SHORT COMMUNICATION

STUDY THE DECOMPOSITION RATE OF COMPOST UNDER DIFFERENT COMPOSTING TECHNIQUE

Punam Lal Kerketta, R.K. Bajpai and Anup Kumar Paul

Indira Gandhi krishi vishwavidalaya Raipur (C.G) India
Email: anupfmkvk@rediffmail.com

Abstract: The experiment was carried out during the December 2007 to March 2008, at instructional farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur.Different composting techniques were used - 1, one perforated pipe method 2. two perforated pipe method 3. Three perforated pipe method. 4. U shape perforated pipe method 5, turning method 6, traditional method 7. NADEP method, the changes in different physical, chemical and biological parameters was studied at 30, 60, 90 and 120 days after filling. Treatment under aerobic decomposition of paddy straw, soybean straw and fresh cow dung and soil were taken into5:2 ratios for each pit. EC and moisture content were found under the NADEP method of composting. The bulk density, ash percent increased with days of decomposition progresses and maximum increase was found at 120 days. The highest pH recorded in NADEP method of compost (7.0, 9.0, 8.2 and 7.7) at 30, 60, 90, and 120 days respectively, while the lowest pH was recorded on the traditional method of composting (5.56, 7.1, 6.7 and 7.0). The highest EC was recorded in traditional method of compost (1.4 dS m^{-1}) at 120 days.

Keywords: Bulk density, EC, moisture, pH, temperature

INTRODUCTION

India has vast potential of organic matter and FYM occupies a prominent position among the different organic material available in the country. In India, solid waste generation is estimated as, 25-39 million MT/annum of municipal solid waste (MSW), 320 million MT/annum of crop residues, 210 million MT/annum of cattle manure, 6.0 million MT/annum of sugarcane press mud and 3.3 million MT/annum of poultry manure (Singh, 2004). In addition, 10-15% of 75 million tones/annum of fruits and vegetables produced in the country are also available as by-products for recycling in agriculture. Food processing industry alone produces around 5.0 million MT/ annum of bio-solids. Management of such an enormous amount of bio-solids and recycling of nutrients and organic matter embedded in these resources has become an important environmental issue and economic necessity

Production compost from biodegradable wastes would help in increasing the availability of manure and supply of nutrients to bridge the gaps between nutrient demands and supply in agriculture. There is a need to increase production of quality compost at minimum cost through adoption of appropriate technologies. The quality of compost prepared from different waste will need to be assessed through physical chemical and biological assays minimum content of phytotoxic compound and heavy metal content. However, the direct application of crop residue is possible in the presence of sufficient amount of soil moisture and direction for rapid decomposition. Therefore compositing is an alternative to direct incorporation in soil in semi arid sub humid regions. Hence, it is important to develop a suitable technique for preparation of minerals enriched compost by using low cost amendments in the shortest possibilities and evaluate its quality and maturity.

MATERIAL AND METHOD

The study was conducted during the December 2007 to March 2008 research farm of Indra Gandhi Krishi Vishwavidyalaya, Raipur. Experimental completely randomized design (CRD). With 7 treatments 3 Replication Size of pit1× 1× $1m^2$ treatments are

Treatments No.	Treatment	No.of holes in Tube	Size of hole in tube (diameter)
T_1	One perforated pipe of 29.5cm diameter	193	2.5 cm
T_2	Two perforated pipe of 29.5 cm diameter	386	2.5 cm
T_3	Three perforated pipe of 29.5 cm diameter	579	2.5 cm
T_4	U shape perforated pipe of 29.5 cm diameter	519	2.5 cm
T_5	Manual turning of compost 15 day		-
T_6	Traditional way compost preparation		-
T_7	NADEP method of compost preparation	111	$10X10^2$

Preparation and Filling of Pits

The size of pits was 1x1x1 m length, width and height respectively. The pit was layered with the polythene sheet. Firstly 15 cm chopped paddy straw spread at bottom of pits. Then after this layer was moisten with 15-20 liter of water. Later 5 cm and 1 cm layer of cow dung and soil was spread over it. This sequence of layer was continued till its height reaches 15 cm above ground level. Finally this 15 cm raised layer was covered with 5-10 cm thick soil.

Raw Material

Paddy straw, soybean straw, (126 kg of each, 5-6 cm long residue) were chopped with thresher / chaff cutter into small pieces (5-6 cm long) fielding up of the pits. 35 kg fresh cow dung and soil were taken into 5:2 ratios respectively for each pit.

Perforated Pipes

To enhance the aeration into the pits, 29.5 cm of diameter polyvinyl chloride pips were used. The hole were (2.5 cm diameter) made in the pipes for aeration. The number of holes varied according to treatments.

RESULT AND DISCUSSION

The highest temperature was recorded in NADEP method of compost followed by treatment turning method of compost and three perforated pipe method of compost. While, the lowest temperature was recorded in traditional method of compost. The temperature of the different compost method ranges from ambient to thermophilic (higher than 45^0C) within a month. In the compost pit initially temperature increase due to presence of mesophilic microorganisms and were overcome the thermophilic ones, which resulted to increase in temperature up to 70 ^{0}C. However, a temperature drop was observed in first 15 days in all method of compost. This early temperature drop could results due to the retardation of composting caused by organic acid formation at the early stage the increase temperature in NADEP method of compost might do better aeration which resulted better growth of microorganism.

In the physical properties moisture content of different samples was recorded among all the techniques, NADEP method of compost showed low moisture content (58.80, 48.3, 53.44 and 40.66 %) followed by turning method (59.30., 52.2, 56.7, and 53.7 %) at 30, 60, 90 and 120 days respectively. While highest moisture content was recorded on one perforated pipe method of compost. In NADEP method of composting there was sharply decrease in moisture content from its initial stage, which might due to better aeration achieves.

Bulk density of different composting techniques showed that highest bulk density (0.47, 0.61, 0.66 and 0.74 Mg/m^3) found on NADEP method of compost and it was at par with the turning method of compost (0.49, 0.58, 0.60 and 0.70 Mg/m^3) at 30, 60, 90 and 120 days respectively. However, lowest bulk density (0.47, 0.47, 0.51 and 0.56 Mg/m^3) showed by the traditional method of compost. The highest bulk density of NADEP method might be due to higher aerobically microbiological decomposition due to proper aeration results in higher degree of biodegradation.

The pH of compost pit was significantly affected by different composting technique at all the four stages of observation. that the highest pH recorded in NADEP (T_7) method of compost (7.0, 9.0, 8.2 and 7.7) at all the stages followed by turning method of compost (T_5) (6.0, 8.4, 7.7, and 7.3) and three perforated pipe method of compost (T_3) (5.5, 8.3, 7.7 and 7.4). While the lowest pH was recorded on the traditional method (T_6) of compost (5.56, 7.1, 6.7 and 7.0). In the mesophilic stage *ie.* at 30 days after pi filling, pH was acidic in all method of compost. Whereas, at thermophilic stage *ie.* at 60 DAF. The pH rose to 8 to 8.6 which might be due to release of NH_4 gas at this stage. Latter again pH come down to neutral *i e* around pH 7.5. Similar finding also reported by Golueke (1972). A high pH level can favor nitrogen loss through ammonia volatilization in conjunction with high temperature and low C/N ratio (Ekinci *et al.,* 2000) Initial stage of microbial degradation, organic acid are frequently produced, which can lead to a reduction of pH. Similar results also reported by Eklind *et al.* (1997).

Electrical conductivity (EC) was recorded at 30, 60, 90 and 120 DAF. That the lowest EC was recorded on NADEP (T_7) method of compost (1.06 dS m^{-1}) at 120 days after decomposition period, which was at par with turning method of compost (1.33 dS m^{-1}) and three perforated pipe method of compost (1.33 dS m^{-1}), while the highest EC was recorded in traditional method (T_6) of compost (1.4 dS m^{-1}). A low electrical conductivity could be an indicator of complex nutrients and therefore desirable. The decrease of EC in the NADEP composting process might be due to direct consequence of the increased concentration of nutrients, such as nitrate and nitrite.

CO_2 evaluation rate was observed at 20, 40, 60, 80, 100 and 120 days after filling. The highest CO_2 was recorded in NADEP (T_7) method of compost at 20, 40and 60 days followed by turning (T_5) method of compost and three perforated pipe (T_3) method of compost, while the lowest CO_2 was recorded on the traditional (T_6) method of compost. The respiration rate evaluation was faster during initial period of composting and later slowed down with time. Availability of easily decomposable organic compounds seems to induce rapid microbial growth in initial period and decreased in later periods may be attributed to the exhaustion of those substances these results are in agreement with those reported by Mishra *et al.* (2001).

Respiration intensity is directly related to the speed of microbic metabolism and therefore it is inversely related to compost maturity. Consequently in the early composting phases, corresponding to a fast microbic multiplication due to the most readily fermentable organic fraction, respiration intensity is very high. Later on, after a decrease in biologic activity, respiration intensity too decreases strongly until it reaches low values that remain constant in a stable product.

At 60 days after composting the respiration rate was slow down which indicates that the low level biological metabolism result are in confirmed those of Epstein (1996). However, respiration rate decreased with increase in composting time this may be due to the reduction of volatile solids, which in turn affected microbial activity. Our result also supported by Changa *et al.* (2003).

Table 1. Effect of moisture content during composting at 30, 60, 90 and 120 days

Treatment	**Moisture percent**			
	30	**60**	**90**	**120**
I perforated pipe method	60.84	58.91	67.94	61.59
II perforated pipe method	60.96	56.07	64.26	59.57
III perforated pipe method	60.70	55.24	60.22	56.34
U Shape perforated pipe method	59.35	54.50	63.21	57.84
Turning method	59.30	51.40	57.77	48.27
Deshi method	59.33	54.79	57.33	55.13
NADEP method	58.80	43.80	52.11	42.43
SEm ±	**-**	**2.09**	**2.55**	**2.79**
CD	**NS**	**6.35**	**7.74**	**8.46**

Table 2. Effect of Bulk density (Mg/m^3) on different composting techniques at 30, 60, 90 and120 days

Treatment	**Bulk density (** Mg/m^3)			
	30	**60**	**90**	**120**
I perforated pipe method	0.480	0.49	0.55	0.61
II perforated pipe method	0.480	0.54	0.57	0.64
III perforated pipe method	0.483	0.57	0.59	0.66
U Shape perforated pipe method	0.470	0.56	0.58	0.65
Turning method	0.493	0.58	0.60	0.70
Deshi method	0.470	0.47	0.51	0.56
NADEP method	0.470	0.61	0.66	0.74
SEm ±	**-**	**0.02**	**0.02**	**0.02**
CD	**NS**	**0.07**	**0.07**	**0.08**

Table 3. Effect of pH level on 30, 60, 90 and 120 days of composting

Treatment	**pH**			
	30	**60**	**90**	**120**
I perforated pipe method	5.93	7.80	7.60	7.10
II perforated pipe method	6.00	8.18	7.80	6.80
III perforated pipe method	6.51	8.39	7.75	7.43

U Shape perforated pipe method	6.33	8.15	7.80	7.21
Turning method	6.60	8.41	7.73	7.36
Deshi method	5.56	7.16	6.70	7.03
NADEP method	7.05	9.00	8.29	7.73
SEm ±	**0.23**	**0.30**	**0.35**	**0.12**
CD	**0.71**	**0.92**	**1.07**	**0.37**

Table 4. Effect of electrical conductivity (dS m^{-1}) at 30, 60, 90 and 120 days of composting period

Treatment	**Electrical conductivity** (dS m^{-1})			
	30	**60**	**90**	**120**
I perforated pipe method	1.67	1.64	1.68	1.06
II perforated pipe method	1.60	1.60	1.76	1.40
III perforated pipe method	1.58	1.58	1.49	1.13
U Shape perforated pipe method	1.68	1.62	1.84	1.26
Turning method	1.54	1.42	1.20	1.13
Deshi method	1.62	1.63	1.50	1.40
NADEP method	1.62	1.58	1.43	1.06
SEm ±	-	-	**-**	**0.07**
CD	NS	NS	**NS**	**0.21**

Table 5. Effect of CO_2 evolution rate (mg $CO_2/m^2/hr$) on different composting techniques at various time intervals

Composting technique	**20 days**	**40 days**	**60 days**	**80 days**	**100 days**	**120 days**
I perforated pipe method	526.883	587.420	351.847	243.690	93.380	42.327
II perforated pipe method	5551.247	639.570	349.063	272.300	79.983	40.033
III perforated pipe method	562.607	654.230	360.050	218.887	75.773	34.827
U Shape perforated pipe method	557.970	644.093	358.307	216.003	71.393	36.273
Turning method	570.457	640.970	381.927	224.840	75.147	32.337
Deshi method	512.047	582.427	353.107	200.053	81.517	46.807
NADEP method	624.907	730.477	412.460	226.790	64.053	30.290
SEm±	**10.64**	**3.71**	**4.005**	**5.49**	**2.56**	**1.28**
CD at 5%	**32.27**	**11.26**	**12.14**	**16.66**	**7.78**	**3.89**

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