Efficiency Of The Earthworm, *Eisenia Fetida* In Vermi stabilization Of Silkworm Litter Mixed With Leaf Litter

[1]Vasanthi Padmanabhan,
[1]Associate Professor,
[1]Department Of Zoology,
[1]Government Arts College, Salem, Tamilnadu, India.

Abstract: Vermicomposting is an eco-friendly technology and has a tremendous scope in the recycling of sericultural wastes. proper utilization of sericultural waste as raw material for vermicomposting and it serve as organic manure and helps to improve the soil health and nutrient availability. Vermicompost technology involves earthworms and composting of any organic wastes within 50-60 days. It contains useful microorganisms and rich in plant nutrients. Application of organic manure improves the physical, chemical and biological properties of soil with direct on moisture retention, root growth, nutrient conservation, *etc*. The cost of the inorganic fertilizers can be reduced by using traditional application of organic manures which can be reduced by indigenous production by farmers themselves thereby effective utilization of sericulture waste minimize the environment pollution and good alternative to restrict the use of inorganic fertilizers. These bio fertilizers can replace chemical fertilizer to some extent and create a better environment for the growth of plants. It is an eco-friendly and cost effective technology using earthworms The effort was made in the present study to evaluate the vermistabilization of silkworm litter mixed with pre-decomposed leaf litters in different combinations using the earthworm Eisenia fetida. The total nutrient content like N, P, K was higher in all the worm - worked substrates than in worm- unworked substrates and nutrients also gradually increases according to the ratios of substrates. The microorganism isolated from silkworm and leaf litters (compost without inoculation of earthworms) was Bacillus sp. and Streptococcus sp Pseudomonas Sp. and Solmenella Sp. and E.coli Sp. in vermicompost.
Keywords: *Eisenia fetida*, silkworm, vermicompost, sericultural waste, Streptococcus, Bacillus, Salmonella.

INTRODUCTION

In India waste treatment and waste disposal is a significant area of concern and particularly the treatment of solid waste such as kitchen and garden waste, agricultural waste, plastics, cloths, glass and metal and general household waste is of great concern. The treatment often involves the solid waste being dumped at the back of homes or fields or the waste is put straight into landfill. However that the waste management is a very important area and many problems such as health, sanitation and environmental concerns can be prevented as well as profit being made if waste can be effectively recycled. Biodegradable wastes like crop residues, tree wastes, animal wastes, urban and rural wastes, agro-industries by-products etc are the major manorial resources and can be converted into bio-fertilizers if used scientifically. Otherwise, these wastes pose environmental problems like foul smell, occupying large spaces, production of disease carrier microbes. Biological material like earthworm is a boon to minimize the pollution caused by mismanagement of these organic wastes by enhancing the process of degradation of complex substance. It is essential to use appropriate species of earthworms in waste management

During the sericulture operations huge amount of wastes and by products like unused leaves and branches of mulberry plants, silkworm larval litter, dead larvae, pupae, cocoon wastes and reeling wastes are produced. Along with the silk, the industry produces about 5000 ton of wastes in different forms as by product (Gunathilagaraj and Ravignanam, 1996). The waste in sericulture contains organic matter like larval excreta, leaf litter, dead larvae, moth and cocoons (Kamili and Mosoodi, 2000). A large volume of organic matter generated from sericulture activities, animal shelters and household activities are dumped to putrefy without proper utilization.

Under present day condition, it becomes very essential to protect environment from further degradation by recycling utilizable waste by effective technology like vermitech i.e incorporating earthworms for the production of vermicompost.

Vermicomposting is the biological degradation and stabilization of organic waste by earthworms and microorganisms . (Edwards and Neuhauser, 1988). This is the essential part in organic farming today. It helps to avoid the environmental pollution and expenditure of resources to treat the organic waste.Because of its quality vermicompost is considered superior to other types of compost. Composting with worms (also called **vermicomposting**) is usually done with the common red wiggler worm (*Eisenia fetida*).This worm's specialized digestive system converts food waste and other organic materials to a nutrient-rich compost called **vermicast (**or) **worm castings**. It thrives in an **aerobic** (with air) environment. It is able to process large amounts of food waste and rapidly reproduce in a confined space. Organic wastes from animal and plant origin are presently best utilized for vermin composting by indigenous and exotic earthworms (Nath *et al.,* 2009).Reports showed that the seri-waste from mulberry culture can also be utilized for production of organic manure by this method.

Application of organic manure improves the physical, chemical and biological properties of soil with direct on moisture retention, root growth, nutrient conservation, *etc*. The cost of the inorganic fertilizers can be reduced by using traditional application of organic manures which can be reduced by indigenous production by farmers themselves thereby effective utilization of sericulture waste minimize the environment pollution and good alternative to restrict the use of inorganic fertilizers. These bio fertilizers can replace chemical fertilizer to some extent and create a better environment for the growth of plants. It is an eco-friendly and cost effective technology using earthworms as bioreactors for converting organic materials into valuable compost. Several types of composting technologies are employed for recycling organic waste materials, among which vermicomposting technology is gaining much importance and rapidly spreading all over the world.

Vermicomposting technology has been engaged as a common practice of organic matter of recycling .Vermicompost can be thus used as a nonpolluting natural fertilizer, or a pH neutralizer, since the product that comes out of the back end of a worm is more neutral in pH than what goes in the front end. Earthworms also contribute to the soil in other ways.

Earthworms chelate nutrients, making chemically unavailable minerals available to plants. The bacteria that live in earthworm guts can fix nitrogen, as greater rates of nitrogen fixation are found in casts compared to surrounding soil. Earthworms are also able to eliminate dangerous chemicals. The bacteria in the gut help destroy harmful chemicals and breakdown organic wastes. Microbes living in worms have the ability to breakdown complex organic molecules like cellulose and lignin.

Vermicomposting recycles organic waste that may otherwise end up in landfills. It is an easy process, compared to conventional composting, which requires frequent turning and the management of complex ratios of materials. Vermicast provides many beneficial microorganisms and nutrients to the soil, including beneficial bacteria, fungi, and protozoa as well as nitrogen, phosphorus, potassium, calcium, and magnesium. The importance of vermiculture and first time realized the role of earthworm in agriculture and called them as 'ploughman of the earth'. Lee, (1985) reported that the earthworms are soil invertebrates and consusme large quantities of organic materials and add the nutrients to the soil. M. O. Apolinario, E. S. Corrria, and A. S.,(1998), explained that the *Eisenia fetida* is epigean, meaning that it lives near the soil surface. It lives on the surface of the soil or in the top 10 inches of the topsoil under the litter layer. As *Eisenia fetida* is a commercial species, it is commonly found in vermicomposting bins or on worm farms. However, as it is an epigeic composter, it can be often found in the woods within the ground cover of the leaves. Otherwise it is found in manure piles on farms or fields. It is therefore adapted to many different climates, including variable temperatures moisture contents, and pH levels. These vermiresources have vast and diversified potentials for waste recycle bio-fertilizer production, land reclamation, environmental detoxification and food sources.(Darwin C.R., 1881) An optimal pH range of 5 to 8 for vermicomposting of activate sludge and found that the 100% earthworm mortality for feed with pH values smaller than 5 and greater than 8. The pH of feed plays an important role in vermicomposting, especially if the feed contains high ammonia and nitrogen. (Kaplan *et al*., 1980) Hartenstein and Hartenstein, (1981) showed that earthworms can consume 0.8 kg-biosolids/(kg-worms / day) . *Eisenia foetida* with biosolids as a feed substrate can process 75% of their body weight per day. Das *et al*.,(1997) estimated that from one hectare of mulberry farm, approximately 15 MT of sericultural waste is generated annually in the form of silkworm rearing waste and other farm wastes which is equivalent to 280-300 Kg of nitrogen, 90- 100 Kg of phosphorus and 150-200 Kg of potash. Lachnicht and Hendrix., (2001) reported that the earthworm casts usually have a greater population of bacteria and higher enzyme activity than the surrounding soil. Earthworms are very important in inoculating soils with microorganisms. Many microorganisms in the soil are in a dormant stage with low metabolic activity, awaitijg suitable conditions like the earthworms gut(or)mucus (Lavelle *et al* .,(1983) to become active. vegetable wastes. Urban wastes include municipal solid waste, aerated biosolids, paper sludge, etc

Das *et a*l., 2003 investigated that the in vermicomposting process exotic earthworms *Eisenia foetida* is frequently used because of its high multiplication rate their high fecundity and decomposition rates and thereby converts the organic matter into vermicompost . since it is a surface feeder it converts organic materials into vermicomposting from top.

Kaushik and Garg (2003) stated that during vermicomposting, the important nutrients such as nitrogen, phosphorus, potassium, and calcium present in the feed material are converted through microbial action into forms that are much more soluble and available to plants than those in the parent substrate.

OBJECTIVE OF THE STUDY

To utilize the silkworm litter along with pre-decomposed leaf litters in different combinations using the compost worm, *Eisenia fetida* to produce a valuable vermicompost and analysis physico chemicals like P^H, EC, macronutrients such as N,P,K. and microorganisms present in it.

MATERIALS AND METHODS

Earthworm *Eisenia foetida*, (red worm, manure worm) is live in organic horizons and ingest large amount of un decomposed litter and is most suitable because these are proliferic breeders with high multiplication rate, have short life cycles with less mortality and are voracious feeders which give out high quality vermicasts.

COLLECTION OF THE ANIMAL

Adult *Eisenia fetida* were procured from a Vetrivel vermicompost producer, 5/72, Pookottum Kadu, Jahir Ammapalayam, Slaem Dt.

COMPOSTING

The silkworm litter i.e., the larval excreta and Pupal excreta were collected from the silkworm rearing unit in RSRS, Salem, Tamil Nadu, and Partially Decomposed leaf litters were collected from our college campus and after removing stones, sticks and other wastes, the leaf litters were again subjected to decomposition for 25 days in a cement tank by sprinkling water, regular mixing and turning of the leaf materials and was kept under thatched shed.

The Partial Decomposed leaf litter was kept separately in a cement tank and was covered with a wire mesh. The cow dung was collected from the cattle sheds and kept it for about 7-10 days to cool and dried it and powered and the same used for the study.

The decomposed silkworm litter and leaf litters were powdered manually by grinding with stone mortar and mixed with powered cow dung. The powered materials were sieved separately through a sieve net 1mm x 1mm to get a particle size less than it as referred by Reinecke and Vender, (1985).

VERMIBED PREPARATION

Vermicompost beds were prepared using earthern pots(24 cm x 25 cm x 10 cm) containing powdered silkworm waste, leaf litter in different ratios (0:100; 25:75; 50:50; 75:25; and 100:0)respectively with five replicates for 40 days. Twenty five numbers of mature worm earth worms worms were introduced in each bed. The bedding was maintained the moisture (65% to 85%) throughout the experiment by regular watering.

COLLECTION OF VERMICOMPOST

The experiment was terminated on 40th day and the worm-unworked and the worm-worked substrates were removed, the vermicompost was sieved through 2mm sieve and collected stored in polythene bags for further analysis.

PHYSICO -CHEMICAL ANALYSIS AND IDENTIFICATION OF MICROBES

The worm-unworkwd and worm-worked organic materials were air dried and P^H was analysed by using P^H meter (Falcon *et al* 1987)

Estimation of Electrical conductivity: Electrical conductivity (EC) was analysed by using Electrical conductivity meter (Falcon et al 1987)Macronutrient Assay: Macronutrients such as nitrogen(N) phosphorus(P) potassium(K) and calcium were analysed . Microbial study: Compost and vermicompost samples were collected for microbial studies by dilution plate technique with Nutrient Agar – Hi media.Identification of Microbes:The isolated microbes from the samples were identified by staining methods.

RESULTS AND DISCUSSION:

The physico-chemical analysis of the compost without earthworms and with earthworms inoculation of different ratios of silk worm litter and leaf litter mixture are shown in Table -1 & 2.

Table: 1.Physico-chemical analysis of compost without earthworm inoculation in leaf litter and silkworm litter mixture at different combinations.

Combination ratio	P^H	Electrical conductivity ds/m	Nitrogen %	Phosphorous %	Calcium %	Potassium %
0+100	7.50	0.47	1.01	0.32	9.08	0.47
25+75	7.38	0.58	1.13	0.43	10.5	0.39
50+50	7.32	0.69	1.05	0.38	10.9	0.57
75+25	7.98	0.75	1.24	0.42	9.09	0.37
100+0	8.12	0.52	1.11	0.36	8.07	0.29

Table: 2.Physico-chemical analysis of compost with earthworm inoculation in leaf litter and silkworm litter mixture at different combinations.

Combination ratio	P^H	Electrical conductivity ds/m	Nitrogen %	Phosphorous %	Calcium %	Potassium %
0+100	8.37	0.49	1.14	0.35	11.5	0.52
25+75	8.65	0.63	1.52	0.43	15.1	0.45
50+50	8.68	0.98	1.81	0.38	18.3	0.62
75+25	8.92	0.92	1.63	0.54	11.2	0.48
100+0	8.57	0.84	1.78	0.47	12.8	0.35

Hou *et al.*, (2005) reported that the pH between the range of 6.5 and 8.6 is the best condition for worms to survive and the pH between 5.5 and 8.5 is optimal for microorganisms to be active in the compost. The shifting of pH to lower levels could be further attributed to the mineralization of nitrogen, phosphates and bioconversion of organic materials into intermediate species of the organic acids (Ndegwa et *al*., 2000).

In the present study the P^H values measured in all the ratios without earthworm inoculation of silkworm litter and leaf litter showed basic in nature. The samples obtained after vermicomposting , P^H value was increased . The results obtained from the different ratios were similar to the Cohen S.Lewis H.B., (1949) . They have reported that the increase of pH may be attributed to the decomposition of nitrogenous substrates resulting in production of ammonia. Ammonia which forms a large proportion of the nitrogenous matter was excreated by earthworms.

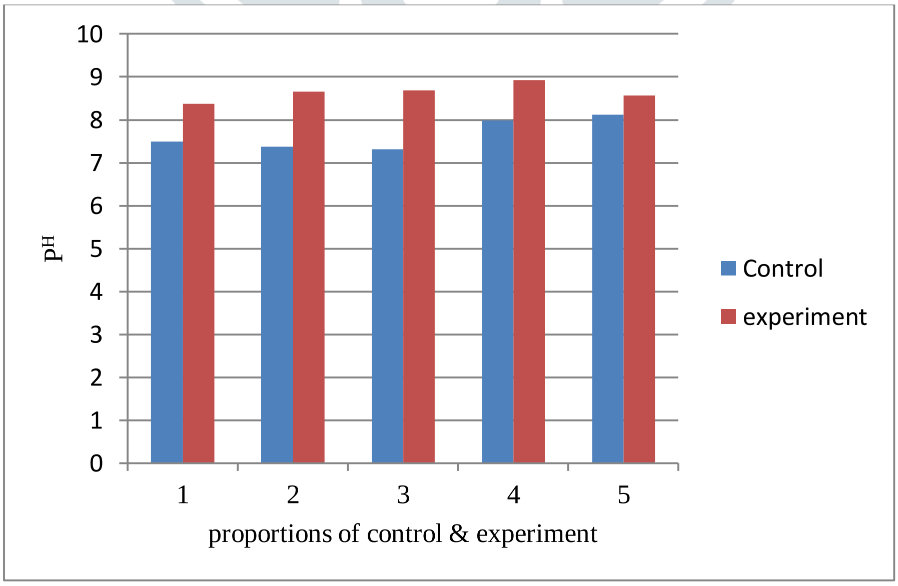


Figure: 1. P^Hcontent of compost without earthworm and inoculation of earthworm

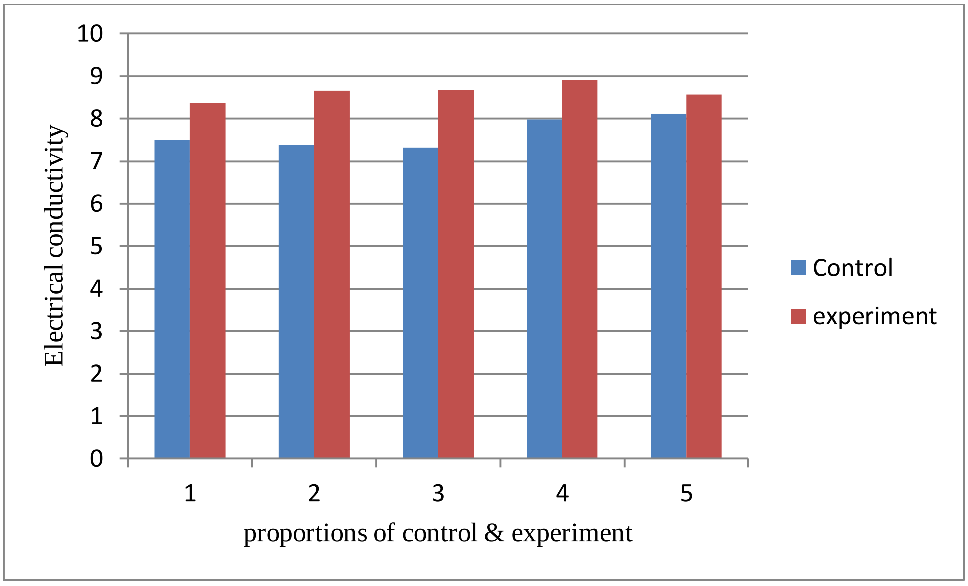


Figure: 2. Electrical conductivity of compost without earthworm and inoculation of earthworm

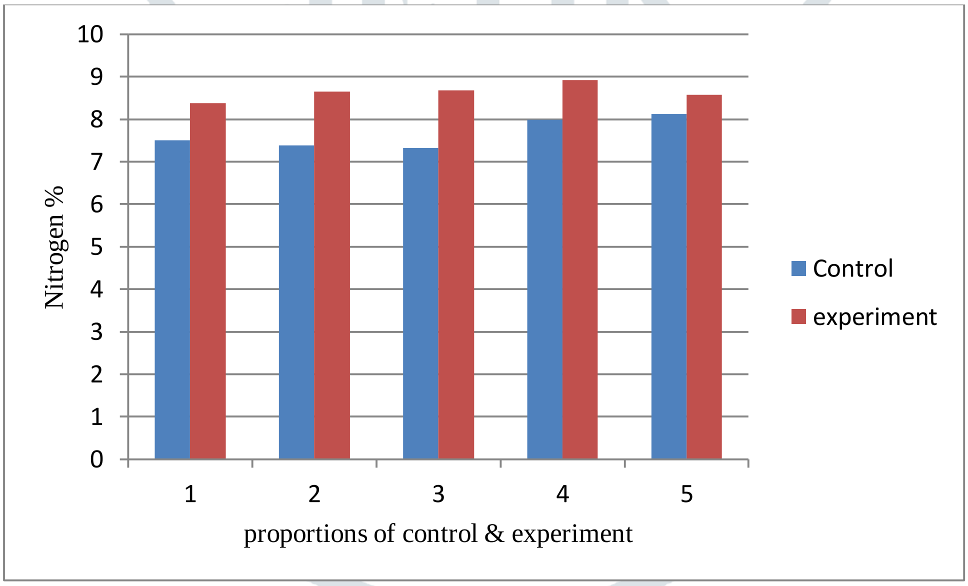


Figure: 3. Nitrogen content of compost without earthworm and inoculation of earthworm

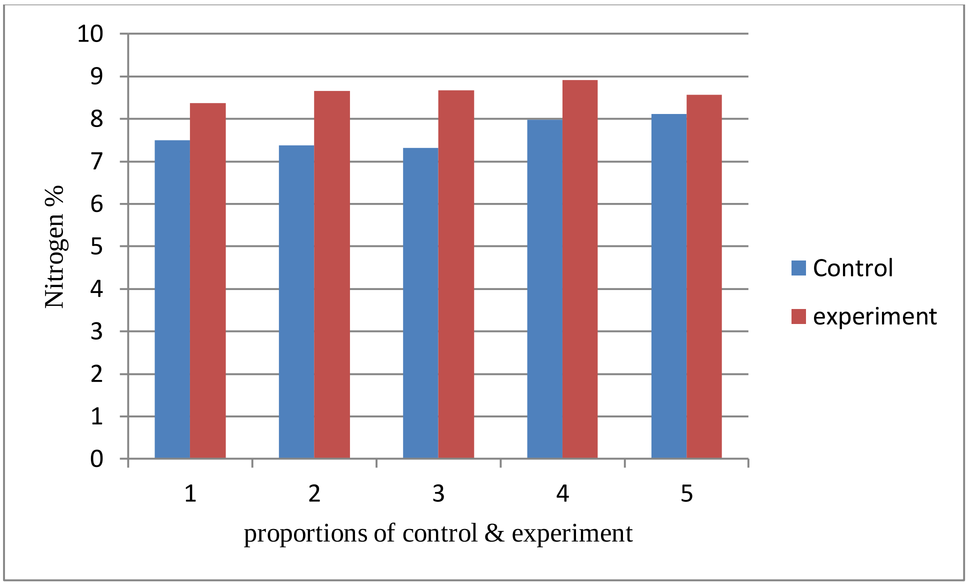


Figure: 4. Phosphorous content of compost without earthworm and inoculation of earthworm

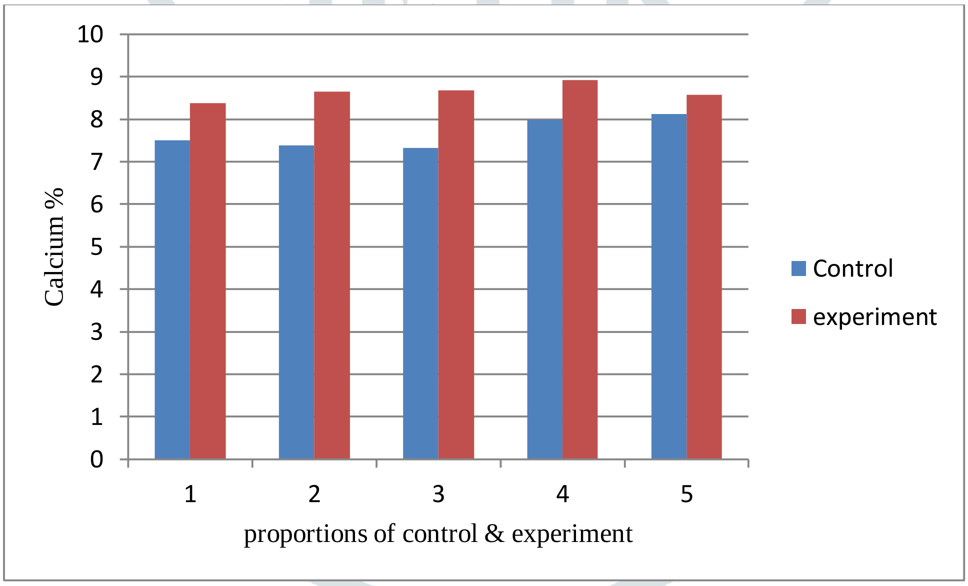
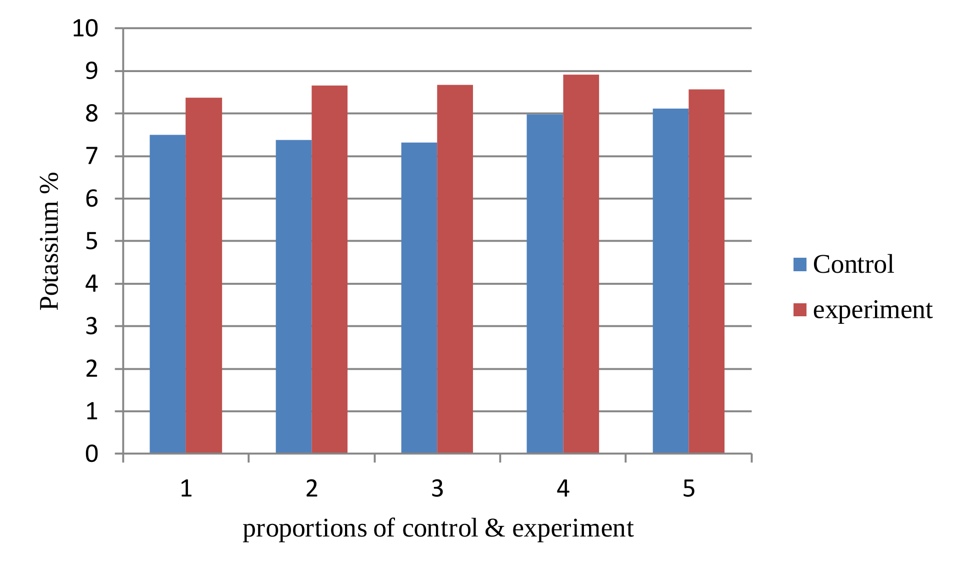


Figure 5:Calcium content of compost without earthworm and inoculation of earthworm



Figure;6. Potassium content of compost without earthworm and inoculation of earthworm

K.Rajasekar *et al*., (2009) stated that the total content of nitrogen, phosphorus, calcium and EC values were higher in all the worked substrates than in worm –un worked substrates. In present experimental analysis the values of electrical conductivity (EC) in the vermicomposting showed more relatively when compared to the samples without earthworm inoculation of silkworm litter and leaf litter which indicates that the salts level was increased during vermicomposting processes. This is due to the metabolic activities of earthworms and microorganisms and they brought out rapid mineralization of compounds. From the result it was clear that there was a significant increase in the NPK content in the vermicompost.

Kaushik and Garg (2003) stated that during vermicomposting, the important nutrients such as nitrogen, phosphorus, potassium, and calcium present in the feed material are converted through microbial action into forms that are much more soluble and available to plants than those in the parent substrate.
Lee (1985) found that the earthworm caused contain more nitrogen, phosphorus and calcium. Easter Rani, et al., (2007) found that the worm *Eisenia Fetida* is capable of ingesting excreting orgnic materials high a rate.
Guna thilagaraj and Ravi Gnanam (1996) reported that the macro and the micro nutrients in the vermicompost of sericulture were more.
Gaur (1982) found that nutrients are richer in earthworm casts. Lakshimi Bai and Vijaya Lakshimi (2002) has reported similar increase in NPK values on subjecting sugar factory filter press mud to vermicomposting.
Uma Mageshwari and Vijaya Lakshimi (2003) found that macro nutrients NPK and micro nutrients Ca and Fe were more.
The present study also reveals that nutrients like N,P,K gradually increase according to the ratios of substrates . The results obtained were according to the previous studies.
Suthar and Singh,(2008); Atiyeh *et al*., (2001); Alidadi *et al*., *(*2005) reported that the bacteria and fungi decompose organic matter they release acids. In the early stage of composting these acids often accumulate and the drop in pH in turn encourages the growth of fungi leading to the breakdown of lignin and cellulose.
Lachnicht and Hendrix., (2001) reported that the earthworm casts usually have a greater population of bacteria and higher enzyme activity than the surrounding soil.
The bacteria isolates from the compost without inoculation of earthworm of silkworm and leaf littes were Basicillus sp, Streptococcus and from the compost with inoculation of silkworm litter and leaf litter were Pseudomonas, Salmonella and E.coli.
The isolated bacteria were found to gram positive strains.
Flack and Hartenstein, (1984) Ranganathan and Parthasarathi,(1999) have reported that earthworms engulf microbes in their food and during passage through the gut population of this micro flora gets enhanced The activities of enzymes during decomposition depend on earthworms as well as microbes present in soil and the decomposition of organic matter is brought about by living organisms present in the soil.

REFERENCES:

1. Atiyeh, R.M., J. Dominguez, S. Subler, and C. A. Edwards. 2001. Changes in biochemical properties of cow manure during processing by earthworms (*Eisenia Andrei*, Bouche) and the effects on seedling growth. *Pedobiologia* 44: 709-724.
2. Alidadi, H., A.R. Parvaresh, M.R. Shahmansouri and H. Pourmoghadas, 2005. Combined compost and vermicomposting process in the treatment and bioconversion of sludge. Iran. J. Environ. Health Sci. Eng., 2: 251-254.
3. Cohen S.Lewis H.B., (1949) The nitrogen metabolism of the earthworm. J. of Biological Chemistry, 180: 79-92
4. Darwin C.R., 1881 The formation of vegetable mould through the action of worms, with observations on theihabitats.MurrayLondon.pp.326
5. Das, P.K., Bhogesha., B.M., Katiyar, R.S., Vijayakumari, K.M., MahavaRao, Y.R. and Rajanna, L. (2003). In: Advance in Indian Sericultural Research. Edited by S.B. Dandin and V.P. Guptha, CSRTI, Mysore.
6. Flack and Hartenstein, (1984) Growth of the earthworm *Eisenia foetida* on microorganisms and cellulose. Soil Biology of Biochemistry, 16, 126-130.
7. Gaur (1982) A Manual of Rural Composting FAO/UNDP, Regional Project RAS/75/004. Field Document No.15. FAO, Home, , 102.
8. Guna thilagaraj and Ravi Gnanam (1996) Agric. J, 83, 455-457.

9. Hartenstein, R., and F., Hartenstein, 1981. Physicochemical changes effected in activated sludge by the earthworms *Eisenia foetida*. Environ. Quality 10 (3): 377-382.
10. K.Rajasekar *et al.,* (2009) Effects of different management practices on degradability and nutrient release capacity. Soil Biol.Biochem., doi: 10.1016.
11. Kamili and Mosoodi, 2000 Principle of Temperate Sericulture. Kalyani Publisher, New Delhi, pp: 105-116.
12. Kaplan D.L., R., Hartenstein, E.F., Neuhauser, and M.R., Malecki.1980. Physiochemical requirements in the environment of earth worm *Eisenia foetida.* Soil Biology and Biochemistry 12: 347:352.
13. Kaushik and Garg (2003) Vermicomposting of mixed solid textile mill sludge and cow dung with epigeic earthworm Eisenia foetida, Bioresource technology, 90, pp 311-316.
14. Lachnicht and Hendrix., (2001) Lachnicht, S. L. and Hendrix, P. F. 2001. Interaction of earthworm Diplocardia mississippiensis (Megascolecidae) with microbial and nutrient dynamics in subtropical Spodosol. Soil Biol. Biochem., 33: 1411-1417.
15. Lakshimi Bai and Vijaya Lakshimi (2002) Poll Res., 19¸481-483.
16. Lavelle *et al* .,(1983) Lavelle, P., Rangel, P. and Kanyonyo, J. 1983. Intestinal mucus production by two species of tropical earthworms: M. lamtoniana and P. corethrurus. In: New Trends in Soil Biology, (Lebrun, P. eds.), Dieu-Brichart Press, Louvain le Neuve, Belgium, pp: 405
17. Lee, K.E., 1985, “Earthworms, their ecology and relationships with soils and land use”, Academic Press, Sydney.
18. M. O. Apolinario, E. S. Corrria, and A. S.,(1998),
19. M. O. Kaushik, P., and Garg, V.K., 2003. Vermicomposting of mixed textile mill sludge and cow dung with epigeic earth worm *Eisenia foetida*. *Biores. Technol*., 90 (3):311-316.
20. Nath, G., Sing, K., and Singh, D. K., 2009. Chemical analysis of vermicomposts / vermiwash of different combinations .
21. Ndegwa et *al*., 2000). Effects of C-to-N ratio on vermicomposting of biosolids Bioresource Technology 75 (2000) 7-12.
22. Ranganathan and Parthasarathi,(1999) Precocious development of *Lampito mauritii* and *Eudrilus eugeniae* reared in pressmud. Pedobiologia ., **45**: 904-908.
23. Reinecke A. J., and Venter J., M.K .,1985. The influence of moisture on the growth and reproduction of the compost worm *Eisenia fetida* (Oligochaeta). *Revue de Ecologieet Biologie du Sol* 22: 473-481.
24. Suthar and Singh,(2008) Vermicomposting of domestic waste by using two epigeic earthworms (Perionyx excavatus and Perionyx sansibaricus) International Journal of Environment Science and Technology, vol. 5(1):99–106.
25. Uma maheswari S & Vijayalakshmi., (2003). Poll Res., 22 339-341.