Comparative Study of Nutrient Values of Ordinary Compost and Vermicompost for Same Proportion of Waste

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Abstract

Organic waste can be converted into a useful material like soil known as 'fertilizer' which is rich with Nitrogen, Potassium and Phosphorus and is used to add into plants to enhance the growth and health of a plant. This fertilizer from biodegradable wastes can be prepared using any of the methods such as Ordinary Composting, Vermicomposting, Millicompost (composting using Millipedes), using industrial sludge, etc. Various parameters such as Temperature, Volume Reduction, Nutrient values, Moisture Content, etc. also differ with the type of waste and method used for making compost. In this study the various characteristics of ordinary compost and vermicompost have been studied for the same type of waste, quantity and proportion. It has been observed that for same waste, there is huge difference between nutrient values, bulk density and volume reduction. Temperatures of both the composts are comparatively same throughout the period of study. Volume reduction in compost with earthworms is larger than ordinary compost. This study has been carried out for solid waste management in Government Engineering College, Surat. So after the comparison, the Vermicomposting method is proved to be beneficial.

Keyword- Vermicompost, Ordinary Compost, Nutrient Values

I. INTRODUCTION

Composting is a process in which the organic solid waste is allowed to decay. This process involves decomposition of organic waste into humus kind of material which is a good fertilizer for soil. Microorganisms play a vital role in this process. For sustainability of these microorganisms, sufficient amount of Carbon, Oxygen, Nitrogen and Water is required. Materials that can be added to compost are Organic waste, Green waste, animal excreta, Human excreta, tea leaves, food leftovers, rotten vegetables and fruits, vegetable and fruit skins, industrial sludge, etc. Time taken to compost to get prepared is dependent upon the waste added to the composting. But average time taken is about 2 to 3 months. Composting can either be ordinary composting, Vermicomposting (Compost using Earthworms), Milli-Compost (Composting using Millipedes)[7], Using industrial sludge, etc. Following are the composting methods adopted in this study.

A. Ordinary Composting

In this method, simply all the waste is collected and piled up in a pit or in a container and left open to atmosphere to get decayed. If the composting is done in pit, then it is covered with soil at top and mixed at specific time intervals. And if composting is done in a container then holes are made in containers at sides and bottom for air circulation. Water is added in at alternate days in any of the method used in order to maintain optimum moisture content for process.

B. Vermicomposting

Vermicomposting is a process in which decomposition of organic material like fruit and vegetable waste is done by adding various species of worms such as red wigglers, white worms and earthworms. In this process compost would take comparatively less time as taken for ordinary composting.

Sometimes during the process of composting a liquid is produces from the compost, which is called as 'Vermi Wash'[5]. This vermi wash is due to addition of excess water into the compost which extracts out from it. Vermi wash is having so many nutrients which are helpful to plants to grow, so that it can also be added in plants along with water as growth booster. If it's not produced from compost, then it can be made by mixing 1 part compost and 2.5 part water [5].

The outcome of this will result into development of a technology that will be used in the production of compost from the waste generated in college campus and hence making a more sustainable solid waste management.

C. Materials

The following materials were utilized for this study

1) Plastic: Plastic containers were used in this methodology. One container is meant for ordinary composting and one container is for vermicomposting.
2) Soil: Soil available in GEC, Surat campus is collected. Earth is evacuated about 50 cm and then soil is collected from it. In the allotted space, soil is filled for a height of 2.5 cm in both containers. This layer will act as vermibed for earthworms.
3) Earthworms: Earthworms used for this study are 'Red Wiggler Worms'. Earthworms are collected in Chikhli, Navsari. Abot 30 numbers of worms are added in the containers.
4) Wastes:

- Green Waste: Around 2 kg of green waste including green and dried leaves, grass, weeds, branches, etc. Collected from campus and is divided into two equal parts.
- Food waste: Around 1 kg of this waste is collected from canteen. This includes Skin of vegetables, tea leaves, wasted foods, etc.
- Cow dung: Cow dung to be added in compost should be few days older. Around 3 kg of cow dung is collected from Olpad, Surat. It is left to get a little dry and then added in composting.

5) Shelter: A sheet of plastic is used to cover the setup to keep the containers safe from predators [6].
6) Water: Water is added in both the composts at after 2 to 3 days and also temperature is measured before adding water.

II. METHODOLOGY

For preparing the compost, containers of 65cm x 22cm x 24cm are used [6]. This can be carried out either in a synthetic bag or a trench. Holes are provided at four sides of container for air circulation.

Bottom slopped soil layer has a slope of 1:9. The slope is provided in order to collect vermiwash at one end of the container. A layer of plastic is provided above the slopped soil layer so that wash moves over it smoothly and gets collected at one end. Over that, a layer of dried grass is placed so that the soil does not come along with wash. Then a 2.5 cm thick layer is placed over it. Green wastes like leaves, Grass, Weeds, etc. and kitchen waste are added above the soil layer. After that, cow dung is added to the compost according to decided proportion. Cow dung used for compost should be 10 to 15 days older because heat generated in initial stages of decomposition is higher, which is not suitable for microorganisms. Top soil layer is provided to ensure safety against birds, cats and dogs.

After addition of all the waste, a little amount of water is sprinkled over it. After 10-12 days, in one of the containers about 30 earthworms were added. The temperature of the compost should be around 25 - 35ºC at the time of addition of worms[6] or should be around normal temperature[3]. If the temperature is more, then water is added to the container and temperature is brought down. Also by inserting hand into the compost, warmness of compost can be checked. It is necessary to reduce the heat otherwise the earthworms will not be able to survive and will be died. For this study, earthworms used are of 'Eisenia Fetida' specie. They are also known as 'Red worms' or 'Red Wiggler worms'.

Fig. 1: Eisenia Fetida or Red Wiggler Worm

Various layers for materials are as follows:

1) Slopped Soil Layer at slope 1:9
2) Plastic layer
3) Dried grass
4) 2.5 cm thick bottom soil layer
5) Green waste
6) Kitchen Waste
7) Cow Dung
8) Top Soil layer

A. Constituents in Each Compost

C_1 = Ordinary Compost, C_2 = Vermicompost
C_1 = Green Waste + Dry Grass + Weeds + Kitchen Waste + Soil + Cow dung
C_2 = Green Waste + Dry Grass + Weeds + Kitchen Waste + Soil + Cow dung + Earthworms

B. Laboratory Work

1) Physical Parameters

- Volume Reduction: Volume reduction is found out by deducting the final volume of the manure after composting from the initial volume of waste.
- Temperature: Temperature of the manure is measured by inserting thermometer in the compost at 2 to 3 days of interval. And temperature variation is checked.

2) Chemical Parameters

- pH: For measuring pH of compost, about 5 gm sample is dissolved with 25 ml distilled water and then let it still for about 10 minutes. Then pH of the solution is measured by inserting the pH paper into it.
- Total Nitrogen (N): Available Total Nitrogen in both samples is measured by Potassium Permanganate Method.
- Phosphorus (P): Total Phosphorus is measured with the help of 0.5 M Sodium Bicarbonate as extranatent and Ammonium Molybdate for determination with the help of Spectrophotometer.
- Potassium (K): Total Potassium is measured by means of 1 N Ammonium Acetate solution using Flame Photometer.

III. RESULT AND ANALYSIS

A. Chemical Parameters

Sr. No.	*Type of Sample / Parameter*	*Ordinary Compost (C1)*	*Vermicpompost (C2)*
1.	*pH*	*8*	*7*
2.	*Total Nitrogen (N) %*	*0.32*	*0.43*
3.	*Total Phosphorus (P)%*	*0.07*	*0.13*
4.	*Total Potassium (K)%*	*0.43*	*0.43*

Table 1: Nutrient Values in both compost

1) pH: pH of ordinary compost was observed to be higher than the vermicompost. Ordinary compost was having 8 pH while vermicompost has 7 pH.
2) Total Nitrogen (N): The values of available nitrogen was found higher in Vermicompost than Ordinary Compost. Total Nitrogen value in Ordinary Compost was observed as 0.32% and that of in Vermicompost observed as 0.43%. Total Nitrogen value in Vermicompost is 34.4% more as compared to Ordinary Compost. The percentage values of nutrients are on the basis of weight. i.e. 0.43% of Nitrogen indicates 4.3 gm nitrogen is available per 1 kg of compost.
3) Total Phosphorus (P): Similarly, as total Nitrogen, higher value of available Phosphorus was found in Vermicompost as compared to Ordinary Compost. It shows that after digestion of organic compost, more phosphorus content was released in Vermicompost as compared to ordinary compost. Value of Phosphorus was around 85.2% more in Vermicompost than Ordinary Compost.
4) Total Potassium (K): From Table 1, it is observed that there is not any difference in Total Potassium value of both the composts.

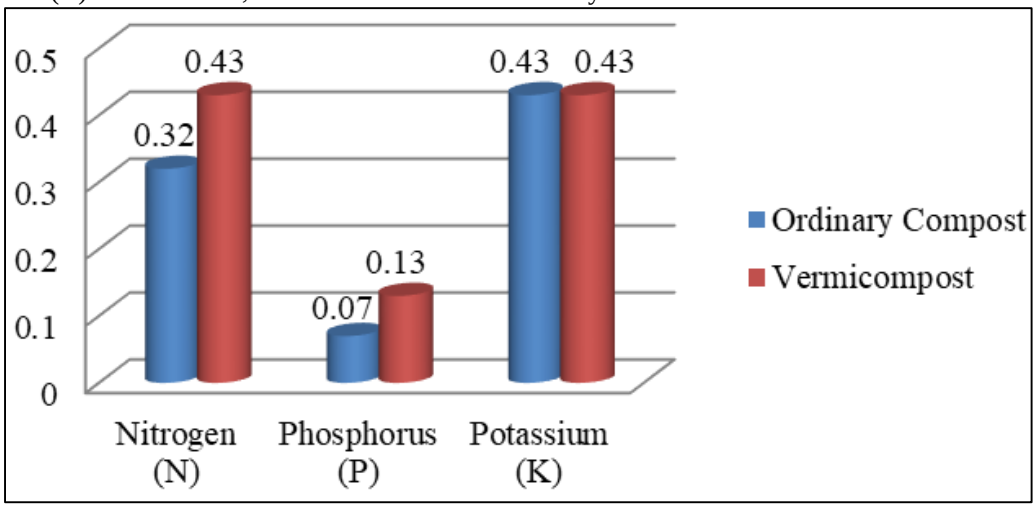

Fig. 2: Nutrient Value Comparision

B. Physical Parameters

1) Temperature: Following chart shows temperature variation in both the compost measured at interval of 2 to 3 days. It is clear from the graph that there is no more temperature variation between both the composts throughout the period of study. From graph, we can say that average temperature of both composts is 30°C for entire study period.

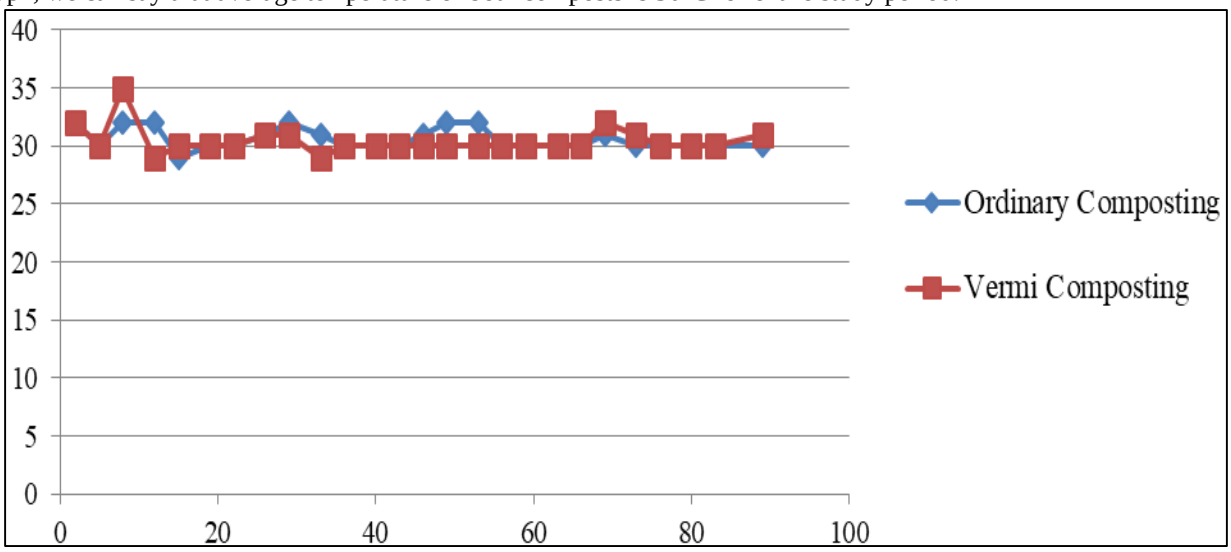

Fig. 3: Temperature Analysis of Compost

2) Volume Reduction: As shown in below figure, a considerable volume reduction can be observed. This volume reduction was recorded at 35th day. After 35th day, there is no more volume reduction noted in both composts.

Fig. 4: Volume Reduction at 35th day

IV. CONCLUSION

- After analysis of all the parameters of both composts, it can be concluded that Vermicompost is superior to the Ordinary Compost for field applications.
- Nutrient values like Total Nitrogen (N), Total Phosphorus (P) are comparatively higher in Vermicompost than Ordinary Compost. But value of Total Potassium (K) was found to be equal in both composts.
- Temperature variation was also nearly equal for both composts having an average value of 30oC.
- Volume reduction was also found more in Vermicompost as compared to Ordinary Compost, which leads the Vermicomposting method over Ordinary Composting as a better Solid Waste Management.

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