VERMICOMPOSTING ORGANIC WASTE: A REVIEW

M. Sultana
Dept. Of Civil Engineering, Shreeyash College of Engineering and Technology Aurangabad,MS, India
drmasarrats@gmail.com

ABSTRACT

Vermicomposting is the process by which worms are used to convert organic materials (usually wastes) into a humus-like material known as vermin-compost. Vermicompost technology is a biotechnological process where you can convert organic waste into compost using specialized earthworms. Vermicompost helps improve soil structure, texture, porosity, water holding capacity, reduce erosion, drainage and aeration . It improves plant growth by enabling the growth of new shoots and leaves thereby increasing productivity. It helps to neutralize the pH of the soil. This technology has been widely used over the years to provide a cleaner alternative to recycling organic waste in an eco friendly manner. In this perspective the present review paper has been written in order to create awareness regarding gaining wealth from waste through vermicomposting.

***Keywords**: Vermicomposting, earthworms, ecofriendly.*

Introduction

In recent years, the disposal of organic wastes from domestic, agricultural and industrial sources has caused increasing environmental and economic problems and many different technologies to address this problem have been developed. Compost is a natural fertilizer that allows an easy flow of water to the growing plants. The earthworms are mainly used in this process as they eat the organic matter and produce castings through their digestive systems. Vermicompost is considered an alternative to chemical additives in agricultural crop production that reduces economic costs, while producing healthier organic products for consumers and enriching the environment as observed by Kaplan (2016). Vermicomposting a new trend towards management of agricultural waste was studied by Jaybhaye and Satish (2016). Gopal et.al.(2017) reported changes in structure and function of bacterial communities during coconut leaf vermicomposting. Vermicomposting of leaf litters a way to convert waste into best was studied by Nagar et.al.(2017). Swati and Hait (2017)carried out a review on fate and bioavailability of heavy metals during vermicomposting of various organic wastes. Sharma and Garg (2018) carried out comparative analysis of vermicompost quality produced from rice straw and paper waste employing earthworm *Eisenia fetida*. Maheshwari and Priya (2018) studied vermicompost, a backbone for sustainable agriculture. Changes in the composition and function of bacterial communities during vermicomposting may explain beneficial properties of vermicompost was cited by Dominguez et.al.(2019).Vermicomposting of paper industry sludge with cowdung and green manure plants using Eisenia fetida a viable option for cleaner and enriched vermicompost production was studied by Karmegam et.al. (2019). Vermicomposting of different organic materials using the epigeic earthworm Eisenia foetida was reported by Ramnarian et.al.(2019). Boruah et.al.(2019) carried out vermicomposting of citronella bagasse and paper mill sludge mixture employing *Eisenia foetida*. A study was conducted by Mousavi et.al.(2019) on vermicomposting of grass and newspaper waste mixed with cow dung using Eisenia fetida and physicochemical changes. Koval, I. Mikhno(2019) reported ecological sustainability preservation of national economy by waste management methods. Vermicompost is boon to enrichmentof micronutrient content in soil was reported by Rautela et.al.(2019).Singh et.al.(2020) studied Earthworms and vermicompost an eco-friendly approach for repaying nature's debt. Fudzagbo and Iderawumi (2020) studied vermicompost technology, impact on the environment and food security. Vermicomposting of organic waste with *Eisenia fetida* increases the content of exchangeable nutrients in soil was reported by Jawaher and Dohaish(2020).A review on vermicomposting methods from different wastes an environment friendly, economically viable and socially acceptable approach for

crop nutrition was reported by Ahmad et.al.(2021). Management of banana crop waste biomass using vermicomposting technology was carried by Mago et.al.(2021). Vermicomposting a management tool to mitigate solid waste was studied by Alshehrei and Ameen (2021). Sustainable management of diseases and pests in crops by vermicompost and vermicompost tea a review was carried out by Yatoo et.al. (2021)

Methods of Vermicomposting

Three commonly used methods for vermicomposting are discussed below:

1. Bed Method: This is an easy method in which beds of organic matter are prepared. Vermiculture bed or worm bed (3 cm) can be prepared by placing after saw dust or husk or coir waste or sugarcane trash in the bottom of tub / container. A layer of fine sand (3 cm) should be spread over the culture bed followed by a layer of garden soil (3 cm). All layers must be moistened with water.
2. Bin Method: The most common method for small scale composting is bin composting method. The bin can be constructed of several materials such as wooden/plastic/recycled containers like bathtubs and barrels. A vermicompost bin may be in different sizes and shapes, but its average dimensions are 45 × 30 × 45 cm. Around 10 holes with 1–1.5 cm in diameter holes in bottom, sides and cap of bin is useful for aeration and drainage. The bin method is prepared to use in small scale such as home composting, in kitchen or garage and so on. The bin can be made of various materials, but wood and plastic ones are popular.
3. Pit composting: For large scale composting, pits of sizes 2.5 m × 1 m × 0.3 m under thatched sheds with sides left open are advisable.

Discussion

Vermicomposting is one of the ecofriendly method used for making vermicompost with the help of earthworms. This is the process where earthworms convert the organic waste into rich manure with high nutritional content. Kulkarni (2017) reported that vermicomposting to be one of the best method for treating domestic and solidwaste. Muralikrishna and Manickam (2017) on solidwaste management described that vermicomposting and vermiculture will serve as a best source of supplemental income for the farmers.Baoyi et.al.(2018) concluded that earthworms had an impact on the bacterial community and one of the important method for stabilizing the organic wastes. Lee et.al. (2018) have revealed that industrial sludge can easily converted through vermicomposting into vermicompost within a short span. Margit Olle(2019) showed that vermicompost is optimal organic manure for better growth and yield of many plants. Ramnarian et.al.(2019) showed that vermicompost produced is the best option for farmers to replace for chemical fertilizers and obtaining better rates for the organic produce as it is cheap and locally available. Boruah et.al.(2019) found that the population of earthworms significantly increased after experimentation. According to Karmegam et.al. (2019) paper mill sludge increased vermicompost which be better for sustainability. Mousavi et.al.(2019) showed that this technique of vermicomposting helps to transform various organic waste(newspaper waste grass clipping and cowdung) into a nutrient rich compost. Yadav and Garg (2019) inferred that when sludge of bakery industry was mixed with cowdung it was converted into a rich manure with the help of earthworms. Bhat and Vig (2019) found that using earthworms can cause vermiremediation and toxicity reduction of sugar industrial sludges which will serve as sustainable alternative to the growing menace for treating large amount of industrial solid waste. Rorat and Vandenbulcke(2019) Vermicomposting is considered as an eco innovation technique in biowaste treatment where vermicompost can be applied for agriculture, gardening and remediation of polluted areas.Singh et.al.(2020) observed that after utilization of earthworms for vermitechnology can lead to sustainable development with respect to economic social and ecological framework.

.Fudzagbo and Iderawumi (2020) has showed that vermicomposting is a sustainable and ecofriendly technology for converting the organic waste into a valuable vermicompost .

Zhang et.al.(2020) suggested that maximum temperature requirement for vermicomposting of dewatered sludge using E.fetida is 25°C. Vermicomposting an eco biotechnological process playing an important role for managing organic waste and sustains agriculture as observed by Korav et.al.(2021)Mago et.al.(2021) concluded that NPK rich vermicompost was produced after undergoing vermicomposting process by utilization of banana crop waste biomass and cowdung . Alshehrei and Ameen (2021) found vermicomposting as a new approach for treating solid organic waste. Ahmad et.al.(2021) reported vermicomposting to be ecofriendly economic and social approach that can convert waste into black gold described as vermifertilizer.Thakur et.al.(2021) concluded that vermicompost is yet superior than conventional compost because it contains four times more nutrients as compared with regular cattle dung compost. Vukovic et.al.(2021) showed that vermicomposting is a complex biological process of earthworms and microorganisms forming vermicompost of wastes produced in agriculture, food processing, sewage treatment etc.

Benefits of Vermicomposting

1. Vermicomposting process increases the fertility of soil
2. This technique is useful to enhance germination, plant growth and yield of crops
3. Organic waste can be converted by earthworms into a potentially rich soil conditioner for thegrowth of plants
4. Vermicomposting is highly environment friendly , economical viable and efficient technologyfor handling waste
5. Vermicompost technique has a greater potential to drastically mitigate organic waste generation
6. Improves the water holding capacity of the soil
7. Increases nutrient availability in soil
8. It nurtures the soil with different plant growth hormones such as auxins, gibberellic acid etc.
9. It also improves the physical soil structure
10. Prevents soil erosion
11. Suppresses soil borne plant diseases
12. Maintains optimum pH value of soil
13. Increases N, P, Ca and Mg availability
14. Induces biological resistance in plants

Conclusion

Vermicomposting is considered as one of the promising method for disposing of organic waste products. The resulting vermicompost contains more valuable plant nutrients than other types of compost. Vermicomposting is helpful in the management of food, agricultural and animal wastes. Thus, this technique serves as an excellent approach to reduce environmental burden of these wastes. It is also important to increase the awareness of farmers about the significance of vermicomposting and encourage more research on the vermicompost methodology as an alternative approach for using renewable and organic resources in sustainable agriculture that will improve plant growth and provide long-term food safety. Therefore, information that enables farmers to discriminate among products that have different levels of effectiveness is necessary, and on-farm participatory research should contribute to addressing this need. The vermicompost is an eco friendly and cost effective method. It is an ideal method for the management and development of solid waste. To conclude hold promise to play a significant role in protecting environment as it uses waste as raw material and in building up of soil fertility and improving soil health for sustainable agriculture practices.

References

1. A. Swati, S. Hait(2017). Fate and bioavailability of heavy metals during vermicomposting of various organic wastes—a review Process Saf. Environ. Prot., 109 , pp. 30-45
2. Agnieszka Rorat and Franck Vandenbulcke(2019). Earthworms converting domestic and food industry wastes into biofertilizer Elsevier Industrial and Municipal sludge pp.83-106
3. Jorge Domínguez, Manuel Aira, Allison R. Kolbe, María Gómez-Brandón & Marcos

Pérez-Losada (2019). Changes in the composition and function of bacterial communities during vermicomposting may explain beneficial properties of vermicompost. *Sci Rep* 9, 9657. https://doi.org/10.1038/s41598-019-46018-w

4. Ali Ahmad, Zubair Aslam , Korkmaz Bellitürk, Naeem Iqbal , Shoaib Naeem , Muhammad Idrees, Zohaib Kaleem , Muhammad Yasir Nawaz , Muhammad Nawaz , Muhammad Sajjad1 , Wajeeh Ur Rehman , Hafiz Naveed Ramzan , Muhammad Waqas, Yousuf Akram, Muhammad Asif Jamal , Muhammad Usman Ibrahim , Hafiz Amir Tauqeer Baig , Ahmad Kamal(2021). Vermicomposting Methods from Different Wastes: An Environment Friendly, Economically Viable and Socially Acceptable Approach for Crop Nutrition: A Review International Journal of Food Science and Agriculture, 5(1), 58-68 http://www.hillpublisher.com/journals/jsfa/
5. Anjana Thakur , Adesh Kumar , Vinay Chava, Basava Kumar,Sushant Shiva Kiran, Varun Kumar,Athokpam(2021). A review on vermicomposting: by-products and its importance Plant Cell Biotechnology and Molecular Biology 22(11&12):156-164
6. Archana Singh, Natchimuthu Karmegam, Gopal Shankar Singh, Tunira Bhadauria, Soon Woong Chang, Mukesh Kumar Awasthi, Sivasubramaniam Sudhakar, Kantha Deivi Arunachalam, Muniyandi Biruntha, Balasubramani Ravindran, (2020). Earthworms and vermicompost: an eco-friendly approach for repaying nature's debt. Environmental Geochemistry and Health, 10.1007/s10653-019-00510-4
7. Baoyi Lv, Meiyan Xing & Jian Yang (2018). Exploring the effects of earthworms on bacterial profiles during vermicomposting process of sewage sludge and cattle dung with high-throughput sequencing Environmental Science and Pollution Research volume 25, pages12528–12537
8. El Jawaher A. and Bin Dohaish (2020). Vermicomposting of organic waste with Eisenia fetida increases the content of exchangeable nutrients in soil Pak. J. Biol. Sci. 23(4) 501-509
9. Fatimah Alshehrei , Fuad Ameen (2021). Vermicomposting: A management tool to mitigate solid waste Saudi Journal of Biological Sciences Volume 28, Issue 6, Pages 3284-3293
10. Fudzagbo and Iderawumi Joshua Fudzagbo and Abdulraheem Mukhtar Iderawumi (2020). Vermicompost Technology: Impact on the Environment and Food Security Agriculture and environment Volume 1 – Issue 1, 87-93
11. Gopal, M., Bhute, S.S., Gupta, A. (2017). Changes in structure and function of bacterial communities during coconut leaf vermicomposting. Antonie van Leeuwenhoek 110,1339-1355 https://doi.org/10.1007/s10482-017-0894-7
12. Hongwei Zhang , Jianhui Li, Yingying Zhang and Kui Huang(2020).Quality of Vermicompost and Microbial Community Diversity Affected by the Contrasting Temperature during Vermicomposting of Dewatered Sludge Int. J. Environ. Res. Public Health 17, 1748
13. Iyyanki V.Muralikrishna and ValliManickam(2017) . Solidwaste management Elsevier Environmental Management pp: 431-462
14. Jaybhaye, M. and A.B. Satish,(2016) Vermicomposting: A new trend towards management of agricultural waste (Paddy straw) Int. J. Curr. Res. Aca. Rev., 4:61-67
15. Jorge Domínguez, Manuel Aira, Allison R.Kolbe, Maria Gomez- Brandon, Marcos Perez- Losada (2019). Changes in the composition and function of bacterial communities during vermicomposting may explain beneficial properties of vermicompost. *Sci Rep* 9, 9657 https://doi.org/10.1038/s41598-019-46018-w
16. Kaplan, M.(2016). The national master plan for agricultural development in Suriname. Final report. Kaplan Planners Ltd. Regional and Environmental Planning. https://www. share4dev.info/kb/documents/5426.pdf
17. Lee, L.H.; Wu, T.Y.; Shak, K.P.Y.; Lim, S.L.; Ng, K.Y.; Nguyen, M.N.; Teoh, W.H.(2018). Sustainable approach to biotransform industrial sludge into organic

fertilizer via vermicomposting: A mini-review. J. Chem. Technol. Biot. 2018, 93, 925–935.
18. Maheswari, U.N. and M. Priya(2018). Vermicompost , a backbone for sustainable agriculture-review article. Eur. J. Biomed.Pharm.Sci,5: 835-846
19. Margit Olle (2019). Review: Vermicompost its importance and benefit in Agriculture Journal of Agricultural Science Vol.2 93-98
20. MonikaMago, Anoop Yadav , Renuka Gupta, V.K.Garg (2021).Management of banana crop waste biomass using vermicomposting technology Bioresource Technology ,Volume 326, 124742
21. Nagar, R., A. Titov and P. Bhati, (2017). Vermicomposting of leaf litters: way to convert waste into best. Int. J. Curr. Sci, 20:25-30
22. Natchimuthu Karmegam, Periasamy Vijayan, Mani Prakash, J. Arockia John Paul(2019). Vermicomposting of paper industry sludge with cowdung and green manure plants using Eisenia fetida: A viable option for cleaner and enriched vermicompost production Journal of Cleaner Production, 10.1016/j.jclepro.2019.04.313
23. Santosh Korav, Anudeep B. Malannavar and Lochan Sharma(2021). A Review-Vermicomposting: An Effective option for Agriculture Waste Management. Biological Forum – An International Journal 13(2): 211-219
24. Sartaj Ahmad Bhat and Adarsh Pal Vig(2019). Vermistabilization and detoxification of sugar industry sludges by earthworms Elsevier Industrial and Municipal sludge pp.61-81
25. Seyyed Alireza Mousavi, Sara Rahimi Sader, Faezeh Farhadi, Majid Faraji, Farzaneh Falahi (2019). Vermicomposting of grass and newspaper waste mixed with cow dung using Eisenia fetida: physicochemical changes Global nest journal Volume 22, issue1pp: 8-14
26. Sharma, K. and V.K. Garg, 2018. Comparative analysis of vermicompost quality produced from rice straw and paper waste employing earthworm *Eisenia fetida* (Sav.).Bioresour. Technol. , 250:708-715
27. Sunil J. Kulkarni (2017). Vermicomposting- a Boon for Waste Minimization and Soil Quality International Journal of Research and Review.; 4(2):76-81.
28. T.Boruah, A.Barman, P.Kalita, J.Lahkar , H.Deka (2019). Vermicomposting of citronella bagasse and paper mill sludge mixture employing *Eisenia fetida* Bioresource Technology Volume 294, 122-147
29. V. Koval, I. Mikhno (2019). Ecological sustainability preservation of national economy by waste management methods Econ. Ecol. Socium, 3 , pp. 30-40
30. Vukovic, A.; Velki, M.; Ecimovic, S.; Vukovic, R.; Stolfa Camagajevac, I.; Loncaric, Z. (2021). Vermicomposting—Facts, Benefits and Knowledge Gaps. Agronomy 11, 1952.
31. https://doi.org/10.3390/agronomy11101952
32. Yadav, A.; Garg, V.K. (2019). Biotransformation of bakery industry sludge into valuable product using vermicomposting. Bioresour. Technol., 274, 512–517
33. Yatoo, A. M., Ali, M. N., Baba, Z. A., & Hassan, B. (2021). Sustainable management of diseases and pests in crops by vermicompost and vermicompost tea. A review. Agronomy for Sustainable Development, 41(1), 1–26.
34. Yvonne Indrani Ramnarain, Abdullah Adil Ansari & Lydia Ori(2019). ermicomposting of different organic materials using the epigeic earthworm *Eisenia foetida* International Journal of Recycling of Organic Waste in Agriculture volume 8, pages 23–36.