Comparative Study of Reduction in Biomass of Green and Dry Leaf Litter of Eucalyptus during Vermicomposting

Praveesh Bhati[1], Ritu Nagar[2]

How to cite this article:
Praveesh Bhati, Ritu Nagar/Comparative Study of Reduction in Biomass of Green and Dry Leaf Litter of Eucalyptus during Vermicomposting/Indian Journal of Waste Management. 2020;4(2):9–13.

Abstract

Huge amount of green and dry leaf waste require extensive area for making vermicompost. This process is completed in two stages. The primary decomposition by microbes can occur in an open area, which reduces the bulk of the waste, while the second stage, carried out by exotic earthworms require a smaller area. The present attempt was made to find out the rate of reduction in the volume of eucalyptus leaf litter during vermicomposting. There has also been work to compare the decline in biomass of green and dry leaf litter during the vermicomposting process. The obtained results showed that during vermicomposting of green, dry leaf litter and cattle dung, the amount of organic waste was reduced by about 44-64%. Of the total volume reduced, about 35% decreased in the first four to five weeks, while the remaining reduction occurred in eight weeks. The obtained results recommend that, as large areas are required in the initial decomposition process, once the amount of waste is reduced to half of their initial volume, then the remaining waste can be transferred to a smaller area, where the second process of vermicomposting is done under controlled condition.

Keywords: Eucalyptus leaf litters; Biomass reduction; Green leaf; Dry leaf; Vermicomposting.

Introduction

Waste management is an immense challenge for developing country.[1] There are many efforts have been done to resolve this problem.[2] Disposable waste requires large area where waste materials have to be dumped. Municipal solid waste (MSW) contains verity of different component some of them can be recycled.[3] Bioorganic waste is one of them, generated from plants and animals. These are rich in different types of organic compound along with water that makes it bulky and spacious.[4] Although there are several methods are available to treat bioorganic waste but vermicomposting is more appropriate, eco-friendly and sustainable approach to manage such type of wastes. In vermicomposting process initial stage requires large area to accommodate massive quantity of waste. As soon as decomposition of waste goes into progress, the volume also gets reduce and shrink into small area. Several scientists have confirmed that about 20–77% of the volume of biomass get reduce during composting or vermicomposting process .[5-7] During decomposition of waste heat is also generate, that turn water into vapor as consequence Biomass also get reduced.[8-9] Helena et al., (2015) carried out work on vermicomposting of cattle manure and found 45.9 % reduction in the biomass of waste.[10] Banu et. al., (2008) also reported that about 40 % volume of waste materials get reduce during composting process.[11] It has also found that bio solid waste is reduced up to 45 % by weight during composting and vermicomposting.[12]

Author's Affiliation: [1]Scientific Officer, DNA Finger printing Unit, UTD road, Civil line, Sagar, Madhya Pradesh 470001, India. [2]Guest faculty, Govt. College, Gulana, Shajapur, Madhya Pradesh 465001, India.

Corresponding Author: Praveesh Bhati, Scientific Officer, DNA Finger printing Unit, UTD road, Civil line, Sagar, Madhya Pradesh 470001, India.

E-mail: bhati_p212@yahoo.co.in

Eucalyptus plant belongs to the Myraceae family including more than 740 species. It is a long tree which has height of more than 100 feet.[13] This tree is notable for their speedy growth. Eucalyptus is evergreen tree but their some tropical species slumped their leaves at the end of the summer season.[14] Although leaf litters provide shelter and food for terrestrial living being and after undergo decomposition produces manure that nourishes the soil. Present efforts have made to find reduction in the volume of leaf litter waste of Eucalyptus tree during vermicomposting process.

Materials and Methods

Collection of plant leaves

This work was done with green and dry leaves. Green leaf of Eucalyptus (*Eucalyptus globulus*) plucked from randomly selected trees from the college campus of Govt. Madhav Vigyan PG College, Ujjain (MP). Dried fallen leaves were collected from the ground around the eucalyptus trees. These leaves were washed with distilled water to remove dust and allowed to air dry in the shade.[15-16]

Collection of cattle dung

Cattle dung was collected in plastic sterile container from randomly selected cattle houses of municipal territory of the study area, Ujjain (M.P.) India.[17]

Preparation for vermicomposting

The collected green and dried leaves were cut into small pieces. Different combinations of both types of leaves were prepared by mixing with or without cattle dung (Table No. 1). The process of making vermicompost was done in plastic containers. Each composition was prepared in triplicate. Composting bins (plastic containers) were placed in the room. The windrow compost method was used in which neither composting materials covered nor provided active ventilation with pipes. Vermicomposting mixture was agitated after regular intervals to enhance passive aeration.[18]

Measurement of Biomass Reduction

The reduction in the amount of biomass (height) of the vermicomposting mixture was measured by scale. This measurement was done daily until the procedure was completed. Before measurement, the scale was disinfected by 70% alcohol and allowed to air dry. The vermicomposting mixture was evenly poured inside the cans. Before taking the height of the vermicomposting mixture, each cane was jolted twice on the surface to fill the gap between the waste materials. The scale was placed vertically at a fixed point on each side of the container. The mean value of the height measured was taken into account for the final result.[19]

Fig. 1: Measurement of reduction in biomass (Height) during vermicomposting process.

Results

The results obtained from thirteen weeks of experimental work to evaluate the reduction in height of biomass during vermicomposting are shown in Table No. 2 and figure no. 2. The results obtained showed that in the initial stage, the height

Table 1: Different mixture of leaf litters and cattle dung prepared for vermicomposting.

Mixture set	Code No.	Proportion	Total weight	Weight of leaf litters	Weight of cattle dung
Vermicomposting of green leaf	P1	100%	2.0 kg	2.0 kg	----
	P2	50 %	2.0 kg	1.0 kg	1.0 kg
Vermicomposting of dry leaf	P3	100%	2.0 kg	2.0 kg	----
	P4	50 %	2.0 kg	1.0 kg	1.0 kg
cattle dung (Control)	P5	100 %	2.0 kg	----	2.0 kg

Table 2: Data showing height of biomass (cm) reduced during vermicomposting.

No. of weeks	Vermicomposting of green leaf		Vermicomposting of dry leaf		Cattle dung
	100 % Leaf	50 % Leaf	100 % Leaf	50 % Leaf	
1	28.90	26.42	28.78	26.13	14.84
2	25.39	23.45	25.28	24.75	12.78
3	23.86	21.23	23.17	21.53	11.11
4	20.42	19.84	21.63	19.45	10.68
5	18.77	17.38	19.27	17.62	10.34
6	16.57	15.83	18.28	16.31	9.72
7	14.42	14.89	16.83	15.18	8.74
8	13.83	13.95	15.25	13.66	7.95
9	11.59	12.25	14.23	12.59	6.17
10	10.90	10.52	11.56	10.83	6.17
11	9.37	9.58	9.59	8.95	6.17
12	9.22	9.12	9.17	8.16	6.17
13	8.65	8.10	8.59	7.90	6.17

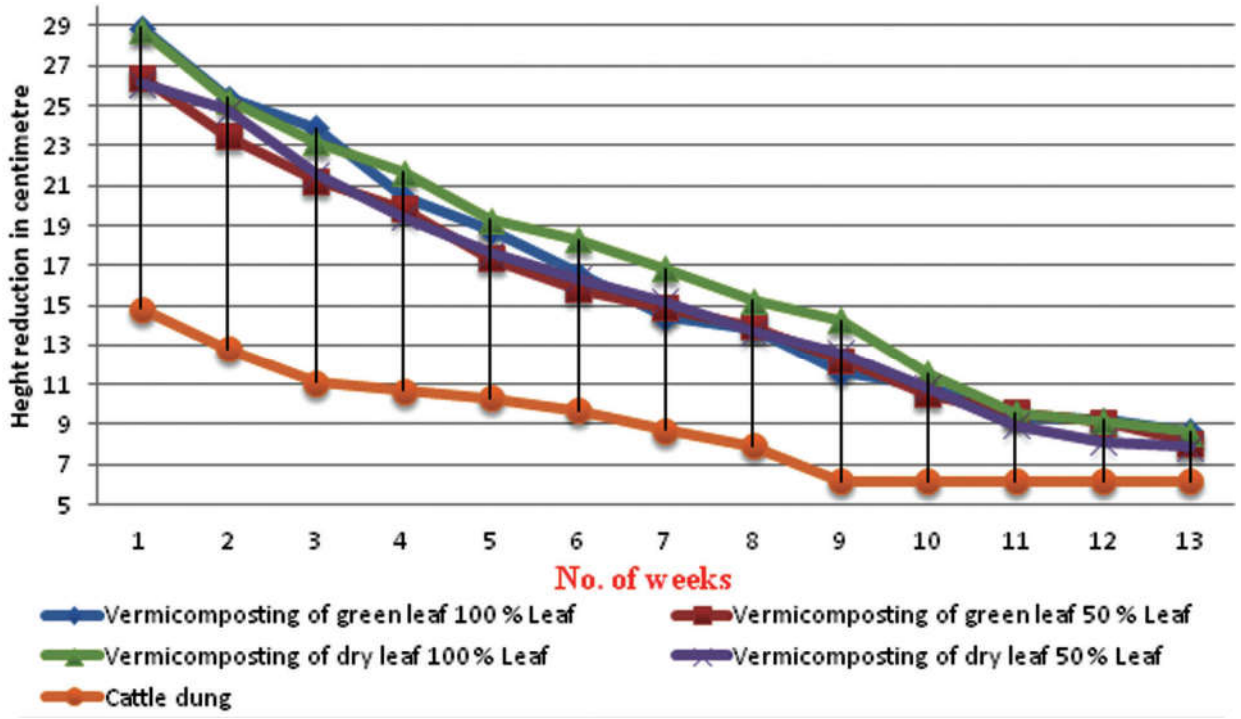

Fig. 2: Biomass reduction in different composition of green and dry Eucalyptus leaf litters of vermicomposting mixtures.

of 100% green leaf litter was 28.90 ± 0.5 cm, height of 50% green leaf litter was 26.42 ± 0.5 cm, height of 100% dry leaf litter was 28.78 ± 0.5 cm, height of 50% dry leaf litter was 26.13 ± 0.5 cm and height of 100% cattle dung was 14. 84 ± 0.5 cm. It was also found that the initial height of the green leaf litter set was comparatively higher than that of the dry leaf litter. The tabular data also shows that 100% leaf litter height was found to be higher than 50% leaf litter mix set. The height of the waste started decreasing during vermicomposting. The first five weeks, the height of the vermicomposting mix was decreasing faster than the rest of the weeks. At the end of process, the height of 100 % green leaf litter was found 8.65 ± 0.5 cm, in 50 % green leaf litter was 8.10± 0.5 cm, in 100 % dry leaf litters was 8.59 ± 0.5 cm, in 50 % dry leaf litters was 7.90 ± 0.5cm and 6.17 ± 0.5 cm was recorded in 100 % cattle dung.

It was also found that biomass of dry leaf litter was more declined rapidly than mixture of green leaf litters. Bar diagram shows that in 100 % green leaf litter, total height was reduced up to 16.74± 0.5

Table 3: Total variation in biomass reduction in centimeter (cm.)

Biomass reduction in centimeter	Vermicomposting in green waste		Vermicomposting in dry waste		Cattle Dung
	100 %	50 %	100 %	50 %	
	16.74 ± 0.5 cm	15.35± 0.5 cm	16.69± 0.5 cm	16.85± 0.5 cm	6.61± 0.5 cm

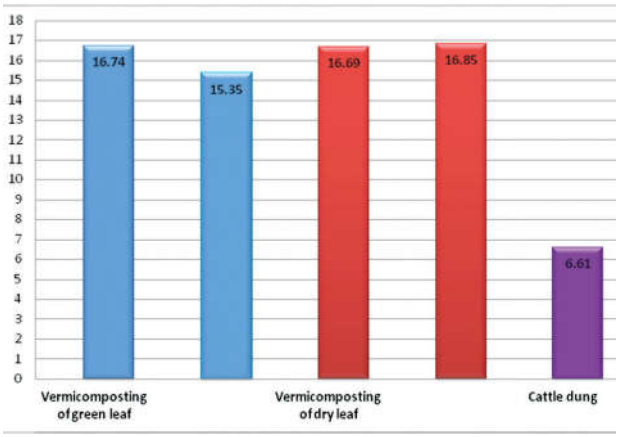

Fig. 3: Total biomass reduction in different sets of vermicomposting.

cm while in 50 % green leaf litters it was recorded 15.35± 0.5 cm. Similarly in 100 % dry leaf litters reduction was recorded 16.69 ± 0.5 cm while in 50 % leaf litters it was recorded 16.85± 0.5 cm as compared to control (6.61± 0.5 cm) (Table no. 3 & Figure no. 3).

Obtained result also states that, during vermicomposting about 57 % height was reduced in 100 % green waste, 58 % height was reduction took place in both 50 % green and 100 % dry leaf waste and 64 % reduction was recorded in 50 % dry leaf waste as compared to 44.5 % reduction was noted in 100 % cattle dung.

Discussions

Vermicomposting is a useful way to convert organic waste into compost. It is a sustainable technology to overcome the problem of waste generated. The present experimental work was carried out to solve the problem of life litter and the rate of biomass reduction during the process was also evaluated. The obtained results show that during the process of decomposition more than 40% of the biomass is reduced in height and their weight is also reduced. The obtained results were compared with outcomes of different researchers. Norbu (2002) also conducted experiments on municipal solid waste and found that the biomass of the waste decreased rapidly in the first two weeks, and then set to a stable level.[20] Singh, et al. (2004) also concluded that maximum depth reduction occurs in the first seven days and stabilizes after 25 days.[19] Our finding is agreement with the result recorded by Moqsud (2010) who stated that composting was completed in about 35-40 days and the volume of the organic waste was reduced up to 50-70 % from original volume.[21] Zheng (2004) reported that microorganisms reproduced very rapidly at early stage of composting due to the abundance of easily-degradable organic matter.

Conclusion

Despite the different composting mix of green and dry leaf litter, the biomass reduction rate during vermicomposting shows similar trends. The present results also show that in the first stage of vermicomposting, a larger area is required to complete half the process whereas in the second stage when earthworms are to be added, a smaller area is required to complete the remaining half of the stage. This finding also suggested that the initial stage could be accomplished at the waste generation site and that this stage also does not require additional attention for it to flourish. Once the amount of waste reduce, it can be transferred to the vermicomposting unit for the final stage.

References

1. Cointreau SJ. Environmental Management of Urban Solid Wastes in Developing Countries. A Project Guide. Technical Paper Number 5.World Bank Urban Development. The World Bank, Washington. U.S.A; 1982.
2. Rushbrook P, Pugh M. Solid Waste Landfills in Middle and Lower Income Countries. A Technical Guide to Planning, Design, and Operation. The World Bank, Washington. U.S.A; 1999.
3. Environmental Protection Agency (EPA). Campaigning against waste [EPA 530-F-02-033]. Washington, D.C; 2002.
4. Eklind Y, Beck-Friis B, Bengtsson S, Ejlertsson J, Kirchmann H, Mathisen, B, et al. Chemical characterization of source-separated organic household wastes. Swedish Journal of Agricultural Researches. .1997; 27: 167-178.
5. Martins O and Dewes T. Loss of nitrogenous compounds during composting animal wastes. Biores Technol. 1992 ;42:103–111.

6. Rao Bhamidimarri, SM and Pandey SP. Aerobic thermophilic composting of piggery solid wastes. Water Sci Technol. 1996; 33(8):89–94.
7. Tiquia SM and Tam NFY. Fate of nitrogen during composting of chicken litter. Environ Pollut (in press). 2000a.
8. Vogt KA, Grier CC and Vogt DJ. Production, turnover, and nutrient dynamics of above- and below ground detritus of world forests. Adv. Ecol. Res. 1986; 15:303-377.
9. Nagar R, Titov A and Bhati P. Reduction of Green leaf litter biomass during vermicomposting process. 5th International conference on advanced research in applied science, environment, agriculture & entrepreneurship development, dec. 4th -6th, 2017 Bhopal (m.p.), India.2017a.
10. Helena CL, Komakech AJ and Vinneras B (2015). Vermicomposting as manure management strategy for urban small-holder animal farms - Kampala case study.Waste management (New York, N.Y.), ISSN: 1879-2456, Vol: 39.2015. 96-103.
11. Banu JR, Yeom IT, Esakkiraj S, Kumar N and Logakanthi S. Bio management of sago earthworm, Eudrilus eugeniae" Environmental Biology. 2008.29:143.
12. Ndegwa PM and Thompson SA. Integrating composting and vermicomposting in the treatment and bioconversion of bio solids" Bio-resource Technology. 2001.76:107.
13. Nagar R, Titov A and Bhati P."Vermicomposting of green Eucalyptus leaf litter by Eisenia foetida and Eudrilus eugenia. International Journal of Environment, Agriculture and Biotechnology. 2017b ; 2(6):2811-2818.
14. Kumar HD and Sahoo L. A review on Phyto-chemical and pharmacological of Eucalyptus globulus: A multipurpose tree. International Journal of Research in Ayurveda & Pharmacy. 2011; 2 (5):1527-1530.
15. Thangaraj R. Leaf litter waste management by vermicomposting using local and exotic earthworm species. Journal of Science. 2015; 5(5):314-319.
16. Taylor BR. Air-drying depresses rates of leaf litter decomposition. Soil Biol. Biochem. 1998; 30(3):403-412.
17. Shouche S, Pandey A and Bhati P. Study about the changes in physical Parameters during vermicomposting of floral wastes. Journal of Environmental Research and Development.2011; 6(1):63-68.
18. Njoroge J. Field Notes on Organic Farming'. Kenya Institute of Organic Farming, PO Box 34972 Nairobi, Kenya.1992.
19. Singh NB, Khare AK, Bhargava D and Bhattacharya S. Effect of substrate depth on vermicomposting. Journal-EN. 2004;85:16-21.
20. Norbu T. Pre-treatment of municipal solid waste by windrow composting and vermicomposting. Ph.D. Dissertation, School of Environment Resource and Development, Thailand.2002.
21. Moqsud A. Composting barrel for sustainable organic waste management in Bangladesh, waste management Er Sunil Kumar (Ed.), ISBN. 2010.
22. Zheng GD and Chen TB. Dynamic of lead specialization in sewage sludge composting. Journal of Water Sci. and Technol. 2004.50(9):75-82.