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VERMITECHNOLOGY, A SCENARIO OF SUSTAINABLE AGRICULTURE - A MINI REVIEW

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ABSTRACT

Vermicomposting is a simple biotechnological process of composting, in which certain species of earthworms are used to enhance the process of waste conversion and produce a better product.It is a nutritive plant food rich in NKP, macro- and micro- nutrients, beneficial soil microbes like N-fixing bacteria and mycorrhizal fungi and are excellent growth promoters. It can act as a good nutritive bio-fertilizer and excellent growth promoters. Earthworms are considered as naturalploughers, which proliferate along with other microorganisms and provide required conditions for the biodegradation of wastes. Agricultural practices always stood for the sustainable food production with least interference in natural system. At present, the situation has changed. During the time of first green revolution in 1950-60s, chemical fertilizers entered the agricultural sector to boost the crop production and to feed the growing population in the under developed countries. But in long run, the fertility of the soil has been lost due to the lack of organic nutrients. Also the soil get addicted to the destructive agrochemicals in severe manner. Here comes the importance of the concept of 'sustainable agriculture', which can be made possible by means of Vermicomposting.

Keywords: Vermitechnology, Vermiculture, Vermicompost, Earthworm, Organic- farming

INTRODUCTION

Vermitechnology is an important aspect of biotechnology. It deals with the involvement of earthworm to use the organic matter and to transform it to useful quality manure. The term 'Vermitechnology' has been defined as the method of converting wastes into useful agricultural resources through the processing done by earthworms.(Senapathi B K ,1992).It is highly ecofriendly, economically viable and socially acceptable technology having several categories : vermi-composting; vermi-filtration; vermi-remediation; vermi-agro production; vermi-protection; vermi-production (Sinha etal, 2010).However there are strong pillars for vermitechnology : Vermi-culture and Vermi-composting. The main heroes, earthworms are considered as natural bioreactor, which proliferate along with other microorganisms and provide required conditions for the biodegradation of wastes (Sinha etal, 2009). As we know agricultural practices always stood for the sustainable food production with least interference in natural system. During the time of first green revolution, entry of chemical fertilizers did a great job to boost the production and to feed the growing population in the under developed countries. But in long run, the productivity of the soil has been lost due to the lack of organic nutrients. (Kale R. D.1995).Even though it has not picked the pace, in the recent future this becoming a best solution to overcome the deleterious effects of chemical pesticides.

VERMICULTURE

This emerging technology is highly dependant on the efficiency of earthworms. Thus utilization of vermiculture is one of the important parts to be considered, Vermiculture referred to as the development of mass earthworm culture on compostable or decomposable organic matter. Vermiculture (from Latin *vermes*– worms, and *culture* – farming) has been practiced for at least a hundred years.(*Vig.etal 2005*).Earthworms are the inhabitants of earth since pre-Cambrian era, i.e.; about 600 million years ago. They are terrestrial invertebrates belonging to the Order Oligochaeta, Class Chaetopoda, Phylum Annelida (*Piearceet al., 1990*). The role of earthworm in composting procedure had been mentioned by Charles Darwin (1881) in his book 'Formation of Vegetable Mould. Earthworms are an important link in the food chain of many invertebrate and vertebrate animals (*Macdonald 1983*). They are bilaterally symmetrical and segmented. They have no skeleton and they move with the help of body muscles and setae. They are hermaphrodite. When mature, the swollen area of the epidermis called clitellum, forms a cocoon in which eggs are deposited. The eggs are usually fertilized the young develop with in the egg without a free larval stage, the newly hatched worms resembling adults. (*Edwards etal, 1996*).Approach to vermiculture was suggested by Oliver (1937) and Barrett (1942), who both considered that some epigeic (surface dwelling) species of earthworms, as well as the organic wastes on which they had fed, could be used by farmers and growers to improve agricultural soils and crop production *(Edwards etal,2010).* The earthworm, which lives below the soil, is not suitable for vermicompost production. Based on their biological and ecological parameters suitable earthworm can be selected. Based on these parameters, three types of earthworms are selected for vermiculture.(*Costa etal*)

(1) Epigeic-(Greek for "upon the earth") – These worms live in the surface litter and feed on decaying organic matter. They do not have permanent burrows. They are phytophagous, very small in size, very active and have high regenerative capacity within a short period of time. Normally they are richly pigmented worms. These "decomposers" are the type of worm used in vermicomposting. The commonly employed species in vermicomposting are *E. foetida, E. eugeniae* and *P. excavatus.*

(2) Endogeic-Greek for "within the earth") – These are also burrowing worms but their burrows are typically more shallow and they feed on the organic matter already in the soil, so they come to the surface only rarely. They have intermediate life cycles with limited regenerative capacity and small to large in body size. They are geophagous, e.g. *Metaphir eposthuma* and *Octochaetoma thurstoni.*

(3) Anecic-(Greek for "out of the earth") – These are bur- rowing worms that come to the surface at night to drag food down into their permanent burrows deep within the mineral layers of the soil. They have long life cycle and are large in body size slightly pigmented at anterior and posterior ends. They are phytophagous in nature, e.g. *L. terrestris.*

Indian blue (*Perionyx excavatus*), African night crawler (*Eudrilus euginae*) and the Tiger worm (*Elsinia foetida*) are promising worms used for vermicompost production. Both mono and poly cultures of earthworm can be used to transform cattle waste into a good quality vermicompost *(Meenaetal, 2010).*Approximately 4,400 different species of earthworms have been identified worldwide; *Eudrillus eugeniae* and *Eisenia foetida* are being used as composting earthworms in most of the countries. *Eisenia foetida* is perhaps world's most widely used earthworm for vermicomposting (*Krishnamurthy R V etal, 1986*).In India, in addition to these, two more species, namely *Perionyx excavants* and *Perionyxs ansibaricus* are also used for the purpose. *(Sehar etal,2016).*Also The utility of epigeic earthworms for successful degradation of organic wastes is well documented for different industries such as paper and pulp, dairy, sugar processing, winery and distillery, wood and wood chips, textile mills, oil and power (fly ash) *(Sharma etal, 2009).*

The selection of suitable species demand the following characteristics *(NPEC, 2004)*

- Worm should be efficient converter of plant and animal biomass to body proteins
- It should have high consumption, digestion and assimilation rate
- Worm should have wide adaptability to environmental factors (mainly the temperature variations).
- Growth rate should be fast
- Worm should have compatibility with other worms
- Worm should be disease resistant
- Worm on introduction in substrate, should have least inactivity period (vermi-stabilisation period)

They serve as “nature’s plowman” and form nature’s gift to produce good humus, which is the most precious material to fulfill the nutritional needs of crops. *(Hussaini, 2012).* They improve the moisture holding capacity of soil reduces water for irrigation. It also improves physical, biological and chemical properties of soil; soil porosity and softness. There are also ample opportunities in the reduction of uses of energy and GHG emissions in vermicompost production locally at farms by the farmers themselves, *(Singh, 1993).*

VERMICOMPOSTING

Vermicomposting is the aerobic processof the bio-degradation and stabilization of organic material by earthworms and microorganisms to formhumus like material known as vermicompost. This is one of the best strategies to be followed in organic farming today. Also this technology has been focused to be the most economical way to complement waste management systems. *(Lim etal, 2015).* Vermicompost is the product of vermiculture. It is a peat like material with excellent structure, porosity, aeration, drainage and moisture holding capacity*(Dash etal,1985*).It is a transformed version of various types of wastes including kitchen waste, agricultural waste, agro industry waste, animal dung into vermicompost.Different combinations of different wastes can be used to enhance the quality of vermicompost. One of the best combinations is cow dung or mixed dung+grambran+wheatBran+vegetable waste in the ratio of 10:1:1:1+ some powdered egg shell (*Kale etal, 1998*).

Vermicompost is a rich source of NO3, PO4, Ca, K, Mg, S and micronutrients, thus it can impart similar effect in growth of plants as chemical fertilizers do. *(Singh etal, 1993).* Itworks differently from conventional compost in several means. In vermicompost mostly mesophilic and fungal population prevails, but conventional compost resided by thermophilic organisms. Thus the properties like electrical conductance, moisture content, optimum temperature that support earthworm population etc get changed. In many ways vermicompost is superior to conventional compost in increasing soil fertility. Vermicompost shows pesticidal action to protect crops from pests and diseases. It may suppress or repel pests, or may induce biological resistance in plants to protect themselves (*Mamtha etal, 2012*).A number of nitrogen fixing microorganisms like Actinomycetes, Azotobacter, Rhizobium, Nitrobacter etc. were found in vermicompost and the microbial activity of beneficial microorganisms in worm castings is 10-20 times high than that of in the soil and other organic matter *(Edwards, C.A, 1995).* Vermicompost also has a positive effect on the vegetable plant growth or other conditions, stimulating shoot and root development*(Edwards et al., 2004).*Finished vermicompost can be mixed directly into the soil as a living soil amendment or as a plant medium.Vermicompost have large particulate surface areas that provides many micro-sites for microbial activities and for the strong retention of nutrients (*Edwards etal, 2006*).This process allows us to compost the degradablematerials and at the same time utilize the products obtained after composting toenhance crop production and eliminate the use of chemical fertilizers*(Ansari and ismai,2012).*This low cost technology often result*s* mass reduction, shorter time for processing, a ready made end product with reduced phytotoxicity.It can be used as a source of organic matter for soil amendment, as a growth media for soilless cultivation and as a tool for eco friendly waste management (*S K.K etal,2016*).Vermicompost possibly contribute to the optimum nutrient composition (both micro and macronutrients),increased secondary metabolite production (support natural plant defense system),enhanced photosynthesis and chlorophyll production, higher germination rate and improved yield.(*Theunissen etal,2010*).

Vermiwash is a byproduct of vermitechnology. It is the liquid bio fertilizer, which consists of excretory products and mucus secretion of earthworm along with plant micronutrients. Also it found to contain many enzymes, organic acids and various microbes. Diluted vermiwash with cow's urine and water (1:1:8), can be used as a foliar spray, biopesticide and bio fertilizer.(*Sharma etal,2009*).

CONCLUSION

Vermicomposting is popular because of its simple methodology with low investment. A vermicompost unit can be established either as a small-scale unit or as pilot unit. It is highly recommended strategy to manage the household waste problem. With increasing awareness, the demand for live earthworm and vermicompost is developing fast. Thus there arises a scope for the more and more marketing outlets. Moreover, women population of our society can find an income-generating hobby from this technology. Overall, the widespread use of vermitechnology could result in increased employment opportunity and rapid development in rural areas.In last three decades, India has achieved a tremendous increase in food grain production. But problemslike low crop production, infertile soil, pest and disease incidences, depleted sub-soil water table, heavy dependence on agro-chemicals, Increased deficiency of micronutrients have distracted the agricultural economics of the country. The sustainable agriculture is the need of future population to have economic security, ecological security and food security. Vermitechnology whether low or high technology, may have contributory role in organic-waste management and the sustainable agriculture.

> ***"All the fertile areas of this planet have at least once passed through the bodies of earthworms."~ Charles Darwin*** **1881**

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