ISSN 2229-5518

Solid waste management by vermicomposting

Sonu kumari

Abstract—The extent of this study provides the knowledge of vermicomposting. Vermicomposting is a good technique for recycling food waste.

The vermicomposting was done for 45 days in which E. fetidia earthworms were used. There were four substrate prepared of different composition. The compositions were Soil+cowdung, Soil+ vegetable waste + fruit waste, Soil +vegetable waste+fruit waste+cow dung, soil+ paper waste+ cowdung. Chemical anaysis was done at periodic interval of 15 days during which TP, TK, TOC, TKN, C:N were analysed. It is conclude that vermicomposting is very suitable in areas where there are no facilities to process the waste i.e villages. It provides income and good organic manure to the farmers.

Index Terms—Chemical anaysis, Earthworms, Municipal solid waste, organic manure, Substrate, vegetable waste, vermicoimposting,

1 Introduction

India is on the path of Rapid industrialization and uirbanization. Better work opportunities and the dream of better lifestyle has spread rural urban migration. The infrastructure development of the boomed structure has not able to keep waste in flux within the cities and the Municipalities are straining their limits providing basic service. The municipal solid waste increases continuously. Solid waste has been major environmental issue in India. MSW in cities is collected by respective Municipalities and transport to the outskirts of the city. The limited reviews and high amount make them ill equipped to provide high cost involved in collection, storage, transportation, processing etc ac a result a substantial part of MSW generates remains unattended and grows in heaps at collection centre. There is lack of awareness among the peoples about the proper segregation at the source. As India population has been increasing continuously. Along this the education system also grows continuously. The largest amount of solid waste is generating in Solid universities and college campus. The higher Amount of waste produce in universities and college campus includes food, fruit waste and papers waste. Composting is an aerobic process. Composting is often promoted as a “natural” process of solid waste treatment. One reason for this reputation is that compost piles can be readily constructed in the backyard, and the product is a useful soil conditioner. Normal composting takes longer time for stabilization so we prefer rapid composting using effective microorganisms (EM). Vermicomposting is the process that accelerated the composting process by which the time required for composting is reduce [1].Efficient Microorganisms (EM) are a mixed culture helpful in vermicomposting.They are soil-based, beneficial microorganism’s e.g. lactic acid bacteria, yeast, phototrophic bacteria and naturally-occurring microorganism.

Sonu Kumari is currently pursuing masters degree program in Environmental Engineering in Sri Balaji College of Engineering and Technology, Jaipur, Rajasthan, India, PH-0141-2264820, 2263486, 2177296. E-mail: ssonuchoudhary@gmail.com

EM can be applied to many environments to break down organic matter. EM is not-genetically-engineered, not pathogenic, not harmful and not chemically synthesized. EM technology is the technology of using natural beneficial and efficient microorganisms (EM). It involves growing, applying, managing and re-establishing high populations of beneficial microorganisms in the environment or system. Vermicomposting is the organic technology that is totally natural and also it has been found to be useful to the peoples in various ways. The municipal solid waste includes vegetable waste that are comes from the market, households, mess. The collection and disposal of this organic waste is a great problem. This organic waste can be managed easily by vermicomposting that are very cheap, economical and beneficial [2]. The problem associated in maintaining of organic waste is that of its high moisture content due to which it is bulky. The solid waste i.e. food wastes high in organic and moisture content are not only difficult for collection, transport and storage but also cause serious problems i.e. environmental pollution. If this high moisture content waste not be treated well than this waste by forming leach ate cause ground pollution.

2 MATERIAL AND METHOD

2.1 Wooden Boxes

For performing the process of vermicomposting the four boxes are used. The wooden boxes are 70 x 40 x 30 cm in size.

2.2 Substrates used for vermicomposting

T1	Soil + cow dung (0.5:1)
T2	Soil + vegetable + fruit waste (1:1 colllege waste: cowdung)
T3	Soil + vegetable + fruit waste + cow dung(1:1 colllege waste: cowdung)
T4	Soil + paper waste + cow dung (1:1 paper waste: cowdung)

2.3 pH and Electrical Conductivity

To measure the pH and EC of the substrates the 10 gm samples were taken from each substrates and than kept it in a bottle. Mixing it with distilled water .After that the pH was determined using a digital hand pH meter (ISO 9001, Control Dynamics pH meter, India) and EC was measured by digital EC meter at room temperature.

2.4 Chemical analysis

The tests were performed periodically in 15 days. Total Kjeldahl nitrogen (TKN) and total organic carbon (TOC) of the pre-decomposed bioinoculated residue and the vermicompost were estimated by using a Micro Kjeldahl method [3] and Walkey and Black's Rapid Titration method [4] respectively. Total phosphorus (TP) was determined spectrophotometrically while total potassium (TK) was detected by the flame emission technique [5]

3. RESULT AND DISCUSSION

3.1 The variation of temperature during vermicomposting is as follows

Table 3.1 Variation of temperature during vermicomposting

Date	Temperature
1 August 2012	25˚C
15 August 2012	24˚C
30 August 2012	23˚C
15 September 2012	24˚C

3.2 Chemical analysis

The chemical analysis of the samples was done in which the a small proportion was taken out from the each substrates and tests are performed including Ph, Electrical conductivity ,total nitrogen and total phosphorous and total potassium. All values are mean of three replicas ± S.D and the dilution: 1:5 (wt. /vol.)

Table 3.2 Variation of pH during vermicomposting

Treat ments	0 day	15 days	30 days	45 days
T1	6.1±.19	5.9±.02	5.9±.01	6.2±.01
T2	5.8 ±02	5.7 ±.04	5.6 ±.02	5.8 ±.03
T3	6.0±.21	5.9±.04	6.0 ±.04	6.1 ±.05
T4	5.9+.06	5.8±.03	5.9±.03	6.0±.03

Table 3.3 Variation of EC during vermicomposting

Treat ments	0 day	15 days	30 days	45 days
T1	2.86±.03	3.01±.03	3.13±.01	3.09±.01
T2	2.99±.02	3.20±.04	3.34±.02	3.36±.03
T3	2.87±.18	2.91±.06	3.15±.05	3.16±.04
T4	2.88±.16	3.06±.02	3.21±.02	3.47±.05

Table 3.4 Variation of TKN during vermicomposting

Treat-ments	0 day	15 days	30 days	45 days
T1	0.70±.11	0.72±.01	0.73±.03	0.74±.01
T2	0.54±.03	0.55±.02	0.57±.13	0.58±.04
T3	0.74±.17	0.75±.05	0.76±.01	0.77±.05
T4	0.30±.02	0.30±.16	0.32±.04	0.33±.07

Table 3.5 Variation of TP during vermicomposting

Treatments	0 day	15 days	30 days	45 days
T1	0.20±.02	0.21±.03	0.23±.03	0.25±.01
T2	0.11±.03	0.13±.02	0.14±.05	0.16±.05
T3	0.22±.05	0.23±.01	0.24±.02	0.25±.02
T4	0.19±.04	0.20±.05	0.23±.04	0.24±.01

Table 3.6 Variation of TK during vermicomposting

Treatments	0 day	15 days	30 days	45 days
T1	0.19±.02	0.20±.05	0.27±.03	0.31±.06
T2	0.46±.03	0.48±.02	0.51±.05	0.55±.03
T3	0.44±.05	0.45±.03	0.48±.01	0.50±.04
T4	0.36±.01	0.37±.01	0.39±.04	0.40±.01

Table 3.7 Variation of TOC during vermicomposting

Treatments	0 day	15 days	30 days	45 days
T1	22.3±.07	21.8±.11	20.29±.02	19.82±.11
T2	15.3±.05	14.1±.03	12.25±.03	10.95±.14
T3	11.3±.04	10.2±.05	9.95±.09	8.69±.07
T4	9.3±.06	9.1±.08	8.38±.13	8.03±.18

Table 3.8 Variation of C:N during vermicomposting

ISSN 2229-5518

Treat-ments	0 day	15 days	30 days	45 days
T1	22.34±.03	20.02±.18	16.39±.17	15.11±.13
T2	31.67±.02	29.14±.10	25.15±.19	22.59±.16
T3	15.37±.11	12.59±.19	11.93±.25	8.55±.17
T4	15.27±.16	11.97±.15	11.52±.09	10.78±.14

3.3 Graphical representation

3.3.1 Temperature during vermicomposting

The figure 3.1 represents the temperature during vermicomposting.

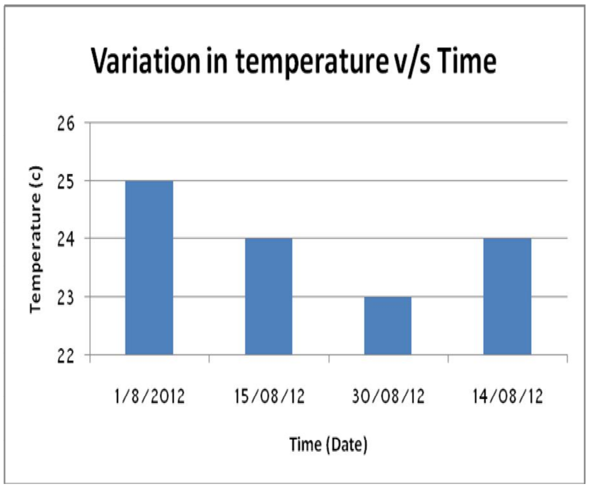

Figure 3.1 showing the variation of temperature during vermicomposting

3.3.2 pH

For the initial 15 days the pH decreased. The lowering of pH due to production of CO_2 which was an acidic gas and when it came in contact with water it might had formed carbonic acid, due to which pH had decreased. But after some days the pH rises due to decomposition of organic waste.

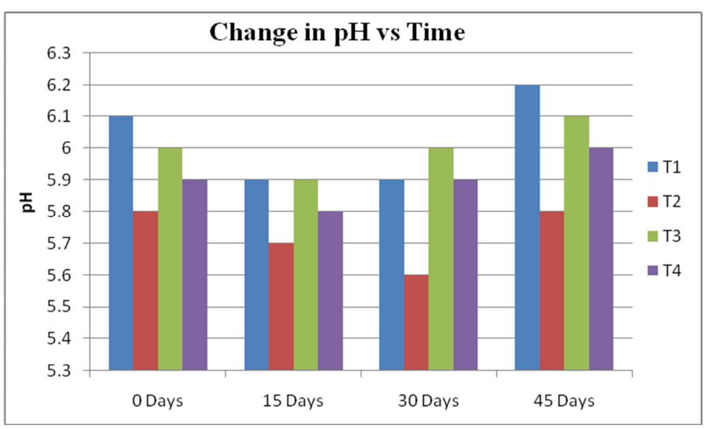

Figure 3.2 Showing Graphical representation of pH during vermicomposting

3.3.3 EC

The increase in EC might had been due to the loss of weight of organic matter and release of different mineral salts in available forms such as phosphate, ammonium and potassium generated during ingestion and excretion by the earthworms

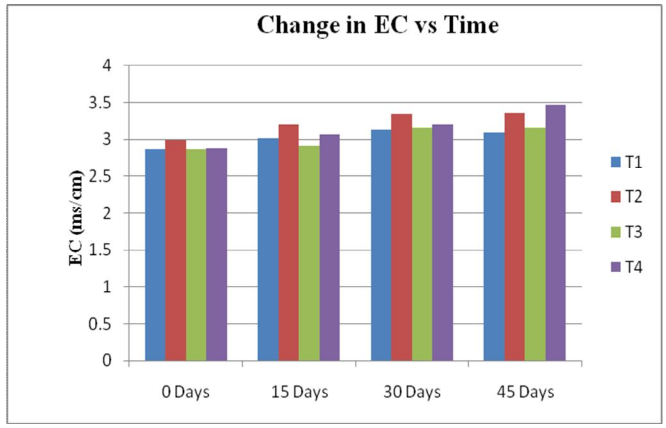

Figure 3.3 Showing graphical representation of EC with time during vermicomposting

3.3.4 TKN

The TKN in the graph shows increase during every interval. The percentage of nitrogen increase depends on the percentage of nitrogen content organic matter used. The increase level of nitrogen gives the good compost. The involvement of nitrogen also depends on number of earthworm and types of earthworm used in compost.

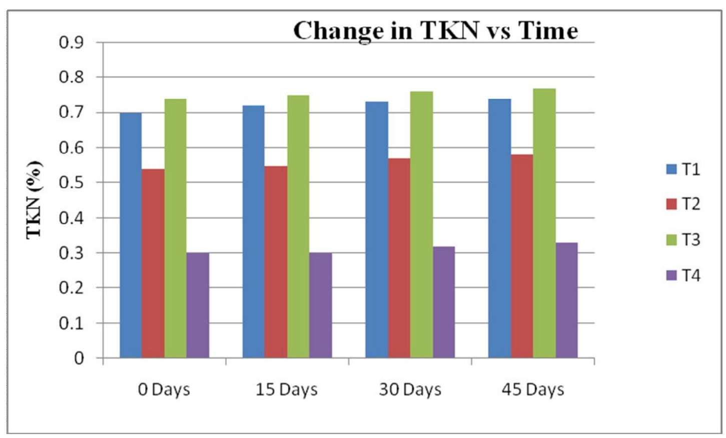

Figure 3.4 Showing graphical representation of Change in TKN during vermicomposting

3.3.5 TP

The content of TP is increasing with regular interval. The increasing of content of total phosphorous shows that the composting is taking place in well order

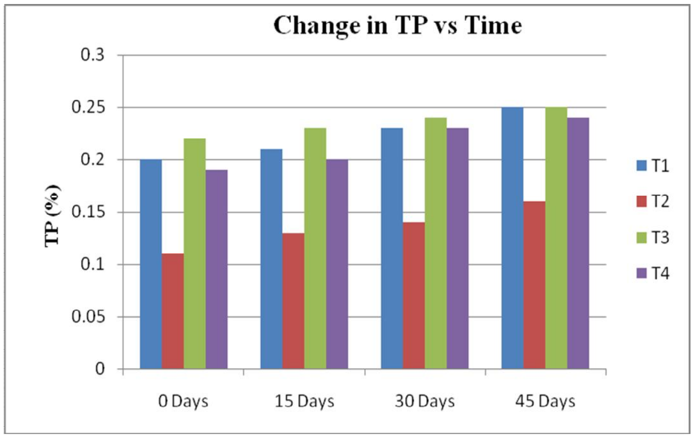

Figure 3.5 Showing the graphical representation of Change in TP during composting

3.3.6 TK

The presence of Total potassium increase gradually. The increase of TK is depends on the type of organic matter used for the vermicomposting.

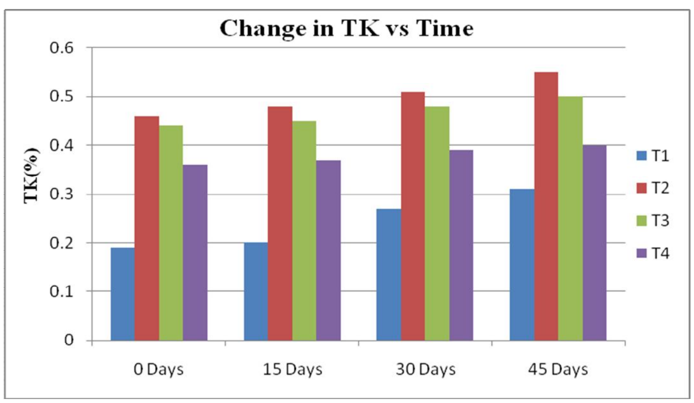

Figure 3.6 Showing the graphical representation of Change in TK during vermicomposting

3.3.7 TOC

The TOC of the substrates decrease gradually.

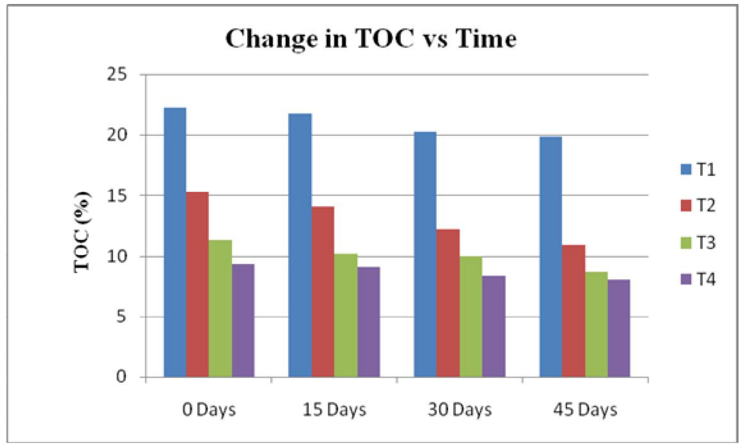

Figure 3.7 Showing the graphical representation of Change in TOC during vermicomposting

3.3.8 C: N

The C: N ratio gradually decreases. At the starting the C:N ratio of the compost of different samples vary between 15 to 31 and it decreases with time after 45 period there were decrement in all of the samples C:N ratio.

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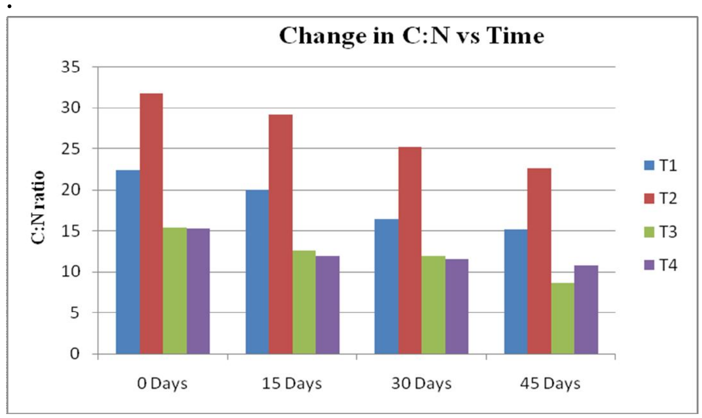

Figure 3.8 Showing the graphical representation of Change in C:N during vermicomposting

4 CONCLUSION.

TABLE 4.1 Expenditure on vermicomposting facility
For 51 kg waste vermicomposting gives the following result

S. No.	PARTICULARS	AMOUNT (Rs)
1	Cost of shedding	1500
2	The depreciation cost of shed for 45 days(taking its life = 10 yrs)	150

3	Cost of earthworms (250 in number) @ Rs 0.50 / Earthworm	125
4	Labor (1 in number @ Rs 100 / day)	3000
7	Miscellaneous	200
	Total expenditure	4975.00

4.2 Output
The output from the vermicomposting facility can be calculated as follows

Table 4.2 Output and profit from the vermicomposting facility

S. No.	Particulars	Amount (Rs)
1	Sale of earthworms (750 in no.) @ Rs. 0.50 / EW	375.00
2	Sale of vermicompost(51x 45x 0.50= 1147.5 kg) @ Rs 5.0 / kg	5737.50
	Total sale	6112.50
	Net Profit	1137.50

So, in the first rotation there is a net profit of Rs 1137.00.

4.3 Future scope of the study

There are a lot of ill effects of chemical fertilizers; due to that organic farming is a better option. As the name suggest organic farming it includes the use of organic manure, green manures, composts, bioinoculants, biofertilizers and so on to provide nutrients to the plants. Composting is a slow process hence vermicomposting increases the rate of formation of organic manure and known as rapid composting. Vermicomposting plays vital role in organic farming. Study has shown positive result of vermicomposting and better interactions of bioinoculants with earthworms which may further reduce the time of composting and improve the quality of compost. Hence vermicompost can be used for organic wastes to yield compost at a faster rate for organic farming.

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