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Original Research Paper

Vermicomposting of Green Waste Using Earthworm *Lumbricus Rubellus*

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ABSTRACT

India produces huge volume of organic waste annually. This waste comes from agriculture, urban and industrial sources and also from domestic activities. Utilization of this waste material for productivity process is important for both economical and environmental reasons. In the present study an attempt was made to convert the biodegradable green wastes into value added compost using an exotic earthworm, *Lumbricus rubellus*. The experiments were carried out in a plastic tray at 50% concentrations of green waste for a period of 60 days. Chemical analysis of worked substrates indicated step-wise increase of nitrogen and phosphorus. The increase of phosphorus and nitrogen were found to be high for green waste undergoing vermicomposting. During the composting period the organic carbon decreased from its initial value 7.12% to 5.09%. The results indicate that 50% concentration of waste mixed with bedding material was ideal for the vermicomposting.

INTRODUCTION

Increasing population, rapid industrialization and trend of urbanization cause the problem of various types of waste products, which is increasing day by day. The wastes are produced from different sources like institutional, commercial and agricultural. This waste produces odorous conditions and pollution problem. The ecological demands required all these waste to be treated prior to discharge to the environment. Hence, it is necessary to manage this huge quantity of biodegradable solid waste in an ecofriendly manner. In this context, several physical, chemical and biological methods have been tried to treat solids namely, gravity separation (Singh 1992), anaerobic digestion (Rajesh Banu et al. 2007), fungal composting (Logakanthi et al. 2006), thermal treatment and vermicomposting. Earthworms show the potential to manage paper mill sludge successfully. The end product of vermicomposting is rich in essential micro and macronutrients along with microorganisms in a very simple form (Logakanthi et al. 2000, Parthsarathi et al. 2007). Adding cast not only improves the soil structure and fertility but also leads to improvement in overall plant growth and thus increases the yield too (Kavian & Ghatnekar 1991, Kavian et al. 1998). The experiments were carried out for a period of 60 days to assess the ability of earthworm, *Lumbricus rubellus* to compost the green waste.

MATERIALS AND METHODS

The wastes used in this experiment were fruit waste, vegetable waste and leaves. They were collected from markets in Nagercoil and from gardens. The waste materials were air dried and grinded into small pieces. pH, moisture content, nitrogen and phosphorus of the raw material were measured using the methods of Trivedy & Goel (1984). Potassium was analysed using flame photometer (Chemito, Model: 1000). Total organic carbon was analysed using TOC analyser.

Bedding material preparation: The standard bedding material was prepared (Rajesh Banu et al. 2005). Raw materials used were mango foliage, cow dung and saw dust. The bedding material was prepared by taking dry weight of mango foliage, cow dung and sawdust in the ratio of 4:4:1.

Vermi tub treatment process: The green waste at 50% concentration was mixed with standard bedding material at 50%. It was placed in the plastic tubs of size 10" × 14" × 40" accommodating 2 kg of material. Ten breeders belonging to the species *Lumbricus rubellus* were inoculated in the sample. All introduced worms were of nearly same size in length and in weight. The experiment was carried out at an ambient temperature of 27-34°C. The moisture content was analysed using moisture balance (Sartorius model: MA 30-000V3) and was maintained at 25-35%. The pH of the bedding material during the study ranged from 7.6-8.0. The experiment was carried out for a period of 2 months. The upper surfaces of the culture tubs were covered with wire mesh to avoid entry of predators.

RESULTS AND DISCUSSION

The physico-chemical characteristics of the green waste are presented in Table 1. The moisture content of the green waste was above 30%. The pH is high (8.4). The amount of organic carbon in the green waste was found to be 7.12%. The concentration of nitrogen was 0.247mg/100g, phosphorus 0.1mg/100g and potassium 0.0098mg/100g. The different

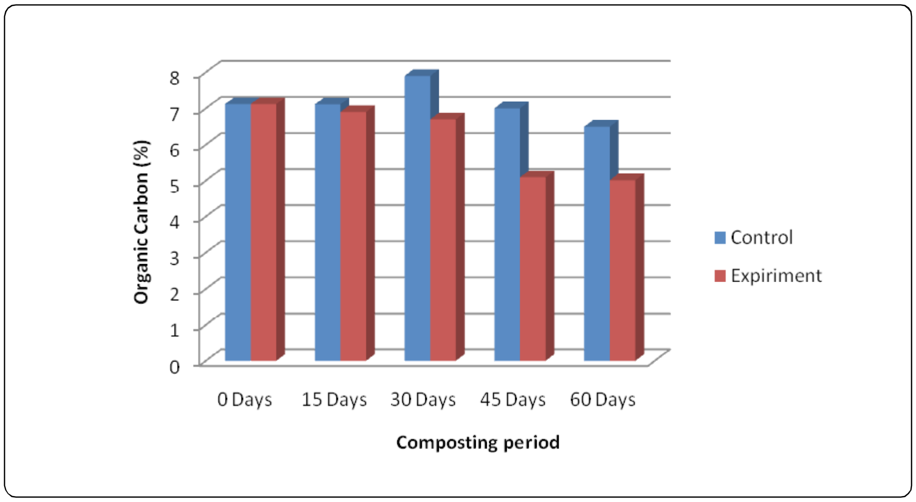

Fig.1: Removal of total organic carbon during vermicomposting of green waste.

physico-chemical properties of control and vermicompost are given in Table 2. The values were taken every 15 days.

Fig. 1 illustrates utilization of total organic carbon during vermicomposting of green waste. In the case of 50% green waste, concentration of TOC was reduced from 7.12 to 7% and 5.09% for control and composting, respectively. It was evident that the green waste that underwent vermicomposting showed better utilization of TOC when compared to the control. This might be attributed to the respiratory activity of earthworms and microorganisms (Curry et al. 1995, Edwards & Bohlen 1996). The rate of TOC removal was found to be high in 50% concentration. At lower green waste concentration the activity of earthworm was high, which increased the rate of organic carbon degradation by enhancing microbial activity (Kavian et al. 1996).

Fig. 2 illustrates the variations in nitrogen during the period of vermicomposting. Nitrogen content increased with the increase in composting period. In 50% concentration, nitrogen from its initial value of 0.247mg/100g was increased to 0.249 and 0.356mg/100g, respectively for control and vermicomposting. The increase in nitrogen and phosphorus in the vermicompost indicated that there was enhanced mineralization of these elements due to microbial and enzyme activity in gut of the earthworms. Similar observations were reported earlier by many investigators (Robinson et al. 1992, Lair et al. 1997).

Phosphorus variations in the green waste during composting period are shown in the Fig. 3. Robinson et al. (1992), have reported that the increase in the phosphate level during composting is mainly due to the activity of microorganisms that mineralize the phosphate. From the figure, it is

Table 1: Physico-chemical characteristics of waste material.

Sl.No	Parameter	Values
1	pH	8.4
2	Moisture content (%)	31.5
3	TOC	7.12 %
4	Phosphorus	0.10 mg/100g
5	Potassium	0.0098 mg/100g
6	Nitrogen	0.247 mg/100g

Table 2: Effect of vermicompost (experiment) and control on different physico-chemical parameters of green waste.

Sl. No	Para-meters	Duration of Compositing (Days)									
		0 Days Control	15 Days Exper-iment	30 Days Control	45 Days Exper-iment	60Days Control	Exper-iment	Control	Exper-iment	Control	Exper-iment
1	pH	8.5	8.4	8.3	8.2	8	8	7.9	7.6	7.75	7.49
2	Organic Carbon (%)	7.12	7.12	7.11	6.9	7.09	6.7	7	5.09	6.5	5.01
3	Moisture Content (%)	31.8	31.5	31.4	28.1	31.1	26.3	29.3	24.1	28.4	22.3
4	Available Nitrogen (mg/100g)	0.247	0.247	0.253	0.281	0.265	0.296	0.270	0.356	0.274	0.496
5	Available Phosphorus (mg/100g)	0.11	0.10	0.12	0.14	0.125	0.17	0.15	0.182	0.14	0.189
6	Exchange Potassium (mg/100g)	0.0097	0.0098	0.0099	0.11	0.010	0.18	0.013	0.19	0.098	0.259

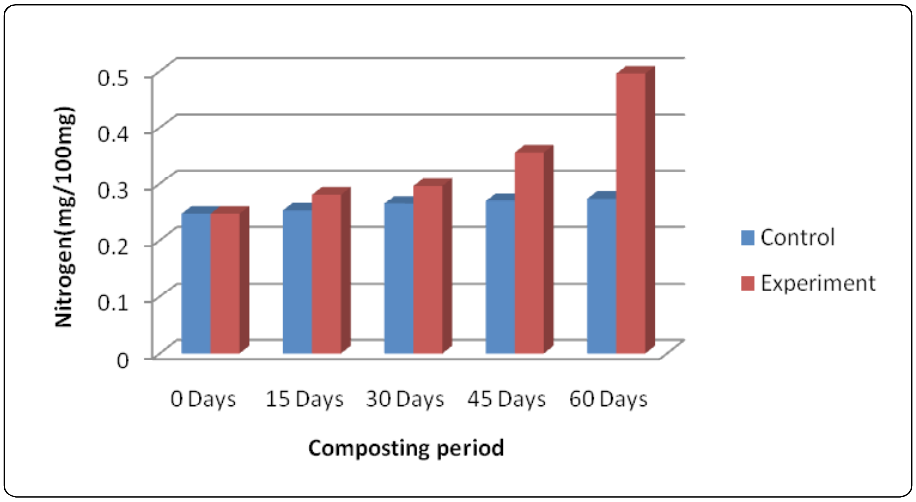

Fig. 2: Pattern of nitrogen variation during vermicompositing of green waste.

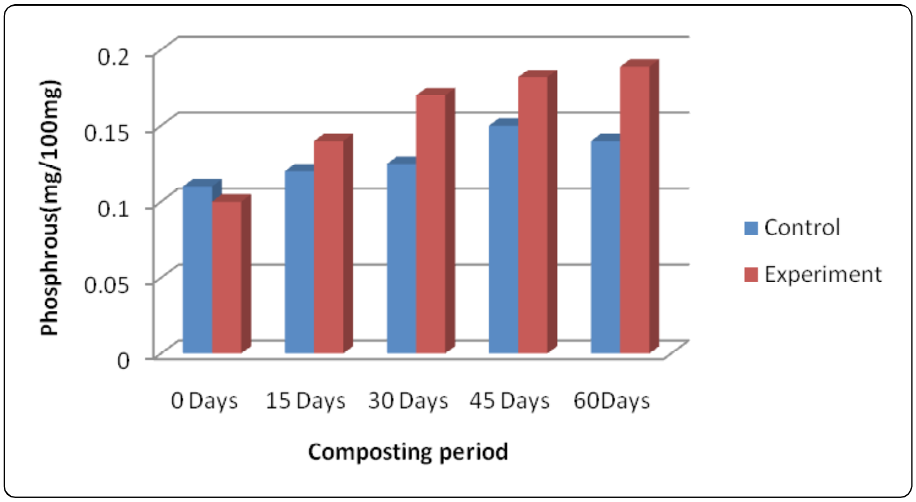

Fig.3: Pattern of phosphorous variation during vermicompositing of green waste.

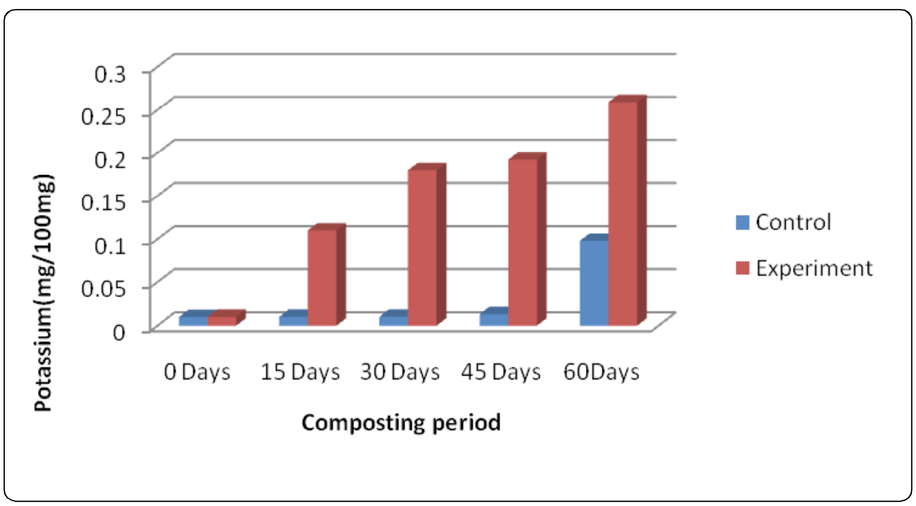

Fig. 4: Pattern of Potassium variation during vermicompositing of green waste.

clear that the increase in phosphorus was higher for green waste that was subjected to vermicomposting than that of control.

Fig. 4 shows the variation in potassium in the green waste during composting period. The increase in potassium was higher for green waste that was subjected to vermicomposting than that of the control. The increase in potassium was from its initial value of 0.0097 to 0.013 mg/100g and 0.192 mg/100g for control and vermicomposting.

The present study indicates that bedding material is very essential for the composting and it also helps in the growth of earthworms, which is indirectly responsible for the increase in microbial population, nitrogen, phosphorus level and reduction of organic carbon in the compost. It can be concluded that green waste was found to be non-toxic to the earthworm and amenable to vermicomposting. Further studies employing different earthworm species and on the impacts of low nutrient level and high moisture content would help to evaluate the process, and its application will pave the way for pilot scale experiment.

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