>
<thead>
<tr>
<th>Bog/year</th>
<th>PO4 in discharge</th>
<th>PO4 minus incoming</th>
<th>TP in discharge</th>
<th>TP minus incoming</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-K 2002</td>
<td>0.49</td>
<td>0.35</td>
<td>1.02</td>
<td>0.01</td>
</tr>
<tr>
<td>M-K 2003</td>
<td>0.69</td>
<td>0.32</td>
<td>1.42</td>
<td>0.05</td>
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<tr>
<td>M-K 2004</td>
<td>0.94</td>
<td>0.01</td>
<td>1.66</td>
<td>-1.10</td>
</tr>
<tr>
<td>ASH 2002</td>
<td>0.51</td>
<td>0.45</td>
<td>1.09</td>
<td>0.24</td>
</tr>
<tr>
<td>ASH 2003</td>
<td>0.40</td>
<td>0.26</td>
<td>1.32</td>
<td>-0.56</td>
</tr>
<tr>
<td>ASH 2004</td>
<td>1.09</td>
<td>0.95</td>
<td>1.97</td>
<td>0.17</td>
</tr>
</tbody>
</table>
Calculating amounts to apply changing from known practice

- What is your current material and fertilizer rate?
- How much N did that contain?
- Decide on new product
- Calculate amount of that product to apply based on previous N rate
Calculations

45 lb N using 12-24-12

I used 375 lb/acre 12-24-12 – how much P?

\[ 375 \times 0.24 \times 0.44 = 39.6 \text{ lb/acre} \]

0.24 is the bag number converted to a decimal
0.44 converts $P_2O_5$ to actual P

How to implement P reduction?
Calculating amounts to apply changing from known practice example #1

Currently using 375 lb/acre 12-24-12

Fertilizer contains 12% N

375 lbs contains 45 lbs N \[375 \times (12 \times 0.01)\]

New choice is 18-8-18 – still want 45 lbs N

Use 250 lbs \[45 / (18 \times 0.01)\]

How much P is in that?
Calculations

How much P?

I used 250 lb/acre 18-8-18 – how much P?

\[ 250 \times 0.08 \times 0.44 = 8.8 \text{ lb/acre} \]

0.08 is the bag number converted to a decimal

0.44 converts \( P_2O_5 \) to actual P
Calculation examples are also in the 2008 Chart Book
Phosphorus reduction and monitoring

- Plot and whole farm research shows P reduction is viable

- But for how long and how do we monitor?

- Yield records and **tissue sampling**
  - Tissue to ‘catch’ a problem before yield declines
  - Also yield can be up or down due to other factors
Tissue standard is 0.1-0.2% P

<0.1% --- increase P rate and retest next year

0.1 – 0.11% -- stay the course but retest next year

0.12 – 0.15% -- test again in 2-3 years

0.16% or greater – test again in 3-4 years
BMPs for P reduction

- Use no more than 20 lb/acre
- At sensitive sites, reduce below 20 lb/acre
- If possible avoid discharge of water after fertilizer applications – impound or tailwater
- Flood management is critical
  - Harvest -- hold 2-4 days then discharge at a moderate pace to finish by no later than day 10
  - Winter -- Release from beneath ice ASAP
Most Phosphorus Loss occurs during flooding/drainage as inorganic P released from the soil.
P Release increased with amount of P Fertilization

Total P Release primarily when soil became anoxic

(rapid rise after day 10)

10 fold difference in release