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Vermicomposting: Ameliorating the Process by Inoculation of Waste Decomposer

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Abstract

The rapid growth of population and urbanization has led to an increase in organic waste production, posing environmental challenges. Traditional methods like land filling and incineration contribute to pollution and greenhouse gas emissions. Vermicomposting, a natural and sustainable waste management technique, uses earthworms to convert organic matter into nutrient-rich vermicompost, improving soil fertility and structure. It is an eco-friendly and efficient waste management method, particularly beneficial for India, a country with a high population density and a need for increased food production. It has been found to be effective in decomposing waste in 45–60 days, usually. The process can be enhanced to achieve faster degradation in a shorter duration using a waste decomposer. The present study deals with the same. It was observed that the vermicompost with added inoculum showed faster degradation as compared to the vermicompost bed without inoculum. This method can help improve crop quantity and quality in India, a country with a high population density. Increased food production demands improved crop quantity and quality. Progress is being made, but more attention is needed to reduce vermicomposting duration for organic farming.

Keywords: Floral Waste, vermicomposting, waste decomposer, faster degradation

INTRODUCTION

The rapid increase in population and urbanisation has led to an alarming rise in organic waste production and its associated environmental challenges. Traditional methods of waste disposal, such as land filling and incineration, are not only resource-intensive but also contribute to pollution and greenhouse gas emissions. In this context, vermicomposting, a natural and sustainable waste management technique, has emerged as a viable alternative. Vermicomposting utilizes earthworms to convert organic matter into nutrient-rich vermicompost, a valuable resource for improving soil fertility and structure. There are so many raw materials used for vermicomposting.

Ramnarain Y.I. et al. (2018) have explored the process of vermicomposting on Eisenia fetida using dry grass clippings, rice straw, and cow manure. They significantly showed that the combination of rice straw and grass had the highest rate of vermicompost production. The recycling of municipal waste is needed to solve environmental problems throughout the world. Organic material in municipal waste is rich in proteins, cellulose, lignin, and nutrients (Das et al., 2018). Nutrients can be recycled in composting, which is extensively accepted as an efficient tool to manage solid waste (Alshehrei and Ameen, 2021). Composting transforms waste into stable humus-like substances in aerobic biodegradation (Gong et al., 2018). The end product can be utilised to improve soil properties in agricultural fields (Papafilippaki et al., 2015) or as an alternative to peat as a potting substrate (Gong et al., 2018).

Few previous studies have demonstrated that cellulose and lignin in vegetable waste delay the thermophilic composting process. These wastes can be treated with vermicomposting, a distinct category of compost (Gong et al., 2019). The earthworms in vermicomposting are known to improve cellulose degradation (Aira et al., 2007; Karmegam et al., 2021). In addition, different additions such as cow dung and mushroom spent straw have been successfully added to wastes rich in cellulose and lignin (Balachandar et al., 2021). The addition of nutrient-rich green manure also improved the degradation of cellulose during vermicomposting (Karmegam et al., 2021). Micro algal biomass also improved the vermicomposting process (Alshehrei et al., 2021). The use of the mangrove fungus Acrophialophora jodhpurensis as a bio-catalytic actor during the vermicomposting of food waste improved the final vermicompost quality and shortened the composting period. The amendments of biochar, cow dung, and mangrove fungi were found to be the most effective in improving the compost quality. All three mangrove fungi improved the vermicomposting process. Mangrove habitat is a suitable habitat for active fungi used in vermicomposting.

Vermicomposting is a low-cost technology solution that converts agricultural waste into organic fertilizers by allowing earthworms and microorganisms to engage throughout the worm gut (El-Haddad et al., 2014). However, vermicomposting time ranges from 100 days (Garg et al., 2006), 90 days (Bansal and Kapoor, 2000), and 75 days (Bharadwaj, 2010), respectively. Sharma and Garg (2020) described the 3-week pre-degradation of Parthenium and buffalo dung before the vermicomposting process using E. fetida, which lasted 90 days. A traditional vermicomposting method requires 45–60 days, but Kauser and Khwairakpam (2022) used the rotary drum compost method, which reduced the duration of vermicomposting by 15-20 days, i.e., within 25–30 days, matured product was obtained.

Vermicomposting represents a sustainable and eco-friendly solution to the growing challenges of waste management and soil degradation. Its numerous benefits, including waste reduction, soil enrichment, and economic viability, make it a compelling choice for individuals, communities, and agriculture. As we strive for a more sustainable and resilient future, embracing vermicomposting can play a vital role in addressing environmental concerns and promoting sustainable practices worldwide. Attempts have been made to obtain a good-quality product while decreasing the duration of the process. Nowadays, organic farming is promoted by agriculturists and environmentalists to save lives from the hazardous effects of chemical fertilizers. The present study is aimed at reducing the time duration of vermicomposting and obtaining good quality and quantity of compost.

MATERIAL AND METHODS

Inoculum Preparation – 1 Liter inoculum was prepared with the help of commercially available waste decomposer of brand Generic purchased online. For this 1 liter of distilled water was added with 10 grams of jaggery and 0.15 grams of waste decomposer and left for 7 days.

Preparation of the Vermicomposting Bed: Simultaneously A total of six beds with equal composition mixtures were prepared for the experiment. The composition mixture was made from 1 kg of floral waste, 1 kg of cow dung, and 250 grams of coconut peat and mixture and allowed to partially decompose for 7 days. The experiment was carried out further by adding 20 earthworms (Eisenia fetida) in each 6 bed labeled as A,B,C,D,E followed by adding of inoculum in 5 beds keeping one bed A as control bed without inoculum. The other five beds were inoculated with the above inoculum in a gradual, increasing manner as test samples, i.e., 5 ml (B), 10 ml (C), 15 ml (D), 20 ml (E), and 25 ml (F).

Optimization of Physical Parameters

The physical parameters were maintained at their optimum value as per protocol of Shouche et al. (2011).

Table 1: Composition of mixture for degradation and volume of inoculum added

S. No.	Composition mixture	Group	Volume of inoculum added (ml)
1.	1Kg Floral waste +1 Kg Cow dung +250gms coconut peat	A	Without inoculum (control)
2	1Kg Floral waste +1 Kg Cow dung +250gms coconut peat	B	5ml
3	1Kg Floral waste +1 Kg Cow dung +250gms coconut peat	C	10ml
4	1Kg Floral waste +1 Kg Cow dung +250gms coconut peat	D	15ml
5	1Kg Floral waste +1 Kg Cow dung +250gms coconut peat	E	20ml
6	1Kg Floral waste +1 Kg Cow dung +250gms coconut peat	F	25ml

Fig. 1. Prepared inoculum

RESULTS AND DISCUSSION

It was observed that in bed A, which is a control bed, the mixture was decomposed in 47–50 days, which is the usual time period for vermicomposting. There was no significant change in beds B and C as compared to bed A. In bed D, a slight decrease in duration was observed at 43 days. However, in bed E, the mixture, in which 20 ml of inoculum was added, took 30–32 days to degrade completely, and the mixture in bed F showed the fastest degradation in 16–18 days. The above results showed that adding a supplement or waste decomposer can make the decomposition process faster. However, the composition of the inoculum should be kept optimal and should not hamper the growth of earthworms. Hence, the results were satisfactory with 20 ml of inoculum in our study.

A B

Fig. 2. (A) Vermicomposting Bed Day 1 (B) Vermicomposting Bed Day 32 after adding 20 ml inoculum

The use of the mangrove fungus Acrophialophora jodhpurensis as a bio-catalytic actor during the vermicomposting of food waste improved the final vermicompost quality and shortened the composting period (Alshehrei and Ameen, 2021). Tiwari et al. (2021) concluded that vermicomposting is an effective waste management tool for temple waste on the one hand and also removes pathogens from compost made from faeces, sewage sludge, and plant wastes.

Composting within vessels has demonstrated high efficiency in improving soil characteristics like soil conductivity, stabilisation, tolerance to erosion, soil fertility, and plant nutrition (Celik et al., 2004). In-vessel composting technology is more suitable for organic substrate degradation as it takes less space and time, along with better control and high performance (Kim et al., 2008). On the other hand, vermicomposting is also an aerobic degradation of organic compounds involving the use of earthworms to convert the organic compound into a humus-like substance known as vermicompost (Munroe, 2007). Composting and vermicomposting are also commonly recommended as biological waste treatment methods for converting organic waste into usable soil conditioners (Tognetti et al., 2005).

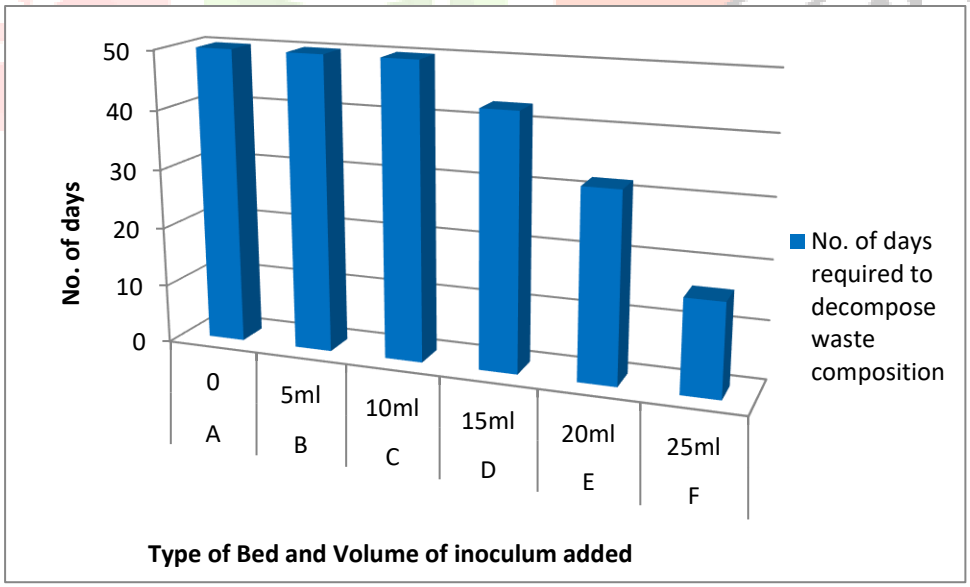

Fig. 3. No. of days required for vermicomposting using waste decomposer

CONCLUSION:

Vermicomposting has been a very efficacious and eco-friendly process of waste management. So, a great deal of scientific work has been done in this field, and assorted results are also proposed. India is a country of farmers with a higher population density. There is a need for a higher quantity of food production. With the increasing requirement, it becomes necessary to aid in the quantity and quality of crops. In this direction, a lot of progress is going on, but still more attention is needed. By reducing the time duration of vermicomposting, organic farming will benefit.

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There is no conflict of interest

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