VERMICOMPOSTING WITH COW DUNG BANANA PLANT AND VEGETABLE WASTES

Fakhruddin[1], Dr. Sneha Gupta[2]

[1]M.Tech Student, Department of civil engineering, Madan Mohan Malaviya University of Technology, Gorakhpur. 273010, India
[2]Assistant Professor, Department of civil engineering, Madan Mohan Malaviya University of Technology, Gorakhpur. 273010, India

---

ABSTRACT:- *Vermicomposting is a simple biotechnological process of composting, in which certain species of earthworms are used to convert the organic waste into compost rich in nutrients. Nowadays, farmers mostly use chemical fertilizers for agricultural purposes, which pollute the soil and decrease their fertility and also contaminate the groundwater. Vermicompost has been proposed to be used in the place of chemical fertilizers for overcoming the problems and to utilize organic waste. Vermicompost has better water holding capacity, which also increases the fertility of the soil. Vermicomposting technology can be characterized as environmentally friendly and sustainable. The paper intends to study various techniques adopted by people in the industry as well as in researches and develop vermicompost using organic wastes by optimizing the methods as obtained from the study. The paper discusses the usage of organic wastes like cow dung, banana plant stem and leaves and vegetable wastes individually and in mixed proportions using the earthworm Eisenia Fetida. The future scope of the work shall be to use the vermicompost with other organic wastes like sawdust, rice husk, etc. and use it as material for plant saplings and then compare them for their growth in terms of their height, foliage, flowers, etc.*

Keywords: Eisenia Fetida, cow dung, banana plant stem, vegetable waste

1. INTRODUCTION

Recycling of organic waste through vermicomposting is very popular globally due to its ability to convert the waste to manure as a substitute for chemical fertilizers. Banana is grown in about 120 countries in the world which generates about 86 tonnes of crop waste per hectare. In India, it is cultivated in 4.6 lakhs hectare area with a production of 14.2 t and productivity of 30.5 t/ha. The whole plant (leaves, stem, and rhizome) of banana, after harvesting of the fruits, is left in the field which takes several months to degrade naturally. Such banana plant-derived wastes can also be utilized for recycling through vermicomposting. Earthworms, in vermicomposting, are used to derive a stable compost rich in available plant nutrient elements and plant growth hormones than traditional composting. Among the several epigamic earthworms Eisenia Fetida is most favored for vermicomposting due to its wide range of tolerance towards different environmental variables. In vermicomposting, earthworms have a crucial role, as they influence the activity of microorganism through fragmentation and ingestion of the organic matter. The importance of earthworm microbial communities is well documented in the vermicomposting of lignocellulosic materials.

2. LITERATURE SURVEY

Charu Gupta et al. (2019) Vermicomposting technology is an old age practice in India and a well-known technology throughout the world. It represents an attractive, efficient and ecofriendly approach in treatment and management of solid wastes generated from all sources such as industrial, agricultural and domestic. The other added advantage is that in vermicomposting the material is neither landfilled nor burned but recycled. Thus, vermicomposting is a technology that focuses on conservation of resources and their sustainable utilization. Vermicomposting can also be used for the treatment of food-waste, paper, cardboard, manures, and bio-solids. It can be used in soil amendment. In addition, vermicomposting may also help in employment generation. Vermicompost can also be used in greenhouse application, in establishing new plants such as rootstock in vineyards. Vermicompost can be used for both agricultural and horticultural production. However, there are still many research gaps that need to be addressed such as insufficient scientific study on enhancing the growth rate of earthworms.

Norman Q. Arancon et al. (2019) revolves around the development of vermiculture as an art, a science, and an industry. It traces the early development of vermicomposting, which was used to manage organic wastes that were considered environmentally hazardous when disposed of improperly. It also presents the vermicomposting process, including its basic requirements, technology involved, and product characteristics, both in solid form and as a liquid extract. Research reports from different sources on the performance of the products are also provided. The discussion attempts to elucidate the mechanisms involved in plant growth and yield promotion and the suppression of pests and diseases. Certain limitations and challenges that the technology faces are presented as well.

Natchimuthu Karmegam et al. (2019) The increase in major plant nutrients, TKN, NeNO3 - , TP and TK, decrease in TOC, C/N, C/P and OMC related to that of enzymatic and microbiological activities in vermicompost of PMS, CD and TEP/GLS combinations in this study indicates that green manure plants, TEP and GLS amendment positively supported the enhanced bioconversion of PMS into vermicompost using E. fetida. The worm growth and reproductive activity in PMS, CD and TEP/GLS treatments are in support of the encouraged vermi conversion process. The PMS generated from paper industries in combination with CD and green manure plants TEP/GLS (50% PMS þ 25% CD þ 25% TEP/GLS, 2:1:1 ratio) can be used for enriched vermicompost production with E. fetida, which in turn helps sustainable utilization of PMS. The maturity of the vermicompost as indicated by the activities of the enzymes, DEH, UA, SPA and ALP corroborated with the seed germination assay using cowpea and maize highlights that the vermicompost is suitable for agricultural use. The results of the present study signify that the industry generated organic wastes like PMS and organic materials with poor nutrient contents can be utilized for vermicomposting by amending the green manure plants for 'nutrient rich' vermicompost production. Further studies with the amendment of green manure plants in Vermi-conversion systems may provide possible utilization of different organic materials for nutrient recovery in an eco-friendly manner. However, the changes in the heavy metal contents in PMS amended with CD and green manure plants need to be established.

H. C. Parmar et al. (2019) conducted at the Agriculture Research Station, College of Agriculture, Anand Agricultural University, Jabugam during three consecutive seasons of the years 2015-16 and 2016- 17. This was to evaluate banana Pseudostem and maize fodder waste with and without cow dung and Anubhav biodegradable bacterial consortium (ABBC) for it bi-product in terms of vermicomposting, time required for degradation and the nutritive quality of vermicompost. The experiment consisted of eight treatments and conducted in RBD with three replications. Results shows that, the treatment Banana pseudostem + 5% Cow dung + Anubhav biodegradable bacterial consortium and the treatment Maize fodder waste + 5% Cow dung + Anubhav biodegradable bacterial consortium were significantly higher for N, P, K content during all the three seasons and in pooled analysis with less number of days to harvest and high recovery. While, microbial count were recorded maximum in banana Pseudostem based vermicompost than maize fodder waste. Overall, vermicompost produced from the banana Pseudostem and maize fodder waste by using ABBC @ 1 lit/t and 5 % cow dung provided the major nutrients in more balanced proportion. The main perspectives of this study is to decrease the environmental pollution by making vermicompost from banana pseudostem waste or maize fodder (waste) instead of dumping on road side or burning or left in the field and also reduce the use of chemicals by using vermicompost.

3. MATERIALS AND METHODS

3.1 Collection of banana plant stem, cow dung and vegetable waste in the present study, the Banana plant wastes were collected from the village parvat chhapra padrauna, dist-Kushinagar (U.P) India. Collected materials were chopped into small pieces and allowed to pre-decompose for 40 days. Urine free cow dung was obtained from cattle shed Padrauna dist-Kushinagar. Vegetable waste was collected from the vegetable market and different houses. Earthworms were collected from padari Kushinagar. The partially decomposed material was mixed with cow dung in three different ratios (Table 10). The experiment was conducted in the bed of size (length 6, width 2 and height 2) ft. The bed was filled with Banana plant stem, cow dung, and vegetable waste according to the different treatments. Healthy, juvenile earthworms of Eisenia Fetida were released in the bed at the rate 40.

Table.1 Description of materials used and their ratio in the experiment.

Sample	Ratio
Cow dung	1
Cow dung and banana plant stem	3:2
Cow dung, banana plant stem and vegetable waste	3:1:1
Cow dung and vegetable waste	3:2



3.2 BED METHOD: Two methods are used in vermicomposting. Bed method and pit method. But the bed method is easy to maintain so that is why we used the bed method.

3.2.1 Preparation of beds

Vermicompost was developed in four different ratios that are why four beds are required for sample and size of the bed is (6x2x3) ft. The bed was constructed on the pucca / kachcha flor using 1st class bricks. This size bed is used for small-scale vermicomposting for personal requirements (5-10 tonnes of vermicompost annually). This method is easy to maintain and practice. The tops of the beds were covered with thin mesh, to allow gaseous exchange.

3.2.2 Species of earthworms

Eisenia Fetida :(tiger worm, manure worm): It is preferred because of its high multiplication rate and converts the organic waste into vermicompost within (50-55) days.

Dendrobaena Veneta: It is medium-small earthworm averaging about 1.5g when fully grown.

Lumbricus Rubellus: It is usually reddish-brown and about 25-105 mm length with around 95-120 Segments.


Lumbricus Rubellus

Dendrobaena veneta an earthwor...

EISENIA FETIDA

1. PROCEDURE FOR VERMICOMPOST PREPARATION

1. Vermicomposting unit should be in a cool and moist.
2. Cow dung, a chopped dried banana plant and vegetable waste in ratio 3:1:1
3. Kept for partial decomposition for 20-25 days.
4. Beds of partially decomposed material of size 6x2x2 feet should be made.
5. Red earthworms should be released on the upper layer of the bed.

6. Water should be Sprinkle after the release of worms.
7. Beds should be kept moist by the sprinkling of water and covering with gunny bags/polythene
8. The bed should be turned once after 30 days for aeration.
9. The compost gets ready in 55-60 days.
10. The finished product is ¾ of the raw materials used.
11. When the raw material is completely decomposed it appears black and granular.
12. Watering should be stopped as the compost gets ready.
13. The compost should be kept over a heap of partially decomposed cow dung so that earthworms could migrate to cow dung from compost.
14. After two days compost can be separated and sieved for use.

2. CHEMICAL ANALYSES:

The pH was measured using a digital pH meter (Systronics) in 1:10 (w/v) aqueous solution for all the samples (deionized water). Total organic carbon (TOC) was measured after igniting the sample in a muffle furnace at 550 _C for 60 min (Nelson and Sommers, 1982). Total Kjeldahl nitrogen (TN) was measured using the method described by Jackson (1958). Available P was measured according to Olsen et al. (1954). Inductively Coupled Plasma-Atomic Emission Spectrometer (ICP-AES, Spectro Analytical, and Germany) was used for both total and available elemental analysis of samples at different stages of decomposition. Tri-acid digestion technique and water extract of samples were used for total and available elemental analysis of the samples respectively. Both triacid and water extracts were analyzed using ICP-AES for P, K, Ca, Mg, Mn, Zn, Fe, and Cu. The samples were finely ground (60 mesh) then oven-dried at 60 _C for 48 h. Ground and dried samples weighing 0.5 g were transferred to 100 mL conical flasks. 12 mL of a triacid mixture of nitric acid, sulphuric acid and perchloric acid [HNO3: H2SO4: HClO4: 9:2:1 (v/v)] was added to the flasks and digested at 200_Cuntil the digest was clear or colorless.

3. PREVENTIVE MEASURES

1. The floor should be compacted to prevent earthworms' migration into the soil.
2. 20-25 days old cow dung should be used to avoid excess heat.
3. Aeration should be maintained for proper growth and multiplication of earthworms.
4. Optimum moisture level (30-40 %) should be maintained.
5. 18-25°C temperature should be maintained for proper decomposition,

4. CONCLUSIONS

The utilization of BS blended with CD in vermicomposting using earthworm Eisenia Fetida could be feasible. Maximum enrichment of nutrients (K, Mg, and Fe) was observed when BS was spiked with CD in higher proportion. The C: N ratio declined till 60 days and reached the most optimal range in all the treatments.

5. REFERENCES

1. Chandra Khatua a,b, Somoshree Sengupta a,b, Vamsi Krishna Balla a,b, Biswanath Kundu a,b, Ashish Chakraborti c, Sudipta Tripathi d, ⇑
2. Sara Sabaa, Giacomo Zaraa, Angela Biancoa, Matteo Garaua, Monica Bononib, Mario Deromaa Antonio Paisa, Marilena Budronia.
3. Aira, M., Monroy, F., Domínguez, J., 2006. Changes in microbial biomass and microbial Activity of pig slurry after the transit through the gut of the earthworm Eudrilus eugeniae (Kinberg, 1867). Biol. Fert. Soils 42, 371–376

4. Droussi, Z., D'orazio, V., Provenzano, M.R., Hafidi, M., Ouatmane, A., 2009. Study of the biodegradation and transformation of olive-mill residues during composting using FTIR spectroscopy and differential scanning calorimetry. J Hazard. Mater. 164, 1281–1285.
5. Umamaheswari S and Vijayalaksmi G S, Poll Res., 2003, 22 339-341.
6. Umamaheswari S, J. Ecotoxicol. Environ Monit., 2005, 15, 69-72.
7. Trivedy R K and Goel P K, Chemical and biological methods for water pollution studies. Environ. Pub. Karad, India, 1986, 99.
8. Tandon H L S, Methods of analysis of soils, plants and waters. New Delhi, India, 1993.
9. Cohen S and Lewis H B, Fed Proc., 1949, 9, 191.
10. Lee E K, Earthworms. Academic Press, London, 1985.
11. Esther Rani D V, Perumalsamy K and Isaiarasu L, J Ecotoxicol Environ Monit., 2007,
12. 17(1), 37-41.
13. Gunathilagaraj K and Ravignanam T, Madras, Agric. J, 1996, 83, 455-457.
14. Gaur A C, A Manual of Rural Composting FAO/UNDP, Regional Project RAS/75/004. Field Document No.15. FAO, Home, 1982, 102.
15. 16 Lakshmi Bai L, and Vijayalakshmi, G S, Poll Res., 2000, 19¸481-483.
16. Muthukumaravel K, Vermicomposting of Solid Wastes, M. Sc., Dissertation, Bharathidasan University, Tiruchirappalli, 1996.
17. Vasanthy M, Thamaraiselvi C and Ramadoss, A, J Ecotoxicol Environ Monit, 2005,