Potential of spent mushroom substrate in vermicomposting

Adi Ainurzaman Jamaludin
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By

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Part 1

Introduction

1.1. Vermicomposting
1.2. Composting
1.3. Nutrient elements
1.4. Spent mushroom substrate
1.1. Vermicomposting

- pH 5.5 – 8.7
- Temperature 25°C-30°C
- 60% - 80% moisture content
- Shorter Duration
- Cost effective & natural method
- Produced Better End Product; ‘Vermicompost’

Vermicomposting

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1.2. Composting

Composting

- Utilize microorganisms
- Aerobic / Anaerobic
- Produced - CO₂ and H₂O
- Methane Gas (under anaerobic condition)
- Temperature 60°C and reduce to 25-30°C
- 30 to 40 days

Humus known as 'compost'

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## 1.3. Nutrient elements

<table>
<thead>
<tr>
<th>Nutrient element</th>
<th>Vermicompost</th>
<th>Compost</th>
<th>HiWave™Compo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mixture Organic Waste</td>
<td>Mixture Organic Waste</td>
<td>Vegetable Waste (80%) + Food Waste (20%)</td>
</tr>
<tr>
<td></td>
<td>Garden Waste (%)</td>
<td>Garden Waste (%)</td>
<td>Garden Waste (%)</td>
</tr>
<tr>
<td>Organic carbon</td>
<td>n.d.</td>
<td>9.8 – 13.4 %</td>
<td>12.2 %</td>
</tr>
<tr>
<td>Nitrogen (N)</td>
<td>1.16 %</td>
<td>0.51 – 1.61 %</td>
<td>0.8 %</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>0.604 %</td>
<td>0.19 – 1.02 %</td>
<td>0.35 %</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>1.574 %</td>
<td>0.15 – 0.73 %</td>
<td>0.48 %</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>0.98 %</td>
<td>1.18 – 7.61 %</td>
<td>2.27 %</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>0.372 %</td>
<td>0.093 – 0.568 %</td>
<td>0.57 %</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>0.166 %</td>
<td>0.058 – 0.158 %</td>
<td>&lt; 0.01 %</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.0093 %</td>
<td>0.0042 – 0.110 %</td>
<td>0.0012 %</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.0049 %</td>
<td>0.0026 – 0.0048 %</td>
<td>0.0017 %</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>0.246 %</td>
<td>0.2050 – 1.331 %</td>
<td>1.1690 %</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>0.0429 %</td>
<td>0.0105 – 0.2038 %</td>
<td>0.0414 %</td>
</tr>
<tr>
<td>Moisture</td>
<td>n.d.</td>
<td>32-66 %</td>
<td>n.d.</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>0.0017 %</td>
<td>n.d.</td>
<td>n.d.</td>
</tr>
<tr>
<td>C/N ratio</td>
<td>7.89</td>
<td>n.d.</td>
<td>15.25</td>
</tr>
</tbody>
</table>

Note:
1. Composting process using high rate composting machine equipped with microwave & infrared technology that can perform all 5 processes (fermentation, drying, granulation, sanitizing, blending & processes) to convert organic waste into dry granular organic fertilizers within 7 days.
2. Analyzed by Malaysian Agricultural Research and Development Institute (MARDI).
3. Data from MIF Sdn. Bhd.
4. Data from Pollution Engineerings (M) Sdn. Bhd.
5. Data from Nagavallemma et al. (2004).

C:N ratio:
- below 20 is indicative of acceptable maturity
- 15 or lower being preferable

Morais and Queda (2003).
Nutrient elements

<table>
<thead>
<tr>
<th>Nutrient elements</th>
<th>$T_1$</th>
<th>$T_2$</th>
<th>$T_3$</th>
<th>$T_4$</th>
<th>$T_5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic carbon</td>
<td>16.88 %</td>
<td>23.51 %</td>
<td>23.96 %</td>
<td>19.66 %</td>
<td>32.14 %</td>
</tr>
<tr>
<td>Nitrogen (as N)</td>
<td>1.90 %</td>
<td>1.46 %</td>
<td>1.75 %</td>
<td>0.94 %</td>
<td>0.87 %</td>
</tr>
<tr>
<td>Phosphorus (as P)</td>
<td>0.57 %</td>
<td>0.38 %</td>
<td>0.46 %</td>
<td>0.24 %</td>
<td>0.23 %</td>
</tr>
<tr>
<td>Potassium (as K)</td>
<td>2.74 %</td>
<td>1.43 %</td>
<td>1.39 %</td>
<td>0.67 %</td>
<td>0.40 %</td>
</tr>
<tr>
<td>C/N ratio</td>
<td>8.9</td>
<td>16.1</td>
<td>13.7</td>
<td>20.9</td>
<td>36.9</td>
</tr>
</tbody>
</table>

Note:
- $T_1$ - Cow dung : Spent mushroom substrate (80:20)
- $T_2$ - Cow dung : Spent mushroom substrate (60:40)
- $T_3$ - Cow dung : Spent mushroom substrate (50:50)
- $T_4$ - Cow dung : Spent mushroom substrate (40:60)
- $T_5$ - Cow dung : Spent mushroom substrate (20:80)
1.4. Spent mushroom substrate

Chemical Composition

- Protein
- Fiber
- Cellulose
- Lignin
- Dry matter

Nutrient rich organic by product of mushroom industry

Utilize microorganisms

Primary source

- Wood saw dust (usually use for King oyster mushroom)
- Straw or corn cobs
- Cotton waste

Directly dispose (open burning / landfill)
Part 2 Materials & Methods

2.1. Vermicomposting methods
2.2. Harvesting the vermicompost
2.1. Vermicomposting methods

Step 1: Worm bin should be shallow (8 to 12 inches deep) & should have a lid to keep condition moist & dark.

Step 2: Drill holes in the top and sides for air circulation and drainage.

Step 3: Add about 8 inches of moistened bedding materials/ feed materials.

Step 4: Leave the feed materials for pre composting (1 week – 3 weeks) for stabilize the temperature.

Step 5: Start the vermicomposting by lay the earthworms on top of the bedding/ feed materials.

Step 6: Maintain the moisture content by sprinkle the water onto materials.
2.2. Harvesting methods

Step 1: When the bedding starts to resemble dark, crumbly soil (depending on species & feed materials), it is time to harvest the vermicompost.

Step 2: Move all contents over to one side of the worm bed.

Step 3: Add new dampened bedding to the empty side and start placing food scraps on that side.
Part 3 Troubleshooting
3.0. Troubleshooting

Troubleshooting

Dead Worms
- The bin is too dry
- Over population of mites
- Exposed to extreme temp.
- Not getting enough food

Odor Problems
- Food in the bin is naturally odorous
- The bin doesn’t get enough air
- The bin is too wet

Fruit Flies
- Be sure to bury food scraps
- Avoid overfeeding
- Wash all fruits in warm water
- Over population of mites
- The bin is too wet

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Part 4  On going research
4.0. On going research

- Comparison of nutrient elements heavy metals in vermicompost from different ratio of spent mushroom substrates and goat manure.

- Potential of spent mushroom substrate and sewage sludge in vermicomposting for reducing the heavy metals contaminations.

- Comparison of nutrient elements in vermicompost from different types of spent mushroom substrates.

- The effects on usage of vermicompost from spent mushroom substrate in vegetables plantations
Sekian, terima kasih