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Research Article

DEPLETION IN THE BIOMASS OF FLORAL WASTE-CATTLE DUNG MIXTURES DURING VERMICOMPOSTING

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ABSTRACT

Vermicomposting is a way of comprehensive interactions between the organic matter, microorganisms, earthworms and other soil invertebrates consequence in the breakdown, bio-oxidation and stabilization of organic matter. This process not only converts waste into valuable product but also diminution the size of waste. In present study floral waste was taken as a raw material and processed through Vermicomposting method with and without cattle dung. The Process carried out with different compositions of floral waste (FW)-cattle dung (CD) mixtures under aerobic condition in a plastic bins to find the rate of depletion of biomass. The initial substrate depth of five different compositions viz. 100% FW, 75% FW, 50% FW, 25% FW and 100% CD were 25cm, 16 cm, 13 cm, 11 cm and 8 cm which were depleted 80% ± 1 , 68% ± 1,61% ± 1,54% ± 1 and 25% v respectively. The rate of biomass reduction was higher in summer season followed by winter season and rainy season. Obtained result also explored that first twelve days in every season, biomass reduction rate was highest while last 10 days this rate was very slow. The time for substrate stabilization during vermicomposting was also found to be lesser in summer as compared to rainy season. The substrate depth variation with respect to time followed a declined curve.

INTRODUCTION

Composting is a microbial decomposition process in which organic solid waste is subjected to biological breakdown in a moist, warm and aerated environment (Finstein and Morris, 1975; Haug, 1993; Narayan, 1993; Miller, 1996). When microorganisms viz. bacteria, fungi, and actinomycetes (or protozoa) decompose organic materials in the presence of atmospheric oxygen, then generate metabolic heat, carbon dioxide and water (Ryckeboer *et al*., 2003). Many types of solid waste, such as food, paper, wastewater sludge, and garden wastes, are acquiescent to biodegradation as they possess major amounts of heterogeneous organic substrates, including sugars (as sucrose), fats, proteins, hemicelluloses, celluloses, and lignins (Gray *et al*., 1971a; Rhyner *et al*., 1995; Eklind *et al*., 1997). During decomposition process complex organic compound turn into simple form along with this water content of waste also turn into vapor form due to metabolic heat which leads to cause decreasing the biomass. In the process of composting, 2/3rd of carbon is generated in the form of CO_2 and remaining 1/3rd is combined with nitrogen in the living cell of the microbes (Ryckeboer *et al*., 2003). It has been reported that about 40% volume of waste materials reduced from their initial value due to composting (Banu *et. al.*, 2008). Ndegwa and Thompson (2001) also suggested that during the process of composting and vermicomposting, biosolid waste reduced approximately 45% by their original weight. It is necessary to evaluated the ratio of initial volume of floral waste and finished good so that we can calculate the conversion ratio of solid organic waste.

The purpose of this paper is to describe loss of biomass of organic waste during composting and provide information about processes and data useful to predict the amount of organic waste taken into the bed for composting.

MATERIALS AND METHODS

Collection of composting wastes

Vermicomposting process was carried out of the cattle dung and floral waste. The cattle dung (CD) was collected locally

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from randomly selected cattle houses of municipal territory of the study area, Ujjain. The cattle dung was collected in large-sized rectangular plastic pot containers and was brought to vermicomposting unit, Government M.V.M., Ujjain. *Eudrilus eugeniae* and *Eisenia foetida* were equally used in this study, obtained from vermiculture centre of Govt. Madhav Science College, Ujjain (M.P.). The floral wastes (FW) was used in this experiment, collected from Shri Mahakaleshwer and Iskon temple. The non-recyclable items were separated through hand sorting from collected floral waste (Suthar and Singh, 2008).

Preparations of vermicomposting materials

Collected floral wastes were chopped into small pieces. The chopped wastes were mixed with cattle dung in different ratio (Table no.1).Each composition was prepared in two sets. Composting bins were kept in bricks room. The windrow compost method was used in which it was not covered and ventilation was not provided with pipes. Bins were sprinkled with distilled water after turning it upside down to maintain high moisture content. Twenty earthworms (*E. eugeniae and E .foetida*) were added in each composting bins (Singh, *et.al.*2004). During process period, biomass reduction was measured.

Table 1 Representative mixture of floral waste -cattle dung in different compositions

S.No.	Compositions	Floral waste	Cattle dung	Total volume
1.	100% Floral waste	2.0kg	0.0 kg	2.0 kg
2.	75% Floral waste	1.5kg	0.5 kg	2.0 kg
3.	50% Floral waste	1.0kg	1.0 kg	2.0 kg
4.	25% Floral waste	0.5kg	1.5 kg	2.0 kg
5.	100% Cattle dung	0.0kg	2.0 kg	2.0 kg

Measurement of biomass reduction

Reduction in the biomass of floral composting mixture was measured by plastic scale (Photo.no.1). This was done after interval of 24 hours throughout the complete process. Before the measurement, scale was disinfect by 70% alcohol and allowed to air dry.

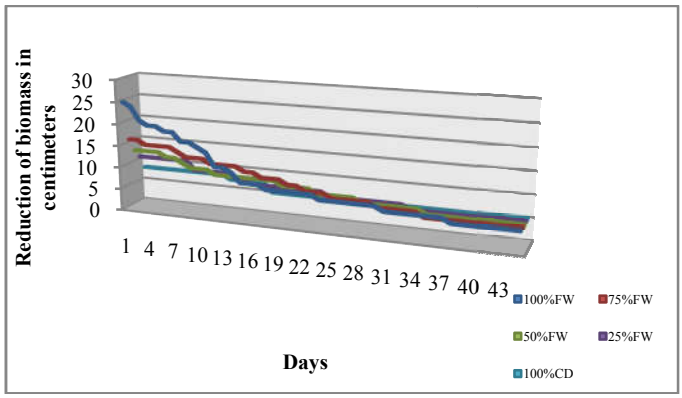
Photograph no.1 Measurement of biomass reduction of composting wastes

Composting materials were spreaded evenly in composting bins. Before taking the depth of composting materials, bins were jerk on the surface two times so that gap between floral wastes was filled with adjacent composting materials. Scale was kept vertically on the composting materials in all four sides of bin. From the surface of composting materials, length was measured to the edge of plastic bin. Mark was put at measuring site. After taken the four values, their mean was considered (Singh, *et. al.,* 2004).

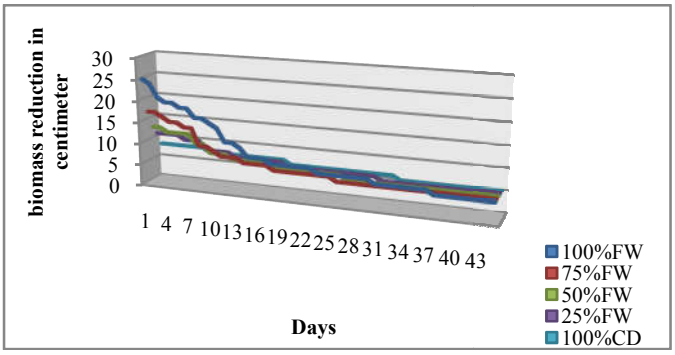
RESULTS

Based on the observation carried out for a period of 45 days in three seasons viz. rainy, winter and summer, the results of the reduction in the substrate column depth with respect to the time during the course of vermicomposting are presented in figures. The initial substrate depth of five different compositions viz. 100% FW, 75% FW, 50% FW, 25% FW and 100% CD were 25cm, 16 cm, 13 cm, 11 cm and 8 cm respectively. After decomposition, biomass of floral waste -cattle dung and controlled cattle dung were decreased 20,11,08,06 and 02 cm respectively. All the initial values were considered as control and any changed in the level of biomass of composting bins was determined as reduction level. Result obtained shows that in three seasons, among the five different composting mixtures, highest biomass was depleted in 100% FW which was up to 20 cm^3 while lowest depletion was seen in 100% CD that was only 2 cm^3.In the rainy season, (Photo no.2) biomass of vermicompost was decreased rapidly up to first twelve days of composting but soon after rate of depletion reduced. In all mixtures, depletion of biomass set at constant value (5 cm^3) after 38^{th} day of Vermicomposting. In winter season (Photo no.3) the rate of biomass reduction was slowest as compared to rainy seasons. Initial 10 days biomass of floral -cattle dung waste depleted rapidly but after it became slower. After 35^{th} day, biomass reductions of all mixtures were set around $5cm^3$. In summer season (Photo no.4), the rate of biomass reduction was highest. First nine day of vermicomposting, biomass was reduced rapidly but later it was set at constant value at 21th day. It was also noticed that in summer season, reduction rate of biomass highest and in rainy season, it was lowest.

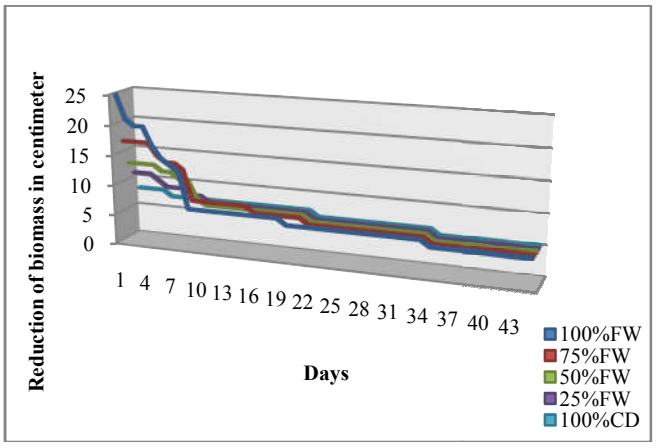
The maximum depth reduction was took place in the first twelve days. The depth reduction rate subsequently slowed down during the 20 to 30 days of vermicomposting. Afterwards, (i.e., after about 30 days), almost no depth reduction was observed. It has been found that highest biomass reduced in 100% floral waste while it was minimum in 100 % Cattle dung. It was also revealed that the rate of biomass reduction affected by season, temperature, moisture content, nature of biomass and quantity of cattle dung. These reductions in the bulk density may be due to the high initial moisture content of the raw waste that was released in the form of water vapor. Along with this complex organic matter also turn down in to simple form therefore their density was reduced. Norbu (2002) also carried out experiment on municipal solid waste and found that, biomass of waste reduced rapidly in first two week then it was set as constant level. Singh, *et. al.* (2004) were also concluded that the maximum depth reduction takes place in the first seven days and later it was established after 25 days. Similar observation was also recorded by Moqsud (2010) who stated that composting was completed in about 35-40 days and the volume of the organic waste reduced 50-70 % of the original volume. Zheng (2004) reported that microorganisms reproduced very rapidly at early stage of composting due to the abundance of easily-degradable organic matter. For this, the rate of volume reduction is usually fast.



Photograph no.2 Depletion of biomass of floral waste-cattle dung mixtures in Rainy season



Photograph no 3 Depletion of biomass of floral waste-cattle dung mixtures in Winter season



Photograph no.4 Depletion of biomass of floral waste-cattle dung mixtures in Summer season

Note: Series-1:100 % floral wastes
Series-2:75% floral waste-25% cattle dung
Series-3:50 % floral waste - 50% cattle dung
Series-4: 25 % floral waste - 75% cattle dung
Series-5: 100 % cattle dung

CONCLUSION

Temple's waste is one of the major sources of municipal solid waste in Ujjain city. Floral waste obtained from temples is mostly of organic nature and contributes 10% to 20% of urban solid wastes. Alone from Shri Mahakaleshwer temple generate 1000 kg floral waste and other nirmalya per day. Under the present condition of environmental degradation, composting technology offers recovery of valuable resources like manure from floral waste. During vermicomposting process, biomass reduction increased along with time duration. This rate depends upon compositions of mixture as well as seasons. Despite the different depletion rate of biomass in three different seasons, similar composition showed similar trends of biomass reduction over time in floral waste-cattle dung mixtures. From the waste-treatment point of view, the results presented above suggest that, the pre composting system is better treatment options than the direct vermicomposting system by itself because they resulted in higher reductions of biomass by approximately 40%, representing a significant reduction in both the handling and transport costs of the waste. The higher reductions in 100% floral waste suggest that more unstable substrates were present then 100% cattle dung.

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