VOLUME - 10, ISSUE - 03, MARCH - 2021 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Agricultural Science

'VERMICOMPOSTING: AN ECOFRIENDLY APPROACH TO REIMBURSE THE NATURE DEBT'

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KEYWORDS : Vermicompost, eco-biotechnological process, natural fertilizer

1. INTRODUCTION

With the momentous increase in population globally, there is no doubt that food supply will have to be increased in same manner in order to meet the demand of the consumers. As there are various forms of fertilizers which plays a crucial role for maximizing yield of crops which has become one of the priorities of the farmers in present context.[1] Today major concerns of researchers are towards environment friendly approach in producing high quality organic fertilizer. Vermicomposting is an environment friendly and cost effective technique for solid waste management and sustainable agriculture (Manaig, 2016). Vermicomposting is beneficial to us as it helps in degradation of solid waste and the worm cast can be used as organic fertilizer (Mehta & Karnwal, 2013). Different biological and agricultural wastes can be used as substrates for vermicomposting. The anonymous use of such organic wastes might upgrade the quality of compost formed.[2] Quality of vermicompost mainly depends upon types of raw material used and species of earthworm used (Jafarpour, Pessarakli, & Kazemi, 2017). Vermicompost is finely divided manure with high porosity, aeration, organic matter content and high water holding capacity and rich in microbial activities due to the interaction between earthworm and micro-organisms (Dominguez & Edwards, 2004). It is rich in NPK, micronutrients, beneficial microbes and contains plant hormones and enzymes as well in contrast to the conventional compost. It is proving to be a wonderful growth promoter as well as plant protector from diseases and pests (Sinha & Herat, 2002). Vermicomposting technology is a simple technology that has been under the spotlight of sustainable technology in the past decades. With the help of the earthworms' feeding behaviour, vermicomposting has the ability to process wastes through degradation and decomposition. vermicompost is a stabilized humus product which is formed by the transformation of complex and energy enrich organic foods into stabilised humus. The breaking down of organic wastes by using windrows, boxes or heaps for the production of worm-worked compost on a large commercial scale for the development of simple and effective system for worm breeders.[3]

Vermicompost also helpful for the improving plant growth and development.[4,5]

For the preparation of vermicompost the body of earthworm are generally act as a filter for all these organic matter into the compost of nutrient value like sodium, potassium, phosphorus and other macronutrients. The most favourable conditions of temperature for vermicompost is around (20–30°C) and moisture (60–70%). For the vermiprocess around 5 kg of worms (numbering approximately 10,000) can produce1 ton of waste into vermicompost within 30 days The earthworm body made as a filtration Biological oxygen demand by 90 %, Chemical oxygen demand by (80-90%) or total dissolve solids by (90-92 %), total suspended solids (TSS) around (90–95%) by wastewater.[4]

vermicomposting is "economically viable" (affordable by all nations), "environmentally sustainable" [6] (friendly to the environment-flora, fauna, soil, air and water, with no adverse effect on them) and "socially acceptable" (beneficial to the society with no adverse effect on human health) technology.[7] Thus, vermicomposting is an eco-biotechnological process that transforms energy rich and complex organic substance into stabilized humus like product 'vermicompost' with the aid of earthworms.[7] Vermicomposting results in bioconversion of the waste into two useful products: the earthworm biomass and the vermicompost. The former product can further be processed into proteins (earthworm meal) or high-grade horticultural compost and the latter product (vermicompost) is also considered as an excellent product since it is homogeneous, with greatly increased surface areas and microsites for microbial decomposition and that which tends to adsorb and retain nutrients over a longer period, without adversely impacting the environment. therefore, vermicompost application helpful for the increasing activity of microbes in the soil system.[8] vermicomposting systems or manure heaps are one of the hotspots in the heterotrophic activity for the purpose of supported a high-detritivore biomass from which epigeic earthworms were going to interacting intensively to the other bacteria, fungi and other soil fauna. The content of N and P by the Inoculation of N2 fixing bacteria for the Enriching vermicompost with rock phosphate leading to significantly the available P.[9] There are various system and process for the formation of vermicompost.[10]

Accor to S. M. Bhosale:

It is the process through which converting organic wastes under the application of earthworm for the purpose of use of natural soil by certain materials. There are following features of this process, such as; Vermicomposting is environment friendly, low cost effective for the enrichment of soil with various nutritive value, It is good process for the waste management, It is having two main features for the human's welfare as; Solid waste degradation, The production of cast while as a natural fertilizer, Transforming to garbage waste materials into the gold materials by potential of earthworms. So, it plays an important role as compare to chemical fertilisers and Eisenia fetida is one of the commonly used species for vermicomposting of earthworms.[11]

1.1. BENEFITS OF VERMICOMPOSTING SYSTEM IN CORRESPONDENCE TO EISENIA FETIDA:

There are following benefits seen by the method of vermicomposting; This Systems going in accordance to natural way. Due to increase in the growth rate of E Fetida there is increase in effectiveness and also increases in decomposition. No need of some external energy for generating operating system by electricity.[11]

1.2. COMMONLY SPECIES OF EARTHWORMS USED FOR VERMICOMPOSTING:

Earthworms of different species and ecological categories differ greatly in their ability to digest various organic residues. There are nearly 4400 species of earthworms have been identified in the world. However, only few of these eathworms are used in the vermicomposting. Commonly adopted worms in 107 vermiculture are Bimastos parvus, Dendrobaena rubida, D. veneta, Eisenia fetida, E. hortensis and Eudrilus andrei, E. eugeniae, Amynthas diffringens, A. morrisi, Lampito mauritii, Metaphire anomala, M. birmanica, Perionyx excavatus, P. sansibaricus, Megascolex megascolex, Pontoscolex corethrurus, Octochaetona serrata, O. surensis, Pheritima elongata, P. posthuman But relatively few have been used on a widespread scale and/or researched adequately. In broad, earthworms can be classified as soil dwelling worms and compost worms. Soil worms eat soil minerals and some organic matter in the soil or on its surface while compost worms prefer an environment of decaying organic matter rather than soil. The growth rate and tolerance level to environmental changes differ from species to species in vermicomposting. And the quality of final compost is also affected by the species of worm used in decomposition process. (2).[12]

1.3. BENEFITS OF VERMICOMPOSTING TO SOIL STRUCTURE:

It is observing that other than effectiveness to the economic substitute for the inorganic fertilisers it also shows good effects in others also such as; For land reclamations, Decreasing heavy metal by different waste, Decreases the pathogens, microbes, Adjustment of the biological structure of land, Better planting for the structure of growth and germination.[13]

1.4. IN FUNCTION OF WORMS IN VARIOUS ASPECTS FOR BETTER STRUCTURE OF SOIL (VERMICOMPOSTING)-

There are various aspects of functioning of worms for enrichment ang growth pattern of the structure of soil, as given as; **For environmental purpose-**Soil reclamation, Biotransorbent, Reduction of heavy metals, Reduction of various microbes, pathogens (Biological oxygen demand and chemical oxygen demand) **New research outcomes as** Reduction of greenhouse gases, Effects of nano- particles, Biocontrol agent and for the animal and aqua culture foods. **Plant growth** by the process of vermicompost it stimulates the growth pattern of the plant body in all dimensions.[13]

1.5. EFFECTS ON SOIL STRUCTURE: (VERMICOMPOSTING)

There are following features of processing of earthworms for improving general features of soil, such as, Enhancing the fertility of soil, Adjusting the pH value of soil, Physical composition of soil enhancement, Humus formation, Enhancement of nutrition of soil, Higher in biodiversity of microbes, Improving the structure of soil, Higher porosity, Higher aeration, Higher drainage, Water holding capacity increases.[13]

1.6. SPECIES OF WORMS FOR VERMICOMPOSTING

Epigeic species is one of the commonest species of earthworm which is used for the conversion of organic wastes to the natural soil conditioner purpose as a vermicomposting. There are many characteristics property of this species which plays a valuable role in vermicomposting, such as; natural ability to feed organic wastes, higher rate of reproduction and short life cycleon other hand different species of epigeic type, *Eisenia foetida* is more commonly used for vermicomposting.[14]

2. MATERIALS USED FOR VERMICOMPOSTING

There are many plant materials and substrate used for the product of vermicomposting, such as; Discarded crop residues, Menacing crop weeds as a soil conditioner, Vermi-composting of leaf litter, Crop residues, Weeds can be an effective solution to waste , Conventional cow dung compost, Mixture of cow dung with other plant residues (which gives a better substrate), Lantana camara, banana pseudo stem, Mycostraw, Vegetable waste, Lantana, Ageratum.[14]

2.1 BASIC NUTRITIONAL COMPOSITION OF VERMICOMPOST

There are many nutritive values are present in the vermicompost which helpful for the enhancement of the plant growth and development, such as; Nitrate (No3-), Phosphate (PO43-), Sulphate (SO42-), Potassium (K+) , Microorganisms (bacteria, fungi, actinomycetes) , Enzymes (Dehydrogenase, Urease) Having potential to inhibit pathogens have is useful for the bio-fertilizer or bio-pesticide. Extracts like humic acid, vermin-tea for the purpose of raising crop productivity, Raw materials/feed. These all are used for the maintaining better quality of soil, growth rate of crops yield, general management of crops and plant development.[15]

3 PHYSIOCHEMICAL PROPERTIES OF VERMICOMPOST

There are many properties of vermicompost as compare to other chemical fertilisers; Enhances nutrient content for using in agricultural lands, Plant available nutrient are abundant in Vermicompost as comparing to the normal compost, it was found that vermicomposting reduces the concentration of ammonium-nitrogen nitrogen, (cannot be taken by plants directly, thus increasing the quantity of nitrate-nitrogen by 28 folds) by Atiyeh et al. 2000, highly influenced by feeding material. Carbon ©, Nitrogen (N), Phosphorous (P) and Potassium (K) concentrations were higher in the goat manure vermicompost as compared to the cattle manure. (due to nutrient uptake by earthworms), Removing heavy metals like cadmium, lead, chromium, copper, Improves aggregation, Maintains Stability, Maintains pH of soil, Maintains EC (electrical conductivity), Maintains bulk density, Maintains water holding capacity (WHC), Maintains organic matter (OM), micro- and macro- nutrients.) and biological properties (microbial population, enzymes), Increases soil structural stability and Decreases vulnerability of soil to calamities like soil erosion. All these properties of vermicompost makes eco-friendly by reducing all the toxicity to Enviorement and soil and work excellent as compare to other chemical fertilisers and compost.[15]

4 ACTIVITY PERFORMED BY EARTHWORM IN FORMATION OF VERMICOMPOST

Basically, this vermicompost is completely made by the microbial activity and earthworm which plays an important role for enhancement of soil fertility and growth. These earthworm shows following activity by; Consuming the organic matter, fragmenting and mixing through it by the help of mineral particles to form aggregates. While in feeding, earthworms increase the microbial activity more which enhances the breakdown of organic matter and also stabilization of soil aggregates for the fertility and growth of soil structure. They also intake a large range of organic residues like; sewage sludge, animal wastes, crop residues, and industrial refuse which has been fully established. leading to a composting or humification effect while in process of feeding where earthworms fragment the waste substrate and increasing the microbial activity and rate of decomposition of the material. Finally, at the end the product passes from the earthworm gut is named as vermicompost which is different as other compost due to its physiochemical properties.[16]

5. VERMIWASH (VERMICOMPOST)

These are the substances having the soluble plant nutrients other than some enzymes, organic acids, growth hormones and mucus of earthworms having following properties, such as; It is having an inherent property. These are not only liquid organic fertilisers but also the mild type of biocide. These are

the indispensable part of the vermiculture industry, made by the combination of both secretion and wash of the earthworms. There is no such special instrument or device for this collection. Only the culture was done for the earthworms in the bottom of the container for tap.[17]

6. NUTRITIONAL COMPOSITION OF VERMICOMPOST

Basically, these vermicompost formed by the microbial activity of the earthworm and also filtration process of some organic substances passing through their gut. They having many macronutrients and micronutrients, such as; **Macronutrients** like Sodium, Potassium, Phosphorus, **Micronutrients**, Magnesium, Calcium, Iron, Zinc and Copper.[18]

7. DISCUSSION

As per above study it concludes that vermicomposting is one of the important and beneficial process for the various aspect of the plant growth with preventing against various diseases, fights with many pathogens, prevent toxicity and eco-friendly which promotes the general structure of plant growth. It is depending upon the humus formation by the earthworms which decays the residues and forms the compost. This is differ from other chemical fertilisers and compost. It involves with the bio- oxidation and stabilization of organic material through the interactions between the earthworm and microorganisms. Earthworms are mainly responsible for the fragmentation and conditioning for the substrate, by two main aspect of increasing their surface area for the growth of microorganisms and biological activity. On other hand It possessing the various kinds of macro and micronutrients which plays an important role for the growth of plant structure like sodium, potassium, nitrogen etc. It also helpful for the preventing various heavy metals in the soil like cadmium, copper, lead which toxifies the crop yielding. There are many compositions of this vermicompost like cow dunk, Discarded crop residues, Menacing crop weeds as a soil conditioner, Vermi- composting of leaf litter. Hence this proven that vermicomposting is one of the better options for the farmers for the increasing growth rate of plant as eco-friendly without any use of chemical fertilisers and unwanted toxic substances.

8. ACKNOWLEDGEMENT

Authors are thankful to Institute of agriculture sciences (SAGE University) for providing necessary infrastructure and research facilities. Authors would like to extent there for most By-line to Vice Chancellor Prof Dr. Ankur Arun Kulkarni, Pro Vice Chancellor Dr. Hiren Doshi and Head of Department Dr. Deepak Kumar Sinha for constant check on the progress of the project, for minor detailing and correction.

Table. no.1. According to Piya, S., Shrestha, I., Gauchan, D. P., & Lamichhane, J. Varities of earthworm in substrate (vermicomposting).

S. NO.	NAME OF SUBSTRATE	SPECIES (EARTHWORM)
1.	Domestic waste	P.sansibaricus P. excavatus
2.	Cattle waste	E. foetida
3.	Human faeces	E. foetida
4.	Food industry sludge & cow dung; 1:1	E. foetida
5.	Cow dung	E. foetida
6.	Woodchips (Quercus rubra) and lake mud	E. foetida
7.	Cow dung Azolla Eichornia	Eudrilus eugeniae

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