WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 15, 1264-1272. Research Article ISSN 2277–7105

TO ANALYZE WASTE MANAGEMENT TECHNIQUE BY MAKING COMPOST PIT FOR AGRICULTURAL RESIDUES

Dr. Neelam Tripathi[1] and Dr. Rekhani Jyoti Pal*[2]

[1]Associate Professor, Department of Botany, School of Science, Anjaneya University, Raipur.

[2]Associate Professor, Department of Biotechnology, Research Institute, Ambala Cantt.

Article Received on
20 June 2024,

Revised on 09 July 2024,
Accepted on 30 July 2024

DOI: 10.20959/wjpr202415-33416

***Corresponding Author**
Dr. Rekhani Jyoti Pal
Associate Professor, Department of Biotechnology, Research Institute, Ambala Cantt.

ABSTRACT

The quantity of waste adding to the mainstream can be simply reduced by home composting. This research was focused on the understanding of the effectiveness of the household composting waste as a waste management technique for household garbage. It has been reported that agricultural production in India leads to the generation of the high volume of agriculture residue, which in turn results in large land accumulation. In addition, the dependency of farmers on chemical fertilizers depletes the soil quality and causes severe health effects on humans and animals. Therefore, in order to overcome these problems, it was thought to develop a farmer-friendly composting process for which a rapid composting pit was developed. In this study compost prepared in two pits by using different feeding materials were tested and analyzed for different parameters (such as colour, moisture content, temperature, ash content, phosphorous, C/N ratio, lignin). It was found that the compost formed in both the pits were rich in macro as well as micro nutrients and it proved to be a good soil conditioner.

KEYWORDS: Waste management, composting pit, organic content, vermicomposting.

INTRODUCTION

Home Composting is not a new technology and it has been practiced for many years around the world, as a simple and low cost method to manage household organic waste. Composting is one of the most efficient and commonly used methods of processing biodegradable solid waste under controlled (predominantly) aerobic conditions. Home composting is now being

encouraged as a means of reducing the organic waste being discarded and sent to the landfills. It results in the production of a stable product i.e. compost which can be used as a low grade manure and soil conditioner in agricultural and horticultural areas depending upon its quality. Compost obtained is rich in macro nutrients such as Nitrogen, Phosphorous and Potassium as well as micro nutrients and thus can be utilized for the growth of plants. A good home composting programs can significantly reduce the quantity of organic waste adding to the mainstream and subsequent emissions upon final disposal. Valuable products (compost) are produced through this process while reducing the costs incurred for collection, transportation and final disposal at dumpsite. Home composting encourages the community involvement on waste management activities and it facilitates easy transferring of source separation concepts to the people. Home based composting compared to the compost produced from mixed waste is of high quality as the waste does not get contaminated with hazardous materials. There are various technical options available as household level composting systems that vary from simple pit /heap methods to complex bin or rotating drum designs. Traditional composting methods (pit, heap, Jeewakotu) have been common practices in many rural/sub-urban areas with different kinds of organic matters. About 60% of the Indian population relies directly or indirectly on agriculture. The organic content of MSW tends to decompose causing odour nuisance which also pollutes the environment. In order to ensure a safe disposal of the MSW, it is desirable to reduce its pollution potential for which several processing methods are available. Among different methods of composting such as (Indore method, Bangalore method, passively aerated composting method, In-vessel composting method, NADEP method of composting and Vermicomposting) NADEP method of composting have been as base method selected for the Designing rapid composting for agricultural residues in this study.

1. SITE SELECTION: Field of a local marginal Farmer been selected for the Construction of Pit which is situated at Kapsi Village, Ambala.

2. FEEDING MATERIAL SELECTION: Paddy and Citronella grass both are the major crop in the selected field. Rice Straw and Oil extracted Citronella grass were selected for the feeding as they were present in an abundant amount in the selected agricultural field as residues. Apart from this some household waste products collected from local houses were also used in compost pit with agricultural waste. The particle size of rice straw used was

approximate 1 feet in length and that of Citronella grass used was about 1-2 feet long. Two types of mixtures were adopted for feeding.

MATERIAL AND METHOD

1. DESIGN OF RAPID COMPOSTING PIT: Two pits were constructed for the process. One of household waste and other of a mixture of Rice straw & citronella grass. Construction of pits completed in 4 days. Both the rectangular pits were made of brick masonry (using 152 bricks each of standard size 270mm x 100mm x 70mm with 0.900 m^3 of mortar) with a concrete base. The size taken of the pit adopted was 11′ (length) x 5′ (breadth) x 2′ (height). Perforated Pipes each of 2.8″ diameter were laid in the tank for providing passive aeration. 4.2″ thick PCC plinth was also laid in order to make the base leak-proof.

2. PREPARATION OF BIOLOGICAL ACTIVATOR: 20 litres of Biological Activator was prepared by adding 2 kg jaggery in 2 litres of water. Two kg of old compost, 200 g Component 1 and 200 mg Component 2 were added & mixed thoroughly. 1 litre each suspended culture of selected microorganisms and 10 litres of water was added in the mixture. The solution was then kept for fermentation for 5 days. After Fermentation, the solution was scaled up to 20 litres.

3. METHODOLOGY ADOPTED: In Pit-1: 150 kg of household waste was feed in 5 layers of approx. 30 kg each. Sufficient amount of water and activator was sprinkled on each layer.

In Pit-2: 125 kg of rice straw and citronella grass was feed in 5 layers of approx 25 kg each.

Sufficient amount of water and activator was sprinkled on each layer. Pits were then properly covered with jute bags. Visual Monitoring of both the pits was done and the growth of fungi was observed. The temperature of the pits was recorded regularly up to 7 days and then periodically at an interval of 10 days. At a regular interval of 10 days concentration of parameters such as moisture content, Ash content, Total Volatile Solids, Carbon, Hydrogen, Nitrogen, Sulphur, Sodium, Potassium, Phosphorus and Lignin was determined in the laboratory.

RESULTS AND DISCUSSION

After 60 days of Rapid Composting Period, Compost formed in both the pits was taken to a lab for various tests and results generated were as follows:-

1. Color & Odor: Both Pit compost were brown in color with earthy odor.

2. Temperature: The variation in temperature of composting materials in Pit-1 and Pit-2 with time has been illustrated in Figure 1 and Figure 2 respectively.

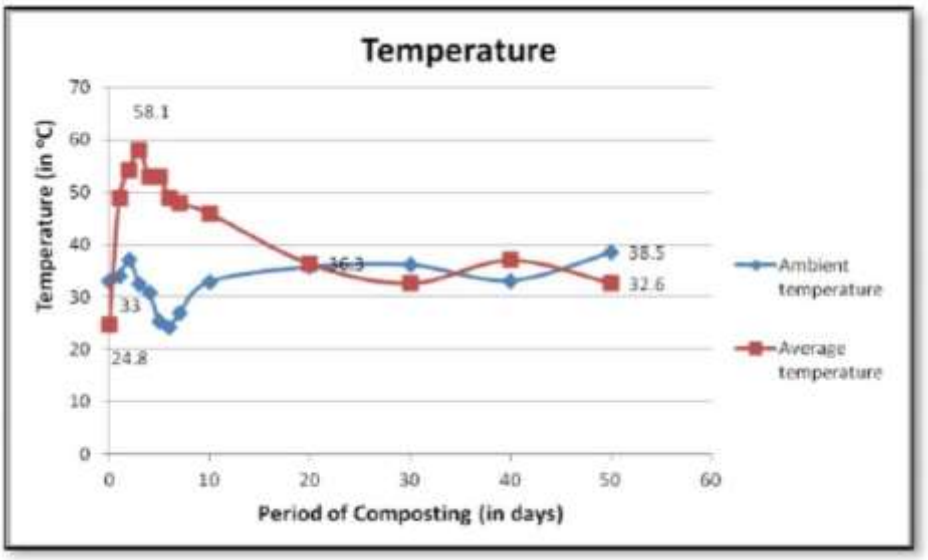

FIG 1: PIT 1.

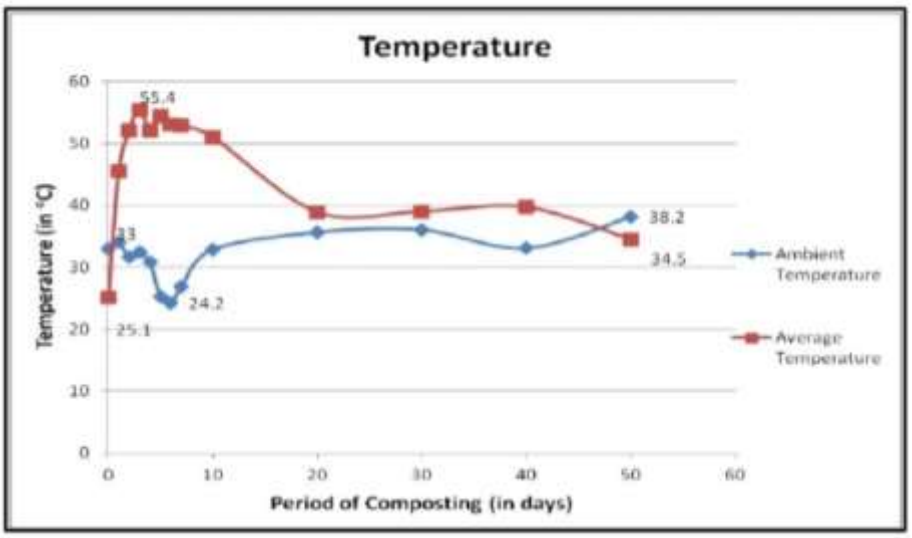

FIG 2: PIT 2.

It was observed that after feeding, temperature shoots up the next day. This temperature rise was a result of intense microbial activity, which was further favored by the high concentration of easily decomposable organic matter. The thermophilic phase of microorganisms initiated on 2nd day in both the Pits and thus the temperature reached above 55 ºC in both the Pits i.e. 58.1ºC in Pit-1 and 55.4ºC in Pit-2 respectively. This temperature rise makes the compost pathogen free.

3. Moisture Content: The variation in moisture content of composting materials in Pit-1 and Pit-2 with time is presented in Table-1.

Table 1: Variation of Moisture content with time during composting.

S. No.	Period of Composting (in Days)	Moisture Content (in %)	
		Pit-1	Pit-2
1.	0	8.04	8.13
2.	10	8.57	10.84
3.	20	27.96	29.84
4.	30	37.88	42.05
5.	40	45.32	53.19
6.	50	58.68	54.58
7.	60	10.67	07.33

It can be observed from Table-1 that the initial moisture content of feed was low as the matter taken up for feeding was dry. Moisture lost during the composting process can be viewed as an index of decomposition rate, because heat generated during the process accompanies decomposition. After observing moisture content of 10th day sample, it was found to increase moisture content in both the pits to maintain it nearly 40% -50% which was best suited for the composting process. At the end of the process, Compost was sun-dried which showed a sudden decrease in the moisture content of the final products.

4. Total Solids, Total Volatile Solids and Ash Content: The ash content increment in the Pit-1 and Pit-2 with respect to the period of composting has been presented in Fig.3.

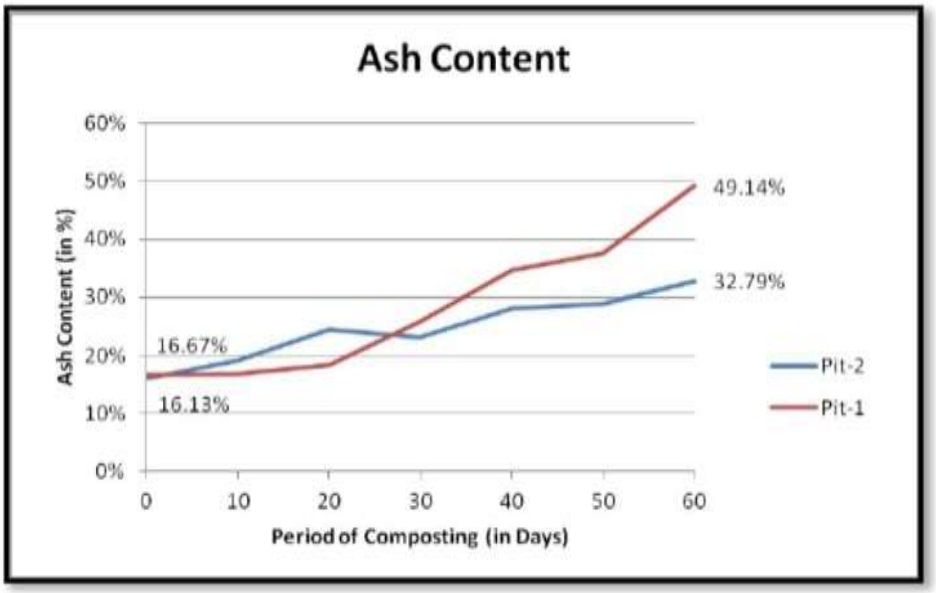

FIG 3: Ash content.

The results of the analysis indicated that ash content of Pit-1moderately multiplied three folds than its initial value while that of Pit-2 becomes doubled than its initial value. The enhanced mineralization of agro waste materials due to composting may be the reason for higher Ash content in the final product. Decrease in Total Volatile Solids in the pits i.e. 29.71% loss in Pit-1 and 19.86% loss in Pit-2 also indicated the degradation of organic material.

5. Carbon Content and Nitrogen Content: C/N ratio is the key parameter for the maturity of the compost. Degradation of carbon and mineralization of nitrogen, both are important aspects of composting. Carbon degraded by 32.65% in Pit-1 while 30.99% in Pit-2. Nitrogen mineralized with the course of time, nitrogen content reached up to 1.988% in Pit-1 and 1.876% in Pit-2, which is more than 1%, compared to the compost formed as per standards shown in figure 4.

The results clearly indicate that there was a continuous decrease in the values of C/N ratio after 10 days of the stabilization process. The decrease in C/N ratio was 80.66% in Pit-1 as compared to 67.43% in Pit-2. The initial level of C/N ratio was 64.466 in Pit-1, which reduced to a final value of 12.469. Similarly, the value of C/N ratio in Pit-2 reduced to 14.835 from an initial value of 45.553.

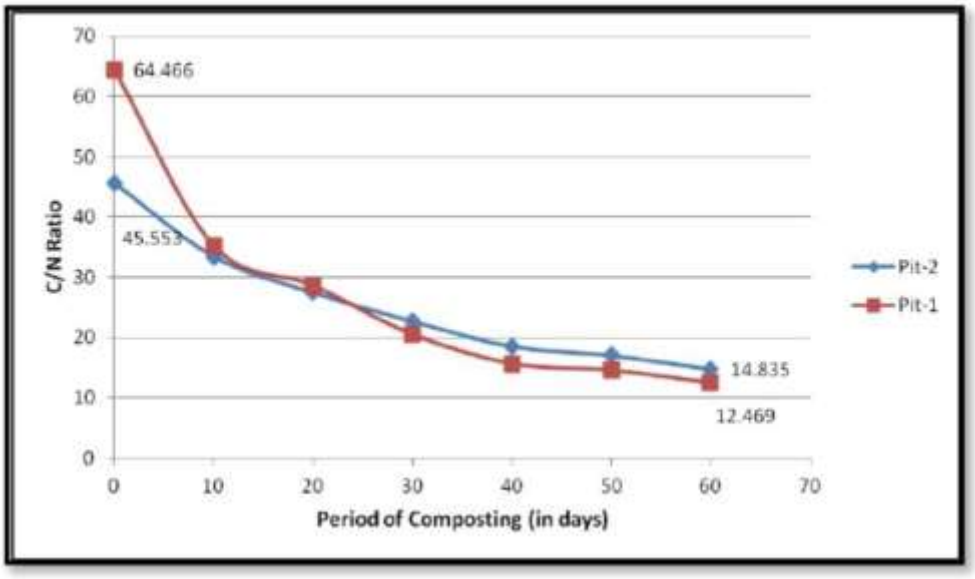

Fig 4: Carbon and Nitrogen content.

6. Lignin Content: Lignin degradation during composting is governed by- temperature, the original lignin content and the thickness of the material. During the Thermophilic phase,

rapid degradation of lignin was measured. In Pit-1 the lignin concentration was reduced to 14.5% in 10 days period from an initial concentration of 21.5% whereas, in Pit-2 the concentration reduced to 16.4% in 10 days period of composting from an initial concentration of 25.8%. Lesser degradation was observed in Pit-2 because of long leaf size (not more than 2 feet) of citronella grass.

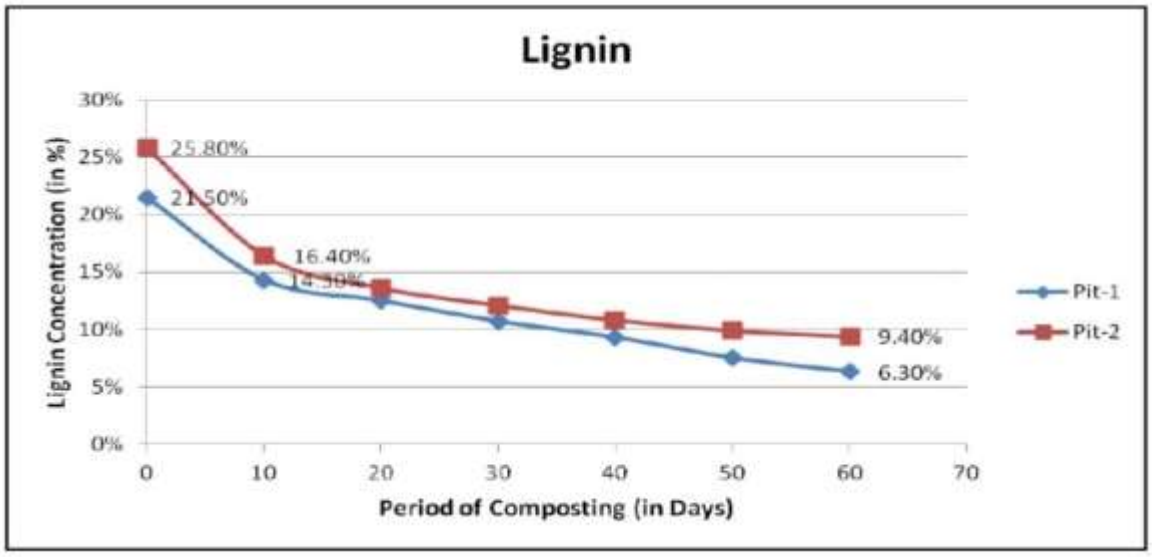

FIG 5: Lignin Concentration.

CONCLUSIONS

It can be concluded that Rapid Composting is one of the best techniques for treatment of Agricultural Residues. Composting Process reduces the volume of waste as well as convert it into a useful product i.e. compost. Conclusions drawn from the work conducted under this study are:

1. Rapid Composting method is more efficient in terms of composting cycle time. Composts in this method were matured in 60 days compared to other conventional methods which normally take more than 90 days.
2. The problems of fly breeding, odor generation, and rodents were eliminated because of the aerobic design of Pit.
3. The temperature increased rapidly from mesophilic to thermophilic phase and then gradually reduced through the maturation phase.
4. More production of compost can be done by increasing the number of composting cycles per year.

5. Thermophilic phase was found retained for more time in Pit 2 than in Pit 1 because of the density of citronella.
6. Lower ash content of Rice straw-Citronella grass mixture (Pit 2) revealed that oil content in citronella hindered organic matter degradation.
7. Composting period recommended being reduced up to 30 to 40 days in comparison to 60 days for potassium-rich compost.
8. Optimum Moisture Content was obtained in between 40%-50% for accelerating the process and should not be increased more than 60% to avoid leachate formation.

REFERENCES

1. Bernal, M., Parades, C. and Ceggara, J. Maturity and Stability Parameters of Composts Prepared with a wide Range Of Organic Wastes, Bioresource Technology, 1998; 63: 91-99.
2. Boelens, J., Wilde, B., and Baere, L. Effects on Household Biowaste Collection, Composting Process and Compost Quality, Proceedings of Organic Reclamation and Composting Association Conference, Brussels, Belgium, 1995.
3. Central Pollution Control Board, (CPCB), Report on management of municipal solid waste, Delhi. India, 2000.
4. Central Environmental Authority, Parisara Puwath, Published by Central environmental Authority, January-March, 2008; 1(26): 8.
5. Chandra, R., Kumar, N. and Tyagi A.K. Nutrient dynamics and decomposition rates during composting of sulphitation pressmud by different methods, Journal of Environmental Science & Engineering, 2007; 49(3): 183-8.
6. Chang, J.I. and Chen, Y.J. Effects of bulking agents on food waste composting, Bioresource Technology, 2010; 101(15): 5917-5924.
7. Database of Municipal Solid Waste in Sri Lanka, Ministry of Environment and Natural Resources, January 2005; 140.
8. Dhal, G.C., Singh, R., Khwairakpam, M., and Kalamdhad, A.S. Composting of water hyacinth using Saw dust/Rice straw as a bulking agent, International Journal of Environmental Sciences, 2012; 2(3): 1223-1238.
9. Goyal, S., Dhull, S. K., and Kapoor, K., K. Chemical and biological changes during composting of different organic wastes and assessment of compost maturity, 2004.
10. Kalamdhad, A.S. and Kazmi, A. A. Rotary drum composting of different organic waste mixtures, Waste Management & Research, 2009; 27(2): 127-138.

11. Khwairakpam, M., Bhargava, R. Vermi technology for sewage sludge recycling, J. Hazard. Mater, 2009; 161: 948–954.
12. Kumar, S., Goyal, S.K. and Kumar A. A Study on Design & Development of NADEP Compost Tank, Progressive Agriculture, 2011; 11(1): 207-209.
13. Liu, D., Zhang, R., Wu, H., Xu, D., Tang, Z., Yu, G., Xu, Z., and Shen, Q. Changes in biochemical and microbiological parameters during the period of rapid composting of dairy manure with rice chaff, Bioresource Technology, 2011; 88(5): 1345-1358.
14. Manual on Municipal Solid waste Management, Ministry of urban Development, 2016.
15. Mamo, M., Halbach, T. R.and Rosen, C. J., Department of Soil, Water and Climate, University of Minnesota, 1998, Utilization of Municipal Solid Waste Compost for Crop Production, www.dost.gov.ph, 23rd June, 2008.
16. Singh, J. and Kalamdhad, A.S. Assessment of compost quality in agitated pile composting of water hyacinth collected from different sources, International Journal of Organic Waste and Agriculture, 2015.
17. Tatàno, F., Pagliaro, G., Giovanni, P., Floriani, E. and Mangani, F. Biowaste Home Composting: Experimental process monitoring and quality control, Waste management, 2015; 38: 72-85.
18. Technical Guidelines on Solid Waste Management in Sri Lanka, June 2005, Central Environmental Authority, 83 pp. [5] Tom L. Richard, Dept. of Agricultural & Biological Engineering, New York State College of Agriculture and Life Sciences, Cornell University, 2007, Municipal Solid Waste Composting.
19. Wang, X., Cui, H., Shi, J., Zhao, X., Zhao, Y. and Wei, Z. Relationship between bacterial diversity and environmental parameters during composting of different raw materials, Bioresource Technology, 2015; 198: 395-402.
20. Wani, K., Mamta, Rao, R. Bioconversion of garden waste, kitchen waste and cow dung into value-added products using earthworm Eiseniafetida., Saudi Journal of Biological Sciences, 2013; 20: 149-154.