Calculating application rates

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UMN Extension Specialist and Assistant Professor
Does it matter how much compost we apply?

- **YES!**
- Two reasons:
  - Plants need a minimum amount of nutrients
  - BUT too many nutrients can escape to the environment

The soil is like a sponge for nutrients
Environmental losses of nutrients

- Plant uptake
- Leaching
- Volatilization/Denitrification
- Runoff/Erosion

Adapted from Amy Shober, University of Delaware
Land application of compost is a balancing act

Balancing crop needs with nutrient inputs into the fields
Compost is a great nutrient source

Raw manure and bedding

Actively composting

Finished compost
Does it matter how much N, P, K there is?

- Yes! Plants take up roughly 6 units of N for every unit of P
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Applying compost

- Consider using a P-based rate
  - Lower if soil test P levels are high or very high

- Credit N that is applied
  - Never apply more N than is needed
Calculating application rates

Step 1 • Determine P needs of the crop

Step 2 • Determine Plant Available P (PAP) content of compost

Step 3 • Calculate rate of application
Applying Compost at P-based Rate – Step 1

- Step 1: Determine P needs of the crop
  - Use P-removal rates of the crop

Example:
You want to apply compost to a field that will be seeded into alfalfa next year.
## Crop P removal rates

<table>
<thead>
<tr>
<th>Crop</th>
<th>Yield Units</th>
<th>Crop P₂O₅ removal in pounds (per yield unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>Tons (air dry)</td>
<td>10.8</td>
</tr>
<tr>
<td>Barley (grain)</td>
<td>Tons (air dry)</td>
<td>0.41</td>
</tr>
<tr>
<td>Barley (grain &amp; straw)</td>
<td>Bushels</td>
<td>0.55</td>
</tr>
<tr>
<td>Canola</td>
<td>Cwt.</td>
<td>1.3</td>
</tr>
<tr>
<td>Corn (grain)</td>
<td>Bushels</td>
<td>0.28</td>
</tr>
<tr>
<td>Corn (silage)</td>
<td>Tons (as fed)</td>
<td>3.8</td>
</tr>
<tr>
<td>Edible beans</td>
<td>Pounds</td>
<td>0.01</td>
</tr>
<tr>
<td>Grass or hay pasture</td>
<td>Tons (air dry)</td>
<td>8.9</td>
</tr>
<tr>
<td>Grass/legume pasture</td>
<td>Tons (air dry)</td>
<td>11.2</td>
</tr>
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<td>Oats (grain)</td>
<td>Bushels</td>
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</tr>
<tr>
<td>Oats (grain &amp; straw)</td>
<td>Bushels</td>
<td>0.32</td>
</tr>
<tr>
<td>Peas</td>
<td>Pounds</td>
<td>0.01</td>
</tr>
<tr>
<td>Potatoes</td>
<td>Cwt.</td>
<td>0.14</td>
</tr>
<tr>
<td>Red Clover</td>
<td>Tons (air dry)</td>
<td>10.8</td>
</tr>
<tr>
<td>Rye (grain)</td>
<td>Bushels</td>
<td>0.44</td>
</tr>
<tr>
<td>Rye (grain &amp; straw)</td>
<td>Bushels</td>
<td>0.59</td>
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<tr>
<td>Soybeans</td>
<td>Bushels</td>
<td>0.82</td>
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<tr>
<td>Sugarbeets</td>
<td>Fresh Tons</td>
<td>0.73</td>
</tr>
<tr>
<td>Sunflower</td>
<td>Pounds</td>
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</tr>
<tr>
<td>Sweet corn</td>
<td>Tons</td>
<td>11.0</td>
</tr>
<tr>
<td>Wheat (grain)</td>
<td>Bushels</td>
<td>0.53</td>
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**Example:**
You want to apply compost to a field that will be seeded into alfalfa next year. You expect 5 tons per acre in yield.
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**Example:**
You want to apply compost to a field that will be seeded into alfalfa next year. You expect 5 tons per acre in yield.

\[
5 \times 10.8 = 54 \text{ lbs per acre of P}_2\text{O}_5 \text{ needed}
\]
Applying Compost at P-based Rate – Step 2

- Step 2: Determine Plant Available P (PAP) content of compost

  - For phosphorus, we assume that 80% of total P in compost is available the first year.
Applying Compost at P-based Rate – Step 2

- Step 2: Determine Plant Available P (PAP) content of compost

\[
\text{Total P content of compost (from compost analysis)} \times 0.8 = \text{PAP}
\]

\[
5 \text{ lbs } P_2O_5 \times 0.8 = 4 \text{ lbs } P_2O_5
\]
Applying Compost at P-based Rate – Step 3

Step 3: Calculate rate of application

\[
\text{Net P recommendation} = \frac{\text{Plant available P (PAP)}}{\text{P-based application rate}}
\]
Applying Compost at P-based Rate – Step 3

- Step 3: Calculate rate of application

\[
\frac{54 \text{ lbs } P_2O_5 \text{ per acre}}{\text{Plant available } P \text{ (PAP)}} = \text{P-based application rate}
\]
Applying Compost at P-based Rate – Step 3

▪ Step 3: Calculate rate of application

\[
\frac{54 \text{ lbs } P_2O_5}{\text{per acre}} = \frac{4 \text{ lbs } P_2O_5}{\text{per ton}} = \text{P-based application rate}
\]
Applying Compost at P-based Rate – Step 3

- Step 3: Calculate rate of application

\[
\frac{54 \text{ lbs } P_2O_5 \text{ per acre}}{4 \text{ lbs } P_2O_5 \text{ per ton}} = 13.5 \text{ tons per acre}
\]
So how much N was added then?

- We assume that 10-15% of total N in compost is available the first year
  - Use the higher range for composted poultry manure

\[
\text{N credit (first year)} = \text{Total N content of compost (from compost analysis)} \times \text{Availability factor} \times \text{Amount applied}
\]
So how much N was added then?

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  - Use the higher range for composted poultry manure

\[
5 \text{ lbs total N per ton} \times \text{Availability factor} \times \text{Amount applied} = \text{N credit (first year)}
\]
So how much N was added then?

- We assume that 10-15% of total N in compost is available the first year
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\[
5 \text{ lbs total N per ton} \times 0.1 \times \text{Amount applied} = \text{N credit (first year)}
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  - Use the higher range for composted poultry manure

\[
\begin{align*}
5 \text{ lbs total N per ton} \times 0.1 \times 13.5 \text{ tons per acre} &= \text{N credit (first year)}
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\[
\begin{align*}
5 \text{ lbs total N per ton} & \times 0.1 & \times 13.5 \text{ tons per acre} & = 6.75 \text{ lbs N per acre}
\end{align*}
\]
Thank you!