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Vermicompost, a management of biosolid wastes: A review

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Abstract
Vermicompost is one of the ready to use organic fertilizers or manures. Vermicomposting is a biotechnological process, in which organic waste materials converted into organic manure by earthworms. The nutrient status of vermicompost is higher than cowdung compost. It increases the soil fertility by increasing porosity, bulk density, water holding capacity, pH, electrical conductivity, nitrogen, phosphorous and potassium content. The application of the vermicompost is enriches the soil microorganism, fish growth, plant growth and nutrient content of the crop yield. In this review article the author describe the management of organic waste, vermicompost, and economical importance of the vermicompost.

Keywords: Vermicompost, earthworms, organic waste

Introduction
The human beings generate the huge amount of organic wastes that affect the quality of soil, air and water and ultimately entire ecosystem directly or indirectly. Much of the biosolid wastes are highly infectious as they contain an array of pathogenic microorganisms. Their disposal into the environment without prior disinfection causes health and environmental risks. The animal and municipal waste change the soil character, including pH, bulk density, conductivity, water holding capacity and increased the organic carbon content (Khaleel *et al*, 1981) [8]. The management of organic wastes is not only gives the clean and healthy environment but also enhancing the primary productivity by improving the soil quality. Composting is the widely accepted process for the recycle in organic wastes; the direct land application of raw wastes or poorly stabilized materials caused toxicity and pathogenicity towards land (Butler *et al*, 2001) [3]. Composting is the biological transformation of organic matter into a well-stabilized product through the fast succession of microbial populations under aerobic conditions.

Compost is a cost important tool for eco-friendly waste management and also enhanced the soil fertility by soil biodiversity richness, water holding capacity and growth regulation hormones. Vermicompost is an eco-friendly natural fertilizer prepared from biodegradable organic wastes and is free from chemical input. It decreases the cost of production when applied with integrated fish farming system. It also reduces the risk of harmful effects of chemical fertilizer. Vermicompost contain more N. P. K than raw cow dung (Kumar *et al*, 2012) [10]. Vermicomposting, is a bio-oxidative process in which earthworms interact intensively with micro-organisms in the decomposer community, accelerating the organic matter by stabilization with modified physical and biochemical properties. Agricultural industry waste such as sheep manure, pomegranate peels, mushroom, chopped corn, sugar beet pulp and sawdust as well as household waste of food, paper, vegetable and garden (grass and leaves) with cow dung were used as raw material for vermibed; and the obtained vermicompost reduced the electrical conductivity, raising pH, and NPK of treated land and act as fertilizer. The compost having rich beneficial microbial community of bacteria, fungi, actinomycetes, *Pseudomonads*, P- Solubilizers and N_2 Fixers (Sequeira and Chandrashekar, 2015) [17].

Vermicomposting differs from conventional composting because the organic material is processed by the digestive systems of earthworms. The digested casts can be used to improve the fertility and Physico-chemical properties of soil.

In this process, the earthworms actively participate in the degradation of organic matter by physical and biochemical action. Physical participation in degrading of organic substrates results in fragmentation, for increasing the surface area to action and aeration. Conversely, biochemical changes in the degradation of organic matter are carried out by microorganisms through enzymatic digestion, enrichment by nitrogen excrement and transport of inorganic and organic materials.

The earthworms (*Eudrilus* sp.) play major role in the recycling of organic waste and production of organic manure with high humic contents, which are helpful to maintenance the soil structure, aeration and fertility. The bioactive substances present in the humic acid fertilizer can enhance physiological metabolism, growth, yield, seed germination etc., while these features are absent in ordinary fertilizers. Earthworms can 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 (Nagavallemma *et al*., 2004). Different species of earthworms was used for production of vermicompost.

Process of Vermicomposting: Earthworm are used for biodegradable solid waste management. Vermicompost is a simple, cost effective, low maintenance, easy method of waste management. Vermicomposting is an important technique of converting organic waste into nutrient rich compost by earthworms without producing any heat and also without compromising the population of beneficial bacteria. Vermicomposting is an aerobic, bio-oxidative process and stabilization non-thermophilic process of organic waste decomposition by earthworms and promotes microbial activity (Pathma and Sakthivel, 2012) [14]. It is a peat like material with high porosity, aeration, drainage, water holding capacity and microbial activity (Atiyeh *et al*., 2002) [2]. It also enhance the resistance of plants against pests and diseases. Earthworms can 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 (Nagavallemma *et al*., 2004).

Organic waste pollution was increased day to day due to anthropogenic activities and other side shortage of organic manure, in this connection earthworms were used for conversion of organic waste into vermicompost (Ramesh *et al*., 2005) [16]. Organic waste was used to improve the soil physical and chemical properties with nutrient for cultivation (Westerman and Bicudo, 2005) [19]. Vermicomposting is a powerful tool for bulk reduction of waste as well as pathogen free vermicompost (Nair *et al*. 2006) [13]. The compost provide rich nutrient with microbial content called as fertilizer. The accumulation of organic waste, threat to the environment in all the continent, the waste would be manage the sustainable way by using anaerobic conditions without affecting ecosystem. It may use for biogas production and energy management for day by day usage (Khalid *et al*., 2011) [9]. For the reason earthworm is a main technology transfer for bio-waste into valuable materials.

Potential applications of vermicompost in plant growth: Vermicompost (cattle manure) was studied in their efficacy on *Petroselinum crispum*, the result indicated that vermicompost enhance the size of leaves, plant height and yield (Peyvast *et al*., 2008) [15]. Vermicompost contains beneficial microorganisms (*Actinomycetes, Azotobacter, Nitrobacter, Nitrosomonas and Aspergillus*) for plant productivity (Ansari and Hanief, 2015) [1]. Karmakar *et al*., (2015) [6] reported that vermicompost showed good growth and provided maximum nutrient to tested plants. The fungi *Glomus aggregatum and Exiguobacterium oxidotolerans* with vermicompost improved plant growth. While vermicompost applied in the field, it reduced the irrigation frequency and induced the plant growth (Masullo, 2017) [12]. Presence of humic acid in vermicompost induces the plant height, fresh weight and dry weight (Maji *et al*., 2017) [11]. Thus vermicompost is a powerful biofertilizer in sustainable agriculture with reduction of chemical used in agriculture.

Potential applications of vermicompost in Aquaculture: Sustainable aquaculture is one in which the goal is permanence, achieved through the utilization of renewable resources. This leads to development of concept or organic natural farming. Among various components of organic or natural farming, vermicomposting is a key components for making compost through earthworms (Chakraborty, *et al*., 2009) [4]. The organic manures have a significant advantage over inorganic fertilizers. Vermicompost @ 10,000 kg/ha/yr gives best growth of Indian major carps in composite fish culture (Sumitra *et al*., 1981) [18]. Kaur and Ansa (2010) [7] suggests that utilization of vermicompost in aquaculture was more effective as compared to cow dung and hence can be used more effectively for manuring in semi-intensive fish culture without affecting the hydrobiological parameters of that water. Application of vermicompost as an organic manure in fish pond is not only better but also safe than the raw cow dung. This is excellent manure for nursery and rearing pond as it has a potential to produce good rotifers population (Kumar *et al*., 2012) [10]. Pond fertilization with vermicompost @ 10,000 kg /ha/ year gives maximum growth of Indian major carps in comparison to other fertilizers (Godara *et al*., 2015) [5].

Conclusion

Organic waste recycling is an efficient and environmentally friendly technology to convert wastes into value added products. Vermicomposting uses earthworms to turn organic wastes into very quality compost. Vermicomposting is a biotechnological process involved by earthworm; the natural bioreactors playing an essential role in the breakdown of organic matter and maintaining soil fertility. The worms involved recycling of organic waste and enhanced plant and fish growth. The importance of vermicompost is further enhanced as it has simultaneously other benefits; excess worms can be used in medicines and as protein rich animal feed. Finally we conclude that vermicompost reduced the pesticide and chemical fertilizers application, low pest infestation, reduction of irrigation frequency and pesticide free high yield. But high quantity of vermicompost reduces the growth of organism due to presence of high level of soluble salts. As a result, vermicomposts should be applied at required quantity for high production.

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