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Vermi Composting of Market Waste in Salem, Tamilnadu, India

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ABSTRACT

The solid waste generated in Salem city was collected from four zones viz., Ammapet, Hasthampatti, Suramangalam and Kondalampatti was estimated as 335 MT per day and the same is being dumped at Erumapalayam dumping site for the past four decades. The dumping area is overflowing at present. Out of 335 MT of MSW generated daily, vegetables market waste alone works out to be 24 MT. The waste consists of decomposable organic matter with high Carbon-Nitrogen ratio. Hence the organic wastes are composted by vermi composting process in order to convert the organic waste into bio-compost. As a sample project, market waste generated from Suramangalam Ulavar sandai was transported to the vermi compost yard for the further process. Initially the organic waste received is shredded into small pieces and put into the pre-composting yard to aerate and ventilate. The waste taken from the pre-compost yard were prepared into three vermin culture formulations as Bed-I, 1:0.5 (Market waste : Cow-dung) Bed-II, 1:1.0 and Bed-III, 1:1.5. The cow-dung was used as inoculant to accelerate the process.

The moisture is maintained by spraying water over the beds and temperatures also monitored. Every week samples from all the above three beds were collected to analyze pH, Electrical Conductivity (EC), Organic Carbon, Nitrogen, Phosporous, Potassium, C/N ratio and copper contents. It is observed that the waste from Bed-I converted into bio-compost in 40 days and Bed-II in 30 days and Bed-III in 25 days. Hence the study reveals that the market waste can be converted into bio-compost by adopting the vermi composting technology using cow-dung as inoculant in 1:1 substrate which will yield optimum macro nutrients value. The process will reduce the environmental damage and fetch revenue from the waste in a short span of time.

***Keywords**: Vermi Compost, Nitrogen, Phosporous, Potassium, Carbon/Nitrogen (C/N) ratio, Biocompost.*

1.0 INTRODUCTION

In the present day, major environments like air, water, soil are getting polluted due to the various natural and anthropogenic activities like dumping of municipal solid waste without proper treatment, discharging waste water into the water bodies etc. More seriously, the dumping of Municipal Solid waste without proper treatment, proper supervision and control leads to fly breeding and other infectious diseases in the society. It is estimated that 1.0 to 1.1 Kg of solid waste generated per day per person in a well developed city. The Municipal Solid Waste (Management and Handling) rules

2000 published by Ministry of Environment and Forest, New Delhi emphasis the proper collection, transportation and disposal of MSW is to be carried out at the urban areas by the concerned authority without causing damage to the environment.

2.0 STUDY AREA

In Tamilnadu, Salem is one of the fast developing cities having the population of 871577. Salem is the Head quarters of Salem district and which is an important commercial, marketing and transportation hub of the state. Salem is also renowned for Steel and Mango. The solid waste generated in the Salem city from various sources like marriage halls, hospitals, schools and market areas was collected from four zones viz Ammapet, Hasthampatti, Suramangalam and Kondalampatti. The MSW collected from all the zones was estimated as 335 MT per day including vegetable market waste of 24 MT. The total MSW generated is being dumped at Erumapalayam dumping yard for the past four decades without proper treatment. The total extent of the dumping area is about 22 acres and presently overflowing.

3.0 VERMI COMPOST TECHNOLOGY

In India, agriculturalists more traditionally and conventionally compost the bio-degradable organics generated in the agricultural field into manure with the help of earthworms. The manure consists of earthworm castings enriched with macro nutrients like Nitrogen(N), Phosphorus(P) and Potassium(K) which are essential for the growth of plants and crops. The municipal solid waste is experimented as source of vermi compost which recorded higher average yield in the tomato field than the recommended dose of chemical fertilizer (B.Goswami et.al, 2001). The concentration of macronutrients like N, P, K were increased after vermi composting. (Lakshmi Bai et.al, 2000). Assessment of vermi compost and compost on seedling growth revealed that increased growth of seedlings was observed in vermi compost than in compost (Biradar et.al, 2005). The market waste generated from the city consist of biodegradable organics can be converted into valuable bio-compost by applying vermi composting technology since the C/N ratio of the organics is 26.42 (Table 1) which lies in the optimum range as per the recommendations of Manual on Municipal Solid Waste Management 2000. This approach reduces the environmental damage and provides a valuable substitute for chemical fertilizers.

4.0 METHODOLOGY

As a sample of study, 1.5 MT of vegetable market waste generated from Suramangalam Ulavar Sandai was transported to the vermi-compost yard for further process. Initially non- biodegradable matters like plastics, glass were removed by hand sorting. The remaining major fraction of organics was shredded into small pieces of less than 50mm by mechanical shredders. The representative sample of vegetable market waste was collected and sent to Tamilnadu Agricultural University, Coimbatore for analysis and the chemical characteristics of raw market waste are presented in Table-1. The shredded organic waste is subjected to pre-composting to make it suitable for the process. The pre-compost yard was constructed to a size of 30’x20’x1’6” and the bottom and side faces are plastered with cement mortar to prevent seepage of water. In order to drain the excess amount of water in the pre-compost yard, drain pipes were provided at the sides of the yard. Then the shredded organic waste was dumped in pre-compost yard for preprocessing. In order to maintain better aeration and ventilation, 6 nos. of 4” dia PVC pipes were installed to penetrate the waste. The heat generated from the waste was let out through the pipes and concurrently atmospheric air was circulated through the

pipes. Holes are provided in the sides of PVC pipes to maintain uniform air circulation in the waste. The pre-composting process was completed within 10 days and become suitable for vermi compost treatment.

Table 1. Chemical Characteristics of Market Waste

Characteristics	*Proportion*
Moisture content	85.60
pH	8.89
EC (dSm^{-1})	5.42
Total Nitrogen (%)	1.62
Total Phosporous (%)	0.22
Total Potassium (%)	1.85
Organic carbon (%)	26.42
C/N ratio	16.30:1
Copper (mg/kg)	358

The pre-composted organics is now subjected to vermi composting process using earthworms. Here the cow-dung was used as inoculant to accelerate the vermi composting process. The availability of cow-dung was also abundant in Salem city which is basically an agricultural area and a number of milk dairies are also flourishing. The climatic condition of the city is also conducive for vermi composting of organics. Vermi culture formulation were formed in three beds measuring each size of 10'x3'x1'3" in plots. The three beds are identified as Bed-I, Bed-II and Bed-III in three different substrates as 1:0.5 (Market waste: cow-dung), 1:1 and 1:1.5. Eudrilus and Eugenias red worms of 5 kg (approximately 4000 nos.) were put into each bed for further composting. The important parameters i.e., moisture and temperature were controlled by means of spraying water over the beds in three times a day and thereby, the temperature maintained not exceeding 35 ̊C by adorning wet gunny bags over bed and shade and moisture was maintained between 50 % -60%. Under the controlled conditions, the samples from the above three vermi culture formulations were derived at every 10 days and analysed for chemical characteristics in the Tamilnadu Agricultural University, Coimbatore.

5.0 RESULTS AND DISCUSSION

The chemical characteristics of bio-compost obtained from Bed I, Bed II, Bed III are presented in Table 2, 3 and 4 respectively.

Initially, the colour of organic matters seems to be brown and turns into black at the end of composting process. The good quality of bio-compost was obtained from Bed-I at 40^{th} day, from Bed-II at 30^{th} day and from Bed-III at 25^{th} day. From the above, it is evident that optimum results were obtained from Bed-II (1:1). The macro nutrients were obtained as Nitrogen 1.85%, Phosphorous 0.66 %, Potassium 1.62% and C/N ratio is 10.99:1. The chemical characteristics of bio-compost were discussed below.

Table 2. Chemical Characteristics of Bed I (1:0.5)

Characteristics	*Quality of compost at*		
	10 days	*20 days*	*40 days*
pH	8.79	8.88	8.33
EC (dSm^{-1})	3.28	4.20	3.95
Total Nitrogen (%)	1.70	1.76	1.78
Total Phosporous (%)	0.52	0.57	0.63
Total Potassium (%)	1.30	1.45	1.56
Organic carbon (%)	24.67	18.39	16.67
C/N ratio	14.51:1	10.45:1	9.16
Copper (mg/kg)	352.60	346.90	320.40
Colour	Brown	Brownish Black	Black

Table 3. Chemical Characteristics of Bed II (1:1)

Characteristics	*Quality of compost at*		
	10 days	*20 days*	*30 days*
pH	9.23	8.94	8.49
EC (dSm^{-1})	4.14	3.40	2.60
Total Nitrogen (%)	1.68	1.74	1.88
Total Phosporous (%)	0.50	0.64	0.66
Total Potassium (%)	1.38	1.52	1.62
Organic carbon (%)	23.33	21.80	20.67
C/N ratio	13.89:1	12.53:1	10.99:1
Copper (mg/kg)	343.80	340.40	338.30
Colour	Brown	Brownish Black	Black

Table 4. Chemical Characteristics of Bed III (1:1.5)

Characteristics	*Quality of compost at*		
	10 days	*20 days*	*25days*
pH	8.99	9.14	8.30
EC (dSm^{-1})	2.54	2.61	2.80
Total Nitrogen (%)	1.66	1.76	1.82
Total Phosporous (%)	0.64	0.70	0.80
Total Potassium (%)	1.60	1.48	1.52
Organic carbon (%)	19.30	14.28	13.62
C/N ratio	11.63:1	8.11:1	7.57:1
Copper (mg/kg)	341.55	332.00	330.00
Colour	Brown	Brownish Black	Black

5.1 pH

Initially, pH value of raw market waste is observed as 8.89. During the vermi compositing process, pH value of substrate was increasing due to mixing of inoculant and this was slightly decreasing from 8.79 to 8.33 in Bed-I, and 9.23 to 8.49 in Bed-II and 8.99 to 8.30 in Bed-III. It shows that the alkalinity of the bio-compost is slowly reducing in the process.

5.2 Electrical Conductivity

The electrical conductivity of market waste is 5.42 dSm^{-1} and considerably decreasing during the vermi compost process. The reduction of EC in all three beds to about 25% to 50% which reveals the reduction of salinity considerably. The lower level of salinity is the essential character of good bio-compost which is better for crop growth.

5.3 Total Nitrogen

The total Nitrogen present in the raw market waste was 1.62 %. In all three beds, the total Nitrogen is increasing about 12% to 16% due to the recycling of Nitrogen in the process. The increase of Total Nitrogen shows the good quality of bio-compost.

5.4 Total Potassium

The concentration of Total Potassium in the raw market waste was found 1.85 % and it is slightly decreasing to a very minimum to about 12% to 17%. However it is suitable for manure since the value is more than 1%.

5.5 Total Phosphorous

The concentration of Total Phosphorous of raw market was determined as 0.22%. There is a considerable increase of Total Phosphorous in Bed-I it is from 0.22% to 0.63% and in Bed-II it is 0.22% to 0.66% and in Bed-III it is 0.22% to 0.80%. The increase in Total Phosphrous content reveals that the vermi composting process is in order.

5.6 Organic Carbon

The concentration of Organic Carbon of raw market was 26.42. The carbon contents of market waste was utilized as energy by the earthworms and hence Organic Carbon concentration is gradually reducing. The Organic Carbon concentration in Bed-I is 16.67, in Bed-II it is 20.67 and in Bed-III it is 13.62. The reduction of Organic Carbon shows that the earthworms rapidly multiplying and decomposing the organics.

5.7 Carbon/Nitrogen Ratio

The carbon content present in the organics was utilised as source of energy for earthworms. And simultaneously, the Nitrogen is being recycled in the compost. During this process, the casting of earthworms in turn enriches the macronutrients such as N, P, K and hence bio compost will becomes as an organic fertilizer. The C/N ratio of raw market waste was 16.30:1. The final value of C/N ratio was found in three beds ranging from 7.57:1 to 10.99:1. As per the MSW standard, the C/N ration is about 15 to 20:1 for good compost. But the C/N ratio is depends upon the quality of raw organic waste used.

6.0 CONCLUSION

The study reveals that the good quality of bio-compost was obtained from Bed-I (1:0.5) in 40 days, from Bed-II (1:1) in 30 days from Bed-III (1:1.5) in 25 days. The duration in Bed I is quite long and it consumes more time to convert the huge quantity of waste in to bio-compost. The Bed-III consumes very short duration however, the proportion of substrate cow-dung slurry 1.5% seems to be higher.

The conversion of organics into bio-compost in Bed II is in considerable duration of 30 days and the quality of compost gives the optimum values when compared with all the three formulations. The important characteristics such as pH, N, P, K,C/N ratio meets the standards given in the manual on Municipal solid waste Management 2000. Hence vermi culture formulation by adopting Bed-II (1:1) substrate is recommended for treating and converting the huge amount of MSW generated in the Salem city. This process will reduce the environmental damage. Also vermi compost is a valuable input for sustainable agriculture and wasteland development. Municipal Corporations will adopt the vermi compost technology to fetch revenue.

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