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VERMICOMPOSTING AND ITS IMPORTANCE IN IMPROVEMENT OF SOIL NUTRIENTS

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Abstract—*The tremendous increase in population, urbanization, industrialisation and agricultural production results in accumulation quantities of solid waste. This has created serious problem in the environment. In order to dispose this waste safely it should be converted effectively. Vermicomposting is the process by which worms are used to convert organic materials (usually wastes) into a human like material known as vermicompost. The goal is to process the materials as quick as possible and efficiently. Earthworms consume biomass and excrete it in digested form called worm casts which are popularly called Black gold. The casts are rich in nutrients, growth promoting substances, beneficial soil micro flora and having properties of inhibiting pathogenic microbes.*

INTRDUCTION

With the extensive use of chemical fertilizers and improper irrigation, productivity of the soil is getting reduced considerably. Organic farming has twin objectives of system sustainability and environmental sensitivity. Vermicompost contains major and minor nutrients in plant–available forms, enzymes, vitamins and plant growth hormones. Vermi-technology is a process by which all types of biodegradable wastes such as farm wastes, kitchen wastes, market wastes, bio wastes of agro-based industries, livestock wastes, are converted to nutrient rich vermin compost by using earthworms as biological agents. India generates about 320 million tons of agricultural wastes per annum such as rice straw, wheat straw, groundnut straw, coffee husk, cotton stalk, rice husk etc. (Shroff and Devasthali, 1992).

Role of Earthworms in maintaining Sustainable Agriculture

In underdeveloped countries, green revolution has resulted in boosting the production due to intensive agriculture. Although it has resulted in good harvests and productivity by reaping three crops in a year with good irrigation facilities, there was no thought about its adverse impact in the long run on the soil conditions and the environment.

The Species and Ecology

About 4,400 different species of earthworm have been identified, and quite a few are suitable for Vermitechnology. Earthworms are divided into **four groups.**

Compost Earthworms

As their name would suggest, these are most likely to be found in a compost bin.

They prefer warm and moist environments with a ready supply of fresh compost material. They can very rapidly consume this material and also reproduce very quickly. Compost earthworms tend to be bright red in colour and stripy. Compost earthworm species include *Eiseniafetida* and *Eiseniaveneta*.

Epigeic Earthworms

Epigeic earthworms live on the surface of the soil in leaf litter. These species tend not to make burrows but live in and feed on the leaf litter. Epigeic earthworms are also often bright red or reddy-brown, but they are not stripy. Epigeic earthworm species include *Dendrobaenaoctaedra*, *Dendrobaenaattemsi*, *Dendrodrilusrubidus*, *Eiseniellatetraedra*, *Heliodrilusoculatus*, *Lumbricusrubellus*, *Lumbricuscastaneus*, *Lumbricusfestivus*, *Lumbricusfriendi*, *Satchelliusmammalis.*

Endogeic Earthworms

Endogeic earthworms live in and feed on the soil. They make horizontal burrows through the soil to move around and to feed and they will reuse these burrows to a certain extent. Endogeic earthworms are often pale colours, grey, pale pink, green or blue (Fig.3). Some can burrow very deeply in the soil. Endogeic earthworm species include *Allolobophorachlorotica*, *Apporectodeacaliginosa*, *Apporectodeaicterica*, *Apporectodearosea*, *Murchieonamuldali*, *Octolasioncyaneum*and *Octolasiontyrtaeum.*

Anecic earthworms

Anecic earthworms make permanent vertical burrows in soil. They feed on leaves on the soil surface that they drag into their burrows. Anecic species are the largest species of earthworms in the UK. Anecic earthworm species include *Lumbricusterrestris*and *Apporectodea longa.*

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

Objectives

- To collect and identify many of the species of earthworms that can be effectively used for conversion of organic waste into compost.
- To study different compostable waste for the production of Vermicompost.
- To study about the growth of plants in the soil applied with cow dung compost, chemical fertilizer and Vermicompost.

MATERIAL AND METHODS

A series of experiments were conducted during this project work and the materials used and methods employed are briefly enumerated in the following paragraphs.

Collection and Identification of Earthworm

Earthworms were collected from potential area of CUTM and OUAT Campus and also from near by 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

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 earthworm is performed in waste earthen pot with soil and dry cow dung. Earthworm could be suitable 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 saw dust or rice bran above the soil layer, 1/4th with dry cow dung above the saw dust and rest 1/4th to be left as empty space. To this vermibed, 100 adult worms could be inoculated. Soil moisture was maintained at 40 to 50 per cent 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.

1. **Phase I**. This involves the collection of wastes, shredding, mechanical separation ofthe metal, glass, ceramics, etc. and storage of organic wastes. Shredding is a crushing method of decreasing particle size and volume by about 50-70%.
2. **Phase II**. This involves composting by earthworms. Organic wastes can be used firstfor bio-gas production and then slurry can be added to the vermibeds for composting.
3. **Phase III**. This features the screening and sorting of larger undecomposed wastes which can be used for land filling 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 utilised as desired. The selection of species of earthworm for vermicomposting should emphasise 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 low incubation period.

   (iv) Should have very small interval between hatching and maturity.

   (v) Should have high growth, consumption, digestion and assimilation rate.

   (vi) Should have minimal vermin stabilisation (period of inactivity after initial inoculation to organic wastes).

Vermicomposting from Food and Garden Wastes

During this work, food wastes (slurry) from biogas plant and the garden wastes from the institutional area of Odisha University of Agriculture and Technology (OUAT) was added to the vermibeds 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 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% P2O5 and

1.8% K2O 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. Adequate moisture level should be maintained by sprinkling water whenever necessary.
3. Take preventive measures to ward off predatory birds, ants or rats.

RESULTS AND DISCUSSION

Collection and Identification of Earthworm

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

Table 2: Earthworms collected and identified from different locations

Serial No.	Species	Earthworms collected
1	*Eiseniafetida Eudriluseugeniae.*	sewage wastes, nearby kitchen waste tanks
2	*Perionyx excavates P. sansibaricus*	compost, peat, and nearby sewage tanks
3	*Polypheretimaelongate*	
4	*Lumbricusrubellus*	animal manures or sewage solids
5,	*Dendrodrilusrubidus*	rotting wood and straw, pine litter, compost, peat, and nearby sewage tanks and manure

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 comparision to soil applied with cow dung compost and soil applied with chemical fertilizer in optimum level.

Table 3: 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

CONCLUSION

It was found from the above study, vermicomposts 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 vermicomposts 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.

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