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Original Research Paper

Bioconversion of Biogas Slurry into Eco-friendly Manure by Vermiculture Using the Earthworm Species *Eudrilus eugeniae*

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ABSTRACT

Bioconversion of organic waste materials into nutritious compost by earthworm activity is an easy and effective way of recycling when it is compared to farmyard waste. Vermicompost is a potential organic manure which contains NPK, micronutrients and enzymes, which have stimulatory effect on plant growth. *Eudrilus eugeniae* was selected to convert the biogas slurry into vermicompost in this study. The culture was maintained for 45 days. 1st, 23rd and 45th day samples from both control and experimental were taken, dried, sieved, powdered and used for estimation of physical and chemical parameters. At the end of the experiment juveniles and cocoons were observed.

INTRODUCTION

Vermicomposting is an easy and effective way of recycling agriculture waste, city garbage and kitchen waste along with bioconversion of organic waste material into nutritious compost by earthworm activity. Selection of earthworm species is very important factor for the preparation of vermicompost. More commonly used species are *Eudrilus eugeniae*, *Eisenia foetida* and *Perionyx excavatus*. Vermicompost is a potential organic manure rich in plant nutrients and beneficial bacteria compared to farmyard manure in respect to supply of NPK.

Out of total 3000 species of earthworms, only 500 species are found in India. The environmental and ecological condition of our country is deteriorating because of industrialization. Vermiculture, besides minimizing the environmental pollution, also helps to produce a bio-manure which will serve as efficient soil conditioner. A transition from chemical to sustainable agriculture takes 3-6 years (Edwards et al. 1992). In soil, earthworms constitute a major component of the invertebrate biomass in many ecosystems (Dash 1978) of the world. Earthworms process around 20% of the net primary production and take active part during decomposition of organic waste materials. Satchel (1967) summarized evidence, which indicate that the soil structure is invariably good where there is an adequate earthworm population present. The recycling of organic waste using selective tropical species of earthworm, called vermicomposting, is the most economical and speedy process of composting. The technology involved is simple, highly cost effective and at the same time very easy for the farmers to adopt. Contributions in the field of vermiculture have been made by Kubrabanu & Kale (1992) and Radha Kale (1993). The present work deals with the conversion of biogas slurry into vermicompost.

MATERIALS AND METHODS

The earthworms (*Eudrilus eugeniae*) were collected from Sri Paramakalyani Environmental Centre in Alwarkurichi. Earthworms were maintained for 10 days in the laboratory for acclimatization. For culturing, the earthworms were transferred into different rectangular tray. Biogas slurry was

collected from Courtallam area. In the rectangular tray, the bottom was filled with a layer of stones and sand particles to facilitate free movement of earthworms. Slurry was mixed with dried cow dung powder in the ratio of 4:1. Cow dung was previously shade dried and powdered. The slurry was turned, sprinkled with water and maintained for 25 days and then the earthworms were introduced into the culture. The culture was maintained for 45 days in a shady place by sprinkling water. The earthworms converted the organic waste into biofertilizer called vermicompost, which is black in colour. 1st, 23rd and 45th day samples from both the control and experimental were taken, dried, powered, sieved and analysed.

The vermicompost was analysed for the physical parameters like temperature, pH, moisture content, bulk density, specific gravity and electrical conductivity. Nitrogen content was estimated by Kjeldahl method. Potassium was estimated by flame photometry method, and phosphorus by Olsons method.

RESULTS AND DISCUSSION

The soil fertility is related to the number of earthworms present as reported by Philip (1879). The present study deals with the vermiculture by using organic waste as a bed for culturing the earthworms. Table 1 shows the variation in physical parameters during preparation of vermicompost.

Temperature is the most familiar environmental factor with multi-sided effects on plants and animals. The optimum range of most tropical species varied between 20° C and 35°C. In the present study, the temperature was found to be between 27.5 and 29°C. Most of the species of earthworms prefer soil pH 7 as studied by Arhenius (1921). In this experiment pH was formed to be ranging from 6.65 to 8.

Earthworms do not tolerate dry environments. Appropriate moisture content is observed to be 15-34%. In the present study, moisture content increased from 7% to 30%. It is observed that the bulk density of the soil decreases in biogas slurry. In the present work also the bulk density was decreased from 3.14 to 1.22. The specific gravity of fertilized soil is less when compared to unfertilized soil. In this work also it decreased from 0.99 to 0.73. Electrical conductivity was also decreased from 1.6 to 1.1 and 0.78 to 0.65 mmho.

Tables 2 shows variations in chemical parameters, and Table 3 statistical analysis of physical and chemical parameters. In India it was observed that the earthworm soil contains more organic matter, soil nitrogen and phosphorus than parent soil. Russel (1910) reported that the nitrogen content was

Table 1: Analysis of various physical parameters before and after introducing earthworms on various days in biogas slurry.

Sl. No.	Physical Parameters in %	Control			Experiment I			Experiment II		
		1st Day	23rd Day	45th Day	1st Day	23rd Day	45th Day	1st Day	23rd Day	45th Day
1.	Temperature	27.5	27.8	26	28	28	28	27.5	27	28
2.	pH	6.65	7.3	7.3	7.6	7.3	7	7.2	7.5	7.5
3.	Moisture content	11.5	20.5	31.3	10	17.25	21.5	6.5	12.0	20.5
4.	Bulk density	1.33	1.29	1.22	2.14	2.09	1.06	2.19	2.08	1.06
5.	Specific gravity	0.65	0.5	0.4	1	0.98	0.86	1	0.77	0.72
6.	Electrical conductivity	3.1	1.1	0.09	1.6	0.78	0.65	1.2	0.67	0.52

Temperature, °C; Moisture content, %; Electrical conductivity, mmho

Table 2: Analysis of various chemical parameters before and after introducing earthworms on various days in biogas slurry.

Sl. No.	Chemical Parameters in %	Control			Experiment I			Experiment II		
		1st Day	23rd Day	45th Day	1st Day	23rd Day	45th Day	1st Day	23rd Day	45th Day
1.	Nitrogen, %	2.2	2.22	2.3	1.85	1.9	2.58	2	2.02	2.54
2.	Phosphorus, %	1.4	1.47	1.5	1.35	1.55	2.27	1.32	1.78	2.54
3.	Potassium, %	0.6	0.61	0.75	0.2	0.45	0.85	0.24	0.49	0.82
4.	Carbon, %	2.48	2.91	3.8	1.5	1.9	2.5	2.05	2.59	3.0
5.	C/N ratio	1.12	1.04	0.54	1.89	1	0.96	1.25	1.28	1.18
6.	C/P ratio	1.77	1.57	1.2	2.59	1.22	1.1	1.55	1.45	1.17

Table 2: Statistical analysis of various physical and chemical parameters in control and experimental groups.

Variation in physical parameters

Physical parameters	Control			Experiment I			Experiment II		
	Mean	Standard Deviation	t-test	Mean	Standard Deviation	t-test	Mean	Standard Deviation	t-test
Temperature	27.1	0.2756	2.62	28.5	0.4	2.16	27.7	0.2	1.73
pH	7.36	0.2915	4.21	7.27	0.8602	0.42	7.3	0.5	1.03
Moisture content	7.7	12.32	0.31	15.2	6.07	2.34	15.4	7.10	0.09
Bulk density	1.28	1.5362	0.06	2.09	1.926	0.92	2.11	1.93	0.02
Specific gravity	0.48	1.0770	0.12	0.95	2.204	0.07	0.83	0.10	1.03
Electrical conductivity	2.09	0.4898	3.50	1.01	0.413	0.55	0.79	2.08	0.09
Variation in chemical parameters									
Nitrogen	2.24	1.749	0.03	2.11	0.331	1.09	2.18	2.092	0.13
Phosphorus	1.45	1.2	0.07	1.72	0.974	0.36	1.88	2.042	0.47
Potassium	0.65	0.51	0.13	0.2	0.916	0.09	0.80	0.556	1.58
Carbon	3.06	0.9	0.28	1.96	1.752	0.05	2.54	1.857	0.45

increased in the soil in which earthworms were reared. In the present study, nitrogen content was increased from 2.0 to 2.54 %. Graff (1981) has proved that addition of earthworms in the soil enriches phosphorus. In this experiment, amount of phosphorus was increased from 1.4 to 2.56%. The amount of potassium was increased from 0.6 to 0.82%.

It is reported that earthworms soil contain more available carbon compounds in the worm cast. The carbon content was found to be increased from 1.9 to 3.0 %. C/N ratio and C/P ratio was also found out. This ratio has reduced due to worm activities.

At the end of the experiment, juveniles and cocoons were seem along with adult earthworms. The reutilization of biodegradable waste can control the environmental pollution to certain extent.

CONCLUSION

The process of vermiculture helps in improving soil fertility and minimizes the use of chemical fertilizers. This eco-friendly vermiculture-agriculture-ecoengineering makes organic recycling much

more active and enhances plant growth. This technology also provides opportunities for self employment by utilizing the available agricultural resources to the rural people.

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