Plant Growth Promotion with Compost Extracts

Integrated Crop and Livestock Management workshop
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Ted Radovich, Jari Sugano, Archana Pant, Nguyen Hue, Jensen Uyeda
Compost benefits

• Contains most plant nutrients.

• Can improve soil:
  • Structure
  • Moisture holding capacity
  • Nutrient mineralization & retention
  • pH buffering

• Can also suppress some diseases
  • General suppression
  • Antagonism
Compost challenges

- Transportation costs $$
- Quality can be highly variable
- Management for high quality increases costs.
- High rates for short term impact.
Table 1. Some quality characteristics of composts produced in Hawai'i. Values are means±standard deviation.

<table>
<thead>
<tr>
<th>Type/ Source/ Primary feedstocks</th>
<th># of Samples</th>
<th>Total Carbon %</th>
<th>Total Nitrogen %</th>
<th>C:N</th>
<th>NO₃⁻ ppm</th>
<th>NH₄⁺ ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vermicompost</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hawai'i commercial</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Chicken manure</td>
<td>21</td>
<td>20±3</td>
<td>1.6±0.4</td>
<td>13:1</td>
<td>1,748±636</td>
<td>29±18</td>
</tr>
<tr>
<td>Rabbit manure</td>
<td>9</td>
<td>21±3</td>
<td>1.8±0.3</td>
<td>12:1</td>
<td>2,391±882</td>
<td>59±50</td>
</tr>
<tr>
<td>Pig manure</td>
<td>6</td>
<td>25±1</td>
<td>2.0±0.1</td>
<td>13:1</td>
<td>2,924±1,542</td>
<td>61±67</td>
</tr>
<tr>
<td>Horse Manure</td>
<td>6</td>
<td>25±1</td>
<td>2.0±0.2</td>
<td>13:1</td>
<td>4,000±1,045</td>
<td>18±18</td>
</tr>
<tr>
<td>UH experimental</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Food waste</td>
<td>33</td>
<td>26±5</td>
<td>1.8±0.3</td>
<td>13:1</td>
<td>1,212±1,230</td>
<td>122±252</td>
</tr>
<tr>
<td>Mainland commercial</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steer manure</td>
<td>6</td>
<td>16±1</td>
<td>1.1±0.1</td>
<td>15:1</td>
<td>629±231</td>
<td>118±50</td>
</tr>
<tr>
<td>Green waste</td>
<td>6</td>
<td>19±2</td>
<td>1.2±0.1</td>
<td>16:1</td>
<td>1,348±49</td>
<td>28±6</td>
</tr>
<tr>
<td>Other compost</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawai'i commercial</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steer manure/ greenwaste</td>
<td>6</td>
<td>18±1</td>
<td>1.1±0.2</td>
<td>16:1</td>
<td>103±77</td>
<td>58±34</td>
</tr>
<tr>
<td>Greenwaste</td>
<td>7</td>
<td>21±3</td>
<td>0.7±0.5</td>
<td>30:1</td>
<td>118±80</td>
<td>183±24</td>
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<tr>
<td>Hawai'i farmer produced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken manure/greenwaste</td>
<td>6</td>
<td>8±1</td>
<td>0.7±0.0</td>
<td>11:1</td>
<td>593±39</td>
<td>23±4</td>
</tr>
<tr>
<td>Chicken manure/mortalities</td>
<td>6</td>
<td>21±0</td>
<td>2.9±0.1</td>
<td>7:1</td>
<td>1,748±553</td>
<td>--</td>
</tr>
</tbody>
</table>
Commercial green-waste compost  Food-waste vermicompost
Material cost per ton (12/1/2008)

<table>
<thead>
<tr>
<th>Material</th>
<th>Price per ton ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-16-16</td>
<td>$1,000</td>
</tr>
<tr>
<td>Bonemeal</td>
<td>$300</td>
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<tr>
<td>Chicken manure</td>
<td>$200</td>
</tr>
<tr>
<td>Compost (thermal)</td>
<td>$167</td>
</tr>
<tr>
<td>Compost (worm)</td>
<td>$4,000</td>
</tr>
</tbody>
</table>
Compost “Tea”

- Uses air and water to extract:
  - Nutrients
  - Organic acids
  - Microbes
- Ratio of water to compost ranges 10:1-100:1
- Water is not circulated, only air
- 12-24 hrs
• Many growers add microbial enhancer

• Some reports of aeration not necessary

• Archana Pant investigates these factors
## Compost tea

Quality of tea brewed aerobically with foods (ACTME), aerobically without foods (ACT) or passively (NCT).

<table>
<thead>
<tr>
<th>Tea Type</th>
<th>pH</th>
<th>EC</th>
<th>DO</th>
<th>N</th>
<th>NO3-N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerated plus “food”</td>
<td>8.3 ± 0.1</td>
<td>2600 ± 127</td>
<td>7.4 ± 0.1</td>
<td>105.55 ± 13.6</td>
<td>97 ± 13</td>
</tr>
<tr>
<td>12 hrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerated</td>
<td>7.8 ± 0.1</td>
<td>1267 ± 103</td>
<td>8.3 ± 0.1</td>
<td>83.93 ± 9.44</td>
<td>82 ± 9.3</td>
</tr>
<tr>
<td>12 hrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive (8 days)</td>
<td>7.5 ± 0</td>
<td>1273 ± 136</td>
<td>7.8 ± 0</td>
<td>71.70 ± 8.32</td>
<td>70 ± 8.2</td>
</tr>
<tr>
<td>Water</td>
<td>8.1 ± 0</td>
<td>391 ± 14</td>
<td>8.5 ± 0.1</td>
<td>10.96 ± 1.17</td>
<td>11 ± 1.2</td>
</tr>
</tbody>
</table>

Pant et al. (2009)
Above ground fresh weight (g plant$^{-1}$)

- **Compost:**
  - NCT: [Bars]
  - ACT: [Bars]
  - ACTME: [Bars]
  - Control: [Bars]

- **Osmocote:**
  - NCT: [Bars]
  - ACT: [Bars]
  - ACTME: [Bars]
  - Control: [Bars]

Pant et al. (2009)
Above ground dry weight (g plant \(^{-1}\))

\[ y = 0.0511x + 0.1039 \]

\[ R^2 = 0.9814 \]

Pant et al. (2009)
Pant et al. (2009)
Greenhouse Studies

• Yield was improved

• Largely explained by changes in nitrogen uptake

• Phytonutrients, soil biological activity and root growth also affected

• Results were confirmed:
  • in multiple soils
  • with different composts

• 100 ml tea = 10ml compost = 5 g compost = $0.03 per plant = $840 per acre
Chicken manure thermophilic compost extract (1:10)
Questions

• Can less compost be used?

• Can on-farm composted culls be effective?

• Is there a way to avoid spraying leaves?
Initial trial

• 2 treatments: Tea; No Tea

• 5 replications

• Tea brewed from Ho farm compost

• Brewer constructed from local materials

• 0.5 gallons compost in 50 gal brewer

• Injected weekly into drip lines
Compost “Tea”
Results

• Subtle impact on plant growth

• Fresh weight yield difference 800 pounds ($400) per acre

• Compost cost $8

• Vermicompost $90
Summary

• Effect of extracts depend on:
  • Compost quality
  • Amount of compost used in extraction process
  • Nutrient status of plant

• Potential for drip injection
  • Increase quantity of compost
  • Include some vermicompost
  • Evaluate emitter flow rates
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Vermicompost