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VERMICOMPOSTING : ECO-FRIENDLY APPROACH FOR THE MANAGEMENT OF ORGANIC SOLID WASTE INTO VALUABLE BIO FERTILIZER

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ABSTRACT

In India due to increasing population, industrialization, urbanization and economic development leads the generation of municipal solid waste. Management and handling of solid waste has become one of the biggest problems that we are facing today. India produces around 3000 million tones of organic waste per year. Unscientific management of organic solid waste caused a serious threat to the environment. Vermicomposting is effective and environmentally sustainable process for reduction of organic solid waste. The vermicompost improves the soil structure and health, enhancing soil fertility, water holding capacity and in term increase the crop yield. This technology would serve as a potential ecofriendly alternative for solid waste management.

KEY WORDS: Alternative,Environment,Municipal solid waste,Sustainable development,Vermicomposting.

INTRODUCTION

Around the world the problem of solid waste increasing day by day . Management and handling of municipal solid waste in scientific manner is gigantic task for cities and local authority. Rapid industrialization and population explosion in India has led to the migration of people from villages to cities, which generate thousands of tons of MSW daily (Brintha et al. 2015;Brintha and Manimegala, 2015;Kumaresan et al. 2016). Municipal Solid Waste (MSW) commonly known as refuse, trash or garbage consists of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, etc. This comes from our homes, schools, hospitals, and businesses (Hemalatha et al. 2013; Manyuchi and Phiri, 2013; Dasgupta, 2013). Organic waste materials contribute negative impact on the environment. Based on the region's people lifestyle and the population of the city, waste production rate ranges from 2000 to 5000 tons/day. The per capita waste generation is growing by about 1.3% per year in India table 1 (Udhaya et al. 2015).

Table 1: Per capita urban MSW generation

Year	Population (Millions)	Per capita	Total waste generation (Thousand tons/year)
2001	196.4	0.476	32.64
2011	261.2	0.500	48.30
2021	343.9	0.570	72.20
2031	452.9	0.653	110.01
2036	519.7	0.699	131.24
2041	597.5	0.750	160.96

This table shows that population in 2001 dramatically increases by 26% in 2041 . Based on the population, per capita solid wastes also get increases.

Use of chemical fertilizers resulted in pollution of land, water and air environment. There have been harmful effects on the living organisms due to the residues of these agrochemicals in food products. Adverse effects of chemical based fertilizers have shifted the interests of researchers towards organic biofertilizer like vermicompost which can increase the production of crops and prevent them from harmful pests without polluting the environment (Joshi et al. 2014; Chanda et al. 2011; Sinha et al. 2009). The environmentally acceptable Vermicomposting technology converts wastes to wealth. vermicompost enhances the crop yield and lessens dependence on chemical fertilizers thus mitigating climate change. Earthworms have dynamic potentials and can do wonderful job for human and biosphere. Worms are also known as “natural cleaners” (Albasha et al. 2015; Dalal, 2012; Subbulakshmi and Lakandan, 2015).

Vermicomposting or vermiculture is an eco-friendly process whereby earthworms are used to breakdown the biodegradable solid waste into soil and humus known as vermicast, vermicompost or earthworm compost (Nidoni and Math, 2015). A large number of bacteria of different species have been reported by researchers in vermicomposts produced by different species of earthworm table 2 (Joshi et al. 2014).

Table 2: Different types of bacteria in different species of earthworms

Vermicompost earthworm	**Names of bacteria**	**Beneficial traits**	**References**
Eudrilus sp.	Free-living N2 fixers *Azospirillum,Azotobacrer,* Autotrophic *Nitrosomonas, Nitrobacter,* Ammonyfying bacteria, Phosphate solubilizers, Fluorescent *pseudomonas*	Plant growth promotion by nitrification, phosphate Solubilization and plant disease suppression	Gopal et al. (2009)
Eiseniafetida	*Proteibacteria, Bacteroidetes, Verrucomicrobia, Actinobacteria, Firmicutes*	Antifungal activity against *Colletotrichumcoccodes, R. solani, P. ultimum, P. capsici and Fusariummoniliforme*	Yasir et al. (2009a)
Lumbricus terrestris	Florescent pseudomonas, Filamentous actinomycetes	Suppress *Fusariumoxysporum f.* sp. Asparagi and Fusariumproliferatum in asparagus,	Elmer (2009)

		Verticilliumdahliae in eggplant and *Fusarium. oxysporum f.* sp. Lycopersici Race 1 in tomato	
Unspecified	*Eiseniicolacomposti* YC06271	Antagonistic activity against *F. moniliforme*	Yasir et al. (2009b)
E. fetida	*Bacillus* spp. *Bacillus. megaterium*, *Bacillus pumillus*, *Bacillus subtilis*	Antimicrobial activity against *Enterococcus faecalis* DSM 2570, *Staphylococcus aureus* DSM 1104	Vaz-Moreira et al. (2008)
Aporrectodea trapezoids Aporrectodearosea	*Pseudomonas corrugata*214OR	Suppress Gaeumannomycesgraminis var. Tritd in wheat	Doube et al. (1994)
A. trapezoides Microscolexdubius	*Rhizobium meliloti* L5-30R	Increased root nodulation and nitrogen fixation in legumes	Stephens et al. (1994)
L. terrestris	*Brodyrhizobiumjaponicum*	Improved distribution of nodules on soyabean roots	Rouelle (1983)
Unspecified	*Rhizobium trifolii*	Nitrogen fixation and growth of leguminous plants	Buckalew et al. (1982)
Lumbricus rubellus	*Rhizobium japonicum*, *Pseudomonas putida*	Plant growth promotion	Madsen and Alexander (1982)
Pheretima sp.	*Pseudomonas oxalaticus*	Oxalate degradation	Khambata and Bhat (1953)

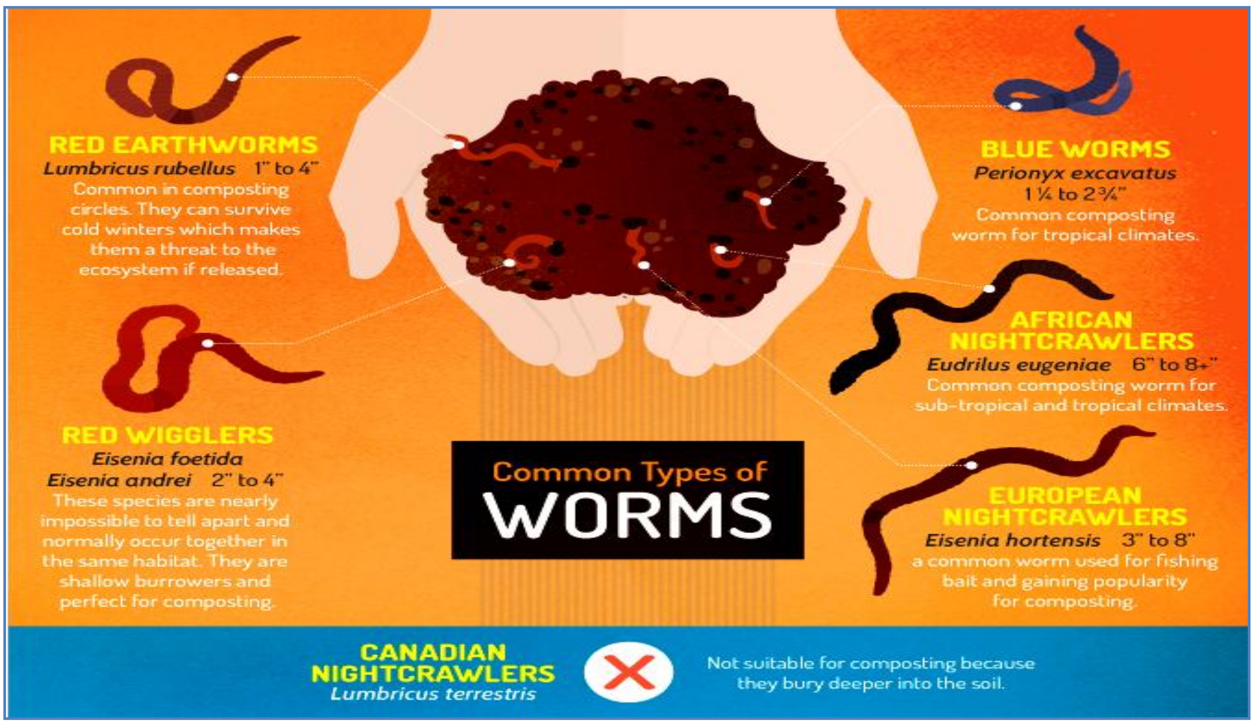
Source: Pathma and Sakthivel (2012)

The composting process and compost quality can be improved by adding inoculating agent like cow manure, poultry manure, yard waste etc. in the municipal solid waste (Alexandar et al. 2010;

Bharadwaj, 2010; Punde and Ganorkar, 2012). Vermicompost has been shown to be richer in a number of nutrients than compost produced by other composting methods (Kumari, 2013; Moorthi et al. 2016; Alidadi et al. 2014).

THE SELECTION OF WORMS

There are an estimated 1800 species of earthworm worldwide (Mehta and Karnwal, 2013). In vermicomposting worms are used as primary agent for decomposition of organic solid waste. Worms that are used for the conversion of biodegradable wastes into vermicompost like *Megascolexmauritii, Eiseniafoetida, Eudriluseugeniae, Perionnyxexcavatus, Lampitomauritii, Eiseniaandrei, Lampitorubellus and Drawidawillis*. Among these *Eiseniafoetida*and *Eudriluseugeniae* are the widely used varieties of worms (Sequeira and Chandrashekar, 2015).*Eiseniafoetida,* commonly known as the “compost worm”, “manure worm”, “red worm”, “tiger worm”, “brandling worm” and “red wiggler” (Parekh and Mehta, 2015).



Source:- https://www.fix.com/blog/composting-with-worms/

ENVIRONMENTAL FACTORS AFFECTING VERMICOMPOSTING PROCESS

Vermicomposting is greatly affected by the fluctuation of ecological factors. Environmental factors such as temperature, moisture, pH, EC and weight reduction required for successful vermicomposting of the organic solid waste (Amaravathi and Reddy, 2016). Earthworms are very sensitive to pH, several researchers have stated that most species of earthworms prefer a pH of about 7.0 (Pandit et al. 2012). Moisture level is a significant factor in vermicomposting process. The environmental factors regulate process in various ways and change the nutritional quality of vermicompost.

GENERAL PROCESS OF VERMI-COMPOSTING

It promotes environmental sustainability by transforming garbage into gold that improves our environment (Londhe and Bhosale, 2015; Aalok et al. 2009; Nagavallemma et al. 2006). Following steps are involved in vermicompost preparation:-

1. Vermicomposting unit should be in a cool, moist and shady site.
2. The raw material used is cow dung, chopped dried leafy material together with these raw material municipal solid wastes (biodegradable) will be used for vermi-composting.
3. Cow dung, chopped dried leafy materials and MSW are mixed and kept for partial decomposition for 15 – 20 days.
4. A layer of 15-20cm of chopped dried leaves/grasses should be kept as bedding material at the bottom of the bed.
5. Beds of partially decomposed material of size 6x2x2 feet should be made.
6. Each bed should contain 1.5-2.0q of raw material and the number of beds can be increased as per raw material availability and requirement.
7. Red earthworm (1500-2000) should be released on the upper layer of bed.
8. Water should be sprinkled with can immediately after the release of worms.
9. Beds should be kept moist by sprinkling of water (daily) and by covering with gunny bags/polythene.
10. Bed should be turned once after 30 days for maintaining aeration and for proper decomposition.

11. Compost gets ready in 45-50 days.
12. The finished product is 3/4th of the raw materials used.

CONCLUSION

The increased production of biodegradable solid waste and its safe disposal becomes the current global problem. Vermicomposting is cost-effective pollution abatement technology which increases soil productivity through improved soil quality. A variety of organic solid wastes viz. domestic, animal, agro-industrial, human wastes etc. can be vermicomposted and converted in to useful product. Vermicomposting plays vital role in organic farming. This technology promotes environmental sustainability by converting a organic waste to a value-added product that improves our environment.

REFERENCES

1) Brintha N, Srijayam M, Elamparithi V, and Manimegala G, "Utilization of municipal solid waste mixed with horse dung by using earthworm *Perionyx excavates*" International journal of advanced research in biological sciences, 2015, vol. 2(3), pp. 295–300.
2) Brintha N and Manimegala G, "Vermicomposting of municipal solid waste using an earthworm *Perionyxexcavatus*" International journal of modern research and reviews, 2015, vol. 3 Issue 6, pp. 711-715.
3) Kumaresan K, Balan R, Sridhar A, Aravind J, Kanmani P, "An integrated approach of composting methodologies for solid waste management" Global J. Environ. Sci. Manage., 2016, vol. 2(2), pp. 157-162.
4) Hemalatha B, "Application of vermicomposting for the biodegradation of msw and crop improvement" International journal of advanced engineering technology, 2013, vol. 4 issue 1, pp. 27-30.
5) Manyuchi MM and Phiri A, "Vermicomposting in solid waste management: a review" International journal of scientific engineering and technology, 2013, vol. 2, Issue 12, pp. 1234-1242.

6) Dasgupta T, "Waste management in Bhopal municipal corporation issues and perspectives" International journal of scientific engineering and technology, 2013, vol. 2 Issue 9, pp. 807-810.
7) Udhaya KK, Henock, Tsegay, "Conversion of solid waste into bio fertilizer by vermicomposting a case study of Padmanadapuram" International journal of innovative research in science, engineering and technology, 2015, Vol. 4, Issue 6, pp. 3801-3808.
8) Joshi R, Singh J, Vig AP, "Vermicompost as an effective organic fertilizer and biocontrol agent: effect on growth, yield and quality of plants" Reviews in environmental science and bio/technology, 2014, vol. 13 no. 3, pp. 1-26.
9) Chanda GK, Bhunia G and Chakraborty SK, "The effect of vermicompost and other fertilizers on cultivation of tomato plants" Journal of horticulture and forestry, 2011, Vol. 3(2), pp. 42-45.
10) Sinha, Rajiv, Herat, Sunil, Valani, Dalsukhbhai, Chauhan, Krunalkumar, "Earthworms vermicompost: a powerful crop nutrient over the conventional compost & protective soil conditioner against the destructive chemical fertilizers for food safety and security" American-Eurasian journal of agricultural & environmental sciences, 2009, vol. 5 (S), pp. 01-55.
11) Albasha MO, Gupta P, and Ramteke PW, "Management of kitchen waste by vermicomposting using earthworm, *EudrilusEugeniae*" International Conference on Advances in Agricultural, Biological & Environmental Sciences (AABES-2015) July 22-23, 2015 London(UK), pp. 81-84.
12) DalalP,"Municipal solid waste management by vermicomposting" International journal of science and nature, 2012, vol. 3(4), pp. 883-885.
13) Subbulakshmi G, lakandan RT, "Promotion of organic farming using vermicomposting technology in TamilNadu" Global journal for research analysis, 2015, vol, 4 issue 6, pp. 26-27.
14) Nidoni P and Math P,"Solid waste management by vermicomposting process" Indian J.Sci.Res., 2015, vol. 12(1), pp.192-196.
15) Pathma J, Sakthivel N "Microbial diversity of vermicompost bacteria that exhibit useful agricultural traits and waste management potential", Springer Plus, 2012, vol. 1(1), pp. 1–19.

16) Alexandar R, Lingan BA and Poyyamoli G, "Sustainable solid waste management with special reference to controlled composting in Puducherry and Cuddalore towns, India" European journal of applied sciences, 2010, vol. 2 (3), pp. 116-121.

17) Bharadwaj A, "Management of kitchen waste material through vermicomposting" Asian j. exp. biol. sci., 2010, vol. 1 (1), pp. 175-177.

18) Punde BD, Ganorkar RA, "Vermicomposting- recycling waste into valuable organic fertilizer" International journal of engineering research and applications (IJERA), 2012, Vol. 2 Issue 3, pp. 2342-2347.

19) Kumari S, "Solid waste management by vermicomposting" International journal of scientific & engineering research, 2013, Vol. 4 Issue 2, pp. 1-5.

20) Moorthi M, Nagarajan K, Senthilkumar A, "Vermi-technology of organic solid waste with using earthworm *EudrilusEugeniae*" The Journal of Zoology Studies, 2016, vol. 3(4), pp. 48-51.

21) Alidadi H, Saffari AR, Ketabi D, Peiravi R, Hosseinzadeh A, "Comparison of vermicompost and cow manure efficiency on the growth and yield of tomato plant" Health Scope, 2014, vol. 3(4), pp. 1-5.

22) Mehta N, Karnwal A, "Solid waste management with the help of vermicomposting and its applications in crop improvement" Journal of biology and earth sciences, 201 3, vol. 3, Issue 1, pp. B8-B16.

23) Sequeira V and Chandrashekar JS, "Vermicomposting of biodegradable municipal solid waste using indigenous Eudrilus sp. earthworms" International journal current microbiology and applied science, 2015, vol. 4(4), pp. 356-365.

24) Parekh SA, Mehta MJ, "Vermicomposting as sustainable option for organic waste management" International journal of innovative and emerging research in engineering, 2015, Vol. 2 Issue 1, pp. 13-20.

25) https://www.fix.com/blog/composting-with-worms/

26) Amaravathi G and Reddy RM, "Vermicomposting of municipal solid waste using different types of earthworm species – a comparative study" International journal of pharma and bio sciences, 2016, vol. 7(3), pp. B724 – B733.

27) Pandit NP, Ahmad N and Maheshwari SK, "Vermicomposting biotechnology: an eco-loving approach for recycling of solid organic wastes into valuable biofertilizers" Journal of Biofertilizers&Biopesticides, 2012, vol. 3 issue 1, pp. 1-8.

28) Londhe PB, Bhosale SM, "Recycling of solid wastes into organic fertilizers using low cost treatment: vermicomposting" International journal of innovations in engineering research and technology, 2015, vol. 2 issue 6, pp. 1-11.

29) Aalok A, Soni P, Tripathi AK, "Role of earthworms in breakdown of different organic wastes into manure: a review" Dynamic soil, dynamic plant, 2009, vol. 3 issue 2, pp. 13-20.

30) Nagavallemma KP, Wani SP, Lacroix S, Padmaja VV, Vineela C, BabuRao M and Sahrawat KL, "Vermicomposting: recycling wastes into valuable organic fertilizer" An open access journal published by ICRISAT (International crops research institute for the semi-arid tropics), 2006, Vol. 2, Issue 1, pp. 1-16.