TO STUDY THE ROLE OF EARTHWORMS IN MAINTAINING SUSTAINABLE ENVIRONMENT BY THE PROCESS OF VERMICOMPOSTING.

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Abstract: Generation of the massive quantity of solid waste round the globe could be a major ecological and technical downside. Vermicomposting could also be a viable choice to handle solid waste in Associate in Nursing environment-friendly method. Vermicomposting could be a method by that all kinds of perishable wastes like farm waste, room waste, market waste, bio waste of agro-based industries, eutherian mammal waste square measure regenerate to nutrient-rich vermicompost by exploitation earthworms as a biohazard. The integrated approach of composting and vermicomposting processes give an improved result. Feeding, stocking density, pH, C/N ratio, temperature and wetness by reasoning appear to be the vital factors that influence the vermicomposting method. In recent years the disposal of organic waste from domestic, agricultural and industrial sources has caused increasing environmental considerations. Vermicomposting is that the method of exploitation earthworms to show organic waste into a black, earthy-smelling, nutrient-rich humus. utilisation of organic wastes through vermicomposting bio technically is Associate in Nursing rising trend as Associate in Nursing "environmentally sustainable", "economically viable and socially acceptable" technology everywhere the planet.

Index Terms **- Earthworm species, solid waste, vermicomposting process.**

I. INTRODUCTION

In view of intensive agricultural practices with multiple crops taken in the same land using large quantities of chemical fertilizers and pesticides, there is tremendous pressure on the soil leading to declining in its productivity. Changes in soil pH, soil acidification and lower humic acid contents are some of the key problems associated with overuse of synthetic fertilizers. The poor soil respiration rate and complete vanishing of natural decomposer communities from agroecosystems have questioned the land sustainability and future food security (Suthar, 2008).

The use of diverse organic sources is becoming popular these days and compost has become an integrated component of plant nutrients. It is estimated that approximately 600 to 700 Mt of agricultural wastes and 1800 Mt of animal dung are produced in India that have very good nutrient potential (Barik et. al, 2011).

The alternative use of these large quantities of nutrient-rich crop residues into compost and recycle them back to the field have drawn the attention of agricultural scientists to reduce environmental pollution and increase the efficiency of C input for higher productivity of crops. One of the options of recycling back these huge amounts of crop residues is through normal composting and vermicomposting using earthworm. Composting provides a means of safely storing organic materials with a minimum of odour release until it is convenient to apply them to the soil. Compost is also easier to handle than the raw materials because of the 30 to 60% smaller volume and greater uniformity of the resulting material.

Vermicomposting with a suitable earthworm, in addition to the benefits of composting, facilitates quick decomposition through shredding activity of organic residues by earthworms and ensuring a better quality of resulting compost. Earthworms consume various organic waste and reduce the volume by 40 to 60%. Each earthworm ways about 0.5 to 0.6g, it's waste equivalent to its body weight and produces cast equivalent to about 50% of the waste it consumes in a day. The moisture content of casting ranges between 32 and 66% and the pH is around 7.0 (Reddy et. al., 1998). The worm castings contain higher percentage (nearly two-fold) of both macro and micronutrient than the garden compost. It is also reported that vermicompost provides all nutrients in readily available form and enhances uptake of nutrients by plants (Sreenivas et. al., 2000) Application of vermicompost also improves soil structure, favouring increased water holding capacity and aeration, because earthworms incorporate organic matter through mucous polysaccharide and turn over a large amount of soil by burrowing, feeding and casting (Stewart and Scullion, 1988).

1.1 Vermitechnology for Sustainable Environment

Vermi-biotechnology is an eco-friendly, socially sound and economically viable innovative type of technology to manage the organic waste resource on low capital input basis that does not call for expensive laboratories or sophisticated industrial instruments. It can provide employment to millions of youth; can eliminate the dependence on chemicals, convert wastes into fertilizers, can bring waste-land under cultivation, can feed hungry citizens and can make a country green and prosperous in a span of just a few years. It is basically composting with earthworms (*Eisenia fetida*, *Eudrilus eugeniae*, *Perionyx excavatus*) and all organic matters eventually decomposes. It can be virtually done anywhere either indoor or outdoor conditions. Organic wastes used for composting (Table 2) are animal dung (cattle dung, sheep dung, horse dung, goat and poultry droppings), agricultural waste (after harvesting and threshing of the produce), forestry wastes (wood-sawing, peels sawdust and pulp), city leaf litter (mango, guava, oranges etc., from residential areas) and paper and cotton clothes.

Table 1: Organic wastes used for composting

Serial No.	Organic wastes	Types of organic wastes
1.	animal dung	cattle dung, sheep dung, horse dung, goat and poultry droppings
2.	agricultural waste	after harvesting and threshing of the produce
3.	forestry wastes	wood-sawing, peels sawdust and pulp
4.	city leaf litter	mango, guava, oranges etc., from residential areas
5.	Food wastes	Waste food including kitchen wastes
6.	Other wastes	paper and cotton clothes

II. MATERIALS AND METHOD

2.1 Collection and Identification of Earthworm

Earthworms were collected from potential area of KISS campus and also from nearby areas of Bhubaneswar and were examined under stereoscopic microscope to study the type of earthworm which were identified by the scientists of Nematology Department, OUAT.

2.2 Vermicomposting

Vermitechnology involves three components, (i) Vermiculture, (ii) Vermicomposting and (iii) Utilisation of products like vermiprotein and vermifertiliser (Dash et al., 1985). As per Dash and Dash (2009), the rearing of the earthworm is performed in a waste earthen pot with soil and dry cow dung. Earthworm could be suitably cultured in 50×25×15 cm size wooden box. Considering the total volume of the box, 1/4th is to be filled with soil, 1/4th with sawdust or rice bran above the soil layer, 1/4th with dry cow dung above the sawdust and rest 1/4th to be left as empty space. To this vermi bed, 100 adult worms could be inoculated. Soil moisture was maintained at 40 to 50 percent and a temperature of around 20-25°C was found to be very suitable. Weekly turning over and quarterly change of organic material is necessary for continual growth. Vermicomposting involves three phases (Dash and Dash, 2009) as follows.

Phase I. This involves the collection of wastes, shredding, mechanical separation of the metal, glass, ceramics, etc. and storage of organic wastes. Shredding is a crushing method of decreasing particle size and volume by about 50-70%.
Phase II. This involves composting by earthworms. Organic wastes can be used first for biogas production and then slurry can be added to the vermi beds for composting.
Phase III. This features the screening and sorting of larger undecomposed wastes which can be used for landfilling or reprocessing. Earthworms can be separated from the compost by a dynamic separation method involving a sieve, and a photo or thermal stimulus. Vermicompost and earthworms thus obtained can be utilized as desired. The selection of species of earthworm for vermicomposting should emphasize the following features (Dash and Dash, 2009):
(i) Should be capable of adapting to high percentages of organic material.
(ii) Should high adaptability with respect to environmental factors.
(iii) Should have a high fecundity rate with a low incubation period.
(iv) Should have a very small interval between hatching and maturity.

2.3 Vermicomposting from Food and Garden Wastes

During this work, food wastes (slurry) from biogas plant and the garden wastes from the institutional area of Kalinga Institute of Social Sciences (KISS) was added to the vermi beds for composting separately. When the compost is ready, it is removed from the pit along with the worms and heaped in shade with ample light. The worms will move to the bottom of the heap. After one or two days the compost from the top of the heap is removed. Put back the un-decomposed residues and worms to the pit for further composting as described above. The vermicompost produced has an average nutrient status of 1.5%, N, 0.4% P_2O_5 and 1.8% K_2O with pH ranging from 7.0 to 8.0. The nutrient level will vary with the type of material used for composting.
Precautions
1. The composting area should be provided with sufficient shade to protect from direct sunlight.
2. The adequate moisture level should be maintained by sprinkling water whenever necessary.
3. Take preventive measures to ward off predatory birds, ants or rats.

2.4 Effects of Vermicompost on growth of plants

Four earthen pots of similar sizes were taken and were filled with soil; equal amount of soil and compost; equal amount of soil and vermicompost; and soil, compost and vermicompost separately. Green gram seeds were sown on these pots and water was sprinkled regularly for germination. After fifteen days the growth of the seedlings were measured separately.

III. RESULT AND DISCUSSION

3.1. Collection and Identification of Earthworm

Earthworms collected from different places during the study were identified as follows.

Table2. Earthworms collected and identified from different locations

Serial No.	Species	Earthworms collected
1	*Eisenia fetida* *Eudrilus eugeniae.*	sewage wastes, nearby kitchen waste tanks
2	*Perionyx excavates* *P. sansibaricus*	compost, peat, and nearby sewage tanks
3	*Polypheretima elongata*	
4	*Lumbricus rubellus*	animal manures or sewage solids
5,	*Dendrodrilus rubidus*	rotting wood and straw, pine litter, compost, peat, and nearby sewage tanks and manure

3.2. Vermicomposting

A status report ready by CAPART recommends epigeic species like *E. eugeniae, E. foetida*, *P. excavatus* and *P. sansibaricus* nearly as good converters of waste. Of these, *P. excavates* and *P. sansibaricus* are endemic species. *E. foetida* is most likely the species best suited to vermicomposting throughout the country, whereas *E. eugeniae*, *P. excavatus* and *P. sansibaricus* are higher suited to the southern components of the country, wherever the summer temperature doesn't rise as high as in Central and North India. The Institute of Natural Organic Agriculture (INORA) in Pune, conjointly advocates the utilization of surface worms as a result of they consume every kind of garbage and multiply quickly. the utilization of endogeics and anecics that ar native to the native soil has been suggested by several others. though surface dwellers are capable of operating onerous on the litter layer and convert all the organic waste into manure, they're of no important price in modifying the structure of the soil. The anecics, however, are capable of each organic waste consumption additionally as modifying the structure of the soil. Earthworms comprising the epigeic and anecic varieties, for the combined method of litter and soil management are suggested, although *P. excavatus* and *Lampito mauritii* along take care of litter and alternative organic waste; *L. mauritii* being associate degree anecic conjointly helps in rejuvenating the soil by burrowing through it. The native endogeics suggested within the standing report of CAPART for maintenance of soil fertility embody *L. mauritii*, *Pontoscolex corethrurus*, *Pheretima posthuma*, *Octochaetona serrata* and plenty of others. Four species of detritivorous (humus-former) earthworms were tested for his or her ability to vermicompost paper waste amalgamated with cow dung in 6:1 (w/w) magnitude relation. The species used were *E. eugeniae P. excavates L. mauritii* and Drawida willsi Michaelsen. As mentioned earlier, *E. eugeniae and P. excavatus* are classified as epigeics or humus feeder earthworms. They generally inhabit humus-laden higher layers of garden earth and manure-pits. They have higher frequency of re production and quicker rate of growth to adulthood than most alternative species; these 2 factors create them economical utilizers of humus, manure, and alternative varieties of organic carbon. Further, as they are doing not burrow into the soil, the vermi reactors supported them needn't contain deep bed of soil. This has the potential of causative towards saving on reactor volume, successively causative to favourable political economy. For of these reasons *E.eugeniae* and *P. excavates* are extensively utilized in vermicomposting throughout the globe and have evidenced to be economical converters of organic feed, particularly manure, into vermi cast.

3.3. Effects of Vermicompost on growth of plants

It was shown from the study that vermicompost enhanced seed germination, enhanced seedling growth and development and increased plant productivity. The soil containing vermicompost was found to be better in comparison to soil applied with cow dung compost and soil applied with chemical fertilizer in optimum level.

Table3. Effects of Vermicompost on growth of plants

Serial No.	Types of soil	Growth of the plants
1	Garden soil	Minimum
2	Garden soil + Cow dung compost	Average
3	Garden soil + vermicompost	Maximum
4	Garden soil + Cow dung compost + vermicompost	Maximum

It was noticed from Table 3. that the growth of the plants was maximum in both the soil containing vermicompost as well as vermicompost and cow dung compost. Researches show that vermicompost further stimulates plant growth even when plants are already receiving 'optimal nutrition'. Vermicompost has consistently improved seed germination, enhanced seedling growth and development and increased plant productivity much more than would be possible from the mere conversion of mineral nutrients into plant available forms. Arancon (2004) found that maximum benefit from vermicompost is obtained when it constitutes between 10 to 40% of the growing medium. Neilson (1951;1965) and Tomati (1988) have also reported that vermicompost contained growth promoting hormone 'auxins', 'cytokinins' and flowering hormone 'gibberellins' secreted by earthworms. It was demonstrated by Grappelli (1985) and Tomati (1983;1987 and 1988) that the growth of ornamental plants after adding aqueous extracts from vermicompost showed similar growth patterns as with the addition of auxins, gibberellins and cytokinins through the soil.

IV. CONCLUSION

It was found from the above study, vermicompost enhances germination, plant growth, and crop yield; Improves root growth and structure; enriches soil with micro-organisms by adding plant hormones such as auxins and gibberellic acids. The effects of vermicompost on plants are not solely attributed to the quality of mineral nutrition is provided but also to its other growth regulating components such as plant growth hormones and humic acids. It also helps environmentally to close the "metabolic gap" through recycling waste on-site.

V. ACKNOWLEDGMENT

I am thankful to all the faculties of Department of Zoology Centurion University of Technology and Management, Bhubaneswar and faculties of Soil Science, Odisha University of Agriculture and Technology, Bhubaneswar for their continuous support during my study.

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