Effect of Fermented Organic Waste Juice on the Growth and Yield of Lettuce

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Abstract

There is need to intensify the production of organic foods as it demands keeps rising. Despite the fact that organic foods enjoys premium price, its high cost of production may not guarantee good profit. One of the factors of production that raises the cost of producing organic food is the cost of fertilizers used. To minimize the cost of fertilizer, organic farms must produce some of the fertilizers from organic waste available to them. Therefore, this work seek to exploit another form of organic fertilizer aside the traditional compost. Organic vegetable waste from Havivia Organic Farm in Israel was collect and fermented by introducing effective microbe in the form of EM 1. After 3 to 6 days, the organic materials were broken down which produced Fermented Organic Juice which can be used as fertilizer. Lettuce were planted on beds with compost incorporated and the fertilizer treatment were 70 ml FOJ/LH2O, 50 ml FOJ/LH2O, 30 ml FOJ/LH2O and a control, that is, no FOJ was applied. 3 applications were done which started at 2 weeks after transplanting. At the end, there were no significant differences between the treatments. However, there was a significant difference between the treatment and the control.

Keywords: Organic Waste Juice; Growth; Lettuce

Background

In recent years, much attention has been given to eating organic food crops and as a result, the need to intensify the production of these crops organically to meet the ever increasing demand which has become the focus of many organic crop farmers. Although organic food crops enjoy premium price, it may not worth it cost of production with respect to the cost in terms of labour, pest and disease management, and fertilizer application. Unlike conventional crop production where farmers use highly concentrated inorganic fertilizers which are applied at lower amount to produce greater effects, organic farmers spend much on buying organic fertilizers which are relatively lower in concentration and therefore must be applied in relatively larger amount to give similar effect as in inorganic fertilizers. To sustain organic food crop production, there is the need for organic farms to be encouraged to process most of their waste into organic fertilizers which are more cost effective and readily available at all times in the production period. Every week, on the average, about 2 - 3 tonnes of crop waste are dumped off at Havivian Organic Vegetable Farm. Therefore, as students and most of all as part of the Havivian Organic Vegetable Farm, we deem it necessary to find alternative fertilizer from organic waste we produce on the field and the pack- house.

In contemporary agriculture, alternative production methods to eradicate or minimize the long- lasting undesired effects of synthetic fertilizers and pesticides are necessary [1]. The organic agriculture system, accepted by the European Union and the FAO as an alternative system to conventional agriculture, appears to be an environmentally friendly growing system. In simple terms, organic farming is a production system that excludes synthetic inputs when possible and uses external inputs only when the system cannot be sustained by internal recycling [2]. Despite organic farming being considered as safe crop production practice, it also causes environmental problems due to the over reliance on compost which according to Bosch., et al. [3] there is enormous emission of Carbon dioxide into the atmosphere.

Therefore, there is the need to find an alternative which will be safe to the environment and also provide the nutrients needed by plants for good growth and development. According to Bosch, *et al.* [4] making Bokashi (Japanese word for “good fermented organic matter”) compared with traditional Composting, results in:

- Lower nutrient losses
- Considerable lower emissions of greenhouse gasses (CO$_2$, CH$_4$, NO$_x$)
- Per unit of end-product, a 27 times lower carbon.
- Less labour required because it does not need to be mixed regularly.

Fermented Organic liquid fertilizer penetrates the soil immediately, plants are given faster access to the nutrients. Some plants will see results from this application almost immediately. In fact, many farmers use this type of fertilizer early in the season to ensure quick root growth, hence plants take hold when it is essential for them to do so (https://bottomline-solutions.net/blog/benefits-using-liquid-fertilizer-farm/). Unlike Organic fertilizers which break down according to nature’s rules, so they may not release nutrients as soon as you need them therefore patience is needed to see improvement in the plant. In fact, you may actually see a deficiency in your plants during the first couple of months until the first application breaks down.

This study examines the effectiveness and availability of nutrients of fermented organic waste juice which are mostly in abundance both from the producers and the consumers and making it useful for plant growth.

**Objectives of the Study**

The study aims to determine the effect of fermented organic juice on the growth and yield of lettuce.

**Hypothesis**

The study expects that the fermented organic waste fertilizer will produce significant yield in lettuce even at lower concentrations because of its high levels of nutrients.

**Methods**

Parameter to be considered include:

- Weight of lettuce.

**Material needed includes:**

- Air tight container
- Wheat bran
- Effective Microbes (EM)
- Sugar/Molasses
- Measuring cylinder
- Graduated beaker
- Organic waste

**Treatments (T)**

- T1 = 30 ml of fermented organic waste juice per 1 litre of water per 0.5m$^2$
- T2 = 50 ml of fermented organic waste juice per 1 litre of water per 0.5m$^2$
- T3 = 70 ml of fermented organic waste juice per 1 litre of water per 0.5m$^2$
- T4 = Control (no fermented organic waste juice).

Preparation of fermented organic waste juice: The preparation of the juice is in two phases.

Phase 1: Culturing of microbes (Bokashi Bran)

- **Materials**: Wheat bran (rice bran and sawdust can be used), Effective Microbes (EM), honey (molasses or brown sugar can be used), measuring cylinder, hand gloves, measuring cup, mixing bowl, water and air-tight container.
- **Preparation**:
  1. 1 Kg of wheat bran will be weighed into the mixing bowl.
  2. 15 ml of honey will be dissolved in 700 ml of warm water at a temperature of 40 degrees Celsius.
  3. 15 ml of EM will be added to the honey solution.
  4. Solution will be poured gradually onto the wheat bran and mixed thoroughly (mixture should be moist and not wet, that is, between 30% - 40% moisture content).
  5. The mixture will be transferred into the air tight container, compressed and then sealed.
  6. The container with the mixture will be stored at a cool and dry place for two weeks.
  7. The successful culture will produce a sweet sour odour.
  8. For storage, mixture will be air dried and packed in a zip-lock bag and placed at a cool and dry place.

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**Figure A**

Phase 2: Fermentation of Organic Waste

- **Materials**: Organic waste, fermentation bucket (two buckets that can fit into each other without touching the bottom and one having holes to allow drainage of liquid), hand gloves, cutting knife, chopping board and microbes culture.
- **Preparation**:
  1. All sort of organic waste at Havivian farm including egg shell will be collected and cut into smaller piece to increase their surface areas for microbial activities.
  2. A handful of the cultured microbes will be sprinkled at the bottom of the fermented bucket.
  3. The waste will be piled at a thickness of 10 - 15 cm and the surface will be covered with a hand full of the culture microbes.
  4. Piling and covering of waste will be repeated until the fermentation bucket is almost full.
  5. Pile will be compress with the hand to ensure that all air spaces are closed completely.
  6. The bucket will be covered and placed at a cool and dry place.
  7. Fermented juice will be collected on the third day and every third day after for two week.

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Caution: If the fermented juice produces a rotten smell do not use it.

![Perforate and none perforated vegetables](image1)

![Vegetable](image2)

![Fermentation](image3)

**Figure B**

### Activities timetable

<table>
<thead>
<tr>
<th>Activities</th>
<th>Details</th>
<th>Time frame</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposal Writing and Submission</td>
<td>Research on topic/literature review</td>
<td>December to 1st January, 2019</td>
<td>Internet computer Books</td>
</tr>
<tr>
<td></td>
<td>Writing of proposal and submission</td>
<td>1st January - 23rd January 2019</td>
<td>By E-mail</td>
</tr>
<tr>
<td>Project performance</td>
<td>Preparation of media</td>
<td>3rd February to 17th February 2019</td>
<td>Wheat bran &lt;br&gt; Fermentation buckets &lt;br&gt; Effective Microbes &lt;br&gt; Honey &lt;br&gt; Measuring scale &lt;br&gt; Non chlorinated water</td>
</tr>
<tr>
<td></td>
<td>Planting of lettuce</td>
<td>18th February 2019</td>
<td>Lettuce Seedlings</td>
</tr>
<tr>
<td></td>
<td>Collection and Fermentation of organic waste</td>
<td>19th February, 2019</td>
<td>Banana peels &lt;br&gt; Red onion &lt;br&gt; Green leafy vegetables waste &lt;br&gt; Potatoes waste &lt;br&gt; Tomatoes waste &lt;br&gt; Fermentation bucket &lt;br&gt; Measuring Scale &lt;br&gt; Cultured microbes</td>
</tr>
<tr>
<td></td>
<td>Application of treatments</td>
<td>4th March, 18th March, 1st April, 2019</td>
<td>Knapsack sprayer &lt;br&gt; Measuring cup</td>
</tr>
<tr>
<td></td>
<td>Collection of growth parameters</td>
<td>At the end of production (14th April 2019)</td>
<td>Knife &lt;br&gt; Measuring scale &lt;br&gt; Thread and rule</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>Data will be recorded analyzed</td>
<td>14th - 21st April, 2019</td>
<td>Microsoft excel</td>
</tr>
<tr>
<td>Submission of final report</td>
<td>Writing and editing of final report</td>
<td>21st April to 10th June 2019</td>
<td>Computer</td>
</tr>
<tr>
<td>Project power point presentation</td>
<td>Preparation slides</td>
<td>1st July, 2019</td>
<td>Microsoft Power point</td>
</tr>
</tbody>
</table>

**Table**

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Economic importance

Processing waste into organic fertilizers will reduce the amount of money used by the farm in purchasing organic fertilizers for crops production of crops such as lettuce and as a result, profit will be increased.

Results

The table below shows the effect of fermented Organic Waste Juice on the weight of lettuce.

<table>
<thead>
<tr>
<th>Treatment (FOJ)</th>
<th>Weight of 6 Plants Per Plot (KG)</th>
<th>Average Plant Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70mls</td>
<td>1.424</td>
<td>0.24</td>
</tr>
<tr>
<td>50mls</td>
<td>1.425</td>
<td>0.24</td>
</tr>
<tr>
<td>30mls</td>
<td>1.455</td>
<td>0.24</td>
</tr>
<tr>
<td>control</td>
<td>1.0</td>
<td>0.17</td>
</tr>
</tbody>
</table>

*Table 1: Data collection on weight of lettuce.*

*Figure 1: Graphical representation of data.*

*Figure 2*
Discussion and Conclusion

There was no significant difference between lettuce yields in relation to 30mls, 50mls and 70mls of the fermented organic juice applied on the lettuce plants. On the other hand, there was a significant difference between the treated plants and the control plant. In the preparation of the trial plot, compost was infused into the planting beds. Therefore, there was an effective interaction between compost and the fermented organic juice which contains effective microbes, hence produced an effect on the lettuce plants except the control.

This agrees with the findings made by Olle and Williams in 2013 [5] which stated that, the benefit of applying EM plus organic matter lies in the ability of the EM to ferment organic matter, thereby releasing nutrients and nutrient-rich organic acids which can be used by plants. This implies that the nutrient potential of compost or organic solution may not be fully utilized by plants in the soil in the absence of effective microbes [6].

Bibliography


4. Agriton Bokashi: information on Bokashi making and applications.


6. 1 Manual - Seven Springs Farm.