PRODUCTION OF ORGANIC MANURE FROM LEAF SUBSTRATES OF *AZADIRACHTA INDICA*

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Abstract

Vermicomposting is a simple and economically viable technology to both of the farming community and the rural uneducated, particularly to the women folk to earn more profit and through this technology they can fulfill their basic needs without depending others. This method is very simple, even a common man can easily understand this process. The production of vermicompost is a skill that can be acquired by any person with self interest and involvement. In this study we concluded that the earthworms capable of producing more manure from neem leaf residues than guava leaves. Physico-chemical parameters of compost obtained from two different plants were comparatively studied. At the end of this process increased population with different life cycles (cocoons, juveniles and adults) of earthworms were observed. Through this process large amount of vermicompost were produced and the same was shared with around five of our neighbors for medicinal plant cultivation and gardening purposes. The excess quantity of matured earthworms were used as a feed for fish. We hope that this interesting technology we used in this research, will be helpful to give some ideas to the people who have more interest and eager on this technology.

1. Introduction

Vermicomposting is a simple biotechnological process of composting, in which certain species of earthworms are used to enhance the process of waste conversion and produce a better end product. The production of compost from any organic waste (agriculture and homestead) using earthworms is called 'vermicomposting'. This valuable biotechnological process can convert house hold waste in to compost within 30 days, it can reduce the C:N ratio and retains more N than the traditional methods of preparing composts. Organic manure in the form of vermicompost obtained from the earthworm is one way to overcome the problems of low productivity [1]. Earthworms feeds the organic waste materials and passes it through their digestive system (digested by microbes present in the guts of worms) and gives out in a granular form (cocoons) which is known as vermicompost. This can made from mix of dung, crop residues and kitchen wastes along with earthworms are rich in terms of nutrient availability compared to farm yard manure (FYM) which is from mere decomposition of dung.

The ecologically distinguished epigeic earthworms are used for producing the organic manure, “vermicompost” [2]. This has gained attention of garden lovers, agriculturists, and agro industries to convert organic matter generated at different levels into rich, odorless, free flowing compost to support sustainable agriculture.

The tropical soils are deficient in all necessary plant nutrients and on the other hand large quantities of such nutrients contained in domestic wastes and agricultural by products are wasted. It is estimated in cities and rural areas of India nearly 700 million tones of organic waste are generated annually which is either burned or land filled [3]. This clearly indicates that earthworm population decreases with soil degradation and thus can be used as a sensitive indicator of soil degradation.

Earthworms belonging to Phylum: Annelid, Class: Chaetopoda and Order: Oligochaeta occupy a unique position in animal kingdom. They are the first group of multicultural, eucoelomate invertebrates who have succeeded to inhabit terrestrial environment [4]. Earthworms that can survive in captivity under semi natural conditions, tolerant to wide ranges of substrates and to other physical parameters like pH, temperature, moisture and physical disturbances can only be maintained as cultures. The application of organic matter including vermicompost favorably affects soil pH, microbial population and soil enzyme activities. It also reduces the proportion of water soluble chemical species which cause possible environmental contamination. In USA and Canada culturing of earthworm started entrepreneurship where as in India they were maintained as cultures for different research activities. In India vermiculture is practiced mainly for recycling of organic wastes [5]. The earthworm species (composting worms) most often used are Red Wigglers (*Eisenia fetida*) or Red Earthworms (*Lumbricus rubellus*). These species are commonly found in organic rich soils throughout the earth. In majority of the temperate regions, through large number of species are organic matter or litter feeders. It is the interrelationship and interaction of primary and secondary decomposers in the decomposer chain [6]. In this study an attempt has been made to know the species composition, abundance biomass of earthworms and their relation to some physico–chemical parameters of two leaves based vermicompost.

2. Materials and Methods

2.1. Sample collection

a) Earthworms

Earthworms were collected from wet lake-shore of Kuthambakkam village, belong to Thiruvallur district, Tamilnadu and the species was morphologically identified and the name conformed as “African night crawler”, *Eudrilus eugeniae* Kin. **(Fig.1).** This species is used in the experimentation used for the formation of vermicompost and physico-chemical parameters of vermicompost which obtained from two different plants.

Figure 1. (a) Earthworms (*Eudrilus eugeniae*) (b) Neem (*Azadirachta indica*)

b) Plant materials

Agricultural wastes these are very common and available in large quantities where used in vermicomposting [7]. Two substrate such as neem tree based (leaves) guava tree based substrate (leaves) along with the cow dung, a proven substrate in previous studies for earthworm *Eudrilus eugeniae* feeding were used for the study. These plant leaf substrates were freshly collected from a village Kuthambakkam, Thiruvallur district, Tamilnadu.

2.2. Preparation of pot

The experiments were performed out in truncated porous earthen pot of approximately 14 liter capacity. The pot was initially filled up to 2.5 cm height with 12.5 cm nominal size chips of stone (aggregates), which was then covered with 2.5 cm thick layer of 1 mm to 5 mm size gravel to ensure proper drainage of excess water [8]. A layer of leaves (neem and guava) mixed with cow dung (**Table-1**) humus in 2:1 ratio was used above the gravel bed to provide natural habitat to the earthworm. The experimental pots were kept in the separated room.

Table-1: Raw materials used for decomposition by earthworms.

S.No	Raw materials	Weight
1	*Eudrilus eugeniae*	81 (gm)
2	*Azadirachta indica*	15 (gm)
3	*Psidium guajava*	15 (gm)
4	Cow dung	7 (kg)
5	Gravel	3 (kg)

3. Steps involved in composting process

- In an initial step, the bottom of the cement tank was covered with a layer of tiles after prepared a tank, then the first layer covered with polythene sheets.
- 15-20 cm layer of organic waste materials were spread on the polythene sheet. Rock phosphate powder might be sprinkled on the waste materials if available (it can help to improve the nutritional quality of compost) then cow dung slurry was sprinkled. Top of the ring was sealed with soil and wet cow dung [9]. Then the materials allowed for 15 to 20 days to decompose.
- When heat evolved during decomposition of the materials, 300 to 500 earthworms were released (**Fig. 2**) through the cracks developed.
- Then the tank covered with wire mesh and gunny bags to prevent birds from picking the earthworms. Water sprinkled every three days to maintain adequate moisture and body temperature of the earthworms.

Figure 2. Earthworms used for vermicomposting.

- The vermicompost was ready in about 3 months. The processed vermicompost was black, light in weight and free from bad odor [10].
- Water supply was stopped for 2-3 days when the compost is ready, this step is in-order to make compost easy for shifting.
- Note: Pile the compost in small heaps and leave under ambient conditions for a couple of hours when all the worms move down the heap in the bed. Separate upper portion of the manure and sieve the lower portion to separate the earthworms from the manure. The culture in the bed contains different stages of the earthworm's life cycle, namely cocoons, juveniles and adults. Transfer this culture to fresh half decomposed feed materials. The excess as well as big earthworms can be used for feeding fish. Pack the compost in bags and store the bags in a cool place this compost can be used as a manure for plant cultivation. Prepare another pile about 20 days before removing the compost and repeat the process by following the same procedure as described above.

4. Physico-Chemical Analysis of Vermicompost

(i) pH

Take 1gm of sample + 25 ml distilled water in a 100 ml beaker. Stir well and keep it for half an hour. After incubation take the readings using a pH meter. Before taking readings standardize pH meter using pH 7 & pH 4 buffer solutions [11].

(ii) Total N (%)

Weigh 0.5 gm sample and transfer it into digestion tube. Add 10-15 ml of diacid (H_2SO_4 : Perchloric acid, 5:2) and keep for digestion at 180˚C in Kjel plus apparatus. After complete digestion transfer the contents into 100 ml volumetric flask and make up to total of 100 ml using distilled water. Then pipette 100 ml of the aliquot and transfer into distillation flask. Also add 10 ml of 40 % NaOH and distilled the content collecting it in 25 ml 2% Boric acid + 2 drops of mixed indicator. Test the completion of evolution of ammonia using red litmus paper [12]. Then titrate the solution N/10 H_2SO_4. End point is the change of color from green to violet. A blank is also conducted for comparative study.

Calculation: N (%) = X x 0.0014 x V x 100/10 x W

(iii) Total P (%)

Pipette 5 ml of the aliquot from the above made up 100 ml solution in a 25 ml conical flask. Add 2.5 ml Burten's reagent (Ammonium molybdate + Ammonium meta vanadate) and shake well. Keep it for half an hour then take readings in spectrophotometer [13]. Filter should be 420 nm. Read phosphorous values from the standard graph expressed in %.

(iv) Total K (%)

Take 1 ml of the aliquot from the above made up solution in a test tube. Add 9 ml distilled water with this. Shake well and take the readings using flame photometer [14]. Before taking the readings, apparatus must be set to zero using distilled water and to hundred using 20 ppm 'K' solution. Read the K value from the standard graph expressed in %.

(v) Total Ca + Mg (%)

Take 1 ml of the aliquot from the above made up 100 ml solution in a china dish. Then add 10 ml buffer solution + 1-2 drops of Erichrome black-T indicator . Shake well and titrate against 0.02 N EDTA solution [15]. The end point is the change of color from wine red to blue. A blank is also conducted.

Calculation: Ca + Mg (%) = Titer volume X Normality of EDTA X 126

5. Results

5.1. Multiplication of Earthworm Population

The neem leaves were decomposed by earthworm in three months and the guava leaves were partially decomposed (Table-2) in three months. The initial population of the both type of compost was merely same (neem leaf based vermicompost-350, guava leaf based vermicompost-369). The final population of the neem leaves vermicompost was highly increased than the guava leaves vermicompost (neem leaf based vermicompost-600 and guava leaf based vermicompost-500).

5.2. Physical and chemical parameters of compost

In physical parameters of compost pH and organic carbon values are highly different between them. The Carbon and Nitrogen ratio (C:N) of guava leaf substrate compost is higher than the neem leaf substrate compost. The available nutrients like Nitrogen (N), Phosphorous (P), Potassium (K) values are noted in Table-3. The nitrogen value is higher in neem compost where as less in guava compost. Also the N, P, K values more in neem compost.

6. Discussion

Earthworm forms one of the major macro fauna among soil biota to maintain dynamic equilibrium and regulate soil fertility. Their existence depends on adequate moisture, soil texture, pH, electrolyte concentration and food source in the given eco-system. This clearly indicates the inter dependency of the environmental factors to the survival of earthworms; when such conditions are created, they can further contribute the soil fertility to their activity.

Litter from such plants when mixes with soil, at different levels of decomposition serves as feed to developing earthworm population. Earthworms can also serve as indicators of several changes are factors associated with soil. Many studies clearly showed that the earthworms are best indicators of heavy metals, toxic pollutions and direct/indirect arthropogenic changes in soil. The study suggest the use of earthworms as bioindicators of man made changes, it necessitates. More field and laboratory investigations needed to find out earthworm's community, structure, species inter relations and life cyclic activities.

Despite the preferences to litter, the present results obviously demonstrated that the worm is polyphagous. This can be related to the ubiquitous distribution of this species in nature. The results also illustrate the decomposition of leaf matter in soil. The extent of the decomposition depends on the nature of leaf litter present in the soil. The present study, shows the importance of *Eudrilus eugeniae* in litter decomposition.

7. Conclusion

The production of degradable organic waste and its disposal becomes the current global problem. Meanwhile the rejuvenation of degraded soils by protecting topsoil and sustainability of productive soils is a major concern at the international level. Earthworms can serve as tools to facilitate these functions. They serve as '*Natures plowman'* and form nature's gift to produce good humus, which is the most precious material to fulfill the nutritional needs of crops. This simple study will be helpful to produce more vermicompost from earthworms and we assure that this technology can give unexpected profits and benefits to farmers.

8. References

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