Available online at
www.agrospheresmagazine.com

ISSN: 2582 – 7022

Agrospheres:e-Newsletter, (2021) *2*(7), 39-41

Article ID: 254

Environmental Hazard and Earthworm

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Article History
Received: 12. 06.2021
Revised: 24. 06.2021
Accepted: 29. 06.2021

INTRODUCTION

Rapidly growing India generates huge quantities of solid wastes on a daily basis due to an urbanization trend. Solid waste covers all actions that seek to reduce the negative impact on health, environment and economy. Developing countries are seriously facing the problems in collection, transportation and disposal of solid waste. Environmentally acceptable vermicomposting technology using earthworms can very well be adopted for converting waste into wealth. Earthworms derive their nutrition from organic materials, living micro organisms and by decomposing animals. Surface living earthworms feed on food material selectively while deep soil living worms ingest soil as such. The type and amount of material available influence the size of earthworms, population, species diversity, growth rate and cocoons production. There are about 3000 species of earthworms distributed all over world and about 384 species are reported in India (Julka, 1986).

Land improvement and reclamation: Research showed that inoculation of Earthworm into soils having no earthworm or having negligible number of natural earthworm is beneficial in terms of growth and yield of plant (Edwards and Bater 1992). Earthworm is a versatile bioreactor and can do wonderful job in land improvement and reclamation. Their vertical and horizontal movement in the soil profile makes numerous burrows which offers natural tilling of the soil, improves aeration and infiltration of water. They feed on the organic matter on the soil surface and release the enriched castings into the soil and thereby mixing the soil minerals and organic materials. Through out the A and B-horizon the activity of earthworm is high in most of the soil. This was first recognized by Charles Darwin who termed the A-horizon as 'Vegetable Mould'. Development of a compact plough pan beneath the plough layer interferes the infiltration of water, aeration, rooting of the crops into the deeper layer etc.

Occasional deep ploughing or deep ripping is usually practiced which is a cost-effective operation to overcome it. A cheap and simple solution of this serious problem is Earthworm. Some anecic species (leaf litter dweller) feed the organic matter on the soil surface, deposit the casts at surface making vertical burrows while the endogenic type of the earthworm make horizontal burrows as they feed the incorporated organic matter and release the casts beneath the soil surface. These types of burrows (diameter ranges from 2-11 mm) facilitate vertical and horizontal movement of water as well as air throughout the soil profile. The tillage operation made by earthworm is seen up to 3 m depth while the depth of the conventional type is up to 30cm only. Again, the macro pores made by the earthworm burrow enhances entry of water in to the profile and eventually charge the ground water. Researchers claims that the gummy material made up of the bacterial and fungal hyphae present in the released castings offers stability to the soil aggregates. (Improved tillage, drainage, better root penetration etc. are the ultimate result of earthworm activity.)

Nutrient recycling and availability: Soil fertility is mainly determined by two major components- one is inherent mineralogical fertility and another is biological where nutrients present in the organic matter are released through decomposition process for recirculation in plant-soil system. An outstanding contributor of the later one is the Earthworm. The earthworm gut is like a 'Miniature composting tube' for which it also be termed as 'Mini Fertilizer Plant'. The organic matter/biowastes ingested by the earthworm breakdown into micronized particles in the 'gizzard' part of its digestive system. Gizzard joins stomach where proteolytic enzymes are secreted. Stomach follows intestine where in digestion and absorption of ingested food takes place. During the digestive process, enzymes like protease at stomach, amylase particularly at intestine converted the ingested protein and starch into simple absorbable forms for plants. Other enzymes such as diastase, lipase, invertase, oxidizing ferment-catalase etc. are also found in some species. The microbes present in the ingested organic matter produce cellulose and chitinase in several species. Thus the castings produced as a result of enzymatic and microbial action within the earthworm gut bear 1000 times more microbial load than that of surrounding soil/ingested materials. The castings further enhance the rate of humification in soil which improves the soil structure, enhances water holding capacity and increases ionic activity. Again, the earthworm burrows facilitating the entry of more Oxygen reduces the evil/undesirable affect of anaerobic decomposition. Moreover, due to the release of Calcium by the calciferous glands the pH of the castings becomes neutral making most of the essential elements available for the plant nutrition.

Waste management: In India waste generation has been increasing rapidly over last few years. According to the 'Swachhata Sandesh Newsletter' by the MoHUA, as of January 2020,147613 MT of solid waste is generated per day. These huge quantities of organic waste create major environmental and disposal problem. In this regards, earthworm could play a promising role in the management of the waste to a great extent. There are two main methods of conversion of organic waste into environmentally acceptable rather valuable materials. Solid organic waste may be spread out over the soil surface usually on pasture (sometimes on crop fields and forest) and allowing them to be incorporated by the earthworm. Secondly, the waste can be stacked into heaps or placed in bins for the production of vermicast/vermicompost which is rich in plant nutrients, growth hormones, vitamins and also reported to act as a powerful biocide against pest and diseases. Vermicompost can be prepared by different methods viz. low cost vermicompost, windrows, stacked bin, continuous flow method etc. Production of vermicompost is now becoming a profitable business enterprise along with a sincere commitment to save our fragile Earth from the environmental hazard.

Table: Few earthworm species suitable for in and ex-situ conversion of solid waste are presented below-

Earthworms for in-situ conversion	*Pontoscolex corethrurus, Aporrectodea longa, A. caliginosa, Allolobophora chlorotica, Lubricus rubellus, L. tessestris, Metaphire* spp etc.
Earthworms for ex-situ conversion	*Eisenia foetida, Eudrilus euginae, Perionyx excavatus, Perionyx* spp, *Amyenthes diffringens, Lampito maurittii, Dichogaster balani, Drawida* spp etc.

Environmental monitoring: Earthworm are also efficient environmental monitoring tool because it can accumulate certain heavy metals (like Cd, Pb, Zn, Cu etc.), agricultural chemicals, industrial effluents and various bio/pesticide and their derivatives. This enables for the entry of these poisonous chemicals into the food chain. Analysis of the tissue of earthworm might be expected to provide a method for the monitoring of the extent of environmental contamination (Lee, 1992; Morgan and Morgan, 1992).

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