

Vermicompost, a Bioenhancer of Soil: A Review

Alkesh I. Shah

Associate Professor & Head, Department of Zoology, B. P. Baria Science Institute, Navsari, India.

ABSTRACT: Bio potential of earthworms help to convert waste into agricultural wealth in a safe and healthy way. It helps to decrease environmental pollution. Vermicompost is rich in plant growth hormones, enzymes and microbial population. It benefits the soil by acting as a good organic fertilizer, decreasing environmental pollution and detoxifying some toxic chemicals in soil. Waste of worms contains nitrogen, potassium and phosphorus 5 to 11 times more than that in ordinary soil. Vermicompost helps to induce biological resistance in plants. It helps to suppress or repel pest attack.

KEY WORDS: Vermicompost, Humus, Earthworms, Biomass, Organic fertilizers, Composting.

I. INTRODUCTION

Vermicompost is nothing but the excreta of earthworms, which is rich in humus and nutrients. Earthworms are reared artificially in a brick tank or near the stem/trunk of trees (especially horticultural trees). By feeding the earthworms with biomass and watching properly the food (bio – mass) of earthworms, they produce the required quantities of Vermicompost.

II. CHARACTERISTICS OF VERMICOMPOST

Among the physical properties of Vermicompost, water absorption is of utmost importance. More the moisture, ventilation, and presence of nutrients, the better is the yield of the plant. Yield of the plants fed with Vermicompost dosage of 500 g/m² increases the result of higher absorption of the nutrients and better feeding of the plant. It seems that earthworms have a role in enhancement of the solubility of the mineral iron or its maintenance in absorbable form in the fertilizer and contribute to the production of Vermicompost [1, 2]. Vermicompost could reduce health and environmental problems. Vermicompost has detoxifying ability, thus its cultivation products are safe. Also, Vermicompost is safe for farmers [3]. In this regard, yield of the plants treated with cow manure dosage of 500 g/m² decreased, which is probably due to its high pH relative to the Vermicompost fertilizer. The reason is that the absorption of ferrous and zinc metals by the plant decreases when the pH increase to 0.3.

The increase in product of the plants treated with manure was regularly maintained, but in the plants treated with Vermicompost a reverse outcome was observed and the product of the plants decreased using the fertilizer dosage of 625 g/m². It may be due to an increase in the concentration of the elements dissolved in the soil after using 625 g Vermicompost, which leads to a reduction in activity of microorganisms of soil and affects the absorption rate of micronutrients by the plant [4].

NUTRIENT CONTENT OF VERMICOMPOST:

Nitrogen:	1.5 – 2.5 %	Magnesium:	0.2 – 0.3 %
Calcium:	0.5 – 1.0 %	Potash:	1.5 – 2.4 %
Phosphorus:	0.9 – 2.4 %	Sulphur:	0.4 – 0.5 %

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III. EARTHWORMS AND GREEN REVOLUTION

Earthworms are regarded as “biological indicator” of soil fertility and a “soil conditioner”. They lead to total improvement in the physical (soil porosity & softness), chemical (good pH and essential plant nutrients) and biological (beneficial soil microbes & organisms) quality of soil and land where they inhabit. They swallow large amount of soil with organics (microbes, plant and animal debris) everyday, grind them in their gizzard and digest them in their intestine with aid of enzymes. Only 5 – 10 percent of the chemically digested and ingested material is absorbed into the body and the rest is excreted out in the form of fine mucus coated granular aggregates called “vermicastings” which are rich in NKP (nitrates, phosphates and potash), micronutrients and beneficial soil microbes [5].

Earthworms restore and improve soil fertility and boost crop productivity by the use of their excretory products – “Vermicompost”. They excrete beneficial soil microbes, and secrete polysaccharides, proteins and other nitrogenous compounds into the soil. They promote soil fragmentation and aeration, and bring about “soil turning” and dispersion in farmlands. Worm activity can increase air – soil volume from 8 – 30 %. One acre of land can contain up to 3 million earthworms the activities of which can bring up to 8 – 10 tons of “top soil” to the surface (in the form of vermicast) every year. Presence of worms regenerate compacted soils and improves water penetration in such soil by over 50 % [6, 7]. U.S. study indicate that 10,000 worms in a farm plot provides the same benefit as three farmers working 8 hours in shift all year round with 10 tons of manure applied in the plot [8].

Indian study showed that an earthworm population of 0.2 – 1.0 million per hectare of farmlands can be established within a short period of three months. On an average 12 tons/hectare/year of soil or organic matter is ingested by earthworms, leading to upturning of 18 tons of soil/year and the world over at this rate it may mean a 2 inches of fertile humus layer over the globe [9]. Studies at CSIRO, Australia found that introductions of earthworms in disturbed/unproductive lands can yield substantial benefits to agricultural productivity of soil degradation.

IV. IMPACT OF UREA ON VERMICOMPOST

Urea is the most commonly used nitrogen fertilizer worldwide. The experiment conducted during this investigation revealed many interesting facts. The chemical fertilizer Urea was found to be quite toxic to the earthworms. Different doses of Urea was administered to the soil and simultaneously one organic fertilizer “Kala Sona” was also used at two doses to conduct a perfect comparison of the two types fertilizer on the earthworm activity. A control set up was run parallel to the experimental set up. There were significant changes in the mortality and weight of tested earthworms after exposure to Urea. There was a positive correlation between earthworm mortality and the concentration of Urea added to soil. The mortality reached 100 % when the dose of Urea reached 3.48 gm/kg which is actual dose being practiced by the farmers in the agricultural land. The weight of earthworms exposed to Urea decreased steadily with the increase in the dose of Urea. The loss in body weight changed with increased exposure time. The sharp decrease in weight of earthworms revealed that the high concentration of Urea was very toxic to the worms or it could be lethal for the total population. However, at the low concentration of Urea there was no significant change in morphology except reduction in the body weight.

The major effects on the earthworms could be seen in terms of the number of adult worms, their biomass and cocoon production which clearly indicates the general health of earthworms. The counting of the number of cocoons and juveniles was also done to estimate the harmful effects on their reproductive activity in the two types of fertilizers. The juvenile and immature worms were also found to be influenced by urea application. Other studies recorded a drastic decrease in earthworm populations and biomass in grassland soils treated only with nitrogenous fertilizers [10]. Healthy earthworms in the organic fertilizer set up can be attributed to the fact that the organic fertilizers probably provide food directly for the earthworms and this might be the reason for the higher earthworm populations in the pots treated with organic matter [11]. Other researchers found similar or different results on this topic. Studies showed that the applications of fertilizers with nitrogen and phosphorous caused significant increases in earthworm number and biomass in an ox soil from India [12]. Similar results were obtained by reference [13, 14, 15]. On the contrary, some studies found a significant reduction of earthworm population in certain conditions; it was reported that organic N had a greater effect on earthworm populations than inorganic N [16, 17, 18]. In reference [19], a negative impact with ammonium nitrate on grasslands has been reported. On the other hand, study in reference [20] found that urea had a

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beneficial effect on earthworm activity. Studies indicate, however, that the form and amount of mineral fertilizer can have negative effects on earthworm populations. For example, ammonium sulphate and sulphur coated urea, which at high doses can lead to soil acidification which decreases earthworm populations. Fertilizers with nitrogen create acidic conditions in soil, which is fatal for earthworm [21, 22, 2].

In their experiment, mortality of all the 20 earthworms were seen in the dose of urea which is practically been applied in the agricultural land by the farmers i.e. 3.48 gm/kg soil. The deleterious effects of urea on earthworm were found under this dose within 24 hrs in the form of all dead worms with lesions and separation of the posterior body parts. Urea had a strong toxic effect on earthworm *Eisenia foetida*, this can be as it excreted its toxic action by way of skin infiltration.

V. CONCLUSION

Vermicompost is rich in all essential plant nutrients. It Provides excellent effect on overall plant growth, encourages the growth of new shoots / leaves and improves the quality and shelf life of the produce. Vermicompost is free flowing, easy to apply, handle and store and does not have bad odor. It improves soil structure, texture, aeration, and water holding capacity and prevents soil erosion. Vermicompost is rich in beneficial micro flora such as fixers, Phosphate solubilizers and cellulose decomposing micro flora, in addition to improve the soil environment. Vermicompost contains earthworm cocoons and increases the population and activity of earthworm in the soil. It neutralizes the soil. It prevents nutrient losses and increases the efficiency of chemical fertilizers. Vermicompost is free from pathogens, toxic elements, weed seeds and other contaminants. Vermicompost minimizes the incidence of pest and diseases. It enhances the decomposition of organic matter in soil. It contains valuable vitamins, enzymes and hormones like auxines, gibberellins.

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