J. Sci. Trans. Environ. Technov. 2009, 2(4): 231-234

A case study on the Leaf litter management through Vermicomposting technology using the epigeic earthworm *Eudrilus eugeniae*

N. Manivannan*, and Thilagavathy Daniel

Department of Biology, Gandhigram Rural University, Gandhigram – 624 302, Tamilnadu, India

Abstract

An African Epigeic Earthworm, *Eudrilus eugeniae* was used for the decomposition leaf litter of *Cassia auriculata* Linn. for the production of vermicompost of high quality in terms of macro and micro nutrients and microbial colonies. The vermicompost so obtained increased the growth and yield of *Vigna unguiculata* (cowpea) significantly.

Keywords : colony forming units, cowpea, *Eudrilus eugeniae*, vermicompost, *Vigna unguiculata*

INTRODUCTION

Earthworms are often referred to as farmer's friend and nature's ploughman. Studies on degradation of organic wastes by earthworms are one of the recent developments in biological sciences. Vermicomposting, method of converting wastes into useful products through action of earthworms, has gained awareness in India, to reduce the solid waste pollution and sustaining our environment. The major role of earthworms in the soil is decomposition of organic materials, developing soil structure and altering physico-chemical properties of soil. Organic matter decomposition, nutrient cycling, soil structure and plant productivity have been studied by several authors (Lavella, 1988; Scheu and Wolters , 1991; Zhang and Schrader, 1993).The worm castings are good fertilizer additive for agricultural crops. Litter, the main component of detritus in terrestrial ecosystem can be readily converted to vermicompost by earthworms. Vermicompost is a finely divided peat like material with good structure, porosity, aeration and moisture holding capacity. Even of the vermicompost dries there is no harm to the microorganisms. So vermicompost is rich in available nutrients required for plant growth (Karmegam and Daniel, 2000a).

Earthworm, *Eudrilus eugeniae,* a tropical species commonly called African night crawler, is large in size, grows rapidly, breeds fast and is capable of decomposing large quantities of organic materials into usable vermicompost (Kale and Bano, 1988; Karmegam and Daniel, 2000b). The present study was undertaken to convert the locally available leaf litter *Cassia auriculata* Linn. into value added vermicompost and testing the efficacy of such vermicompost on growth of *Vigna unguiculata* (L.).

*Corresponding Author
email: *manivannan672002@yahoo.co.in*

MATERIALS AND METHODS

Cassia auriculata Linn. is a common plant widely distributed in the southern part of Tamilnadu, South India. The fresh leaves from these plants were collected and shade-dried for a week and then subjected to initial decomposition in rectangular draining cement tanks by sprinkling water and regular mixing and turning the substrates for 15 days.

For this study earthworms, *Eudrilus eugeniae* were collected from the vermiculture unit of the Department of Biology, Gandhigram Rural University, South India. The vermibeds were prepared using pre-decomposed litter waste and cow-dung in 1:1 ratio on dry weight basis in plastic troughs in triplicates. In one set of troughs clitellate earthworm of 6-7 weeks old were introduced. Another set of troughs was maintained without the earthworm (control). Watering was done regularly to moisten the medium. The vermibeds were mixed well without damaging the earthworms for uniform decomposition. All the experiments were carried out in an experimental chamber at a temperature of 27±1°C. After 60 days the worm-worked (experiment) and the worm-unworked (control) substrates were taken out, air dried, powdered and subjected to physico-chemical and microbial analysis (Daniel *et al.,* 1999).

Physico–chemical parameters such as pH, electrical conductivity (EC), nitrogen (MicroKjeldhal method), phosphorous (calorimetric method), potassium (flame photometer), organic carbon (potassium-dichromate oxidation method), calcium, magnesium (acid digestion method), iron, manganese (spectrophotometric method) and zinc (atomic absorption method) were analyzed.

One gram of the sample was taken in a sterile test tube containing 9 ml of distilled water and shaken in vortex mixer. From this stock various dilutions were prepared from 10^1 to 10^6 with sterile water as described by Kannan (1996). One ml of the dilutions of 10^3,10^4 and 10^6 from

each sample was taken and poured in petriplates containing the respective medium in triplicates and incubated (Subbarao, 1995; Kannan, 1996) for the enumeration of bacteria, fungi and actinomycetes respectively.

Vermicompost was mixed with soil for pot culture studies, where in the growth performance of *Vigna unguiculata* (L.), a medicinal plant, was evaluated by recording shoot length, root length, number of pods and pod length on the 70th day.

RESULTS AND DISCUSSION

The physico-chemical characteristics of the worm-unworked (control compost) and worm-worked (experiment) vermicompost are given the in Table 1.

The pH of the vermicompost changed from its original value towards neutral. Most of the researchers reported that the vermicasts are more neutral and this may be due to the fact that the earthworms neutralize soil as it passes through them by secretions of the calciferous glands from the intestine and also due to mixing of ammonia, which gets excreted (Fincy,1952). Earthworms are responsible for translocation of the accumulated organic debris from the soil surface to the subsurface layers and to the substrate and during this process much of the organic material is ingested, macerated and excreted. They also contribute to several kinds of nutrients in the form of nitrogenous wastes.

The electrical conductivity of the vermicompost was found to be increased. This may be due to the presence of exchangeable calcium, magnesium and potassium in the worm casts compared to the soil (Bhatnagar and Patta, 1996).

Similarly the nitrogen, phosphorous and potassium (NPK) values also showed an increase in all the experiments than in the control. The increase of NPK in worm-worked substrates showed that the activity of the earthworm *E.eugeniae* along with microorganisms promoted mineralization process and brought the nutrients in the ready to use form for plant growth (Mba, 1983; Daniel *et al.*, 1999).

The elevated level of Zinc, Manganese and Iron in the vermicompost indicates accelerated mineralization with selective feeding by earthworms on materials containing these metals. The increased level of macro and micronutrients in the vermicomposts were in conformity with the results of earlier works (Daniel and Karmagam, 2000; Parthasarathi and Ranganathan, 2000).

The microbial colony forming units (CFU) of bacteria, fungi and actinomycetes were observed in the experiment and in the control of all three-leaf litters. All the microbial colony-forming units were higher in the

Table 1 . Comparison of the physico-chemical characteristics of the worm- unworked (control) and worm-worked (WW) compost (70 days).

Parameter	Control (n = 3)	Worm- worked (n = 3)
pH	7.14 ± 0.003	7.04 ± 0.006*
Electrical conductivity (ds/m)	1.07 ± 0.003	1.04 ± 0.003*
Organic carbon (%)	47.14 ± 0.023	29.90 ± 0.125*
Nitrogen (%)	0.73 ± 0.015	0.82 ± 0.007*
Phosphorous (%)	0.52 ± 0.006	0.72 ± 0.006*
Potassium (%)	0.15 ± 0.006	0.23 ± 0.006*
Calcium (%)	0.83 ± 0.007	0.94 ± 0.009*
Manganese (%)	0.71 ± 0.003	0.66 ± 0.003*
Iron (%)	0.12 ± 0.006	0.12 ± 0.005^{ns}
Zinc (ppm)	42.16 ± 0.029	42.95 ± 0.023

* significantly different from control $p < 0.05$ (t-test)
ns – not significant

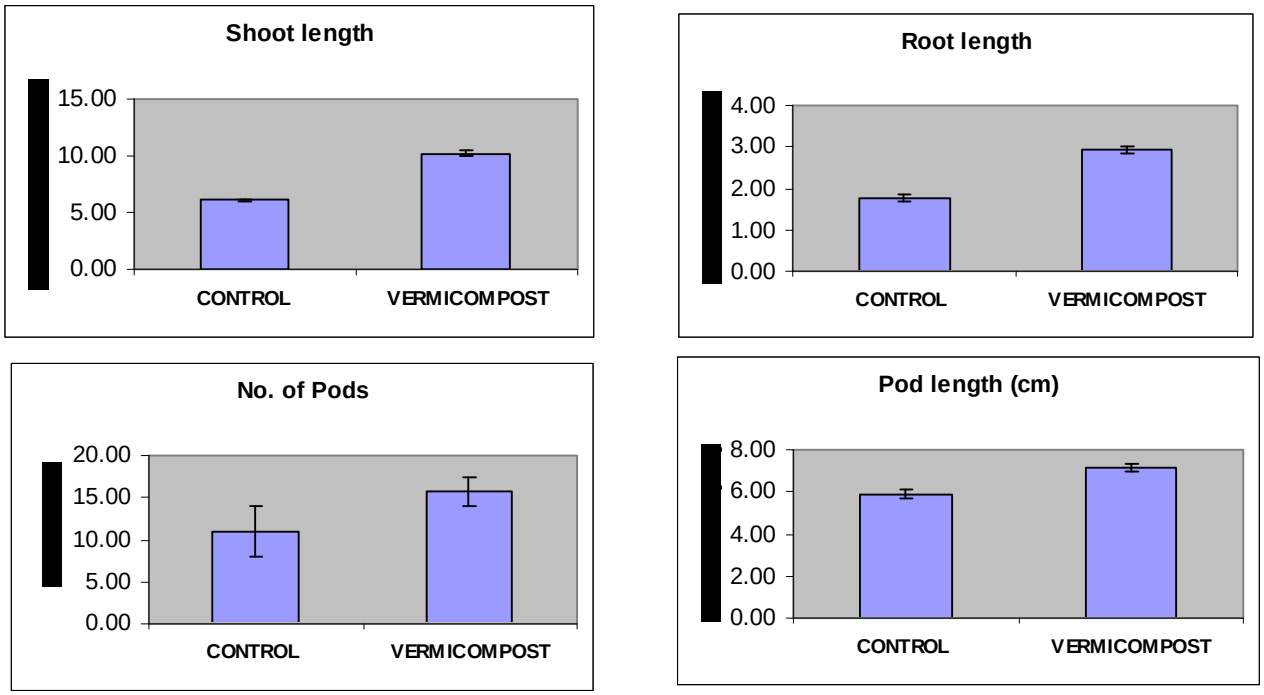

Figure 1. Growth performance of *Vigna unguiculata* in the control pot and in the pots that received vermicompost. Error bars represent mean values ± 3 S.D

worm worked substrates than in the worm unworked substrates. An increase of 2.01, 1.69 and 1.77 folds of bacteria, fungi and actinomycetes, respectively, were recorded in the worm worked substrates of *C. auriculata* over the worm unworked substrates. The increase of microorganisms might be due to the activity of earthworms and their castings which encouraged the growth of microorganisms (Tiwari and Mishra, 1993).

Results of the present study showed the increased growth rate of shoot and root initiation development and weight of *Vigna unguiculata* (L.) on the 70th days. Earlier researchers have also shown that vermicompost application to increase the germination efficiency, root growth and yield of plants (Kulkarni *et al*., 1996; Sevugaperumal *et al*., 1998; Buckerfield *et al*., 1999). Pod parameters are also an important character in the life cycle of plant growth. In the present study, the appearance pods were observed to be more in plants treated with vermicompost. Pot culture studies have shown higher growth performance in vermicompost enriched soil than in the control. Thus the present study clearly indicated that *E. eugeniae* can very well be used for the production of quality vermicompost from some of the locally available *C. auriculata* leaf litters.

REFERENCES

Bhatnagar, R.K. and Patta, R.K. 1996. *Earthworm - Vermiculture and Vermicomposting*. Kalyani Publication, Ludhiana. P. 106.

Buckerfield, C.J. Tamara, C. Kenneth, F. Lee, E. and Webster, A.K. 1999. Vermicompost in solid and liquid as a plant growth promoter. *Pediobiologica*, 43: 753-759

Daniel, T. and Karmegam, N. 2000. Bio-conversion of selected leaf litters using an African epigeic earthworm *Eudrilus eugeniae*. *Ecol. Env. and Cons*., 5: 273-277.

Daniel, T., Karmegam, N. and Alagumalai, K. 1999. Vermiculture- an approach for sustainable agriculture. *J. Ext. Res*., 1: 16-23.

Fincy, A. 1952 Okologische and Bodenkundliche, Studies uber die letstungen der Regencurmer fur die Bodenfructhabarkeliz phl Eranhrl. *Dung* 58: 120 - 145.

Kale, R.D.and Bano, K.1988. Earthworm cultivation and culturing techniques for production of 'Vee Comp. 83. EUAS' and 'Vee meal 83P UAS'. *Mysore J. Agric. Sci*. 2: 339-344.

Kannan, N.1996. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani, India.

Karmegam, N. and Daniel, T. 2000a. Abundance and population density of three species of earthworms (Annelida: Oligochaeta) in foothills of Sirumalai (Eastern Ghats), India. *Indian J. Environ, and Ecoplan*. 3: 461-66.

Karmegam, N. and Daniel, T. 2000b. Decomposition of leaf litters using the compost worm, *Eisenia fetida*. *Indian J. Envrion. and Ecoplan*. 3: 111-116.

Kulkarni, B.G., Nalawadi, V.G. and Giraddi, R.S. 1996. Effect of vermicompost and vermiculture on growth and

yield of China aster (*Callistephus chinensis* Ness). CV. Ostrich plume mixed. *South Indian Hort.*, 44: 33-35.

Lavelle, P. 1988. Earthworm activities and the soil system. *Biol. Fertil. Soil*, 6: 237 - 251.

Mba, C.C.1983. Utilization *of Eudrilus eugeniae* for disposal of cassava peel. *In:* (Ed Satchell,) *Earthworm Ecology from Darwin to Vermiculture*. Chapman and Hall, London, P.315-321.

Parthasarathi, K. and Ranganathan, L.S. 2000. Chemical characterization of mono and polycultured soil worm casts by tropical earthworms. *Environ. Ecol*. 18: 742-746.

Scheu, S. and Wolters, V. 1991. Influence of fragmentation and bioturbation on the decomposition of carban 14 labelled beech leaf litter. *Soil Biol. Biochem*. 23: 1029-1034.

Sevugaperumal, R. Jaisankar, K. and Jeyaraj, K. 1998. Comparative analysis of the effect of vermicompost and *Azospirillum* on Sorghum, *Sorghum valgare* Linn. *ANJAC Journal* 15: 18-21.

Subba Rao, N.S. 1995. *Soil Microorganism and Plant Growth*. Oxford and IBH Publishing Co. Pvt Ltd., (3rd edition), New Delhi.

Tiwari, S.C. and Mishra, R.R. 1993. Fungal abundance and diversity in earthworm casts and in uningested. Soil. *Biol. Fertile. Soils*. 16:131-34.

Zhang. H. and Schrader. S. 1993. Earthworm effects on selected chemical properties of soil aggregates. *Biol. Fertil. Soils*, 15: 229-234.