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Earthworms- Organic waste Mangers- A Review

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ABSTRACT

Earthworms vermicompost is proving to be highly nutritive 'organic fertilizer' and more powerful 'growth promoter' over the conventional composts and a 'protective' farm input (increasing the physical, chemical & biological properties of soil, restoring & improving its natural fertility) against the 'destructive' chemical fertilizers which has destroyed the soil properties and decreased its natural fertility over the years. Vermicompost is rich in NKP (nitrogen 2-3%, potassium 1.85-2.25% and phosphorus 1.55-2.25%), micronutrients, beneficial soil microbes and also contain 'plant growth hormones & enzymes'. It is scientifically proving as 'miracle growth promoter & also plant protector' from pests and diseases. Vermicompost retains nutrients for long time and while the conventional compost fails to deliver the required amount of macro and micronutrients including the vital NKP to plants in shorter time, the vermicompost does.

HISTORY OF EARTHWORMS

Earthworms have been on the Earth for over 20 million years. In this time they have faithfully done their part to keep the cycle of life continuously moving. Their purpose is simple but very important. They are nature's way of recycling organic nutrients from dead tissues back to living organisms. Many have recognized the value of these worms. Ancient civilizations, including Greece and Egypt valued the role earthworms played in soil. The Egyptian Pharaoh, Cleopatra said, "Earthworms are sacred." [1] She recognized the important role the worms played in fertilizing the Nile Valley croplands after annual floods. In 330 BC Greek philosopher Aristotle called earthworms ''the intestines of the soil'' [2]. He believed that soil was an organic entity and he understood that earthworms played an important role in maintaining the life of soil. But even in 4th quarter of 19th Century, people thought that earthworms eat roots of plants and destroy crops, and thus they suggested earthworms be eliminated. The reputation of earthworms was rehabilitated when Darwin published his book entitled ''The Formation of Vegetable Mould through the Action of Worms with Observations on their Habits'' in 1881 [3]. Darwin called earthworms ''ploughs of the earth'' because of their ability to eat soil and eject it as worm castings [1,4]. He believed that worm castings and the movement of worms were wholly responsible for the top layer of rich soil. Darwin claimed that earthworms were one of the most important creatures in the ecosystem. Charles Darwin was intrigued by the worms and studied them for 39 years [4]. Referring to an earthworm, Darwin said, "It may be doubted whether there are many other animals in the world which have played so important a part in the history of the world." The earthworm is a natural resource of fertility and life [5].

INTRODUCTION

Vermicomposting is the process of turning organic debris into worm castings. The worm castings are very important to the fertility of the soil. The castings contain high amounts of nitrogen, potassium, phosphorus, calcium, and magnesium [5,6]. Castings contain: 5 times the available nitrogen, 7 times the available potash, and 1.5 times more calcium than found in good topsoil [6]. Several researchers have demonstrated that earthworm castings have excellent aeration, porosity, structure, drainage, and moisture-holding capacity. The content of the earthworm castings, along with the natural tillage by the worms burrowing action, enhances the permeability of water in the soil. Worm castings can hold close to nine times their weight in water. "Vermiconversion," or using earthworms to convert waste into soil additives, has been done on a relatively small scale for some time. A recommended rate of vermicompost application is 15-20 percent [7].

BACKGROUND

Environmental degradation is a major threat confronting the world, and the rampant use of chemical fertilizers contributes largely to the deterioration of the environment through depletion of fossil fuels, generation of carbon dioxide (CO_2) and contamination of water resources. It leads to loss of soil fertility due to imbalanced use of fertilizers that has adversely impacted agricultural productivity and causes soil degradation. Now there is a growing realization that the adoption of ecological and sustainable farming practices can only reverse the declining trend in the global productivity and environment protection [7,8,9]. On one hand tropical soils are deficient in all necessary plant nutrients and on the other hand large quantities of such nutrients contained in domestic wastes and agricultural by products are wasted. It is estimated that in

cities and rural areas of India nearly 700 million t organic waste is generated annually which is either burned or land filled [10]. Such large quantities of organic wastes generated also pose a problem for safe disposal. Most of these organic residues are burned currently or used as land fillings. In nature's laboratory there are a number of organisms (micro and macro) that have the ability to convert organic waste into valuable resources containing plant nutrients and organic matter, which are critical for maintaining soil productivity. Microorganisms and earthworms are important biological organisms helping nature to maintain nutrient flows from one system to another and also minimize environmental degradation. The earthworm population is about 8–10 times higher in uncultivated area. This clearly indicates that earthworm population decreases with soil degradation and thus can be used as a sensitive indicator of soil degradation. In this report a simple biotechnological process, which could provide a 'win-win' solution to tackle the problem of safe disposal of waste as well as the most needed plant nutrients for sustainable productivity is described [12].

Vermicomposting is an eco-biotechnological process that transforms energy-rich and complex organic substances into stabilized humus-like product vermicompost [12]. In vermicomposting process, inoculated earthworm maintain aerobic condition in the organic wastes, converts a portion of the organic material into worm biomass and respiration products and expels the remaining partially stabilized product, since the potential of some epigeic earthworm to recycle organic waste materials into value-added products is well documented [13, 14, 15, 16, 17,18,19]. The end product, i.e. vermicompost is considered as an excellent product, since it is homogenous, has desirable aesthetics, has reduced levels of contaminants and tends to hold more nutrients over a longer period without impacting the environment. Rapid urbanization resulted in an ever-increasing accumulation of urban solid waste. In India, domestic waste is mostly of organic nature and contributes 70- 80% to the total solid urban waste. However, it can be used as a potential resource for transformation from expensive disposal problem to stabilized vermicompost production for sustainable land restoration practices. Some epigeic earthworms: *Lumbricus terrestri*s, *Eisenia fetida*, *E. andrei*, *Eudrilus eugeniae* and *Perionyx excavatus* have been appeared as key sources to combat the problems of organic waste disposal on a low-input basis 16,[20, 21,22, 23,24]. Recently, [25] demonstrated the potential of a new species, i.e. *P. sansibaricus*, for waste decomposition operations. However, *P. excavatus* and *P. sansibaricus* are considered as endemic to Indian soils and are commonly distributed in many natural soil ecosystems.

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' [26,27].

IMPORTANCE OF VERMICOMPOST VIZ A VIZ CROP GROWTH AND YIELD

Earthworms consume various organic wastes and reduce the volume by 40–60%. Each earthworm weighs about 0.5 to 0.6 g, eats waste equivalent to its body weight and produces cast equivalent to about 50% of the waste it consumes in a day. These worm castings have been analyzed for chemical and biological properties. The moisture content of castings ranges between 32 and 66% and the pH is around 7.0. The worm castings contain higher percentage (nearly twofold) of both macro and micronutrients than the garden compost.

From earlier studies also it is evident that vermicompost provides all nutrients in readily available form and also enhances uptake of nutrients by plants. The studies show the integrated effect of application of fertilizer and vermicompost on soil available nitrogen (N) and uptake of ridge gourd (Luffa acutangula) [28,29]. Soil available N increased significantly with increasing levels of vermicompost and highest N uptake was obtained at 50% of the recommended fertilizer rate plus 10 t ha^{-} vermicompost. Similarly, the uptake of N, phosphorus (P), potassium (K) and magnesium (Mg) by rice plant was highest when fertilizer was applied in combination with vermicompost [29].

IMPROVED CROP GROWTH AND YIELD

Vermicompost is reported to have hormones like activity and this induces greater root initiation, increased root biomass, enhanced plant growth and development and alters the morphology of plants [30].

Vermicompost usually has significant beneficial effects on plant growth increase in growth of chickpea seedlings at the lowest level of vermicompost substitution [31]. There is a good evidence that vermicompost promotes growth of plants [27, 28,32].

Vermicompost has been found to have a favourable influence on all yield parameters of crops like wheat, paddy and sugarcane [15,16]. Ahmed et al. (2010) mentioned the plant height, total dry weight and leaf area significantly increases on the application of biofertilizers. [33] found that plant height of wheat increased by inoculation with *Azospirillum* sp. Many studies have reported the favourable effect of a manure compost on the growth and development of plants by use of the parameters such as rooting, time of flowering, leaf area, development and lengthening of internodes [30].

Vermicompost, which are stabilized organic materials produced by interactions between earthworms and microorganisms in a nonthermophilic process, have been reported to enhance in plant growth and yields in greenhouse crops [34]. Applications of vermicompost have also reported to increase growth and yield in pepper [34].

CONCLUSION

The production of degradable organic waste and its safe disposal becomes the current global problem. Meanwhile the rejuvenation of degraded soils by protecting topsoil and sustainability of productive soils is a major concern at the international level. Provision of a sustainable environment in the soil by amending with good quality organic soil additives enhances the water holding capacity and nutrient supplying capacity of soil and also the development of resistance in plants to pests and diseases [35]. By reducing the time of humification process and by evolving the methods to minimize the loss of nutrients during the course of decomposition, the fantasy becomes fact. Earthworms can serve as tools to facilitate these functions. 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 [36]. The utilization of vermicompost results in several benefits to farmers, industries, environment and overall national economy.

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