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A Study on Solid Waste Management - Vermicompost in Munnirpallam, Tirunelveli District

V. Agatha Christy
Assistant Professor, Department of Zoology, Pope's College, Tuticorin, India

***Abstract*: Solid waste management has become one of the biggest problems that we are facing today. Vermicomposting is the better option to solve this problem. Vermicomposting is the process of conversion of organic waste by earthworms to valuable humus like material which is used as a natural soil conditioner. Vermicomposting is environmental friendly and cost effective technique for solid waste management. Vermicomposting serves two main purposes for, it helps in the degradation of solid waste and used as a natural fertilizer, vermicompost is much better than chemical fertilizer because it is not associated with any kind of risk. Vermicomposting is a mesophilic process and should be maintained upto 320c with the moisture content of 60-80%. *Eisenia fetida* is the most commonly used specis of earth worm for vermicomposting. Earthworms break down organic matter into valuable fertilizer. Vermicomposting has many applications in crop management such as pathogen destruction, water holding capacity of soil, improved crop growth and yield, improved soil physical, chemical and biological properties and production of plant growth regulator.**

***Keywords*: vermicomposting, *Eisenia fetida, Eisenia andrei, Lumbricus rubellus,* Eudrilus eugeniae and Perionyx excavatus**

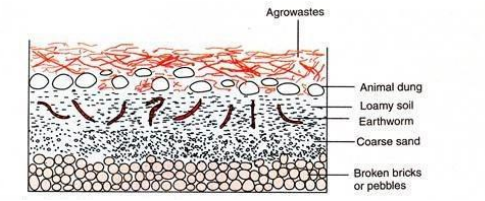
1. Introduction

Vermicompost is the product of the composting process using various species of worms, usually red wigglers, white worms, and other earthworms, to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast. Vermicast also called worm castings, worm humus, worm manure, or worm feces is the end-product of the breakdown of organic matter by earthworms. These castings have been shown to contain reduced levels of contaminants and a higher saturation of nutrients than the organic materials before vermicomposting. Vermicompost contains water-soluble nutrients and is an excellent, nutrient-rich organic fertilizer and soil conditioner. It is used in farming and small scale sustainable, organic farming. Vermicomposting can also be applied for treatment of sewage. A variation of the process is vermifiltration or vermidigestion which is used to remove organic matter, pathogens and oxygen demand from wastewater or directly from black water of flush toilets. Because the earthworms grind and uniformly mix minerals in simple forms, plants need only minimal effort to obtain them. The worms' digestive systems create environments that allow certain species of microbes to thrive to help create a "living" soil environment for plants. The fraction of soil which has gone through the digestive tract of earthworms is called the drilosphere. Vermicomposting has been reported to be a viable, cost effective & rapid technique for the efficient management of organic solid wastes (Logsdon 1994). Vermicomposting, utilizing earthworms, is an eco-biotechnological process that transforms energy-rich & complex organic substances into a stabilized humus-like product (Benitez et al 2000). Vermicomposting is an important aspect, as it converts waste to wealth by using cheap eco-friendly option with activity of earthworm (Mall et al. 2005).

2. Materials and methods

About 0.5-0.6 acre of land will be needed to set up a vermiculture production. The centre will have at least 6-8 sheds for convenience and a dedicated area for finished products. It should also have a bore well and pump set or watering arrangement and other equipments as described in the scheme economics. For a vermi-composting unit, whether small or big, this is an essential item and is required for securing the vermi beds. They could be of thatched roof supported by bamboo rafters and purlins, wooden or steel trusses and stone/ RCC pillars. Farm machinery and implements are required for cutting (shredding) the raw material into small pieces, conveying shredded raw material to the vermi-sheds, loading, unloading, collection of compost, loosening of beds for aeration, shifting of the compost before packing and for air drying of the compost, automatic packing and stitching for efficient running of the unit.

A. Preparation of vermibeds



Normally the beds have 0.3 to 0.6 m height depending on the provision for drainage of excess water. Care should be taken to

make the bed with uniform height over the entire width to avoid low production owing to low bed volumes. The bed width should not be more that 1.5 m to allow easy access to the centre of the bed.

3. Climate and temperature

There may be differences in vermicomposting method depending on the climate. It is necessary to monitor the temperatures of large-scale bin systems which can have high heat retentive properties, as the raw materials or feedstocks used can compost, heating up the worm bins as they decay and killing the worms. The most common worms used in composting systems, redworms *Eisenia foetida, Eisenia andrei,* and *Lumbricus rubellus* feed most rapidly at temperatures of 15–25 °C (59-77 °F). They can survive at 10 °C (50 °F). Temperatures above 30 °C (86 °F) may harm them. This temperature range means that indoor vermicomposting with redworms is possible in all but tropical climates. Other worms like Perionyx excavatus are suitable for warmer climates. If a worm bin is kept outside, it should be placed in a sheltered position away from direct sunlight and insulated against frost in winter. There are few food wastes that vermicomposting cannot compost, although meat waste and dairy products Feedstock are likely to putrefy, and in outdoor bins can attract vermin. Green waste should be added in moderation to avoid heating the bin.

4. About the worms

Of about 350 species of earth worms in India with various food and burrowing habits Eisenia fetida, Eudrilus eugeniae and Perionyx excavatus are some of the species that are reared to convert organic wastes into manure. A combination of epigeic species that form no permanent burrows and live on the surface, anecic that form semi-permanent and vertical burrows extending from the surface and endogeic that typically live throughout the deeper layers may be considered. The worms feed on any biodegradable matter and vermicomposting units are ideally suited for locations / units with generation of considerable quantities of organic wastes. One earthworm reaching reproductive age of about six weeks lays one egg capsule (containing 7 embryos) every 7-10 days. Three to seven worms emerge out of each capsule. Thus, the multiplication of worms under optimum growth conditions is very fast. The worms live for about 2 years. Fully grown worms could be separated and dried in an oven to make 'worm meal' which is a rich source of protein (70%) for use in animal feed.

Vermicomposting is basically a managed process of worms digesting organic matter to transform the material into a beneficial soil amendment. As per the USDA guidelines for compost practices (with effect from Oct 21, 2002), vermicomposts are defined as organic matter of plant and/or animal origin consisting mainly of finely-divided earthworm castings, produced non-thermophilically with biooxidation and stabilization of the organic material, due to interactions between aerobic microorganism and earthworms, as the materials pass through the earthworm gut.

Good quality compost production in ambient temperature can be accomplished in shorter time by the process of vermicomposting that involves use of proper species of earthworms. The native cellulase activity of earthworms and microorganisms in earthworm gut promote faster decomposition of ingested organic material. The combined effect of enzymatic activity and grinding of organic materials to fineness by earthworms produces the vermicomposting and this is not observed in compost pits without earthworm.

The earthworms being voracious eaters consume the biodegradable matter and give out a part of the matter as excreta or vermi-castings. The vermi-casting containing nutrients is a rich manure for the plants. Vermicompost, apart from supplying nutrients and growth enhancing hormones to plants, improves the soil structure leading to increase in water and nutrient holding capacities of soil. Fruits, flowers and vegetables and other plant products grown using vermi-compost are reported to have better keeping quality. A growing number of individuals and institutions are taking interest in the production of vermicompost utilising earthworm activity. As the operational cost of production of this compost works out to less than Rs.2.0/Kg., it is quite profitable to sell the compost even at Rs. 4.00 to Rs. 4.50/Kg.

5. Discussion

Vermicomposting of different wastes such as food waste, agriculture waste, medical waste and industrial waste was done for the degradation of solid wastes and the nutrient rich end product vermicompost was used as a very effective natural fertilizer with no environmental hazards. Different vermibeds were prepared for different wastes and are treated for seven weeks. Every week vermicomposts were analysed for the presence of nutrients such as inorganic phosphate, total organic matter, chloride, carbon, calcium carbonate and sulphate. Moisture content and pH were also determined every week for different vermicomposts. Rate of mineralization and decomposition becomes faster with optimal moisture content. Moisture content of 60-70% was proved having maximal microbial activity and 50% was the minimal requirement for rapid rise in microbial activity pH was increased gradually during vermicomposting and it was attributed to the progressive utilization of organic acids and increase in mineral constituents of wastes. Near neutral pH of vermicompost may be attributed by the secretion of NH_4^+ ions that reduce the pool of H^+ ions. In earthworms the activity of calciferous glands containing

carbonic anhydrase that catalyzes the fixation of CO_2 as $CaCO_3$, thereby prevent the fall in pH. Inorganic phosphate content was increased in vermicomposts of different wastes than simple soil. Even when phosphorus is added to the soil in organic materials such as dung it may become mineralized, often as a chemical precipitate of orthophosphate or adsorbed onto the surface of minerals. Vermicomposts prepared from their respective organic wastes possessed considerably higher levels of major nutrients - N, P, K, Ca, and Mg compared to that of the substrates. Vermicomposting helps in crop improvement. It was analysed by growing plants in different pots containing different vermicomposts and simple soil. Vermicompost contains plant growth promoters with other nutrients and improves physical, chemical and biological properties of soil on repeated application. Many important factors, such as the presence of beneficial microorganisms or biologically active plant growth influencing substances such as phytohormone are released by beneficial microorganisms present in the vermicompost rich soil. Root initiation, increased root biomass, enhanced plant growth and development and sometimes, alterations in plant morphology are among the most frequently claimed effects of vermicompost treatment. Stem elongation, dwarfing and early flowering have been found to be because of the hormone effect in a wide variety of plants and in a number of physiological situations, stem elongation is promoted (or inhibited) by endogenous phytohormones, a class of growth regulating substances which inhibited stem elongation without affecting leaf or flower development.

6. Conclusion

Vermicomposting is effective process of reduction of solid waste and eco-friendly process. It produces high quality fertilizer, which are better compared to other commercial fertilizer in the market. Vermi-composting increases the crop yield and lesser dependence on chemical fertilizer thus mitigating climate change.

So for, the primary objective of this work was to help farmers from rural areas to demonstrate and set up micro enterprises based on vermiculture technology and to improve crop productivity by increasing soil fertility through ecological methods of farming. The training programmes were conducted for different self-help groups (SHGs) covered, multiplying earthworms, managing and collection of organic wastes, application of vermicompost in various crops.

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