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ECO-FRIENDLY MANAGEMENT OF BIO-WASTES BY USING EARTHWORM, *EISENIA FOETIDA*.

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The domestic solid wastes (bio-wastes) collected by municipality workers containing recyclable and compostable organic matter. With rapid growth of urbanization, the generation of municipal solid wastes has increased several folds during last few decades. Disposal of such solid wastes can be done by few methods viz., land filling, incineration, recycling, conversion into biogas, disposal into water reservoirs and composting. Management of such wastes by using earthworm is one of the best recycling technique which will manage wastes and also improve the quality of the products. The present study aims to find out eco-friendly management of bio-wastes like vegetable wastes, kitchen wastes, saw dust and ground nut shell etc by using earthworm, *Eisenia foetida*. The results showed that significantly increased in macronutrients i.e. N, P and K along with other soil parameters. Appreciable amount of NPK are recorded from vermibed groups containing vegetable and kitchen wastes than saw dust and ground nut shell groups over the control groups. On other hand, except lime, Mn and Cu; all other micronutrients like organic carbon, Na, Mg, S, Fe, Ca and Zn were found to be significantly increased in all groups. The results suggest that management of bio-wastes by using vermicomposting technique is superior and helped in production of nutrient rich bio-fertilizer than using other methods of disposal.

Key words : Bio-wastes, bio-fertilizer, macronutrients, vermicomposting, earthworm.

INTRODUCTION

Bio-waste management is one of the biggest environmental challenges facing the world today due to the increasing population and urbanization. World wide burning of such wastes emits air pollutant in the atmosphere (Sukumaran *et al.*, 2008). According to an estimate that, India produces about 300 million tones of wastes annually and more than 60 % are of decomposable (Patole & More, 2011). The disposal of bio-degradable solid wastes from domestic and agricultural sources has caused increasing environmental and economical problems (Joshi & Chauhan, 2006). A sustainable approach to handle these bio-wastes will be to treat and recycle organic waste to produce useful vermicompost. All these wastes serve as an excellent source of nutrients. Earthworms are able to convert these wastes into fine mucus coated faecal pellets, popularly known as vermicast. This quality organic manure, rich in beneficial micro flora and plant promoter substances along with water soluble forms of macro and micro nutrients necessary for plant growth, so that they are immediately available for plant use (Bajsa *et al.*, 2003; More & Patole, 2012).

In recent years much attention has been paid to manage different organic waste resources at low input as well as eco-friendly basis. Vermicomposting is one of the way to reduce this organic waste and its have been practicaHy used all over the world. *Vermes* is Latin word for worms and vermicomposting is essentially composting with worms

Ghatnekar *et al.*, 1998). In nature, all organic matter eventually decomposes; but in vermicomposting, the worm speed up the process of decomposition and get richer end product called 'worm casting'. A wormery is a self contained composting system that does not generate heat, retains most nutrients for reuse and properly maintained its odorless (Manaf *et al.*, 2009).

The bio-wastes like saw dust, ground nut shell, kitchen as well as vegetable wastes are the major sources of municipality wastes. Recycling of these wastes through vermitechnology reduces the problem of non-utilization of wastes. Alternative to chemical fertilizers, locally available organic wastes of anthropogenic and natural products were used as biofertilizers after employing earthworm as decomposers, degradation and recycling to enhance the production of crops which are free from pollution and health hazard (Chauhan *et al.*, 2010). In present study, attempt has been made, management of domestic bio-wastes by using earthworm, *Eisenia foetida*, which becomes major source of municipality wastes and causes air pollution on their burning.

MATERIALS AND METHODS

Collection and culturing of earthworm : The Epigeic species of earthworm, *Eisenia foetida,* was procured from horticulture nursery (Department of Agriculture, Sakri). They were kept in the mixture of partially digested cow dung and soil for 15 days before commencement of experiment.

Collection of bio-wastes : The bio-wastes were collected locally *i.e.* vegetable waste was collected from vegetable market (subji mandi), kitchen waste was collected from hotel (Dhaba), saw dust was colleted from saw mill and ground nut shell from oil mill. Ground nut shell was cut into small pieces using mixer grinder, and the powdered material was used for vermicomposting. The powdered materials were partially decomposed by mixing of small quantity of soil and water for at least 10 days before commencement of experiment.

Collection of cow dung and soil : Two week old cow dung was collected from the cow shed whereas good quality soil was collected from agriculture field.

Experimental setup : The experiments were performed in medium sized plastic tray of approximately 3 litres volume. Four vermibed were prepared in laboratory, the content of the vermibed is shown in table-1. The vermibed were prepared properly by mixing of content and sufficient water was added so that vermibed becomes moist. On second day 100 numbers of randomly grown worms were introduced in the experimental beds, while control beds were without worms. All these trays were kept in laboratory without any disturb, the bedding was kept moist through out the experiment by regular watering. The experiment was terminated on the 90^{th} day, the top layer soil containing worm cast was harvested for analysis of nutrient contents. Similarly top layer soil from control bed was removed and analyzed. The statistical analyses of the reported data are recorded from four replicate samples of each vermibed group. Mean, standard deviation and the student 't' test was adopted to evaluate the level of significance were used to conduct an ANOVA test. Meanwhile, the worms were removed manually and its population was counted (Table I). Percentage of increase in the number of worms can be calculated by formula described by More *et al.* (2010).

$$\% \text{ increase} = \frac{\text{Worm counted} - \text{Worm introduced}}{\text{Worm counted}} \times 100$$

Parameters measured : The vermicompost were analyzed for different parameters viz., pH was measured by pH meter. Nutrients like N, Ca and K were checked by flame photometer; Fe, Mn, Cu, Zn and Mg were measured by using Atomic Absorption Spectrophotometer. Na by kjeldal apparatus and P by colorimeter (Shejami laboratory, Satana, Nasik, M. S.).

RESULTS AND DISCUSSION

Population of earthworms

The population of earthworms was counted at the end of experimental period of 90 days. Per cent increase in population of worms from different vermibed groups are presented in Table I. There are difference numbers of worm in different type of bedding material. The vermibed containing vegetable waste is appeared as an ideal bio-waste in which maximum numbers (70.41%) of earthworm population was counted. Whereas moderate percentage of worms were counted in vermibed groups containing the bio-wastes like groundnut shell, saw dust and kitchen wastes *i.e.* 60.47%, 58.15% and 54.75%, respectively. The result showed that, these differences in worm population could be due to the difference in bedding wastes. On other hand the palatability of earthworms is influences directly or indirectly by chemical nature of organic waste, which also affects time taken for decomposition and therefore it results into variation in worm population. Similar observations have been reported by earlier researchers like Chaudhari & Bhattacharjee (2002); Manaf *et al.* (2009) and More *et al.* (2010).

Table I : Vermibed groups and increased population of earthworm, *Eisenia foetida.*

S. No.	Vermibed groups	Biomass content	Worms counted after 90 days	% increase in number of worms
01	A_1	25 % soil + 25 % cow dung + 50 % vegetable waste	--	--
02	A_2	25 % soil + 25 % cow dung + 50 % vegetable waste + 100 worms	338	70.41
03	B_1	25 % soil + 25 % cow dung + 50 % kitchen waste	--	--
04	B_2	25 % soil + 25 % cow dung + 50 % kitchen waste + 100 worms	221	54.75
05	C_1	25 % soil + 25 % cow dung + 50 % saw dust	--	--
06	C_2	25 % soil + 25 % cow dung + 50 % saw dust + 100 worms	239	58.15
07	D_1	25 % soil + 25 % cow dung + 50 % ground nut shell	--	--
08	D_2	25 % soil + 25 % cow dung + 50 % ground nut shell + 100 worms	253	60.47

A_1, B_1, C_1 & D_1 are control; A_2, B_2 C_2 & D_2 are experimental vermibed groups of bio-wastes.

Table II : Nutrient content of bio-waste composed by earthworm, *Eisenia foetida*.

S. No.	Parameters (Nutrients)	Vermibed groups							
		A_1	A_2	B_1	B_2	C_1	C_2	D_1	D_2
1.	pH	7.50	7.80 (3.84) NS	7.24	7.03 (-2.98) NS	6.64	7.34 (9.54) *	7.10	7.54 (6.20) *
2.	Salinity	0.490	1.032 (52.52) ***	0.428	0.975 (56.10) ***	0.396	0.810 (51.11) ***	0.312	0.484 (35.54) **
3.	Organic C %	1.05	1.30 (19.23) **	1.30	1.51 (13.90) *	0.83	0.87 (4.60) NS	0.87	1.20 (27.50) **
4.	Lime %	5.00	4.30 (-16.28) *	4.20	4.10 (-2.44) NS	4.14	4.00 (-3.5) NS	4.90	4.20 (-16.67) *
5.	Na - ppm	4.00	4.33 (7.62) *	4.50	5.00 (10.0) *	4.16	4.33 (3.93) NS	4.00	4.36 (8.26) *
6.	N/ acre	1.96	2.89 (32.18) **	1.86	2.96 (37.16) **	1.93	2.09 (7.65) *	1.90	2.29 (17.03) *
7.	P/ acre	31.9	38.5 (17.14). *	25.9	30.4 (14.80) *	28.4	31.3 (9.26) *	25.9	31.3 (17.25) **
8.	K/ acre	455	5.12 (25.65) **	350	4.48 (21.87) **	5.02	5.32 (6.02) NS	3.58	4.45 (19.55) *
9.	Ca %	0.6	0.70 (14.28) *	0.66	0.70 (5.71) NS	0.70	0.64 (-9.38) *	0.62	0.64 (-3.12) NS
10.	Mg %	0.3	0.40 (25.00) **	0.30	0.32 (6.67) NS	0.37	0.39 (5.40) NS	0.21	0.25 (16.00) *
11.	S- ppm	22.3	28 (25.56) **	25.6	28.30 (9.54) *	18.6	21.3 (20.3) **	22.3	22.4 (0.45) NS
12.	Fe- ppm	3.70	4.48 (21.08) *	3.59	3.84 (28.4) **	4.75	4.94 (3.85) NS	2.92	3.01 (2.99) NS
13.	Zn- ppm	4.18	4.75 (12.00) *	3.16	3.80 (16.84) *	3.80	4.55 (16.48) *	3.21	3.69 (13.01) *
14.	Cu- ppm	4.40	3.11 (-41.48) **	3.14	2.0 (-57.0) ***	2.83	2.41 (-17.43) *	3.00	2.41 (-24.48) **
15.	Mn- ppm	12.1	8.75 (-38.28) **	20.8	16.7 (-19.80) *	16.3	13.2 (-31.0) **	18.94	15.9 (-19.12) *

* Significant value : P<0.05, ** P<0.01, *** P<0.001. NS = Non-Significant (P>0.05). Values in the parenthesis are percentage change over control.

A_1, B_1, C_1 & D_1 are control and A_2, B_2 C_2 and D_2 are experimental groups of respective bio-waste like vegetable, kitchen, saw dust and ground nut shell respectively.

Nutrient contents

The nutrient values of vermicompost obtained in present investigation are shown in Table II. This table, revealed that as compared to other vermibed, the pH value of vermibed containing kitchen waste is non-significantly decreased. The overall increase in pH may be attributed to the decomposition of nitrogenous wastes resulting in the production of ammonia. This result is confirmed by significant increase in salinity of all vermibed groups. The ammonia forms a large proportion of the nitrogenous matter was excreted by earthworms. The above results also supported that, there was a significantly increase in the NPK content of all experimental groups. The present investigation corroborates with the work of researchers like Kaviraj & Sharma (2003) and Sukumaran *et al.* (2008). They studied that the earthworm casts contain more nitrogen, phosphorus and calcium. Gupta *et al* (2005) found that, the earthworm *Eisenia foetida* is capable of ingesting and excreting organic materials at high rate. Bakthvathsalam & Ramkrishnan (2004) and Patole & More (2011) reported that, percentage of macro-and micronutrients were increased in the vermicompost of organic wastes. The NPK and other micronutrient content of the vermicompost prepared from bio-wastes especially vegetable and ground nut shell alongwith cow dung has significantly higher when compared with compost prepared using individual wastes with cow dung but without earthworms. Gupta *et al.* (2005) and Chauhan *et al.* (2010) reported that the cow dung influences the rate of Vermicomposting and increased the amount of macronutrients in the vermicompost. This increased nitrogen content in the vermicompost may be due to nitrogenous metabolic products of worms which are returned to the soil through their casts, urine, muco-proteins and body tissues. Hence, it is clear that with slight variations in nutrient contents of different experimental vermibed groups; the mixture of different types of bio-waste with cow dung and soil is ideal for production of good quality vermicompost *i.e.* biofertilizer when compared with control vermibed groups.

Conclusion : In present piece of research, most of macronutrients viz., N, P and K and micronutrients like Na, Ca, Mg, S, Fe, Zn etc. were significantly increased. In fact the quality of vermicompost is depends upon percentage of nutrient contents. Secondly, the nutrient content of vermicompost is influenced by pH value of the substrate. The pH value is one of the most important factors affecting the survival of worms. If the pH of substrate is too acidic or too alkaline, the medium is unsuitable for worms. The earthworm prefers a neutral or slightly higher pH. Similar conditions was present in vermibed of present study i.e. the substrate were slightly alkaline in nature. Besides vermicomposting, another advantage is that the bio-wastes are easily converted into vermicompost with increase in worm population. It might help to the municipality authorities and common man to reduce the huge amount of bio-wastes by simple process of decomposition and prevent the land from barren soil and air pollution due to burning of these organic wastes.

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