Journal of AgriSearch, 6(Special Issue):25-27
An Open Access International Peer Reviewed Quarterly
ISSN : 2348-8808 (Print), 2348-8867 (Online)

Vermitechnology Leachate: An Eco-friendly Innovative Technology for Better Crop Production

ARADHANA KUMARI[*1], ANAMIKA KUMARI[2], ALOKA KUMARI[3] AND FARUQUE ALI[4]

ARTICLE INFO

Received on	:	30-04-2019
Accepted on	:	26-06-2019
Published online	:	09-07-2019

ABSTRACT

The disposal of organic wastes from domestic, agricultural and industrial sources has caused increasing environmental concerns. In this regard recycling of utilizable waste is feasible which can be solved by combination of effective technologies like Biodung composting and Vermitech (incorporating earthworms for the production of vermicompost). Vermicompost Leachate resulted in production of vermicompost confirming to the excellent nutrient status recorded in earlier experiments. Organic amendments like vermicompost leachate increase the organic matter content necessary for the maintenance of soil properties, which is beneficial for long-term sustainability and crop productivity. Considering the above it is proposed that large-scale production of vermicompost through vermitech to recycle organic waste could effectively help in managing solid waste and farmers for crop productivity could apply vermicompost thus produced. This could lead to a suitable environment-friendly effort towards a balanced ecosystem. The present article describes the solid waste were successfully processed through partial biodung composting and vermicomposting.

KEYWORD

Organic waste, Biodung composting, Vermicompost Leachate, Earthworms, Crop productivity

INTRODUCTION

With the drastic increase in population globally, there is no doubt that food supply will have to be increased at the same pace in order to meet the demand. Now days, it became one of the priorities of the farmers to maximize yield of crops. Asia is largest consumer of fertilizer (61%) of world (FAO, 2010). Eco-friendly approach of producing high quality naturally derived organic fertilizer is one of the major concerns. Vermicomposting technology has been under the spotlight of sustainable technology in the past decades. In this process, earthworms along with other animals have plays an important role in regulating soil processes, maintaining soil fertility and in bringing about nutrient cycling (Ismail, 1997; Lalitha *et al*., 2000). During this process of biological degradation take place and stabilization of organic waste by earthworms and microorganisms to form vermicompost (Edwards and Neuhauser, 1988). Several terms have been coined to explain the vermicomposting derived liquids based on their preparation method. Recent years efforts have been made potential use of earthworms in recycling of nutrients, waste management and development of vermicomposting systems at commercial scale. These are also called as "Ecosystem engineers" as they increase the numbers and types of microbes in the soil by creating conditions under which these creatures can thrive and multiply. The objective of present review is to clear the confusion of terms that used to describe these liquids.

In India, green revolution created opportunities for farmers low-cost supply of plant nutrients in inorganic form leads rapid displacement of organic manures derived from livestock excreta. Organic wastes can be ingested by earthworms and egested as a peat-like material termed "vermicompost" and liquid of excreta called as "Vermicompost leachate". This technology has been improvised to process the waste to produce an efficient bio-product (Kale *et al*., 1982; Ismail, 1993 and 2005). Epigeic earthworms like *Perionyx excavatus*, *Eisenia fetida*, *Lumbricus rubellus* and *Eudrilus eugeniae* are used for vermicomposting but the local species like *Perionyx excavatus* has proved efficient composting earthworms in tropical or sub-tropical conditions (Ismail, 1993; Kale, 1998). Vermicomposting offers a solution to tonnes of organic agro-wastes that are being burned by farmers and to recycle and reuse these refuse to promote our agricultural development in more efficient, economical and environmentally friendly manner. Sugar and rice industries burn their wastes thereby, destroy the soil organic matter content, kill the microbial population and affect the physical properties of the soil (Livan and Thompson, 1997). Water was constantly applied to the vermicomposting reactor to ensure the moisture level and excess water in the reactor will be leached out. The concept of the preparation of vermicomposting leachate is that nutrients that have been mineralized and assimilated by earthworms and microorganism during the vermicomposting process will be leached out along side with leachate. Table 3 is a summary of studies carried out on vermicomposting leachate/worm bed leachate. It showed high germination percentage and improvement in growth indices.

Vermicomposting process

It is an aerobic, non-thermophilic process of organic waste decomposition that depends upon earthworms to fragment, mix and promote microbial activity. Basic requirements during the vermicomposting process are suitable as follows:

[1] Research and Development Centre, Akhand Deep Sansthan, Bhagalpur, Bihar, India.
[2]Dept. of Botany, T.M.Bhagalpur University, Bhagalpur, Bihar, India.
[3]RCPGD, Dept. of Life Science, University of Kwazulu Natal, Pietermaritzburg, Scottsville-3209, South Africa
[4]Pro Vice Chancellor, B. N. Mandal University, Madhepura.
*Corresponding Authour E-mail: daradhana99@gmail.com

Table 3: Summary of studies on vermicomposting leachate/worm bed leachate

	Plant used	Findings	Reference
Sheep manure	Radish (Raphanus sativus *L.)*	Germination(%), number of leaves, plant height (cm), and shoot dry weight (g) are highest in leachate of 10% dilution. Whereas root dry weight (g) is highest in leachate of 15% dilution	Gutierrez-Miceli *et al.*, 2011
Cow dung, vegetable waste and mixture of cow dung and vegetable waste (1:2)	Strawberry (*Fragaria x ananassa Duch.*)	High leaf area and dry weight of plants were obtained for leachate from cow dung, vegetable waste and mix waste. Foliar application of leachate obtained from mixture of cow dung and vegetable waste showed supremacy in plant growth. Significantly higher fruit yield were obtained if compared to control.	Singh *et al.*, 2010

(* Source: Quaik *et al*, 2012b)

1. Bedding

Bedding is any material that provides a relatively stable habitat to worms. For good vermicomposting, this habitat high absorbency, good bulking potential and low nitrogen content needed.

2. Food Source

Regular input of feed materials for the earthworms is most essential step in the vermicomposting process. When the material with higher carbon content is used with C:N ratio exceeding 40:1, it is advisable to add nitrogen supplements to ensure effective decomposition. Food must be in limited layer because excess of the waste will generate heat. From waste ingested by worms, 5-10% is being assimilated in their body, rest excreted in the form of vermicast.

3. Moisture

Perhaps the most important requirement of earthworms is adequate moisture in the range of 60-70%. If feed stock too wet, it may create anaerobic conditions which may be fatal to earthworms.

4. Aeration

Factors such as high levels of fatty/oily substances in the feedstock or excessive moisture combined with poor aeration may render anaerobic conditions in vermicomposting system.

5. Temperature

The activity, metabolism, growth, respiration and reproduction of earthworms are greatly influenced by temperature. Vermicomposting require moderate temperatures (10-35°C) while tolerances and preferences vary from species to species. The pH can be adjusted by adding calcium carbonate.

Vermicomposting leachate *and* ***Vermicompost aqueous extract*** **(vermicompost teas)**

Water was constantly applied to the vermicomposting reactor to ensure the moisture level and excess water in the reactor will be leached out. The concept of the preparation of vermicomposting leachate is that nutrients that have been mineralized and assimilated by earthworms and microorganism during the vermicomposting process will be leached out along side with leachate. Vermicompost aqueous extracts can be extracted through employing non-aerated or aerated method (Pant *et al.*, 2009). For this process, non-aerated or passive extraction of extract was by placing vermicompost into a fix amount of volume of water with occasional stirring and allowed to sit for 7 days and for aerated extraction, air was pumped and oxygen level was maintained to above 5mgL^{-1}. Sugar, grain, fish emulsion, kelp tea, humic acid and other products are often added during the process to further enhance the microbial activity of the end-product (Ingham, 2005).

The chemical-free method of preparation for these liquids is in favor as an approach of producing environmental friendly biofertilizer. Nutrients present are completely soluble in water due to its preparation method. Hence, it has the potential to be used as a foliar spray fertilizer. Foliar fertilizing compensates the loss of fertilizing effect of conventional soil-applied fertilizer through the prevention of leaching. Available plant nutrients that present in these liquids are

Table1: Physicochemical properties of vermicompost (Mean + SD)

Parameters	Vermicompost
Ph	6.12 + 0.03
Total salts (ppm)	3148.67 + 48.58
Total Nitrogen (%)	1.11 + 0.05
Organic Carbon (%)	9.77 + 5.05
C/N ratio	8.80
Available Phosphate (ppm)	597.67 + 0.58
Calcium (ppm)	322.33 + 24.91
Magnesium (ppm)	137.33 + 19.50
Potassium (ppm)	2428.33 + 326.28
Manganese (ppm)	0.69 + 0.01
Iron (ppm)	0.11 + 0.01
Copper (ppm)	0.01 + 00
Zinc (ppm)	2.13 + 0.05

(* Source: Subler *et al.*, 1998)

valuable and have the potential to be used as nutrients solution in hydroponics culture. Quaik *et al.* (2012a) reported that diluted vermiwash and vermicomposting leachate used as nutrient solution for *Plectranthus ambionicus*, chlorophyll and carotenoids content were higher if compared to control.

Table 2: Nutrient composition of vermicompost and garden compost

Characteristics	
Organic carbon%	9.15 to 17.88
Total Nitrogen %	0.5 to 0.9
Phosphorus %	0.1 to 0.26
Potassium %	0.15 to 0.256
Sodium %	0.055 to 0.3
Calcium & magnesium (Meq/100 g)	22.67 to 47.6
Copper; mg L^{-1}	2.0 to 9.5
Iron, mg L^{-1}	2.0 to 9.3
Zinc, mg L^{-1}	5.7 to 9.3
Sulphur, mg L^{-1}	128.0 to 548.0

(* Source: Nagavallemma, 2004)

Use in Hydroponic Culture

Hydroponics culture has the advantage of being carried out in space limited area. Hydroponics culture is a soilless cultivation method which is a contribution for crop production in area where lands are inadequate for crop production. By using these plant nutrients rich liquids in hydroponics culture, soil borne diseases and pests can be controlled (Jensen, 2002).Usage of other fertilizer can be also reduced.

CONCLUSION

Vermicomposting derived liquids contain valuable nutrients that promote plant growth. Substrates that have been used in these liquids production are mainly animal and agricultural waste. Different terms are used in describing these liquids as there are some differences in preparation. However, controversy is still exists as these liquids are produced from waste substrates especially industrial waste that may contain heavy metals and other harmful elements. Chances of transferring harmful substances from the substrate to the liquids are still unknown. Therefore, further studies are strongly needed especially liquid preparation method as well as on relationship between the substrates and the vermicomposting derived liquids.

REFERENCES

Edwards CA and Neuhauser EF. 1988. Earthworms in waste and environmental Management. SPB Academic Press, The Hague, The Netherland.

FAO. 2010. Current world fertilizer trends and outlook to 2014.Rome, Italy.

Gutierrez-Miceli FA, Oliva-Llaven MA, Nazar PM, Ruiz-Sesma B, Alvarez-Solís JD, Dendooven L. 2011. Optimization of Vermicompost and Worm-Bed Leachate for the Organic Cultivation of Radish. *Journal of Plant Nutrition* **34(11):**1642-1653.

Ingham ER. 2005. The compost tea brewing manual; Latest methods and research. Soil Food Web Inc., Corvalis.

Ismail SA. 1993. Keynote papers and Extended Abstracts. Congress on traditional Sciences and technologies of India, IIT Bombay, pp: 10.27-10.30.

Jensen MH. 2002. Controlled environment agriculture in deserts tropics and temperate regions – a world review. *Acta Hort.* **578**: 19-25.

Kale RD. 1982. Earthworm Cinderella of Organic Farming. Prism Book Pvt Ltd, Bangalore, India, 88 p.

Kale RD. 1998. Earthworm- Cinderella of Organic Farming. Publishers- Prism Book Pvt. Ltd., Bangalore, India.

Lalitha R, Fathima K, and Ismail S A. 2000. The impact of biopesticide and microbial fertilizers on productivity and growth of *Abelmoschus* esculentus. Vasundara The Earth **1 & 2:** 4-9.

Livan MA and Thompson W. 1997. NARI Annual Report. 1992. Evaluation of vermicompost. Proc. Nat. Semi. Org. Fmg. MPKV, Pune.

Nagavallemma KP, Wani SP, Lacroix S, Padmaja VV, Vineela C, Babu Rao M and Sahrawat KL. 2004. Vermicomposting: Recycling wastes into valuable organic fertilizer. Global Theme on Agrecosystems Report no. 8. Patancheru 502-324, Andhra Pradesh, India: *International Crops Research Institute for the Semi-Arid Tropics*. 20 pp.

Pant AP, Radovich TJK, Hue NV, Talcott ST and Krenek KA. 2009. Vermicompost extracts influence growth, mineral nutrients, phytonutrients and antioxidant activity in pak choi (Brassicarapa cv. Bonsai, Chinensis group) grown under vermicompost and chemical fertilizer. *Journal of Science of Food and Agriculture* **89(14)**: 2383-2392.

Quaik S, Embrandiri A, Rupani PF, Singh RP and Ibrahim MH. 2012a. Effect of Vermiwash and Vermicomposting Leachate in Hydroponics Culture of Indian Borage (Plectranthus ambionicus) Plantlets. UMT 11th International Annual Symposium on Sustainability Science and Management. 210-214. [ISBN 978-967-5366-93-2]

Quaik S, Embrandiri A, Rupani PF and Ibrahim MH. 2012b. Potential of Vermicomposting Leachate as Organic Foliar Fertilizer and Nutrient Solution in Hydroponic Culture: A Review. *2nd International Conference on Environment and BioScience IPCBEE* **44**: 43-47.

Subler S, Edward CA, Metzger J. 1998. Comparing Vermicompost and composts. *Biocycle* **39:** 63-66.