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REVIEW ARTICLE

Production of Vermi Compost from Organic Waste: A Review

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ABSTRACT

Generation of the huge amount of organic waste around the world-wide is a major ecological issue. When these organic wastes are recycled as manure for crop production & are subjected to the degradation & assimilative capacity of soil, pollution of streams & rivers receiving these wastes is reduced to a large extent as compared to the direct disposal in water bodies. Utilization of these organic wastes for productivity process is important for economic & environmental reasons. Vermicomposting may be the viable option to handle solid waste. This review provides a general overview of viability of vermicomposting processes as an ecofriendly approach. The approach is based on that perception that tomorrow's ecology is more important than today's economy. The integrated approach of composting and vermicomposting processes provides better results.

INTRODUCTION

Forthe first time, in 1970, vermicomposting was started in Ontario (Canada). Currently, the USA, Japan & Philippines are the leaders of vermicompost producers. In recent years, Indian Government & non-government organizations are also trying to popularize the vermicomposting process to turn Indian farmers towards Organic Farming. Organic farming is a crop production system that involves the use of renewable resources & recycling, returning to the soil the nutrients found in waste products & also excludes synthetically compounded fertilizer, pesticide, growth regulators etc. Vermicomposting is a biotechnological process, in which earthworms are employed to convert the waste into humus like material called Vermicompost. "Vermicomposting technology" is a fast growing one with its pollution free, cost effective and efficient nature. Vermicompost is organic manure produced by the activity of earthworms. An earthworm has a long rounded body with a pointed head & flattened posterior & has no back bone so it can twist & turn. Earthworms are hermaphrodites, which mean they have both male & female sex organs.Earthworms play an important role in the cycling of plant nutrients, turnover of organic matter & maintenance of soil structure. They can consume 10-20% of their own biomass per day i.e. one kg earthworms can consume 1 kg Organic material in a day. They ingest organic matter with a relatively wide C: N ratio & convert it to earthworm tissue with a lower C: N ratio. Thus they affect the physico-chemical properties of soil. They secrete as casting which are rich in Ca, Mg, K, N, P & useful microorganisms. Researchers have identified and named more than 4400 distinct species of earthworm. Each with unique physical and behavioral characteristics that distinguish them one from the other. While earthworm taxonomists identified thousands of individual worm species; out of them only SIX have been identified useful in vermicomposting systems to date. Here Five species are evaluated based on their ability to tolerate a wide range of environmental conditions and fluctuations, and their growth and breeding rate are displayed in Table 1.Two species-Eisenia fetida (Red Worm) and Eudrilus engeniae (African Night rawler) are most commonly used for vermicornposting.

Table I: Earthworms used in Vermicomposting

S. No.	Biological Name (Common Name) Category	Temperature Range	Reproductive Rate	No. of Young per cocoon	Time of emerge from cocoon	Time of Sexual Maturity
		ºF / ºC	Young per worm per week		Days	Days
1.	Eisenia Fetida / Eisenia Andrei (Red worm, Red wiggler brading worm) Eigeic worms	38 - 70 - 80 - 88/ 3.5-21.1-26.7-31.1	10	3	30-75	85-180
		Most useful for vermicomposting system				
	Eudrius Eugeniae	15 - 70 - 80 - 90/	7	2	15-30	30-95

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2.	**(African night crawler) Anecic worms**	7.20-21.1-26.7-32.2				
		Suitable to be growth under temperature controlled conditions / indoor				
	Amynthas Gracilus (Alabama Jumper or	45 – 70 – 80 – 90 / 7.20-21.10-26.70-32.20	7	2	15-30	30-95
3.	**Georgia Jumper)**	Suitable to be growth under temperature controlled conditions				
	Perionyx Exavatus (Traveler)	45 – 70 – 80 – 90 / 7.20-21.10-26.70-32.20	9	1	15-20	30-55
4.		Probably well suited under controlled conditions if traveler tendency is investigated				
5.	**Eisenia Hortensis (European Night**	45 – 55 – 65 – 85 / 7.20-12.8-18.35 -29.45	2	1	42-125	55-85
	Crawler)	Probably well suited under controlled conditions for remediation of very wet organisms				

Different medium for Vermicomposting

Management of solid waste has become one of the biggest problems we are facing today. The term Solid Waste includes both organic and inorganic waste materials generated from domestic, commercial, hospital, industrial, agricultural activities. It has been estimated that India, as a Whole, generates as much as 25 million tones of urban solid waste of diverse composition per year. But per capita waste production in India is minisculous. Most common practices of waste processing are uncontrolled dumping which causes mainly water and soil pollution. Besides dumping or sanitary land filling, the final disposal of solid waste can be carried out by other methods like incineration and composting. Vermicomposting is another biotechnique for converting the solid organic waste into compost by earthworms, as they are natural bioreactor & best tool for waste recycling. As mentioned in table I out of thousand species of earthworm only Five Species are useful for Vermicomposting. Each species of earthworm can consume a particular type of organic waste. On this basis they provide different nutrient containing compost. It enhances plant growth, suppresses disease in plants, increases porosity and microbial activity in soil, and improves water retention and aeration. Vermicompost also benefits the environment by reducing the need for chemical fertilizers and decreasing the amount of waste going to landfills.

Domestic Waste

Every home kitchen generates food scraps for disposal. Throwing these scraps in the garbage can create odor problems and add to the volume of waste going to the landfill. Disposing of kitchen scraps in a garbage disposal is convenient, but it adds to the burden of the waste-treatment system and throws away a potentially valuable resource. Furthermore, garbage disposals are not recommended for homes that rely on a septic system for waste disposal. A viable alternative to disposing of food scraps in the landfill or the sewer system is to compost them by earthworms. As earthworms eat all kinds of food & yard wastes, including coffee grounds, tea bags, vegetable & fruit waste, pulverized egg shells & grass clippings. But avoid garlic, onions, spicy food, bones, meats & dairy products. A little amount of citrus waste can be added but not too much as highly acidic medium is not suitable for worms. The resultingmaterial is a useful addition to gardens and potted plants.

Industrial Waste

Industrial wastes remain largely unutilized and often cause environmental problems like ground and surface water pollution, foul odors, occupying vast land areas etc. Non-toxic and organic industrial wastes could be potential raw material for Vermicomposting. The success of the process depends upon several parameters like quality of raw material, pH, temperature, moisture, and aeration etc., type of Vermicomposting system and earthworm species used. Among all the industries Sugar industry waste, Coir industry waste, food industry waste & biogas slurry may be the best option for Vermicomposting.From sugar industry sugar and alcohol are primary products but it also produces many by-products such as press mud, bagasse, distillery waste, and boiler ash and fermentation yeast sludge. All these wastes serve as an excellent source of nutrients. Earthworms are able to convert these wastes into fine mucus coated faecal pellets, popularly known as vermicompost. This is quality organic manure rich in beneficial micro flora and plant promoter substance along with major and micro nutrients necessary for plant growth.Coir waste is the byproduct from coir industry. Its production is about 1 million tons in India. Coir waste can be used as manure after proper decomposition. Composted coir waste is recommended for irrigated and dry crops. It also increased the yield of groundnut & maize. Usage of fruits produces two types of waste - a solid waste of peel / skin, seeds, stones etc – a liquid waste of juice and washes waters. In some fruits the discarded portion can be very high (e.g. mango 30-50%, banana 20%, pineapple 40-50% and orange 30-50%).Therefore, there is often a serious waste disposal problem, using these waste as a composting medium, one can generate nutrient rich good quality compost.

Temple Waste

The temple wastes consist of vegetable material (mainly flowers, leaves, fruits, sugar, jaggery etc.), milk and milk products, grains and water most of which are biodegradable and contain elements required for growth of microorganisms. It was found that vermicompost obtained by temple waste was rich in carbon, Nitrogen, Phosphorus and Potassium content. Thus, Vermicomposting of temple waste is an excellent and ecofriendly method of temple waste management**.**

Agriculture Waste

Agricultural by-products, e.g. animal dung, farm yard manure and crop residues are potential sources of plant nutrients. According to a conservation estimation, around 600-700 million tons (mt) of agricultural waste are available in India every year, but most of it remains unutilized (Suthar, 2008). India is one of the leading producers of banana (Musa acuminata), which are mostly grown in Tamil Nadu State. After the harvest of the fruits the whole plant (leaves, stem and rhizome) is left in the agriculture field for natural degradation, which takes several months. Banana waste mixed with cow dung was compost by using an epigeic earthworm species Eudrilus eugeniae (Kinberg). Physico- chemical characteristics of banana waste compost are mentioned in table II

Table: II Physico- chemical characteristics of banana waste compost

Treatments		pH	OC (%)	N (%)	P (%)	K (%)	C: N (%)
T1	Initial	8.1 ± 0.03	10.5 ± 0.04	0.16 ± 0.05	0.06 ± 0.0	0.14 ± 0.02	10.5 ± 0.14
	Final	7.4 ± 0.01	6.1 ± 0.01	0.30 ± 0.21	0.21 ± 0.03	0.29 ± 0.01	5.0 ± 0.12
T2	Initial	8.2 ± 0.01	10.9 ± 0.03	0.23 ± 0.03	0.09 ± 0.01	0.16 ± 0.02	12.8 ± 0.35
	Final	7.5 ± 0.03	6.3 ± 0.02	0.45 ± 0.27	0.25 ± 0.01	0.31 ± 0.03	7.3 ± 0.29
T3	Initial	8.1 ± 0.02	18.1 ± 0.01	0.36 ± 0.08	0.13 ± 0.02	0.22 ± 0.01	29.6 ± 0.52
	Final	7.4 ± 0.02	10.2 ± 0.21	0.70 ± 0.67	0.29 ± 0.01	0.46 ± 0.01	10.2 ± 0.54
T4	Initial	8.3 ± 0.03	23.4 ± 0.15	0.48 ± 0.12	0.26 ± 0.02	0.30 ± 0.04	51.7 ± 1.16
	Final	6.9 ± 0.01	10.4 ± 0.17	1.21 ± 0.28	0.56 ± 0.02	0.82 ± 0.03	13.1 ± 0.61
T5	Initial	8.2 ± 0.02	25.5 ± 0.17	0.52 ± 0.17	0.29 ± 0.01	0.31 ± 0.01	55.2 ± 1.20
	Final	7.0 ± 0.02	11.6 ± 0.25	1.25 ± 0.78	0.52 ± 0.04	0.81 ± 0.04	14.2 ± 0.27

All values are the mean and standard deviation of three replicates.

Utilizing the same method, other crop residue can also be used for vermicomposting. Like in Madhya Pradesh Soybean (Glycine max) is the major crop, after the cultivation of the crop waste & farm yard manure can be used for vermicomposting with suitable species of earthworm. As soybean is the leguminous crop its residues enriches the quality of vermicompost.

CONCLUSION

In several countries including India, significant work has been done. Scientists at Indian Institute of Sciences (Bangalore) had developed methods for decomposition by using earthworms, known as Vermicomposting. A good quality vermicompost can be prepared by selecting proper substrate, maintain optimal pH, temperature, moisture content and addition of suitable biotic and abiotic agents to the biowastes during vermicomposting. It is a sustainable biofertilizer & an excellent source of nutrient for crops. It gives 10-15% more crop yield besides improvements in the quality of the product. Vermicomposting may supply an opportunity for employment. Where accumulation of food waste, paper, cardboard, agriculture waste, manures, and biosolids are problematical, composting and Vermicomposting offer good potential to turn waste material into a valuable soil amendment.

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