Vermicomposting process, its merits and demerits- A Concise Review

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Abstract

This review paper concisely describes vermicomposting process, its merits and demerits. Selection of earthworm species is the prime requirement for vermicomposting process. Vermicomposting can be performed either in concrete tanks or pits or cement rings or wooden or plastic container suitable to a given circumstances. In vermicomposting, manure of cattle is regarded to be the accessible animal waste materials within which the earthworms matured flourishingly. Vermicomposting is recognized as an eco-friendly natural fertilizer. Vermicomposting has several advantages as it enhances aeration of soil, its texture and porosity, raises water holding capacity of soil, increases nutrient quality of soil which in turn promotes growth and yield of the plants. It has some demerits also. It demands optimum moisture content in the vermibed. The site of vermicompost processing area often leads to foul smell due to the decomposition of excess feed stock of vermibed.

Key words: Vermicomposting process, merits, demerits

Introduction

Vermicomposting refers to a biotechnological method of composting multifaceted collection of organic waste materials [1–3] which includes selective earthworm species that intensify the waste transformation into a very effective finest quality end product known as vermicompost [4-5]. The transformation of waste materials of industry into vermicompost is significant for detection of pollution as vermicompost has promising prospect in remediation and which can be utilized for reducing waste materials [6]. As in vermicompost, organic matter is broken down into nutrient-laden compost, it provides a natural and sustainable base of nutrients for plants, which in turn assists to reduce the necessity for chemical fertilizers [7]. Vermicomposting can contribute to varied range of advantageous microbes and fungi, these in turn upgrade structural components of soil and elevate plant growth [8]. Vermicomposting relies on the synergistic attempts of earthworms and microorganism as on one hand, microorganisms take part for biochemical breakdown of organic matter while on other hand earthworms acts as prime drivers through fragmenting and conditioning the substrate, which in turn leads to remarkable variations in its biological activity [9]. Earthworms continually harvest and oxygenate the soil, provide it with organic materials and assists moisture for extending it via the burrows they build [10-12]. As selection of earthworm species is the prime requirement for vermicomposting process, it is well recognized that epigeic earthworm species have greater potentiality for decomposition of waste materials than anecic earthworm species and endogeic earthworm species as epigeic earthworm species have higher reproducing capabilities and its humus consuming surface abode nature [13-15].

Literature review

Researchers [16-17] opined that earthworm species *viz., Eudrilus eugeniae* and *Perionyx excavatus* have increasingly used for vermicomposting across the globe and proven to be effective transformers of organic waste materials. Researcher [18] stated that surplus of sugar industry are effectively decomposed by earthworms and transformed them into soil nutrient material and by using the said soil nutrient material farmers get benefitted as it reduces fifty percent operational cost of chemical fertilizers. Nutrient absorption of phosphorus, potassium, nitrogen and magnesium by *Oryza sativa* is maximal when fertilizer is applicable in blended with vermicompost [19]. Vermicomposting can be performed either in concrete tanks or pits or cement rings or wooden or plastic container suitable to a given circumstances [20-21]. Researcher [22] has made a comparative study on the efficiency of heap and pit methods of preparation of vermicompost under field condition. Researcher [23] emphasized the increasing productivity of carrot (*Daucus carota* L.) on application of vermicompost. Researcher [24] made an experiment on the on the growth, nutrient composition and productivity of leafy vegetables (spinach and lettuce) on application of vermicompost, while another Researcher [25] emphasized the influential activity of vermicompost on the growth, quality standard and productivity of tuber crops. Researcher [26] stated that in vermicomposting, manure of cattle is regarded to be the accessible animal waste materials within which the earthworms matured flourishingly. Researcher [27] performed a chemical analysis of composite varieties vermicomposts which includes animal wastes, agricultural wastes and domestic wastes. Researcher [28] worked on the physico-chemical, nutritional and biochemical parameters of vermiwash. Researcher [29] opined that 20 to 45% deficit of organic carbon results in the course of vermicomposting of municipal wastes. Lowering of pH occurs in vermicomposting which may be due to the production of carbon dioxide, organic acid and ammonia by microbial activity [30]. Researcher [31] worked on physico-chemical properties of vermicompost by using *Eisenia foetida* in waste materials of garden while another Researcher [32] worked on physico-chemical parameters of vermicompost derived from waste materials of mango pulp and fish. A number of noteworthy researchers [33-36] worked on the physico-chemical parameters of vermicompost.

Vermicomposting process

Vermicomposting process includes selection of site, collection of vermicomposting materials, sorting and blending of composting materials, preparation of bed layer, inoculation of earthworm species, harvesting of vermicompost and precautionary measures.

Selection of Site: Site selection is depended upon farmers' requirement, either it may be indoors or outdoors. Indoor vermicomposting is being carried out under covered area or in composting bins, here the thatched roof shed preferably open from all sides with kaccha floor erected in east-west direction lenth-wise to protect the site from sunlight. Thatched roof height must be kept 2.4 m from the centre and 1.8 m from the side. Base of the site is raised 15cm to 18cm above the ground to protect from flooding in rainy season.

Collection of Vermicomposting Materials: Vermicomposting materials frequently used are agricultural waste materials, animal dung, city refuge, waste papers, saw dust, straw, biogas slurry.

Sorting and Blending of Composting Materials: The sum total vermicomposting materials collected is then thoroughly mixture and then kept in exposure to sunlight. The mixtured vermicomposting materials are then beaten with a stick to broken down to smaller pieces for enhancing the decomposition of vermicomposting materials. Afterwards, addition of water is done at the ratio of water 5-8 litre: 20-25 kilogram vermicomposting mixture. Afterwards left the vermicomposting mixture left for 14 days. Mixtured vermicomposting materials should be turned two to three times at an interval of 4-5 days.

Preparation of Bed Layer: The bed layer is prepared at about thickness of 10cm, the base materials of which includes paddy husk, sugar cane trash, coir waste etc. Afterwards, cow dung is mixes up to it. Then a very thin layer of soil is distributed to it. Afterwards, sprinklings of water are done to make the prepared bed layer in wet condition, keeping its moisture level at about 40-45%.

Inoculation of earthworm species: The selected earthworm species used for inoculation purpose must have high composting capabilities, better reproducing abilities, matured, healthy and disease free. Earthworm species viz., *Eisenia foetida*, *Eudrilus engeniae* and *Perionyx excavator* is most commonly used for vermicomposting process. In a vermipit, *Eisenia foetida* is applicable at the of 50-100 /cubic feet area, *Eudrilus engeniae* is applicable at the of 50-60 /cubic feet area and *Perionyx excavator* is applicable at the of 150 /cubic feet area. Afterwards, feed mix is uniformly spreaded over the culture bed. Neem cake at about 1-10% is also preferred for mixing with the feed mix for enhancing the growth of earthworms. Finally the top of the loaded mixture is covered up with a jute mat or banana leaves in order to protect the inoculated earthworms from insects, birds etc. Care is to be taken that the total mixture lies within the temperature range of 50-55^{0}C, relative humidity range of 40-45% and pH 6.5-7. Afterwards, the aforesaid total loaded mixture remains undisturbed for some days. Then after 3-4 days, the jute mat or banana leaf covering is withdrawn and the loosening of top layer is being done with the help of hand tools. Now water is sprinkled regularly over this organic bed layer. Then again the top layer is covered up with jute mat or banana leaf and is allowed for proper decomposition.

Harvesting of Vermicompost: Earthworms feed voraciously organic matter,7-10% assimilate and the rest portion is excreted as loose granular moulds of vermicastings on the surface area. In this way, the earthworms will transform the feed mixture into vermicastings at about 2 months. At first, the formed vermicompost will given the smelling of moist soil, later on it appears black colouration, granular form, light weight and rich in humus. Afterwards, watering should be stopped for the reason of separation of earthworms from the prepared vermicompost. As a result, 70-80% earthworms are migrated to the bottom layer and the rest percentage of earthworms can be removed by hand picking. The prepared vermicompost manure is then also sieved in order to make the said manure earthworm free.

Finally the screened vermicompost manure is bagged and then supplied to the market for sale.

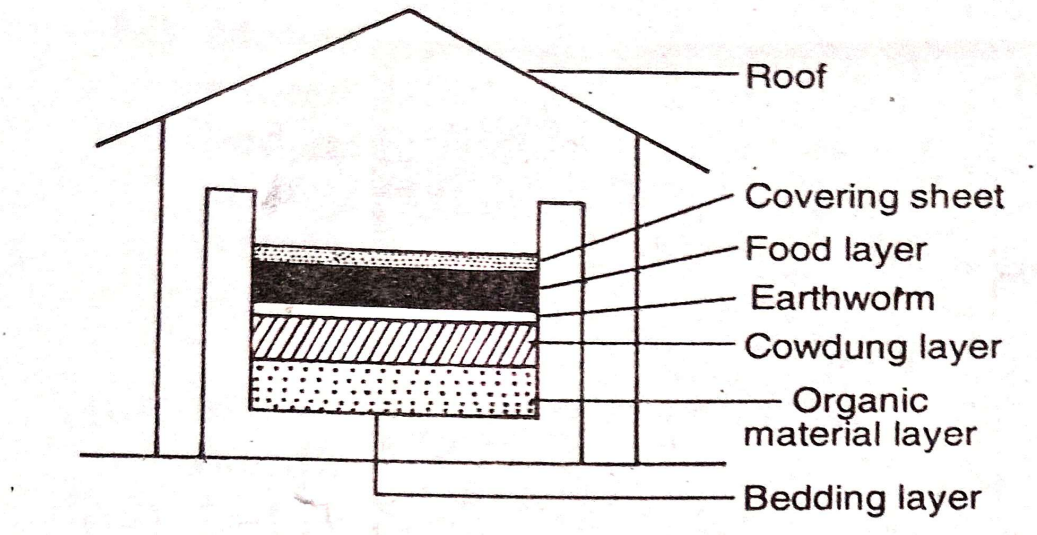
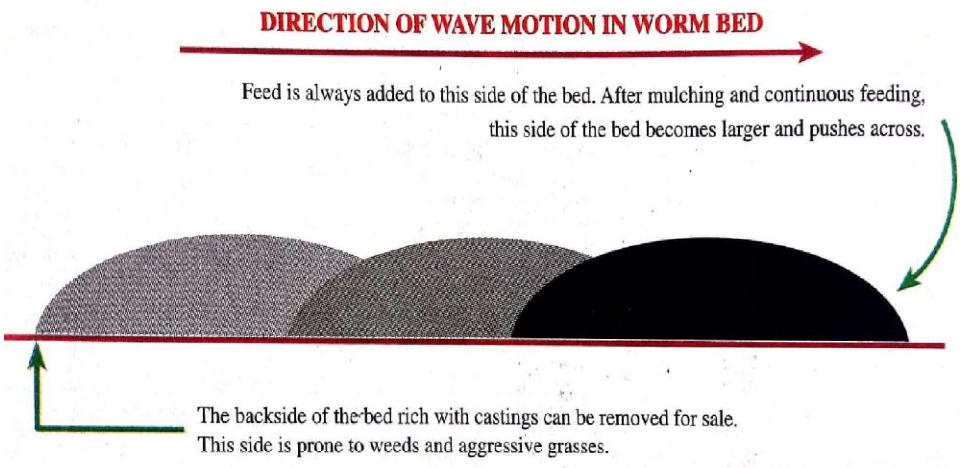


Fig. 1: Vermicomposting process

Fig. 2: Vermibed preparation in cemented pits

Fig. 3: Flow chart of vermicomposting process



Merits of Vermicomposting

1. **Environment-friendly fertilizer**: As vermicompost is prepared from biodegradable organic waste materials and devoid of any chemical inputs, it is recognized as an eco-friendly natural fertilizer.
2. **Improves soil quality**: It enhances aeration of soil, its texture and porosity which in turn reduces compactness of soil.
3. **Raises water holding capacity of soil:** It raises water holding capacity of soil as its high organic matter content.
4. **Enhances plant growth:** It assists preferable root growth and nutrient absorption.
5. **Nutrient enrichment of soil:** It increases nutrient quality of soil, both micro and macronutrients.
6. **Environmental impact:** Recycles waste on site, which aids in closing the metabolic gap. Production of vermicompost lessens greenhouse gas emissions.
7. **Economic impact:** It gives opportunities for unskilled workers in employment at local level. Low capital investment and somewhat uncomplicated technology make vermicomposting practical for underdeveloped agricultural sectors.

Demerits of Vermicomposting

1. **Maintenance of moisture content**: As vermicompost always demands optimum moisture content in the vermibed, so it becomes a troublesome effort for farmers during summer season for maintaining the moisture content of the vermibed.
2. **Problems in the transportation of earthworms**: The earthworms selected for vermicomposting process, needs to the carried in the packaged condition to the site of culture. In case, the weather temperature is higher than 15^{o}C, then the earthworms come out of the pack and on exposure they will die.
3. **Prevalence of foul smell near to the culture site**: The site of vermicompost processing area often leads to foul smell due to the decomposition of excess feed stock of vermibed.
4. **Increased fly and rodent population**: As kitchen wastes are included in the formation of vermibed, several flies and rodent population is seen to be enhanced in the vermicompost processing area associated to nearer domestic sites.
5. **Escaping tendency of earthworms**: Earthworms generally stay in the pit(or bin) but they may sometimes try to come out the bin when they first introduced into the pit(or bin) or in rainy season, when the environmental humidity is higher than the pit(or bin).

Conclusion

Vermicomposting is the method of making compost with the use of earthworms which is rich in humus. Earthworms consume cow dung of farmyard manure along with municipal wastes, non-toxic solid and liquid wastes of industries, household garbages which pass through their body and in the process these components are converted into vermicompost. Vermicompost, a stable fine granular organic matter has several advantages. It looses the soil and provides the passage for aeration, the mucus associated with the cast (faecal matter of earthworm) is

hygroscopic which absorbs and holds water, thus enhancing the water holding capacity of the soil. It improves physical, chemical and biological characteristics of soil which in turn promotes growth and yield of the plants. In economical point of view, it gives opportunities for unskilled workers in employment at local level. Low capital investment and somewhat uncomplicated technology make vermicomposting practical for underdeveloped agricultural sectors.

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