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MANAGEMENT OF FLORAL WASTE GENERATED FROM TEMPLES OF JAIPUR CITY THROUGH VERMICOMPOSTING

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Abstract

This paper aims at management of floral waste generated from temples of Jaipur city through vermicomposting. In this study, flower waste consisted of variety of flowers out of which marigold was chosen as it was found in maximum amount. The vermibeds were prepared by mixing the marigold with cow dung in different proportions *viz.*, 50:50, 60:40, 70:30, 80:20 and 90:10 and they were filled in the earthen pots, individually. Simultaneously, a control (without worms) for each of these concentrations was prepared and maintained. *Eisenia foetida* was introduced into each of these trays except the control. The bioconversion ratio *i.e.*, waste into vermicompost was found to be high in 60:40 proportion than the others. Vermicompost obtained was analysed for various parameters like organic carbon, total nitrogen, phosphorus, potassium, calcium and magnesium. The amount of organic carbon, potassium and phosphorus was more in vermicompost samples for all the groups as compared to compost samples. It was concluded that floral waste with cow dung at 50:50, 60:40 and 70:30 ratios could be converted into a nutrient rich vermicompost.

Key Words: Environmental Degradation, Waste, Environment, Temples, Vermicomposting

Introduction

India is on the brink of a massive waste disposal crisis, but solutions are not forthcoming. However despite such notions about waste materials, they can be reused and can become source of industrial production and energy regeneration if allowed to be managed appropriately. The management however presents a challenge especially in our current era where numerous factors have added constraints and complexity to the process. The efficient management of waste has further turned into one of the most significant problems of our time due to adjacent concerns regarding preservation of lifestyle, protection of the environment and promotion of public health. Traditionally wastes are recognized as extraneous to production and are only managed when demands to resolve the problem is greater than the feasibility of disposal (Seadon, 2010).

Municipal solid waste is increasing enormously in every country with the expansion of population and there will be no shortage of raw materials for the production of vermicompost. Therefore for management of this waste, we can adopt sustainable techniques like vermicomposting as it is good for soil and promotes sustainable agriculture. On one hand, these wastes can be converted into agriculturally useful organic fertilizers which in turn have the potential to reduce the dependency on non-renewable chemical fertilizers and pesticides, and, on the other, it controls waste which is a major pollutant and a consequence of population explosion, urbanization and intensive agriculture (Kaushik and Garg, 2003).

Flowers come as waste from hotels, marriage gardens, temples, dargah and various cultural and religious ceremonies. However bulks of flowers are available from religious places (temples, dargah etc.) where they are used on daily basis thus making them a regular source. Flowers are considered as holy entities and hence are offered by pilgrims to their gods and goddesses. Every day many devotees offer flowers in the temples which are left unused and therefore become waste. There is no segregation of this waste at the source of generation. It is well known that many of us avoid throwing the flowers and other items which are used in prayers in the garbage because of our religious beliefs and instead put them in the plastic bags and throw them directly into the water bodies. A portion of waste is thrown near sacred trees with no suitable mode of disposal. Such disposal of waste creates problems like worm development, water pollution, foul odour, land pollution moreover it is not good aesthetically. Degradation of floral waste is a very slow process as compared to kitchen waste degradation (Jadhav *et al*., 2013). Therefore there is a need of proper and eco-friendly process for floral waste degradation. Vermicomposting is compatible with sound environmental principles that value preservation of resources and sustainable practices and thus, can be a suitable option for the safe, clean and cost effective disposal of the organic fraction of solid wastes. This study aims at vermicomposting of the floral waste because the most important objective of the study is to find out the effective means of waste management of the temples in Jaipur city wherein the maximum waste is in the form of floral waste.

Objective of the study

a. Vermicomposting of segregated floral waste.

b. Physicochemical analysis of the vermicompost.

Material and Methods

Experimental Design

The experiments were conducted in earthen pots (9 pots) with size of 26.5×35 cms. Pots were first washed and dipped in water overnight. In each pot a measured amount of the substrate (floral waste), mixed with cow dung was taken in different proportions depending on the ratios viz., 50:50, 60:40,70:30,80:20 and 90:10 for vermicomposting and composting. Cow dung was used as an inoculant in the vermicomposting process; it enhances the quality of feeding resource attracting the earthworms and accelerates the breakdown of wastes (Suthar & Singh, 2008). It was left for a day to remove excess heat. In the present study *Eisenia foetida*, commonly known as red worm was used.

Experimental Details

Table 1: Experimental Design for vermicomposting

S.No.	Experimental Design	Details
1.	**Group 1- 50:50**	Triplicates (500 gms waste+ 500 gms cowdung+200 gms earthworms) +control (without worms)
2.	**Group 2- 60:40**	Triplicates (600 gms waste+400 gms cowdung + 200 gms earthworms)+control (without worms)
3.	**Group 3- 70:30**	Triplicates (700 gms waste+300 gms cowdung + 200 gms earthworms)+control (without worms)
4.	**Group 4- 80:20**	Triplicates (800 gms waste+200 gms cowdung +200 gms earthworms)+control (without worms)
5.	**Group 5- 90:10**	Triplicates (900 gms waste+100 gms cowdung +200 gms earthworms)+control (without worms)

All the pots were covered on the top by a jute cloth and a wire mesh to protect the earthworms from the predators-centipedes, moles and shrews and to prevent the moisture loss. Small holes were drilled at the bottom of each pot for air circulation and easy drainage. The process of vermicomposting and composting was carried out for a period of 50 days. The temperature and moisture content were maintained by sprinkling adequate quantity of water every day and upside down mixing of waste was done once daily. The pots were kept in dark humid place in the backyard of the University and temperature of 28-32^{0}C was maintained. All the pots were monitored daily.

After 50 days the feed material got converted into loose, granular mounds due to feeding and defecation of the worms, the entire material was collected from each replicate pot. The cast was passed through 3 mm sieve, the earthworms were removed manually. The cast was air dried by spreading in large trays. The bioconversion ratio of flower waste into vermicompost for all the groups was calculated. After sufficient moisture was lost, samples were analyzed. Total N was done by Kjeldahl method and Organic C by rapid titration method of Walkley & Black (1934). Chemical analysis of total and available P and K was carried out following standard methods (Bhargava & Raghupathi, 1993) whereas Ca and Mg by the method of Cheng & Bray (1951).

In the present study, data was analysed using SPSS version 17.0. All the investigations carried out for a particular parameter were repeated three times and mean values were calculated. "t" test was used to analyse the significance of the difference between the mean values of parameters for vermicompost and compost samples. A significance level of $p \leq 0.05$ was considered throughout the study. One way Analysis of Variance (ANOVA) was used to analyse mean levels for the vermicompost samples of different groups.

Result and Discussion

The total weight of the vermicompost obtained from vermicomposting of floral waste were 755.0 g (50:50), 775.5 g (60:40), 685.5 g (70:30), 654.0 g (80:20) and 620.0 g (90:10). The percent conversion of vermicompost was 62.9 % (50:50), 64.4 % (60:40), 57.1% (70:30), 54.5 % (80:20) and 51.6% (90:10). The highest rate of bioconversion was shown by 60:40 (Table 2).

In the present study, organic carbon content of vermicompost sample (Group 1: 3%, Group 2: 3%, Group 3: 3.1%, Group 4: 3.1%, Group 5: 3%) was found to be higher than compost (Group 1: 2.7%, Group 2: 2.7%, Group 3: 2.8%, Group 4: 2.8%, Group 5: 2.7%) in all the groups (Table 3). This could be attributed to the involvement of three factors namely microbial activity, enzymatic activity and worm cast in vermicompost sample than compost sample which lack worm cast. Earthworm accelerates the mineralisation rate and converts the waste into casting with higher nutritional value and degree of humification (Albanel et al., 1988). Worm casts are clumps of digested organic matter excreted out by earthworms, which are rich in carbon. . The carbon content of the cast tend to be due to the addition of intestinal mucus (Blair et al., 1994). They typically have higher amount of total and available nitrogen, organic carbon, total and exchangeable calcium, magnesium, potassium and available phosphorus compared to surface soils (Lavelle, 1994). Due to the continuous addition of worm cast, the carbon content in vermicompost samples was found to be more. It was found significantly higher as compared to compost sample see Table 5-9.

In the present research work, compost samples showed significantly higher Nitrogen Content in Groups 4 and 5 (Table 8 & 9). Total Nitrogen (TN) Content of vermicompost sample was noted lower than the compost sample except for Group 3 (Table 7). This loss of nitrogen might have been due to leaching through vermibed wash during composting. Total Nitrogen percent noted in this study are in agreement with the findings of Iyer et al. (2012) who also observed decrease in nitrogen content in vermicompost and revealed that this decrease in the nutrient component was probably due to the utilization of nutrients by enhanced microbial population in the vermicompost. The higher total Nitrogen content in vermicompost sample of Group 3 could be attributed to appropriate mineralization of nitrogen. The amount of waste and cow dung varies amongst the groups; in Group 1; 500 grams of cowdung was taken and in subsequent groups it was reduced by 100 grams each (Table 2). It might be assumed that neither a higher quantity of cowdung, as in Groups 1 (50:50) and 2 (60:40), nor a lower quantity (Groups 4 and 5) is suitable for the appropriate mineralization. Hence, the combination of flower waste and cow dung (70:30) in Group 3 could be considered suitable for the appropriate mineralization of nitrogen.

In the present research, vermicompost samples had higher P content (Group 1: 2%, Group 2: 1.9%, Group 3: 1.6%, Group 4: 1.2% and Group 5: 1.1%) as compared to compost samples (Group 1: 0.8%, Group 2: 1.7%, Group 3: 0.9%, Group 4: 0.7% and Group 5: 0.8%) see Table 3. It was found significantly higher in the vermicompost as compared to compost harvested at the end of the experiment (Table 5-9). Higher P content in vermicompost was also recorded by Orozco et al. (1996). This might be due to the higher population of P-solubilizers (Chowdappa et al., 1999) or probably due to mineralization and mobilization of phosphorus as a result of bacterial and faecal phosphatase activity of earthworms (Garg et al., 2006).

During this analysis, K content was found higher in vermicompost samples to that of compost sample. It was recorded 0.09% for Group 1, 0.07% for Group 2, 0.1% for Group 3, 0.04% for Group 4 and 0.03% for Group 5 in vermicompost samples (Table 3). The results showed that potassium was significantly higher in vermicompost than compost except for Group 5 where it was insignificantly lower than vermicompost (Table 9). The higher potassium content in vermicompost sample as compared to compost could be corroborated by the findings of Delgado et al. (1995) who also recorded higher K concentration in the end product prepared from sewage sludge. This result is also found similar to the findings reported by Rao et al. (1996) who suggested that the increase in K of the vermicompost in relation to that of the compost was probably because of physical decomposition of organic matter of waste due to biological grinding during passage through the gut, coupled with enzymatic activity in worm's gut.

In this analysis, the mean value of Ca was noted higher in vermicompost samples for Groups 3 (0.008%) and Group 5 (0.005%) as compared to compost (Table 5-9) whereas in rest of the groups there was either none or insignificant difference between vermicompost and compost samples. The increase in Ca content of vermicompost is well supported by Piearce (1972) who stated that the chemistry of faecal material of earthworms is most likely responsible for this.

Data of the present study showed that in the two extreme Groups; 1(0.008%) and 5(0.006%), vermicompost sample had higher magnesium content which was significantly higher in vermicompost sample of Group 1, whereas in rest of the groups the value was higher for compost (Table 5-9). Deficiency of Mg in vermicompost samples of these groups can be rectified by adding Magnesium Sulphate (Sherman, n.d., para.2). Our result is in concomitance with that of Garg et al. (2006) and Yasir et al. (2009) who showed increase in Mg content of vermicompost indicating the conversion of nutrients to plant-available forms during passage through the earthworm gut.

Table 2 - Composition of pre-digested floral waste and its conversion into vermicompost by *E. foetida*

S. No	Particulars	Concentration				
		50:50	**60:40**	**70:30**	**80:20**	**90:10**
1	Weight of floral waste	500	600	700	800	900
2	Weight of cow dung	500	400	300	200	100
3	Total weight of pre-digested mixture	1000	1000	1000	1000	1000
4	Weight of earthworms	200	200	200	200	200

	introduced					
5	No. of days taken for bioconversion	50	50	50	50	50
6	Total weight of vermicompost obtained from each pot	755.0	775.5	685.5	654.0	620.0
7	Percentage of bioconversion of vermicompost(%)	62.9	64.4	57.1	54.5	51.6

Table 3 - Mean and Standard Deviation of physico-chemical parameters in vermicompost and compost samples for all groups

Parameters / Groups		OC	N	P	K	Ca	Mg
Group 1 (50:50)	V	3.0±.00	2.2±1.47	2.0±.00	0.09±.00	0.008±.00	0.008±.00
	C	2.0	3.7	0.2	0.01	0.008	0.002
Group 2 (60:40)	V	3.0±.00	2.0±1.32	1.9±.00	0.07±.00	0.009±.001	0.004±.002
	C	1.9	3.9	0.8	0.02	0.01	0.007
Group 3 (70:30)	V	3.1±.00	2.0±.58	1.5±.05	0.04±.00	0.008±.00	0.004±.003
	C	2.0	1.8	0.2	0.01	0.007	0.005
Group 4 (80:20)	V	3.0±.00	2.7±1.0	1.2±.11	0.04±.00	0.005±.00	0.004±.001
	C	2.0	5.5	.70	0.01	0.005	0.008

Group 5 (90:10)	V	3.0±.00	2.1±.00	1.06±.05	.03±.01	.005±.001	.006±.00
	C	1.9	3.0	.80	.04	.004	.004

Table 4-ANOVA for different parameters for samples of vermicompost

		Sum of Squares	Df	Mean Square	F	Sig
OC	Between Groups	.038	4	.009	-	-
	Within Groups	.000	10	.000		
	Total	.038	14			
K	Between Groups	.007	4	.002	38.071	.000*
	Within Groups	.000	10	.000		
	Total	.008	14			
Ca	Between Groups	.000	4	.000	20.500	.000*
	Within Groups	.000	10	.000		
	Total	.000	14			
Mg	Between Groups	.000	4	.000	1.926	.183
	Within Groups	.000	10	.000		
	Total	.000	14			
P	Between Groups	1.916	4	.479	119.750	.000*
	Within Groups	.040	10	.004		
	Total	1.958	14			
Total N	Between Groups	1.047	4	.262	.248	.905
	Within Groups	10.587	10	1.057		
	Total	11.613	14			

Table 5 - Significant difference between parameters of vermicompost and compost samples of Group 1 (50:50)

Parameters	Vermicompost	Compost	T	P
OC	3.0	2.0	3001.0	.000*
N	2.2	3.7	-1.684	.234
P	2.0	0.2	5401.0	.000*
K	.090	0.01	241.0	.000*
Ca	.008	.008	1.00	.423
Mg	.008	.002	19.0	.003*

*Significant level-p≤0.05

Table 6 - Significant difference between parameters of vermicompost and compost samples of Group 2(60:40)

Parameters	Vermicompost	Compost	T	P
OC	3.0	1.9	3301.0	.000*
N	2.03	3.9	-2.449	.134
P	1.9	0.8	3301.0	.000*
K	.070	0.02	151.0	.000*
Ca	.009	.01	-1.73	.225
Mg	.004	.007	-1.835	.208

*Significant level-p≤0.05

Table 7 - Significant difference between parameters of vermicompost and compost samples of Group 3 (70:30)

Parameters	Vermicompost	Compost	T	P
OC	3.1	2.0	3301.0	.000*
N	2.03	1.8	.690	.562
P	1.5	0.2	41.00	.001*
K	.040	0.01	91.00	.000*
Ca	.008	0.007	4.00	.057
Mg	.004	0.005	-.189	.868

*Significant level-p≤0.05

Table 8 - Significant difference between parameters of vermicompost and compost samples of Group 4 (80:20)

Parameters	Vermicompost	Compost	T	P
OC	3.0	2.0	329.0	.000*
N	2.7	5.5	-4.737	.042*
P	1.2	0.7	16.0	.004*
K	.040	0.01	91.00	.000*
Ca	.005	0.005	1.101	.386
Mg	.004	.008	-3.780	.063

*Significant level-$p \leq 0.05$

Table 9 - Significant difference between parameters of vermicompost and compost samples of Group 5 (90:10)

Parameters	Vermicompost	Compost	T	P
OC	3.0	1.9	331.0	.000*
N	2.1	3	-269.00	.000*
P	1.0	0.8	23.00	.002*
K	.033	.04	-.756	.529
Ca	.005	.004	1.732	.225
Mg	.006	.004	1.429	.289

*Significant level-$p \leq 0.05$

Conclusion

The floral waste with cow dung at 50:50, 60:40 and 70:30 could be bioconverted into a nutrient rich vermicompost. The remaining two ratios i.e. 80:20 and 90:10 can be ruled out because the values of two major macronutrients; phosphorus and potassium were lesser as compared to other ratios. The amount of Organic Carbon, Potassium and Phosphorus was more in vermicompost as compared to compost. The present study clearly proved that flowers can be very well used as substrate for vermicomposting. This study provides a sound basis that vermicomposting is a suitable technology for bioconversion of flowers into value-added compost and reduction of solid waste pollution. It can be successfully applied in temples as a solid waste management strategy with flower as the major organic waste. It will also provide the community with an alternative to the disposal of temple flowers, from the traditional *Jal Pravah* method, that is severely polluting the river banks. As a process for handling organic residuals, it represents an alternative approach in sustainable waste management. It can help to reduce volume of temple waste and to generate additional revenue for the temples.

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