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Research Note :

Production of *Eisenia foetida* and vermicompost from poultry waste

R.K. SRIVASTAVA* **AND** PURNIMA A. BEOHAR
Environmental Research Laboratory, P.G. Department of Environmental Science, Government Model Science College (Autonomous), Pachpedi, JABALPUR (M. P.) INDIA

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It has long been known that earthworms are important in the breakdown of the organic matter and they release nutrients in the form of vermicompost. The use of earthworms as a waste treatment technique for such waste is gaining popularity. This method is commonly known as vermicomposting. Compared to conventional microbiological composting methods. Vermicomposting produce a product that is more or less homogenous, with desirable aesthetics which reduces level of contaminants and tends to hold more nutrient over a large period without impacting the environment.

Poultry waste contains significant amount of organic salts and ammonia that may kill worms. So, it is necessary to neutralize freshly deposited waste by $CaCO_3$. In this neutralized poultry waste and cow dung (in a ratio of 1:1. after maintaining the pH) worms can grow well and the produced vermicompost is of high quality. The present trial demonstration is that vermicomposting can play a significant role in the treatment of poultry waste. Earthworms activity can recover a portion of the nutrient and promote a favorable and physiochemical condition of soil environment. Scientific investigations have established the viability of using earthworms as a treatment technique for numerous waste streams. Hand *et al.* (1988); Raymond *et al.* (1988); Edward and Neuhauser (1988).

Earthworms were sensitive to ammonia and did not survive in the poultry waste they also died in waste in which large quantity of inorganic salts was present. Both ammonia and inorganic salts have very sharp cutoff point between being toxic and nontoxic *i.e.*<0.5 mg/g of ammonia and <5 % salts for worms.

Characteristics of Eisenia foetida that process organic waste:

They have a very wide temperature tolerance and can live in a organic waste with large range of moisture contents. Watanable and Tsukamata (1976), Hartenstein (1978), Kalpana *et al.* (1980), Edward and Neuhauser *et al.* (1988)all investigated that production growth and population biology of *E. foetida,* when fed on the animal manure, the nutrient content of vermicompost differs greatly depending on the parent material. The important feature of vermicompost is that during the processing of poultry waste by earthworms, many nutrients changed the form that are more readily taken up by plants, such as nitrate or ammonium nitrogen, exchangeable phosphorus and soluble potassium, calcium and magnesium.

Optimal conditions for breeding and vermicomposting of Eisenia foetida:

Condition	Requirement
Temperature	25-35 C
Moisture	80-90 %
pH	>5<9
Ammonia content of poultry waste	Low <0.5mg/g
Salt content of poultry waste	Low<0.5%

1:1 combinations of neutralized poultry waste and cow dung were used in vermibins having a basal layer of broken bricks, coarse sand 6-7 cm and a layer of substrate of 30 cm.. Substrate material was semidecomposed for 45 day.

Before to inoculate 50 gm. earthworms in vermibins (worms should be counted and length were measured in cm.). Then these vermibins were covered with wet gunny bags to maintain the moisture and temperature. It should be protected from ants and other predators. After that regular recording of temperature by Thermometer and moisture by Moisture meter was done and during whole experiment, temperature was maintained at 25-27 c and

* Author for correspondence.

moisture at 85%. After 45 days it was found that *Eisenia foetida* completely converted the semidecomposed material into vermicompost and these pots now filled with sweet smelling spongy vermicompost. After completion of composting, earthworms were removed from the compost by drying it on a cemented floor directly in sunlight. By this process, earthworms gathered at the bottom of the compost and then bunches of earthworms were separated from the vermicompost.

After removing the earthworms from the compost, biological analysis of the earthworms was done and chemical analysis of semi decomposed material and vermicompost was also done.

Following chemical parameters were analysed :

- pH
- Electrical Conductivity
- Organic Carbon %
- Organic Matter %
- Total Nitrogen %
- Available Nitrogen %
- Total phosphorus %
- Available Phosphorus %
- Total Potassium %
- Available Potassium %
- Ca

The above analysis was performed according to the standard procedure of Jackson (1973).

- pH and Electrical Conductivity: Potentiometric method (1:2.5 soil water suspension) by pH and EC meter.
- *Organic Carbon Content:* Titrimetric determination (Wakley and Black, 1934).
- Available Nitrogen: Alkaline potassium permanganate method (Subbiah and Asija, 1956).
- Available Phosphorus: Olsen's method (Olsen's *et al.,* 1954).
- *Available Potassium* : Ammonium Acetate Extract Method.
- *Estimation of Calcium :* Complexometric Titration Method.

Shrikhande and Pathak (1951) made a comparative study of physicochemical characters of the casting of different earthworms. Nijhawan and Kanwar (1952) studied the physico-chemical properties of earthworms casting and their effect on the productivity of the soil. Dhawan *et al.* (1955) reported reclamation of saline soils by earthworms. Senapati and Dash(1981)and Sahu *et al.*(1981) found high concentration of nitrogen in organic waste. Ponomareva (1952) reported increase of 400% in crop growth due to earthworms. Hartenstein (1981) reported the role of *Eisenia foetida* in organic recycling. James (1991) reported the soil, nitrogen, phosphorus and organic matter processing by earthworms in tall grass prairie. Kretzschmar and Bruchou (1991) studied weight response to the soil water potential of the earthworms *Aporrectadea longa*. Anton *et al.*(1990) reported the acute toxicity of the fungicide captan to the earthworm *Eisenia foetida*. Anton *et al.*(1990) reported the denitrification in earthworms casts and soil from pasture under different fertilizer and drainage regimes. Zhang and Schrader (1993) reported the use of the solid wastes of the microbial industry by worm composting. Blair *et al.* (1995) reported changes in soil N pools in response to earthworm population under different agro ecosystems treatments. Anne Grace (1996) reported impact of earthworm introduction on the structure and fertility of soil. Gut content analysis of earthworms has revealed that the C:N ratio of ingested soil gradually decreases through its passage in the intestine (Satchell 1967, Lavelle, 1971).

Chemical analysis:

Sr. No.	Analysed parameters	Poultry waste	Cow dung	Semidecomposed material	Vermicompost
1.	Water Holding Capacity (%)	48.8	50.6	-	-
2.	pH (1:2.5)	4.9 (acidic)	9.8 (Alkaline)	7.7	7.723
3.	EC (mS/cm)	1.93	1.03	0.123	0.166
4.	Organic Carbon (%)	22.52	27.6	2.15	2.386
5.	Organic Matter (%)	38.82	47.58	3.7	4.116
6.	Nitrogen: Total N %	1.94	2.38	0.019	0.588
	Available N %	0.19	0.24	0.019	0.059
7.	Phosphorus : Total %	1.33	1.85	0.036	0.373
	Available %	0.13	0.19	0.036	0.0373
8.	Potassium : Total %	3.64	5.36	0.037	0.35
	Available %	0.36	0.54	0.037	0.035
9.	Calcium : Total %	1.58	0.89	24.23	24.631

Biological analysis :

Characters of worm	Weight in gm	Number	Length in cm
During the time of inoculation	28	50	16
After composting	64	45	5.6

Conclusion :

Significance reduction in total mass of poultry waste were obtained by the intensive activity of *Eisenia foetida*. This process yield two products- residual vermicompost with higher nutritive values and an increase in earthworms biomass.

The action of earthworms in this process is both physical / mechanical and biochemical. The physical and mechanical process includes substrate aeration mixing as well as actual grinding. The biochemical process is affected by microbial decomposition of the substrate in the intestine of the earthworms. Vermicomposting results in bioconversion of the waste streams in two useful products : earthworms biomass and vermicompost

Precaution during experiment :

Moisture level in the vermipit should be between 40 -50%. Excess water reduces the activity of the earthworms. Worms should not be injured while handling. Worms should be protected by the predators like white ants, red ants, centipedes toads, lizards, rats etc. The harvesting and the providing of feed mix should be attended in the time, otherwise accumulation of vermicomposting and reproduction of worms would be reduced.

During rainy season, temporary shelter over the pit and proper drainage around the pit should be provided to avoid water entry in side of pit. Semidecomposed material helps faster formation of vermicomposting.

REFERENCES

Anne Grace (1996). Impact of earthworm introduction on the structure and fertility of soils. Ph. D. Thesis, University of Madras, 95 pp.

Anton, F., Laborda, E. and Laborda, P. (1990). Acute toxicity of the fungicide captan to the earthworm *Eisenia foetida* (Savigny). Bull. Environ Contam. *Toxicol.,* **45** : 82-87.

Blair, J.M., Allen, M.F. and Parmelee, R.W. (1995). Changes in soil N pools in response to earthworm population manipulations under different agroecosystem treatments. *Soil Biol. Biochem.,* **26** : 701-706.

Dhawan, C.L., Sharma, R.L., Singh, A. and Handa, B.K. (1955). Preliminary investigations on the reclamation of saline soils by earthworms. proc.*Nat. Inst. Sci. India,* **24** : 631-6.

Edwards, C.A. and Neuhauser, E.F. (1988). Earthworms in Waste and Environmental Management, SPB Acad. Publ., The Hague, The Netherlands.

Hand,P., Hayes, W.A., Frankland J.C.,Sachell, J.E. (1988). The vermicomposting of cow slurry.*Pedobiologia,* **31** : 199-209.

Hartenstein, R. (1981). Use of *Eisenia foetida* in organic recycling based on laboratory experiments. In Workshop on the Role of Earthworms in the Stablization of Organic Residues (Appelhof, M. Compiller). Vol. 1, Proc. Beech Leaf Press, Kalamazoo, MI. pp. 155-165.

James, S.W. (1991). Soil, nitrogen, phosphorus and organic matter processing by earthworms in tall grass *Prairie. Ecology*., **72** : 2101-2109.

Lavelle, P. (1971). Etude preliminaire de la nutrition d' un Ver de terre Africain *Milsonia anomala* (Acan-tho drilidae, Oligocha etes). Ann. ZOO. Ecol. Anim. n hore serie. 133-145.

Nijhawan, S.D. and Kanwar, J.S. (1952). Physiochemical properties of earthworm castings and their effect on the productivity of soil. *Ind. J. Agric, Sci.,* **22**: 357-73.

Phillips, V.R. (1988). Engineering problems in animal waste by earthworms, In: *Earthworms in waste and in environmental management* SPB Academic publishing P.O.Box 97747, 2509 G C The hugue. The Netherland pp 111-118.

Ponomareva, S. I. (1952). The importance of biological factors in increasing the fertility of Sod-Podzolic soils. *Z. Pfl Ernahr Dung.,* **97** : 205-15.

Raymond, C.L., Martin Jr., J.H. and Neuhauser, E.F., (1988). Stablization of municipal sludge using earthworms, In : *Earthworms in waste and environment management* SPB academic Publishing, P.O. Box 97747,2509 GC The Hague, The Netherlands, pp 95-110.

Sahu, S.K., Mishra, S.K. and Senapati, B.K. (1988). Population biology and reproductive strategy of Dichogaster bolani (Michaelson) in two tropical agro ecosystems. *Proc. Ind. Acad. Sci.* (Animal Sci.). **97** (3) : 239-250.

Satchell, J.E. and Lowe, D.C., (1967). Selection of leaf litter by Lumbricus terrestris. In : vieweg, F (ed.): *Progress in Soil Biology*, Braunschweig, F. Vieweg (ed.) In: Progress in soil Biology, pp.102-119.

Senapati, B.K. and Dash, M.C. (1981b). Bioconversion of low fodder quality grasses to compost by earthworms. Proceedings of the National Acad. Sciences. India.

Shrikhande, J.C. and Pathak, A.N. (1951). A comparative study of the physiochemical characters of the casting of different in sects. *Indian J. Agric. Sci.,* **21**: 401-407.

Watanabe, H., and Tsukamoto (1976). Seasonal change in size class and age structure of the Lumbricid *Eisenia foetida* population in a field compost and its practical application as the decomposer of organic waste. *Rev. Ecol. Biol. Sol.,* **13** : 141-146.

Zhang, H. and Schrader, S. (1993). Earthworm effects on selected chemical properties of soil aggregates. *Biol. Fertil. Soils.,* 229-34.