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Eco-Friendly and Resource Generative Vermicomposting Treatment for Garden Waste- A Review

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Abstract: Solid waste management is the major challenge faced by the world in today's date. Conventional solid waste management methods has several disadvantages regarding waste handling and its impact on environment. Environment pollution originated from municipal solid waste treatment is the most trending issue now a days. The production of degradable organic waste and its safe disposal becomes the current global problem. So a sustainable and potential solution that can manage generated waste eco-friendly and efficiently is a need of time. Vermicomposting is a process that decomposes the organic waste by worms and micro-organisms into value added, nutrient-rich and humus-like material called as vermicompost. High lignin contents in garden waste makes the growth of earthworms and micro-organisms difficult in vermicomposting. Effective use of additives can encourage the growth of earthworms, accelerating the decomposition process. They act as a catalyst for the process of vermicomposting and a survival supplement for earthworm. The aim of this review is to study the vermicomposting as potential option to treat the garden waste and effect of various additives on efficiency of vermicomposting process.

Keywords: Vermicomposting, vermicompost, biochar, sugarcane trash, TrichodermaHarzianum, earthworms, vermiwash, garden waste.

1. INTRODUCTION

Municipal solid waste generation is the major issue face by India and many other countries these days. Currently, 1,27,486 tons per day of municipal solid waste is being generated due to various household activities and other commercial & institutional activities (AbhishekNandan et al.,2017). Thus, Municipal Solid Waste (MSW) generation encouraging environmental pollution in greater extent seeking for the need of eco-friendly and sustainable waste management systems. The disposal of organic wastes is a serious problem all over the world and hence an efficient disposal and management of organic solid wastes has become more rigorous (AmrutaChandrakantNimbalkar et al.,2018). Vegetable waste, agro and kitchen waste, garden waste are the major sources of municipal solid waste generated from human activities. In recent years due to high cost of fertilizers and low availability of organic manures, the recycling of Organic wastes for increasing soil fertility has gained importance (Dr. Rosaline Mary et al., 2019).The effluents of organic matter from rural and urban areas can be used as a vermicompost (manure), which is composed of organic matter, without toxicants.

Vermicomposting is gaining attention all over the world as a cost-effective and less time consuming solid waste management method. It is not only a potential option for treatment of organic waste but also a recycling technology. Vermicomposting is one of the recycling technologies which will improve the quality of products and is a possible way to utilize the solid waste by Vermicomposting technology (S. Nathiya et al., 2015). The technology is also considered as a bio ecologically sustainable process in which renewable biological resources with an added value are produced. In this aspect, vermicompost, a plant-nutrient-rich product, and earthworm biomass that can be used as animal, poultry or aquaculture feed, are produced (Joseph Jjagwe et al., 2019). The

vermicomposting of green wastes could not only reduce environmental problems caused by landfills and incineration but could also generate a valuable product (Xiaoqiang Gong et.al.,2018). Aim of this review is to study effect of different bio-inoculants on various parameters of vermicomposting and also suitability of vermicomposting process as a waste management technique.

2. Problems Associated with the Present Solid Waste Management Techniques

Many methods like landfilling, incineration, recycling, conversion to biogas, disposal into sea and composting are adopted for soild waste disposal. But there are innumerous adverse effect of this waste management system on environment. In India like many developing countries, waste is disposed in an open area without any precautions. In most of the Indian cities, waste is thrown outskirts of the city area without any prior treatment which leads to environmental deterioration. The pollutant gases that emerges from pyrolysis process can be directly vented out in atmosphere unless proper treatment is given as they contain high CO concentration. Open dumping of solid waste leads percolation of leachate to underground water and gas emissions resulting into excessive air pollution. It also disturbs aesthetic surrounding by its odorus environment (AbhishekNandan et al.,2017). Various compounds like nitrogen, sulphur halogens releases from incineration plant continuously detoriating the air quality. Huge amount of chemical stews and pollutants can be produce because of breaking down the waste during recycling of waste and if recycling is not done right it can create many environmental problems. Dumping of waste in sea causes nothing but worst effects on marine eco-system. Contamination of seawater, damage to the ecosystem are the current major issues face by many of the countires. Disposal of organic waste in landfill is a major problem. Organic waste undergoes anaerobic decomposition and generates methane and other foul gases. Garden waste contain parts of plant that can grow , risk of fire as it act as fire fuel and increase in cost of removing the dumped waste are the problem associated with disposal of garden waste.

3. Vermicomposting

Proportion of compostable MSW generated in metro region is 50.89%, in other cities it is 51.91%, in overall urban India it is 51.3% & in north, south, east, west India it is 50.41%, 52.38%, 53.41%, 50.41%(Annepu 2012). Almost 50% of MSW generated is liable of composting. Hence feasible and eco-friendly treatment is need of time to treat this waste. Vermicomposting involves the bio-oxidation and stabilization of organic material under aerobic and mesophilic conditions through the combined action of earthworms and microorganisms (Gong et al., 2017). Vermicompost is a nutrient-rich organic fertilizer and soil conditioner which contains water-soluble nutrients and hence a good source of manure for plants and other uses. Earthworms are important Vermiresources having simple, cylindrical, coelomate and segmented body characterized by presence of setae, which actually enhance microbial activity and diversity and leads to the rapid degredation of waste and recovery of nutirents (MuddasirBasheer et al.,2015). The earthworms are used for the bio-conversion of organic waste into dark brown nutrient rich humus leave behind while reducing the biodegradable material such as household wastes by vermicomposting turn into a good source of manure for plants and other uses(Dr. Rosaline Mary et al.,2019). The potential of earthworms in soil processing due to their burrowing nature and composting of organic matter has been realized and simple appropriate vermiculture biotechnology has been developed which may solve the problems of waste processing and management to a large extent (MuddasirBasheer.,2013).

More than 4000 species of earthworms are known, which are broadly classified into three groups (epigeic, anecic, or endogeic). Although all earthworm species cannot be utilized for vermicomposting,several researchers have investigated the effectiveness of the three groups of soil-inhabiting earthworms. It is evident from the available literature that epigeic earthworms comprising Eiseniafetida, Eiseniaandrei, Eudriluseugeniae,

and Perionyxexcavatus are most effective for vermicomposting, owing to the following characteristics(Kavita Sharma et al., 2019):

• High reproduction rates,

• Tolerancetoawiderangeofenvironmentalconditions,

• Rapid rate of vermiconversion,

• Ability to feed on a wide variety of organic wastes.

In vermicomposting, cattle manure is usually considered an ideal supplementary material because it supplies a large amount of labile organic matter and non-assimilated carbohydrates, thus promoting growth and reproduction of earthworms. Moreover, is rich in microorganisms, protozoa, and nematodes, which accelerate the decomposition of organic waste. Cattle manure also stimulates microbial growth and enzyme activities and increases the content of nutrients (N, P, K and micronutrients) in the vermicomposted material (Xiaoqiang Gong et. al., 2019).

Vermiwash is a liquid collected after a passage of water through column of worm action and it is very useful as a foliar spray. The vermiwash and vermicompost are found to improve the trace element content of the soil. However the combination of these are found to be more effective in improving soil micronutrients content. These vermiwash and vermicompost contribute macronutrients in amount that is required by plants. Vermiwash has great growth promoting as well as pest killing properties (B. Esakkiammal et. al.,2016). The process is faster than composting; because the material passes through the earthworm gut, a significant but not yet fully understood transformation takes place, whereby the resulting earthworm castings (worm manure) are rich in microbial activity and plant growth regulators, and fortified with pest repellence attributes as well! In short, earthworms, through a type of biological alchemy, are capable of transforming garbage into 'gold' (Nagavallemma KP et. al., 2006).Due to low cost nature, vermicomposting can be a potentially substitute to thermophilic composting and hence becoming increasingly common and numerous studies have shown that increased plant growth rate and high yield could be achieved when plants grown in the presence of vermicompost (Dr. Rosaline Mary et.al., 2019).

4.Effect of Various Addetives on Vermicomposting Process

4.1 Trichodera

Trichoderma is a potent bio control agent and used extensively for soil borne disease. TrichodermaHarzianum is a fungus that is also used as a fungicide. Studies have also showed that microorganisms like TrichodermaHerzianum which degrade cellulosic substrates can be used to improve vermicomposting (MuddasirBasheeret al.,2015). Earthworms prefer trichoderma in greater extent. Significant increase in coccons and adult earthworm has been recorded in tricoderma treated media (MuddasirBasheer et al.,2015). %Nitrogen content in vermicompost is good in tricoderma treated media.

4.2 Biochar

Biochar is a carbonaceous product resulting from the slow pyrolysis of carbon-rich biomass under low oxygen conditions. Biochar has traditionally been used as a soil amendment in crop production because it increases soil fertility, buffers soil pH, reduces the concentration of exchangeable aluminium, modifies water retention, promotes soil aggregate formation, decreases nitrogen (N) and phosphate leaching, and enhances microbial

activity.Biochar addition increased the growth and reproduction of E. fetida, increased enzymatic activities, accelerated the decomposition of lignin and dissolved organic carbon, enhanced nitrification and humification, reduced the time required for the compost to be toxicity-free for seed germination, and enhanced the vermicomposting process.(Xiaoqiang Gong et al.,2018).Biochar addition effectively promoted final vermicompost maturity and safety. Use of biochar as an additive provides favourable conditions that include large porosity and surface area, and high cation exchange capacity, thereby enabling adequate microbial growth, greater retention of plant nutrients, reduction in greenhouse gas emission and immobilization of heavy metals (M.A. Sanchez-Monederoet.al., 2017).

4.3 Spent mushroom substrate

The Spent mushroom substrate(SMS) is a by-product generated from mushroom production, which contains a large amount of fungal mycelium and extra-cellular lignocellulosic enzymes along with various organic substances (carbohydrates, proteins, and fats), as well as a considerable quantity of inorganic nutrients such as ammonium nitrate, superphosphate, and potassium salt. Vermicomposting of Garden waste mixed with Spent mushroom substrate (SMS) and cattle manure (CM) is a viable practice for the management of Garden Waste. Combined addition of SMS and CM increased the growth and fecundity of E. fetida, stimulated enzymatic activities in the vermicompost, increased degradation of lignin, and enhanced nitrification and nutrient (N, P and K) concentrations following ten weeks of vermicomposting. Spent mushroom subtrate provide key solutions to accelerate the vermicomposting process and improve the quality of final vemicompost product(Xiaoqiang Gong et al., 2019).

4.4 Sugarcane trash

The use of sludge as raw material in the vermicomposting systems can potentially help to convert this waste into value-added products, i.e. vermicompost. Mixing of some bulking agent, e.g. sugarcane trash in sewage sludge not only supports earthworm growth, but at the same time also lowers the risk of earthworm mortality during the process of vermicomposting. Moreover, E. fetida grew and reproduced favorably in sludge that contained sufficient amount of sugarcane trash. The study provides a sound basis that vermicomposting can be a potential technology to convert the noxious community wastes into value-added materials, i.e. vermicompost and earthworm biomass (SurindraSuthar.,2009). Sugarcane trash can also be efficiently use in vermicomposting treatment of garden waste.

5. Concluion

Regarding to the problems associated with different solid waste management techniques, vermicompostinghave been proved to be a eco-friendly and resource generative treatment for garden waste. It is a biotechnique in which garden waste is converted into manure by employing earthworms and microorganisms. Vermicomposting can also be defined as process in which earthworms interacts with decomposer community to stabilize organic waste by changing its physico-chemical properties. Various addetives like sugarcan trash, biochar supports the growth of earthworms and gives nutrient rich vermicompost. They enhance the vermicomposting process and also reduces the total time required for the composting.

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