Organic materials as fertilizers and soil amendments

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Nitrogen Cycle

Organic N

Ammonium $\text{NH}_4^+$

Nitrate $\text{NO}_3^-$

Leaching

Gases ($\text{N}_2, \text{N}_2\text{O}$)

Soil organic matter, Plant residues, Manure

Plants, Microbes

Atmosphere

$N$ fixation
Organic materials

Management depends on:

• C:N ratio
• degree of decomposition
Carbon:Nitrogen ratio

- Ranges from <5:1 to >500:1 in organic materials
- **Low C:N** supplies N to plants
- **High C:N** ties up N by biological immobilization

http://aggie-horticulture.tamu.edu/publications/landscape/compost/chapter1.html
Predicting Nitrogen Availability from Organic Amendments
Field research in Puyallup, WA and Aurora, OR

- Jubilee sweet corn
- 8-11 materials/site/yr
- Control & 4 urea rates
- N recovery from crop and soil
Materials

Primary Amendments
- Broiler litter, raw & composted
- Dairy manure solids, raw & composted
- Yard trimmings, raw & composted
- Rabbit manure, raw & composted

Specialty Products
- Fish fertilizer, pelleted
- Canola meal
- Feather meal, etc.

WASHINGTON STATE UNIVERSITY EXTENSION
Organic amendment nitrogen data

Nitrogen (% dry matter)

- Broiler litter (all)
- Dairy solids
- Dairy solids compost
- Other composts
- Specialty products

- Organic N %
- NH$_4$-N %
- NO$_3$-N %
Amendment decomposition in soil

Days
0 20 40 60 80
Decomposition (%) 0 20 40 60 80

Broiler litter

Fresh Dairy solids

Composted dairy solids

Specialty products

Other composts

Days
0 20 40 60 80
Decomposition (%) 0 20 40 60 80
Plant Available N

- **Broiler litter**: C:N = 9
- **Dairy solids**: C:N = 20
- **Other composites**: C:N = 27
- **Specialty products**: C:N = 7
- **Other composites**: C:N = 16
Lab vs. full-season field PAN (4-site yr.)
Amendment C:N vs. plant-available N (field)

Gale et al., 2006. Journal of Environmental Quality 35:2321
Sample calculations

- How much of this fertilizer should I apply?
- How do these two fertilizers compare?
- What’s the cheapest source of available N, P, K, etc.?
- Does this program match my fertilizer recommendation?

ORGANIC FERTILIZER CALCULATOR
http://smallfarms.oregonstate.edu
### Instructions: Enter your information in yellow cells. Results are in green cells.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>FERTILIZER ANALYSIS (%) (ppm/10,000=%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total % N from label (&quot;as-is&quot; basis) (of product)</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Perfect Blend (4-4-4)</td>
<td>4.0</td>
</tr>
<tr>
<td>Perfect Blend (7-2-2)</td>
<td>7.0</td>
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<tr>
<td>Soft rock phosphate (0-2-0)</td>
<td>0.0</td>
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<tr>
<td>Solubor (20.5% B)</td>
<td>0.0</td>
</tr>
<tr>
<td>Soy meal (6.5-1.5-2.4)</td>
<td>6.5</td>
</tr>
<tr>
<td>Sulfate of potash (0-0-50)</td>
<td>0.0</td>
</tr>
<tr>
<td>Sulfate of potash magnesia (0-0-22)</td>
<td>0.0</td>
</tr>
<tr>
<td>Sup-R-Green (3-2-2)</td>
<td>3.0</td>
</tr>
<tr>
<td>Zinc—Green Cypress (7% Zn)</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### COMPOSTED MATERIALS

<p>| MATERIAL | FERTILIZER ANALYSIS (%) (ppm/10,000=%) |
|----------|--------------------------------------------------|-------------------------------|-------------------------------------------------|-------------------------------------------------|--------|--------|--------|--------|------|-------|--------|--------|
| Composted dairy manure (1.5-0.5-0.5) | 1.5 | 60 | 5 | 10 | 0.5 | 0.5 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |</p>
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Table 1. Plant-available nitrogen (PAN) estimates</strong></td>
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<tr>
<td>2</td>
<td>Amendment total N</td>
<td>Amendment C:N</td>
<td>Plant-available N estimate</td>
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<tr>
<td>3</td>
<td>% dry wt.</td>
<td></td>
<td>28 days</td>
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<tr>
<td>4</td>
<td>% of total N</td>
<td>% of total N</td>
<td></td>
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<tr>
<td>5</td>
<td><strong>Uncomposted materials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>35</td>
<td>&lt;0</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>7</td>
<td>45</td>
</tr>
<tr>
<td>11</td>
<td>6</td>
<td>&lt;6</td>
<td>60</td>
</tr>
<tr>
<td>12</td>
<td>7</td>
<td>&lt;6</td>
<td>60</td>
</tr>
<tr>
<td>13</td>
<td>8+</td>
<td>≤6</td>
<td>60</td>
</tr>
<tr>
<td>14</td>
<td><strong>Composts</strong></td>
<td></td>
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</tr>
<tr>
<td>15</td>
<td>1</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>2-3</td>
<td>15-10</td>
<td>5</td>
</tr>
<tr>
<td>17</td>
<td></td>
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</table>
"Organic Fertilizer Calculator" estimates of plant-available N (PAN)

<table>
<thead>
<tr>
<th>Fresh Amendment total N</th>
<th>Example</th>
<th>Fresh Amendment C:N</th>
<th>PAN 28 days</th>
<th>PAN full season</th>
</tr>
</thead>
<tbody>
<tr>
<td>% dry wt.</td>
<td>Approx.</td>
<td>% of total N</td>
<td>% of total N</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Solid manure w/bedding</td>
<td>35</td>
<td>&lt; 0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Dairy solids</td>
<td>18</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>1.7</td>
<td>Yard Debris Compost</td>
<td>16</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>6+</td>
<td>Specialty products</td>
<td>less than 6</td>
<td>60</td>
<td>75</td>
</tr>
</tbody>
</table>
Soil Quality in Intensive Organic Management Systems

Craig Cogger, Doug Collins, Andy Bary, Ann-Marie Fortuna, and Ann Kennedy
Three Cover Crop Treatments

- Relay planted Legume (RLY)
- Post-Harvest Cereal & legume (PH)
- Short-term Grass-legume Pasture (LEY)
Two tillage treatments are included in the experiment

CONV = Conventional tillage
    (plow, disc, rototill)

SPD = Modified tillage
    (low-speed rotating spader)
Soil amendments include High-C compost and Low-C broiler litter.

Chicken (Broiler) litter: (CKN)
Low C application (1.8 - 3.1 dt/ac)

Mixed on-farm compost: (OFC)
High C application (8 - 17 dt/acre)
Soil quality measurements include physical, chemical, and biological indicators.

- Bulk Density
- Infiltration
- Compaction
- Particulate OM
- Enzyme activity
- Nematodes
- Collembola
- Microbial biomass
- Nitrogen cycling
- Microbial community structure
- Nutrients and carbon
Bulk density is an indicator of porosity, and organic matter.
Bulk density is lower with high-C compost additions.
Measuring water infiltration using a simple field method.
Infiltration is usually faster in plots treated with high-C compost.
The penetrometer measures compaction to a depth of 16 inches.
Amendment had no effect on compaction in the soil profile.
Spader-tilled soils had a less compact profile than conventional tillage.
Compost & Manure
Use/Management and Words of Wisdom
Manure and Pathogens

• Fresh manure can contain Salmonella, E. coli O157:H7, etc.
• We must use manure properly to avoid spreading diseases
Types of Organic Amendments

- **Hot stuff** C:N < 10:1
- **Cool stuff** C:N 15:1 to 25:1
- **Woody stuff** C:N > 30:1
Hot Stuff  C:N < 10:1

- Rapid N availability
- Use as a fertilizer
- Over application leads to excess nutrient levels in soil -- potentially harming crop and water quality.
Hot Stuff

- Poultry manure
- Seed meals
- Fish and feather meals
- Fresh grass clippings
- Fresh rabbit manure
- Dewatered or dried biosolids
Cool Stuff, C:N 15:1 to 25:1

- Slow N availability
- Can add large amounts without risk of over-fertilization
- Use as a soil amendment
- N immobilization (tie-up) likely with fresh materials in first few weeks after app.
- Compost organic matter lasts a long time in soil
Cool Stuff

- Compost (yard debris, most manures, biosolids)
- Fresh materials:
  - Yard debris
  - Cover crop residues
  - Dairy manure solids
  - Coffee grounds
Woody Stuff, C:N > 30:1

- N immobilization
- Need to add N along with organic amendment
- Use as mulch or bulking agent for compost
Woody Stuff

• Straw
• Sawdust
• Paper waste
• Horse manure rich in bedding
Feed the microbes and let them do the work for you!

Organic nutrient management
www.Soils1.org
Compost usage
Research updates
Manure Management
Field day announcements
Thank you

Questions