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CONTENTS OF ENGLISH PART - II

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23. Quality Comparison of Vermicompost and PIT Compost from Muncipal Solid Waste

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Abstract

Approximately 50,000 earthworms per acre of moist soil have been claimed by the scientists. These earthworms generally prefer to live in deep, dark, long. and nmow tunnels or burrow in the soil containing ground as they cannot tolerate extremes of heat and low soil moistures due to which the pit compost is comparable to the fertilizer production from solid waste. The qualities of fertilizer produced by earthworms and pit compost are a subject of comparative study.

In the present investigation, the comparative studies were made by open pit compost method and by vermin-compost method by Eisenia fetida species of earthworms after characterizing the Municipal Solid Waste (MSW). The quality of compost by these methods was tested for the nutrient contents. The analysis indicated that the vermin-compost has higher values of NPK contents as compared to open pit compost. The NPK contents in vermicompost was 1.66%, 0.79% and 0.83% whereas these were0.49%, 0.21%, and 0.14% in pit compost fertilizer respectively.

Key words: Earthworm Municipal Solid Waste, Pit Compost, Nutrients, Pollution.

Introduction

The increasing population both, in cities and in rural area is resulting in to huge quantities of wastes and creating the problems in the management and disposal. Rapid industrialization and increasing consumerisms has put f01ward a increased demand for lm\ cost waste disposal methods. Many developed nations allocated a large sum of money for the centralized solid waste treatment systems to serve the combined needs of homes, colonies and the entire cities. The solid waste on the large scale is adding on to the nutrient burden on recipient water from various sources such as waste dumping sites, collection sites which are resulting in to pollution of soil and water (Rockfeller, 1996).

A rapidly increasing population and high rate of industrialized both have increased tremendously the problem of solid waste management. The problem has further increased because of shortage of dumping sites in cities and has become a problem due to strict environmental legislation. The management authorities and ...scientist are seeking for suitable management alternatives to treat the solid waste with the ecofriendly, cheap and fast methods as a need of present time.

Municipal solid waste (MSW) is highly organic in nature, so vermicomposting has become an appropriate alternative for the safe, hygienic and cost effective disposal of it. Earthworms feed on the organics and convert material into casting (ejected matter) rich in plant nutrients.

Few scientists have worked on this issue to find suitable altemalive melhod to put on the potential of earthworms in vermicomposting for the treatment of solid waste particularly household waste. (Appelholf et al., 1998; Mathur et. Al., 2006; Durg and Yadav, 2007). The pit composting is a simple and low cost method, but is very slow process. But it does not meet the requirements of management expectations.

The action of Ealhwonns in the process of velmicomposting of waste is physical and biochemical l process. In this process, lhe separation of degradable matter, removal of toxic substances, substrate aeration during the decomposition, mixing of material as it is influenced by microbial decomposition process needs additional external energy. (Hand et al., 1998). Many studies have shown that vermicomposting of municipal solid waste accelerates organic matter stabilization and results into better end product in the form of fertilizer. (Frederickson et al., 1997; Neuhauser et al., 1998; Kaviraj and Shanna, 2003). This process gives chelating and phytohormonal elements (Tomati et al., 1995) with a high content of microbial matter and stabilized humic substances.

In India the exotic epigeic species, like Eudrilus euginae (Ashok, 1994),Parionyx excavated (Kale et al., 1982) and Eisenia fetida (Hartenstein et al., 1979) are being largely used for vermicomposting. The local species are also useful. But from management point of view, some exotic species are found better for the decomposition and treatment of municipal solid ·waste. Keeping this in view Eisenia fetida was selected for the comparative study for the vermicomposting with the pit composting to insure the quality of resultant fertilizer. The aim of present investigation was to see whether vermicomposting was an

effective method or the pit composting for municipal solid waste based on the nutrient contents in the form of fertilizer as the end product.

Material and Metiiods

Collection of culture of earthworms

The species of earthwarm Eisenia fetida. were obtained by MSW where these have been cultured for the last 1-2 years for the treatment of different organic wastes including municipal solid waste (MSW). The identified eatlhw01ms were confirmed for their identification by the experts from the field of zoology.

Collection of MSW

The form of organic waste varies from place to place, city to city and also is affected by the method of collection. The organic waste used in present investigation as substrate.(MSW) was collected from the waste collection site, waste was being collected and separated manually for its management and treatment. Sufficient quantities of MS\V samples were collected in plastic bags. This waste was pre-decomposed in hips for eight days prior to the investigation.

Experimental design

The experiment of vermicomposting was conducted in earthen pots, each of suitable volume with capacity 2 kg waste, with small holes at the bottom. A total of 09 earthen pots were used and three sets of 3 pots for Eisenia fetida were maintained and a set of pits of same size without any eailhworms was alnnged simultaneously. One kilogram of waste was taken in each pot and pit along with 200 g of cattle dung and soil (100 g cattle dung and 100 g soil) to provide an initial favorable environmental condition for the natural degradation in pit and in the earthen pots with earthworms. Twenty healthy earthw01ms for the same size (Eisenia fetida) were introduced in each of three sets of earthen pots and nothing (earthworms or any :fungi) was in the compost pits. Moisture content was maintained between 40% and 60% during the entire study period. The total duration of experiments was six weeks excluding pre-decomposition period.

Chemical analysis

The chemical analysis of raw MSW used and vermicompost samples, collected weekly, was done for Total Organic Carbon (TOC), Total Kjeldahl Nitrogen (TKN) and Total Potassium (TK), Electrical Conductivity (EC) and pH. All the analysis was carried out

by using know standard methods which are commonly used. The TKN was estimated by micro-Kjeldahl method (Singh and Pradhan, 1981). Total phosphate (TP) was determined by spectrometric method (Trivedy and Goel, 1986). The TOC was estimated by Walkey and Black's Rapid Titration methods (1934). Total potassium (TK) was estimated by Flame Photometric Technique. The mean of three triplicate sets was used to express the results.

Results and Discussion

In the present study, the comparative treatment of MSW has been carried out with the vermicomposting and pit composting in same environmental condition with same lots of MSW. The results are summarized in Table 1. The clear comparison between these two processes of MSW treatment indicates that the trend of change in the quality of fertilizers is same in both the conversion process (Fig. 1), but more prominent in the vermicomposting than the pit composting. The data reveals that there is significant difference in the quality of fertilizer produced by vermicomposting and pit composting.

Table 1. Summary of Decomposed Fertilizer Contents* of MSW with Vermicomposting and pit Composting

Sr.No.	Parameter	Vermicompost (%)	Pit compost (%)
1.	Total Organic Carbon	9.8	18.4
2.	Total Kjeldahl Nitrogen	1.66	0.49
3.	Total Phosphorous	0.79	0.23
4	Total potassium	0.83	0.42
5.	Electrical Conductivity	1.84	2.60
6	pH	6.86	6.66

***All values are expressed in % except EC (ms/cm) and pH.**

There is considerable reduction in TOC in velmicomposting with Eisenia fetida than the pit composting. The nitrogen content has been increased in vermicomposting as a result of loss of carbon content than in pit composting. The loss in TOC and increase in TK.N is increased with the time of degradation more in vermicomposting (Fig. 2) than in pit composting (Fig. 3). The loss of organic carbon content of MSW in the form of carbon dioxide and water vapors during the process of mineralization of organic matter has resulted in the increase in TKN. The general concept is that the final content of nitrogen in any form in the fertilizer is dependent on: the initial nitrogen content in the waste and the extent of its decomposition (Crawford, 1983; Gaur and Singh, 1995). The decrease in pH

content has been expressed as likely important factor in nitrogen retention by Kaviraj and Shanna (2003) but does not correlate in the present study.

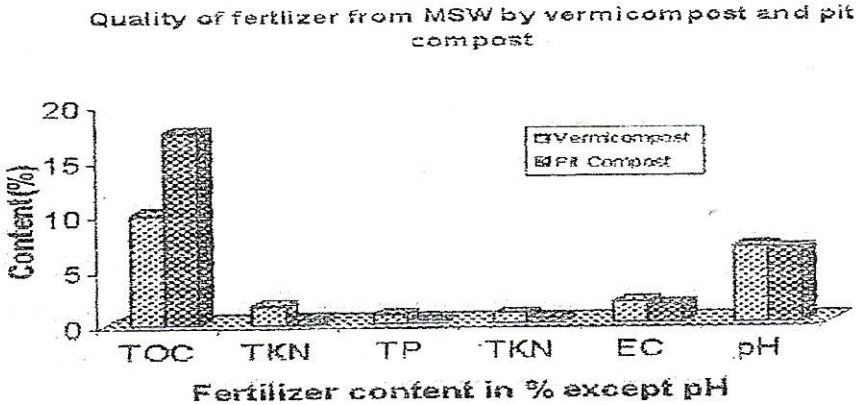

Fig. 1: The Fertilizer quality comparison between vermicompost and pit compost.

The results level that there is higher level of TP and TK in vermicomposting than in pit composting. The difference in results of both treatments is considerable. It reveals that the role of earthworms influences the level of potassium content in the decomposed product. Acid production in the form of carbonic acid, nitric acid and sulfuric acid by earthworms can be the major mechanism for the in solubilization of insoluble potassium. This process is reported to occur in the guts of earthworms more than the other microflora, which might have been played important role in increasing the potassium content in the end product over the pit composting.

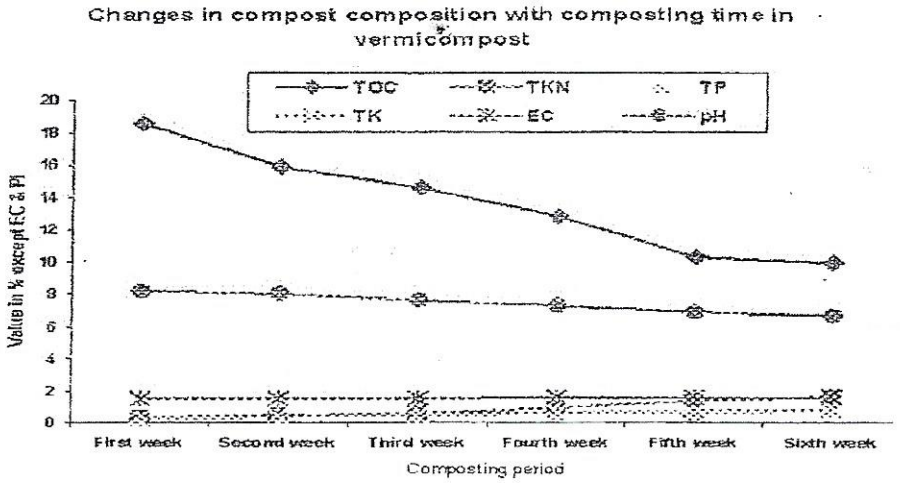

Fig. 2: Changes in compost quality of MSW by vermicomposting at different periods.

The data on EC in both treatments indicates that there is increase in EC as from the initial value of EC (Fig. 2 and 3). There was gradual increase in EC with decomposition period in both the processes. The final EC in vermicomposting was 1.84 ms/cm which was more than the increase recorded (1.6 ms/cm) in pit composting. This increase in EC may be due to loss of organic matter is more in vermicomposting than in the pit composting which is a result of release of different mineral salt contents such as phosphate, ammonium, potassium salts. Similar results are rep0lted by Wong et. al. (1997).

The visible ·observation and the measurement of pH indicated that there was loss of weight and pH of the decomposing matter with the period of decomposition. The pH was decreased in all sets in both vermicomposting and pit composting, may be because of high rate of mineralization process of nitrogen and phosphorus into nitrates or nitrites and orthophosphates . This decrease in the sets of pit composting was relatively more than the decrease in vermicomposting. The mineralization of nitrogen compounds into ammonia might have caused to result in lower level of TKN in pit composting even there is more decrease in pH than the vermicomposting.

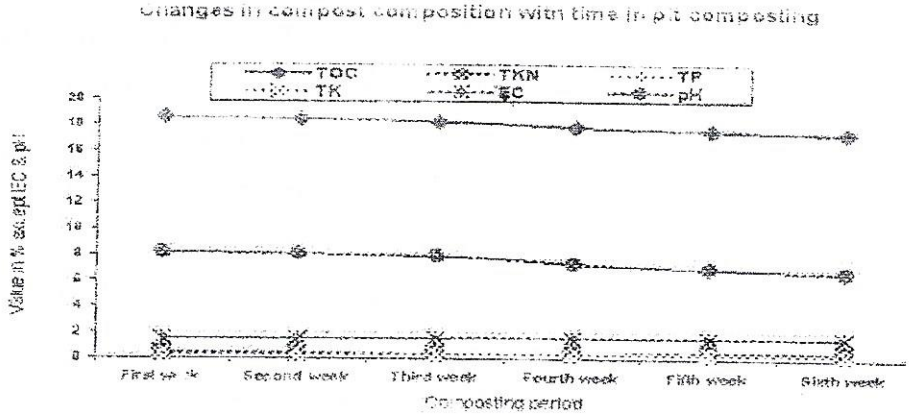

Fig. 3: Changes in compost quality of MSW by pit composting at different Periods.

The results obtained in the present investigation indicate that the quality of fertilizer in vermicompost is better than the fertilizer in pit compost. The concept of organic waste treatment by vermicompost has been conceived by many workers (Mathur et.al., 2006; Appelholf et. al., 1998; Hand at. Al., 1998; Neuhauser et.al., 1998; Frederickson et.al.,- 1997) It ·has been stressed that bio-degradable component of the different wastes could be even disinfected in an eco-friendly manner with process of vermicomposting without causing any adverse impact on the environment and human

health. Vermicomposting is an effective method for the treatment of all kind" of biodegradable wastes including municipal solid waste or household organic waste. It is an age more suppolied but old proven methodology. The same concept can be applied for treating infected biodegradable components of hospital waste. Vermicomposting of biodegradable municipal Solid Waste and household waste is in trend at many places eyen for the disposal of infected bio medical waste.

Conclusion

The chemical analysis of fertilizer produced by the process of vermicompost and pit composting indiated that the quality of fertilizer is rich in NPK contents in vermicompost than the quality of fertilization pit compost.

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