Influence of vermicompost and vermiwash on physicochemical properties of rice cultivated soil

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Keywords Vermicompost, Vermiwash

Abstract

In this study the effect of vermicompost on soil chemical and physical properties was evaluated during samba rice cultivation studies. The experiments were arranged in a completely randomized block design manner with three replications. The soil sampling and plant growth measurements were carried out for two months, i.e., during initial and final stages. The present study has been carried out to study the impact of various vermiproduct such as vermicompost, vermiwash and mixture of vermicompost and vermiwash on soil physico-chemical properties during the pot culture studies of samba rice. The physical properties such as the pH, electrical conductivity (EC), porosity, moisture content, water holding capacity and chemical properties like nitrogen, phosphorous, potassium, calcium and magnesium were found distinctly enhanced in vermicompost treated soil, where as the corresponding physico-chemical values in control were minimum. The soil treated with vermicompost had significantly more electrical conductivity in comparison to unamended pots. The addition of vermicompost in soil resulted in decrease of soil pH. The physical properties such as water holding capacity, moisture content and porosity in soil amended with vermicompost were improved. The vermiproduct treated plants exhibit faster and higher growth rate and productivity than the control plants. Among the treated group, the growth rate was high in the mixture of vermicompost and vermiwash treated plants, than the vermicompost and vermiwash un-treated plants. The maximum range of some plant parameter’s like number of leaves, leaf length, height of the plants and root length of plant, were recorded in the mixture of vermicompost and vermiwash. The results of this experiment revealed that addition of vermicompost had significant positive effects on the soil physical, chemical properties and plant growth parameters.

Introduction

The compost prepared through the application of earthworm is called vermicompost and the technology of using local species of earthworms for culture or composting has been called vermi tech. Vermicompost is usually of a finely divided peat like material possessing excellent structure, porosity, aeration, drainage and moisture water holding capacity [Ismail, 2005].

Vermicompost improves the physical, chemical and biological properties of soil. There is a good evidence that vermicompost promotes growth of plants and it has been found to have a favourable influence on all yield parameters of crops like, wheat, paddy, and sugarcane [Ismail., 1997; Ansari., 2007].

L. mauritii feeds on soft part of the leaves that are at the initial stage of degradation. They consume large amount of organic matter along with the soil. (Bouche, 1977). The vermitepts were prepared in the dimension of (2 x 2 x 2m) (Ibh). The bottom layer was filled with pebbles or coconut shell to absorb the excess water from the composting pit. The second layer was filled with garden soil and old compost inoculum. Cow dung and leaf litter were mixed at 1:2 ratio and added in the pit. Finally the pit was covered by coconut fronds in order to prevent the moisture evaporation due to direct sunlight. Once in 2 or 3 days, the contents of the pit were turned for even decomposition and enhanced aeration. After 30 days the compost was collected and packed in a large vermibed. Vermiwash is a liquid extract from vermicompost and is used as a foliar spray. It contains plant growth hormones like auxins, cytokinins apart from soluble micro and macro nutrients.

Materials and Methods

Preparation of Vermibed and Collection of VermiWash

The raw materials used for vermicompost were leaf litter and cow dung. The earthworm species used for vermicomposting was Lampito mauritii - an anecic indigenous species and two exotic species Eisenia fetida and Eudrilus eugineae. Lampito mauritii feeds on soft part of the leaves that are at the initial stage of degradation. They consume large amount of organic matter along with the soil. (Bouche, 1977). The vermitepts were prepared in the dimension of (2 x 2 x 2m) (Ibh). The bottom layer was filled with pebbles or coconut shell to absorb the excess water from the composting pit. The second layer was filled with garden soil and old compost inoculum. Cow dung and leaf litter were mixed at 1:2 ratio and added in the pit. Finally the pit was covered by coconut fronds in order to prevent the moisture evaporation due to direct sunlight. Once in 2 or 3 days, the contents of the pit were turned for even decomposition and enhanced aeration. After 30 days the compost was collected and packed in a large vermibed. Vermiwash is a liquid extract from vermicompost and is used as a foliar spray. It contains plant growth hormones like auxins, cytokinins apart from soluble micro and macro nutrients.

Physico Chemical Analysis

To determine soil physical and chemical properties, the soil samples were collected two months after addition of vermicompost from depth of 15cm. The pH of the potting
mixtures were determined using a double distilled water suspension of each potting mixture in the ratio of 1:10 (W/V) (Inbar et al., 1993) that has been agitated mechanically for 2 hours filtered. The same solution was used for measuring electrical conductivity with a conductance meter that had been standardized with 0.01 and 0.1M KCl. The water holding capacity (WHC) (% volume) was also calculated as (wet weight - dry weight) / volume X 100 (Inbar et al., 1993). The Gas Pycnometer method was used for determining total porosity of soil. The method is based on Boyle's law (p1v1 = p2v2). The moisture content was determined after drying at 105°C for 24hrs. The nitrogen was measured by following Kjeldhal method (Jackson, 1975). Available phosphorus was measured using the method described by Bray and Kurtz (1945) and analyzed as PHO4-P. Exchangeable potassium, calcium and magnesium were determined after extracting the sample using ammonium acetate (Simard, 1993) and analyzing with a Perkin-Elmer 3110 double beam atomic absorption spectrophotometer (AAS).

**Results and Discussion**

The result on effect of vermicompost on physical properties of the soil observed during initial and final stages of samba rice cultivated in pots is given in Table 1. Following are the initial physical properties observed in vermicompost applied soil during the samba rice pot culture studies. The minimum pH of 7.0 ± 0.03 and minimum EC of 0.04 ± 0.01mS were observed in vermicompost and vermiwash applied pot and the maximum pH of 7.5 ± 0.02 in control pot.

The minimum electrical conductivity of 0.02 ± 0.01mS was observed in vermicompost and vermiwash applied pot and the maximum of 2.12 ± 1.1mS in control pot. The reduction of pH and EC of the soil were also observed in vermicompost and vermiwash applied pots, when compared to control the value was 1.0±1.0ppm [Deepa Devi, 1992] reported that the increase in potassium uptake by vermicompost application may be due to enhancement in potassium availability by shifting the equilibrium among the forms of potassium from relatively exchangeable potassium to soluble potassium forms in the soil. The results indicated that vermicompost increased calcium content of soil. The highest increase recorded value was 5.0±1.0ppm mixture of vermicompost and vermiwash applied pots when compared to control where the recorded value was 1.0±1.0ppm.

Vermicompost contains most nutrients in plant available forms such as phosphates, exchangeable calcium, and soluble potassium [Oro-Zoo et al., 1996]. The highest content of magnesium was recorded as 4.0±1.1ppm in mixture of vermicompost and vermiwash applied pots, when compared to control the value was 1.0±1.0ppm [Deepa Devi, 1992] reported that the available soil calcium and magnesium was enhanced significantly due to the application of vermicompost manure and composted sugarcane trash.

The results on effect of Vermicompost on Growth Parameters of Samba Rice Pot Cultivated Studies in Pots is given Table 3. During the two months observation of samba rice growth the maximum leaf length, number of leaves, root length and height of the plants were recorded in vermicompost and vermiwash applied pot. The observed values were 19±0.1cm, 9±0.01, 15±0.01cm and 23±0.01cm. The minimum leaf length, number of leaves, root length and height of the plants were recorded in control. Their respective values of control pot 7.1±2.1cm, 2.9±1.1, 3.0±2.1cm and 10±2.1cm respectively. Aracron et al., [2004] reported positive effects of vermicompost on the growth and yield in strawberry, especially increase of leaf area, root length and fruits weight in the field conditions. Mishra et al., [2005] reported that vermicompost had beneficial effects on growth and yield of rice, especially caused significant increase of many growth parameters, seeds germination and yield.

The excellent plant growth in vermicompost application was possibly due to some plant growth promoters in worm casts. The earthworm casts and vermicompost influenced the development of the plants and promoted leaf length, root length, and number of leaves, which suggest the linkage between biological effects of vermicompost and microbial metabolites that influenced the plant growth and development [Tomati et al., 1998]. However, the effects of vermicompost and its metabolites on quality of samba rice may depend on a variety of factors, which needs further investigations.
Table – 1: Effect of Vermicompost and Vermiwash (Individual and Combined) on Physical Property Changes During Initial and Final Stages of Samba Rice Cultivation Studies

<table>
<thead>
<tr>
<th>Treatments</th>
<th>pH Initial</th>
<th>pH Final</th>
<th>Electrical Conductivity Initial</th>
<th>Electrical Conductivity Final</th>
<th>Water holding capacity % Initial</th>
<th>Water holding capacity % Final</th>
<th>Porosity (%) Initial</th>
<th>Porosity (%) Final</th>
<th>Moisture Content (%) Initial</th>
<th>Moisture Content (%) Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>7.5±2.02</td>
<td>7.4±2.01</td>
<td>2.12±1.1</td>
<td>2.0±1.0</td>
<td>41±0.02</td>
<td>44±1.02</td>
<td>34±2.10</td>
<td>39±2.00</td>
<td>36±1.02</td>
<td>41±1.1</td>
</tr>
<tr>
<td>Vermicompost</td>
<td>7.4±0.01</td>
<td>7.1±0.01</td>
<td>1.02±1.0</td>
<td>1.01±1.0</td>
<td>43±0.01</td>
<td>47±1.0</td>
<td>36±1.0</td>
<td>41±1.00</td>
<td>39±1.1</td>
<td>44±1.0</td>
</tr>
<tr>
<td>Vermiwash</td>
<td>7.3±2.0</td>
<td>7.2±1.02</td>
<td>2.1±1.1</td>
<td>2.0±1.1</td>
<td>42±1.0</td>
<td>46±1.1</td>
<td>35±1.1</td>
<td>40±1.1</td>
<td>38±1.0</td>
<td>43±1.1</td>
</tr>
<tr>
<td>Vermicompost and vermiwash</td>
<td>7.0±0.03</td>
<td>7.0±0.03</td>
<td>1.01±0.01</td>
<td>0.02±0.01</td>
<td>45±0.03</td>
<td>49±1.0</td>
<td>39±0.03</td>
<td>44±1.00</td>
<td>41±1.0</td>
<td>46±1.0</td>
</tr>
</tbody>
</table>

Table – 2: Effect of Vermicompost and Vermiwash (Individual and Combined) on Chemical Property Changes During Initial and Final Stage of Samba Rice Cultivation Studies

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Nitrogen (ppm) Initial</th>
<th>Nitrogen (ppm) Final</th>
<th>Phosphorous (ppm) Initial</th>
<th>Phosphorous (ppm) Final</th>
<th>Potassim (ppm) Initial</th>
<th>Potassim (ppm) Final</th>
<th>Calcium (ppm) Initial</th>
<th>Calcium (ppm) Final</th>
<th>Magnesium (ppm) Initial</th>
<th>Magnesium (ppm) Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>55±2.1</td>
<td>61±2.0</td>
<td>64±2.0</td>
<td>69±2.0</td>
<td>180±2.0</td>
<td>184±2.1</td>
<td>1.0±1.0</td>
<td>1.5±1.0</td>
<td>1.0±1.0</td>
<td>1.5±1.0</td>
</tr>
<tr>
<td>Vermicompost</td>
<td>59±1.1</td>
<td>64±1.0</td>
<td>68±1.1</td>
<td>73±1.0</td>
<td>184±1.0</td>
<td>189±1.0</td>
<td>2.0±1.1</td>
<td>2.5±1.0</td>
<td>2.0±1.1</td>
<td>3±1.0</td>
</tr>
<tr>
<td>Vermiwash</td>
<td>58±1.0</td>
<td>63±1.1</td>
<td>67±1.1</td>
<td>72±1.1</td>
<td>183±1.1</td>
<td>188±2.0</td>
<td>1.5±1.1</td>
<td>2.0±1.0</td>
<td>1.2±1.1</td>
<td>2±1.0</td>
</tr>
<tr>
<td>Vermicompost and vermiwash</td>
<td>63±1.1</td>
<td>69±0.2</td>
<td>72±1.0</td>
<td>77±1.0</td>
<td>188±1.0</td>
<td>195±1.0</td>
<td>3.2±1.0</td>
<td>5.0±1.0</td>
<td>3.1±1.1</td>
<td>4±0.1</td>
</tr>
</tbody>
</table>

Table – 3: Showing the Chronological Growth Performance of Samba Rice Cultivation with Various Vermitreatments in Two Months Interval

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Number of leaves Initial</th>
<th>Number of leaves Final</th>
<th>Leaf length (cm) Initial</th>
<th>Leaf length (cm) Final</th>
<th>Height of the plant (cm) Initial</th>
<th>Height of the plant (cm) Final</th>
<th>Root length (cm) Initial</th>
<th>Root length (cm) Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>7.1±2.1</td>
<td>13±2.0</td>
<td>2.0±1.1</td>
<td>5±1.2</td>
<td>10±2.1</td>
<td>14±2.0</td>
<td>3.0±2.1</td>
<td>7.0±2.0</td>
</tr>
<tr>
<td>Vermicompost</td>
<td>9.2±1.0</td>
<td>16±1.0</td>
<td>4.0±2.0</td>
<td>7±1.0</td>
<td>14±1.0</td>
<td>19±1.0</td>
<td>6.0±1.2</td>
<td>12.0±1.0</td>
</tr>
<tr>
<td>Vermiwash</td>
<td>8.5±2.1</td>
<td>15±1.1</td>
<td>3.0±1.1</td>
<td>6±1.2</td>
<td>13±1.1</td>
<td>18±1.1</td>
<td>5.0±2.1</td>
<td>11.0±2.0</td>
</tr>
<tr>
<td>Vermicompost and vermiwash</td>
<td>12.1±1.0</td>
<td>19±0.1</td>
<td>6.0±1.0</td>
<td>9±0.01</td>
<td>17±0.1</td>
<td>23±0.01</td>
<td>7.1±1.0</td>
<td>15±0.01</td>
</tr>
</tbody>
</table>

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Reference
Bhasker, A., Macgregor, A.N, and Kirkman, J.H. 1992. Influence of soil ingestion by earthworms on the availability of...


