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Research Article

A Report on Vermicomposting Efficiency of Earthworm Species from Darjeeling Hills and *Eisenia fetida*

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Abstract

Vermicompost is nutrient-rich casts generated by the earthworms that can be used as biofertilizers. Since the potential of fabricating vermicompost varies amongst species, the present study was conducted to determine the vermicomposting efficiency of local earthworm species of Darjeeling hills and *Eisenia fetida*, that was subjected to three different types of treatments for 60 days: monoculture of *E. fetida* (set 1), polyculture of readily available local species (set 2), and polyculture of *E. fetida* and local earthworm species (set 3). At the end of the treatment, while harvesting the compost, all the treatments showed an increase in population size and high decomposition of waste materials. The content of major macronutrients such as organic carbon, nitrogen, phosphorous, and potassium did not vary significantly between the vermicompost obtained through different culturing techniques, although considerable differences in population increase after inoculation were observed. Thus, based on reproductive potential and chemical analysis, it may be concluded that the polyculture of local earthworm species of the Darjeeling region and *E. fetida* can be utilized in generating vermicompost most efficiently, which in turn can contribute towards organic farming and supplementing to the income of the farmers.

Keywords: Local Earthworms; *Eisenia fetida*; Vermicompost

Introduction

Earthworms are the intestine of the Earth [11] and are potential bioreactors that do not only help in eliminating solid organic waste generated from the household, municipality, or agro-sectors but also aid in improving the texture, physical and chemical properties, and microbial population of the soil [7]. Hence, they have a great potential to contribute towards organic farming and land reclamation by reducing pollution. Further, a low level of soil fertility has always been a constrain in boosting up agricultural production in India, resulting in a steep increase in the price of chemical fertilizers [1]. This in turn negatively influences small and marginal farmers. Considering this, the present study was conducted to investigate the vermicomposting efficiency of the readily available local earthworm species of Darjeeling hills and the European counterpart (*Eisenia fetida*), to resolve the problem of the local farmers of Darjeeling and Kalimpong district of West Bengal, India, regarding the shortage of fertilizers mostly caused due to the price constraints.

Materials and Methods

A qualitative study on vermicomposting efficiency was conducted from July-October, 2017 at a local farm in Darjeeling. Earthworms were collected from different habitats of the Darjeeling and Kalimpong regions during the month of July 2017. The collected worms were washed and categorized based on their ecological types as epigeics, endogeics, or anecics [3]. *E fetida* was purchased

from a local agriculturist. Three replicates of vermibeds were prepared using different vermicomposting techniques- monoculture of *E. fetida* (set 1), polyculture of local earthworms (set 2), and polyculture of local earthworms and *E fetida* (set 3).

Preparation of vermibeds

A rectangular plastic container of 50cm×30cm×30cm dimensions and a mixture of kitchen wastes and crop residues were used to prepare the vermibeds. Before introducing the earthworms, the culturing bed was covered with a plastic sheet with numerous punctures for proper drainage. About 2cm of pebbles was laid as the base, followed by 300g of dry soil, 350g of cow dung, and 2 kg of organic wastes. 40 adult *E. fetida* and local earthworms were released separately in set 1 and set 2, whereas for set 3, 20 adult *E. fetida* and 20 adult local earthworms were released in the prepared layer. The culture beds were labeled and covered with a moist jute sack. The entire setup was kept in a shaded place at a temperature of 20 ± 4℃, and water was sprinkled over the sack twice a week to maintain appropriate moisture content.

After 60days, the vermicompost was prepared using a somehassle light separation method [12] in which the finished material was dumped on the floor under the sunlight. Since the earthworms are sensitive to light, they immediately burrow beneath the soil. The mold was then carefully hand brushed till worms were observed. The humus-rich cast was air-dried for 10 days and sieved to get the final crumb-like odorless compost.

The physical properties of the vermicompost were noted and then submitted to the Soil laboratory of Kalimpong Agriculture Office, India for testing the concentration of major macronutrients. The efficiency of each treatment was determined by counting the number of individuals after 60 days of treatment, and evaluating the major macro-nutrients like organic carbon (OC), nitrogen (N), phosphorous (P), and Potassium (K).

Results and Discussion

- **Colour and texture:** For set 1, the vermicompost obtained was dark black, tea-crumb-like in appearance (Figure 1), whereas set 2 showed brownish, tea leaves-like compost (Figure 2). Set 3 vermicompost was blackish clayey (Figure 3), and in all cases, worm cast was produced in aggregates and could be compressed in a bag due to its elastic property, similar to the observation of Ismail, 1997 [6].

Figure 1: Vermicompost obtained from set 1 treatment.

Figure 2: Vermicompost obtained from set 2 treatment.

Figure 3: Vermicompost obtained from set 3 treatment.

- **The population of earthworms:** An increase in population for all the treatments was observed as summarized in table 1. Set 3 treatment showed the highest increase in the earthworm population, followed by sets 1 and 2.

Culture technique	The initial population of earthworms inoculated	The final population of earthworms after 2 months of inoculation
Set 1	40	470
Set 2	40	158
Set 3	20+20	730

Table 1: Increase in the earthworm population after 60 days of treatment.

- **Major nutrients:** The results of the present investigation have been summarized in table 2. Mineral elements are vital for plant growth, and their deficiency leads to the development of visual symptoms. Vermicompost is rich in organic matter, phosphorous, potassium, and calcium with a reduced electrical conductivity [10], although their nutrient content largely depends on the feed used for treatment [4]. In our study, the OC content recorded for sets 1,2, and 3 were 3.48%, 3.46%, and 3.29% respectively. Because the OC content is a reflection of the percent decomposition of waste materials and population built-up trends [1], slightly lower values for set 3 treatment can be attributed to higher worm biomass. Although the differences were insignificant, studies have shown that the earthworm activities bring about a noteworthy decline in OC level of waste resources, and accelerate waste stabilization [8,13], thereby facilitating composting and reduction in soil pollution. The total N content resulted in the highest amount in set 1 (858 kg/ha), followed by set 3 (832.6 kg/ha) and set 2 (817.7 kg/ha). The amount of N content was highest amongst all the examined minerals, similar to the observation of Sharma., *et al.* 2005 [10]. Increased levels of nitrogen content in vermicompost may be due to the earthworm's activity through microbially mediated nitrogen transformation of the waste materials [5]. Further, the highest levels of P and K concentration was noted for set 2 treatment (P: 70 kg/ha and K: 220 kg/ha) followed by set 3 (P: 64 kg/ha and 200 kg/ha) and set 1 (P: 59 kg/ha and K: 125 kg/ha). The status of P and K levels in the vermicompost depends on acid production during organic matter decomposition [2], and since these minerals influence major physiological processes in plants, its deficiency may cause slow and stunted plant growth, development of anthocyanin pigments on the leaves, slower maturation of seeds, poor development of mechanical tissues, etc.

Sample name	Treatments	Organic carbon (OC) In %	Nitrogen (N) In kg/ha	Phosphorous (P) kg/ha	Potassium (K) In kg/ha
Set 1	Monoculture of *E. foetida*	3.48	858	59	125
Set 2	Polyculture of local earthworm species	3.46	817.7	70	220
Set 3	Polyculture of *E. foetida* and local earthworm species	3.29	832.6	64	200

Table 2: Values of macro-nutrients recorded in the vermicompost obtained through different treatments.

Conclusion

To develop a successful vermicomposting unit in the farms, the selection of earthworm species plays a vital role. The species of choice should be voracious feeders and fast breeders [9]. Thus, based on the reproductive potential and chemical analysis, the present observations indicate that the culture of local earthworms of Darjeeling hills and *E. fetida* were more efficient over exclusively culturing local species and *E fetida* alone. The prescribed treatment in our study could generate more batches in a year due to the faster multiplying and mineralization rate of the worms. This could help the local farmers in generating a continuous supply of fertilizers and the sale of the surplus vermicompost and worms, thereby enhancing their income with minimal capital investments.

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