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MANAGEMENT OF PAPER WASTE BY VERMICOMPOSTING USING THE EARTHWORM *LAMPITO MAURITII*

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ABSTRACT

It has been estimated that the world paper industry has been registering a growth of 2.8% per annum resulting in a large amount of paper waste. Disposing paper waste requires a large amount of land fill spaces. Recent studies have shown that earthworms have an ability to decompose a variety of organic residues. Hence the present study was undertaken to analyse the vermicomposting ability of the earthworm *Lampito mauritti* using paper waste as a substrate. Results indicate that there was a significant reduction in pH and an increase in the levels of nitrogen, phosphorous and exchangeable potassium as the days progressed. With increase in days, the earthworm production and weight gain increased. There was a 58% reduction in the substrate at the end of the 65th day.

KEY WORDS : Physico-chemical parameters, Vermicomposting, *Lampitomauritti,* Waste paper.

INTRODUCTION

The paper mill industries form an important part of the economy in many countries. These industries along with educational institutions generate a large amount of waste paper (Basheer and Agarwal, 2013). These wastes are usually incinerated or disposed in land fills leading to loss of nutrients besides causing environmental problems. It has been estimated that the world paper industry has been registering a growth of 2.8% per annum as a result of increased population growth. This in turn would require more landfill space for dumping the toxic organic sludge generated by this industry (Basheer and Agrawal, 2013). However, eventhough paper sludge is a good source of organic carbon, it cannot be directly applied to the fields as it is deficient in other nutrients.

From an environmental perspective, paper wasting is important as systematic collection and recycling of waste paper can significantly reduce the generation of municipal solid wastes besides saving a large amount of raw materials and energy (Mathivannan *et al*., 2017). Eventhough solid waste management is an obligatory function of urban local bodies in India, this service is poorly performed resulting in health problems, sanitation and environmental degradation (Hemalatha, 2013).

Due to ill effects of modern technologies and unsustainable development, the importance of eco-friendly technologies is now given importance. Among this, the applied use of earthworms in the breakdown of a wide range of organic residues including sewage sludge, animal wastes and industrial refuse to produce vermicompost has been recommended by many workers (Hartenstein and Bisei, 1988; Senapati, 1992; Ghatnekar *et al*., 1998). Hence the present study was undertaken with a view to assess the changes in the physico-chemical composition of paper waste after composting by using the earthworm *Lampito mauritti.*

METERIALS AND METHODS

Collection of material

The cattle dung (10 days old) was procured from nearby dairy farm. The moisture content of the

medium was maintained at about 60 % - 70 % and the paper waste was procured from various Departments in the Arignar Anna Government Arts College, Musiri. The procured paper was shredded before using by means of a paper shredder.

Collection of animals

Earthworms (*Lampito mauritti*) were procured from vermicomposting center located in musiri municipal waste collection centre, town panchayat musiri, Tiruchirappalli District, Tamil Nadu, India For the present study, separate vermin-beds were made using ten days (10 days) old cattle dung for mass culture of *Lampito mauritti*. The culture was constantly monitored throughout the period of study with timely spraying of water. Mature clitellate worms for experimental purpose were taken from this stock culture.

Experimental Setup

Two sets of experiments were conducted in the present study.

Pre-decomposition experiment

A ceramic tank of 45 × 30 × 15 cm size was filled with a mixture (3 kg) of dung and shredded paper, it was daily sprinkled with water so that it gets decomposed. This waste was turned up and down regularly for proper aeration and decomposition. This experiment lasted for 15 days.

Composting experiment

In this study, plastic container was filled with the pre-decomposed mixture of cow dung and shredded paper. 25 mature, clitellate worms were taken from the stock culture and were uniformly released on the top of all the three experimental containers. The experiments were conducted inside the vermicompost hut located in Musiri municipal waste collection Centre, town panchayat Musiri, Tiruchirappalli District, Tamil Nadu, India in order to avoid the danger of predators and rain during the months of July and September.

The containers were covered by mesh garden cloth and were observed daily in order to check the various parameters necessary for the survival and reproduction of earthworms. This whole setup was maintained for 65 days till the finely granular vermicompost was prepared.

During the composting process, the material was analysed for different physico-chemical attributes such as pH, total nitrogen, available phosphorus and exchangeable Potassium as per the methods suggested by other workers (Piper, 1996; Jackson, 1973; Ishwaran and Marwaha, 1980) as well as for earthworm number, cocoon production and weight loss of organic substrate (Tripathi, and Bharadwaj, 2004; Wantanabe and Tsukamato 1976). During the course of the investigation, the samples were examined at periodic intervals after 30 and 65 days of vermicomposting.

RESULTS AND DISCUSSION

The effect of vermicomposting on the various physico-chemical variables of the paper waste are presented in Table 1. As evident from the table, pH which was 8.2 units on the initial day of the experiment gradually decreased to 7.4 on the 65th day of the experiment thus recording a change of 87.7%. The possible decrease in pH content could be due to high mineralization of nitrogen and phosphorous into nitrites/nitrates and orthophosphate as suggested by workers (Basheer and Agarwal, 2013; Albasha *et al*., 2015).

With regard to C:N ratio, the present study recorded a decline of 75.67%. A perusal of literature reveals that Basher and Agrawal (2013) while studying the vermicomposting ability of *E. eugeniae* recorded a decline of 82.33%, while Albasha *et al*. (2015) using the same earthworm recorded a decline in C:N ratio of 82.3% When compared with the present study, the ratio was found to be on the higher side. With regard to total nitrogen, the present study showed a gradual increase from 0.20% on the initial day to 0.52% on the 65th day thus recording an increase of 0.32%. Hemalatha (2013) reported an increase in total nitrogen of 0.72% while Basheer and Agrawal (2013) reported an increase of 0.21% and Albasha *et al*. (2015) an increase of 0.24%. Comparing these levels with the present study reveals higher levels when compared to those of Basheer and Agrawal (2013) and Albasha *et al*. (2015) and lower levels when compared to Hemalatha (2013).

The exchangeable potassium levels in the present study showed an increase of 0.30%. Comparing these levels with others reveals that Hemalatha (2013) recorded an increase 0.61% while Basheer and Agrawal (2013) an increase of 0.27% and Albasha *et al*. (2015) an increase of 0.29%. Comparing these levels with the present study reveals similar results eventhough the level recorded by Hemalatha (2013) was on the higher

Table 1. Effect of Vermicompost on different physico – chemical parameters of paper waste collected from Musiri, Trichirappalli, Tamil Nadu.

S. No.	Parameters	Unit	Duration of Vermicomposting		
			0 day	30 day	65 day
1.	pH		8.2	7.8	7.4
2.	Total Nitrogen	(%)	0.20	0.40	0.52
3.	Available Phosphorus	(%)	0.84	0.96	1.64
4.	Exchangeable Potassium	(%)	0.12	0.23	0.42
5.	C:N ratio	(%)	34.2	22.40	8.32

Table 2. Impact of composting period on earthworm number, biomass and cocoon production of *Lampito maruitii.*

Types of waste	Earthworm Number			Body weight (g)			Cocoon production		
	0 days	30	65	0	30	65	0	30	65
Paper waste	30	45	62	48.2	58.4	102.8	Nill	24	58

Table 3. Impact of Vermicomposting on weight loss of organic substrate collected from Musiri.

Type of waste	Initial weight of substrate (g)	Final weight of Vemicompost (g)	Loss (%) during vermicompost
Paper waste	4000 g	1480	58%

side.

The results of the present study reveals that the levels of total nitrogen, phosphorous and exchangeable potassium increased with increase in time as was reported by others (Hemalatha, 2013; Basheer and Agrawal, 2013; Albasha *et al*., 2015). The impact of composting period on the earthworm number, biomass and cocoon production are presented in Table 2. As evident from the Table, the earthworm number increased from an initial level of 30 to 62 after a period of 65 days thus showing an increase of 32 worms. With regard to body weight, the weight increased from 48.2 to 102.8 g thus showing an increase of 54.6 g. The cocoon production was found to be 58 at the end of the composting period.

A perusal of literature reveals that Basheer and Agrawal (2013) recorded an increase of 17 worms with an increase in body weight of 22 g and a cocoon production of 47 during a 65 day composting period. Albasha *et al*. (2015) on the other hand recorded an increase of 17 worms, and an increased body weight of 22 g and a cocoon production of 45 during a 60 day composing period. Mathivannan *et al*. (2017) recorded an increase in worms ranging from 111 to 407 and an increase in body weight ranging from 86.6 - 111.0 g during a 60-day period. A comparison of the results obtained in the present study with those of others reveals that the present study recorded higher worms when compared to Basheer and Agrawal (2013) and Albasha *et al*. (2015) and lower levels when compared to Mathivannan *et al.* (2017). The same appeared to be true with regard to body weight also.

The impact of vermicomposting on the weight loss of organic substrate is presented in Table 3. As seen from the Table, from an initial substrate weight of 4000 g, the weight decreased to 1480 g on the 65th day thus showing a loss of 58% during the period of study.

A perusal of literature reveals that Basheer and Agrawal (2013) recorded a decrease of 55%, while Albasha *et al*. (2015) a loss of 56.4% and Manivannan *et al*. (2017) a loss ranging from 14.1 to 36.3%. A comparison of these results with the present study reveals that the present study recorded slightly higher levels of Basheer and Agrawal (2013) and Albasha *et al.* (2015). The results of the present study clearly indicates that vermiculture can be used for degradation of paper waste.

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