AJES
ASIAN JOURNAL OF ENVIRONMENTAL SCIENCE ■ VOLUME 7 | ISSUE 2 | DECEMBER, 2012 | 251-254

A CASE STUDY

Recycling of organic wastes in agriculture through vermicompost and its significance on environment

■ DEBABRATA MONDAL AND SUBIR KUMAR SINHA

Article **C**hronicle :
Received **:**
13.08.2012;
Accepted **:**
24.10.2012

SUMMARY : The key role of vermicompost in improving physical properties such as yields.aggregate formation, bulk density, porosity and hydraulic conductivity is well known. Although many of these are interrelated. There are about 3000 species of earthworm throughout the world of which about 509 are available in India. Bouch (1997) classified these worms into 3 major categories *viz.*, epigeics, endogeic forms live deep inside the soil. It has been observed that vermicomposts exhibit considerably higher concentration of various elements, as compared the ordinary composts made from similar organic materials. Vermicompost is a peat like material with excellent structure, porosity, aeration, drainage and moisture holding capacity. The study showed vermicompost, applied same does as ordinary compost alone with different rules of phosphatic fertilization to increase the availability of phosphorus in such soils in the manner.

HOW TO CITE THIS ARTICLE : Mondal, Debabrata and Sinha, Subir Kumar (2012). Recycling of organic wastes in agriculture through vermicompost and its significance on environment. *Asian J. Environ. Sci.,* **7** (2): 251-254.

Key **W**ords **:**
Vermicompost, Organic waste, agriculture, Compost, Earth worms

Author for correspondence **:**
DEBABRATA MONDAL
Department of Agricultural Extension, Palli Siksha Bhavana, Institute of Agriculture, Visva Bharati, SRINIKETAN (W.B.) INDIA
Email : mondal.debabrata@gmail.com

See end of the article for **Coopted authors'**

Spectacular achievement has been made in India in the sector of food grain production and much of this success can be attributed towards increased use of inorganic fertilizers for improving the productivity levels of agricultural lands of the country. However, owing to long term and indiscriminate uses of inorganic fertilizers for maximizing the agricultural production, the soil under such condition of fertilization have started showing symptom gradual degradation and rate of responses to fertilizer application are showing trend to decline, this is however not an isolated phenomenon for our country alone and this problem has now become a global concern. Concept of integrated plant nutrient system (IPNS) involving large scale substitution of inorganic fertilizers by organic manures has come up as possible means of solution of this problem. Vermicomposting is a new concept of compost preparation with the help of earthworm and may prove itself to be highly useful in this concept. Not only the vermicomposts exhibit much higher amount of material elements in comparison to traditional composts prepared from similar organic materials but also they contain some hormones and enzymes which also help the well beings of the soil and crop. In addition, these earthworms tend to bring even more resistant organic materials under composting in comparison to the traditional methods of composting. Some relevant aspects of vermicomposting have been discussed in this communication.

Concept of vermicomposting:

Importance of earthworms in improving productivity of soils is known since long. While Greek philosopher Aristotle referred to earthworms as "the intestine fertility'', status of various soil. Since then large volumes of work have been carried out to study the uses of earthworm population of soils for increasing agricultural production. There are about 3000 species of earthworm throughout the world of which about 509 are available in India. Bouch (1997) classified these worms into 3 major categories *viz.*, epigeics, endogeic forms live deep inside the soil. Anecics, on other hand, live in the soil but come to the soil surface time to time for the purpose of execration. Of these 3 groups,

epigeic form of earthworms is of prime importance from the point of view of vermicomposting while the other two help to improve the inherent fertility status of the soils.

The epigeic earthworms can consume large amounts of organic materials as compared to their body weights. While emphasizing the voracious nature of food uptake by earthworms Bhawalkar and Bhawalkar (1993) compared to daily food consumption of different organism with relation to a standard 1000 kg. biomass and showed the efficiency of earthworms in consuming large quantities of material.

Table 1: Consumption of biomass

Daily food	Consumption per 1000 kg. biomass
1000 kg. biomass	Daily food consumption
Elephant	4 kg.
Humans	20 kg.
Mice	200 kg.
Earthworms	500 kg.
Fungi	2000 kg.
Bacteria	20,000 kg.

With such high efficiency of food consumption epigeic earthworms uptake large amount of organic materials of which only 5-10 per cent are utilized for their body synthesis and the rest amount are released as excreta which gives rise to vermicompost. During the course of this process, these materials are, ground by the very efficient gizzard of the worm while various enzymes and hormones present in the digestive juice in the intestine of the earthworms enrich the quality of these cast materials.

Nature and properties of vermicompost:

It has been observed that vermicomposts exhibit considerably higher concentration of various elements, as compared the ordinary composts made from similar organic materials, Shinde *et al.* (1992) reported organic carbon, total nitrogen, available nitrogen and total phosphorus to be considerably higher in vermicompost in comparison to traditional composting by using cow dung.

Table 2: Comparison of vermicomposting

	Vermi compost	Traditional farm compost
Nitrogen	1.60	0.75
Phosphorus	2.45	0.27
Potassium	0.80	0.55
Calcium (ppm)	0.44	0.91
Magnesium (ppm)	96.50	69.0
Cupper (ppm)	4.89	2.0
Carbon. nitrogen ratio	15.50	31.28
Fe (ppm)	17.52	16.40
Zinc (ppm)	24.45	14.50

Work done under a Department of Science and Technology, Govt. of West Bengal sponsored research project at Institute of Agriculture, Visva Bharati revealed that the quality of vermicomposts depends largely on the nature of the organic materials used for the composting. Availability of phosphorus under two types of compost, one with and another without earthworms using different organic wastes have been presented in Table 3.

Table 3: Average value of easily extractable phosphorus (ppm) in different wastes

Wastes	With earthworms	Without earthworms
Kitchen wastes	908.3	484.5
Cowdung	1186.5	626.9
Poultry manure	1248.6	1113.8
Municipal wastes	1005.0	413.4
Mixed leaves	501.0	151.9

Effect of vermicompost on soil properties:

In spite of large volume of work done on vermicomposting, information related to effects of vermicompost on soil properties are extremely meagre. Kale *et al.* (1992) carried out fields trials on application of vermicomposts to rice field and observed increase population of beneficial microbes like nitrogen –fixing bacteria and mycorrhizae over the control plots. Relative efficiency of vermicompost and ordinary compost in increasing available phosphorus status of red and lateritic soil have been studied under laboratory condition at Institute of Agriculture, Visva Bharati, west Bengal research project (Anonymous, 1906). The study showed vermicompost, applied same does as ordinary compost alone with different rules of phosphatic fertilization to increase the availability of phosphorus in such soils in the manner, shown in Table 4.

Table 4 : Average values of available phosphorus (ppm) in red and lateritic soils under vermicompost application

Treatment	Available phosphorus (ppm)		
	Soil-I	Soil-II	Soil-III
Control	9.60	7.2	14.3
OC	27.40	39.1	49.6
VC	66.70	60.80	44.1
P100	60.30	40.5	95.2
OC+ P100	96.30	142.70	104.8
VC+ P100	127.10	127.1	133.4
VC+ P80	112.40	120.7	118.6
VC+ P60	109.00	114.0	109.0

OC=ordinary compost, VC=Vermicompost. 100, 89, 60 indicate % dose of P in ppm.

These results clearly demonstrate that application of vermicompost was highly effective in reducing the inorganic fertilizers for the purpose of getting similar results as were obtained with use of ordinary compost and standard dose of inorganic fertilizer thus supporting the basic principle of integrated plant nutrient system.

Effect of vermicompost on crop production:

The positive effect of vermicomposts on fertility status of soil has good effect on crop growth also. Encouraging results of using Vermicompost on fruiting and flowering plants have been prepared by Pattanaik (1995) kale and Bano (1980) while studying effect of vermicompost on rice crop production also reported 200 kg of vermicompost to result in similar production of rice as was obtain with 300 kg FYM + 20 kg urea and 30 kg suphala (15:15:15). At Institute of Agriculture, Visva Bharati, a study was carried out to assess the effect of vermicompost application on yield of ipomea with relation to various treatment combinations. The results of study have been presented in Table 5.

Table 5 : Average effects of different combination of compost and inorganic fertilizers on yield of ipomea

Sr. No.	Treatment	Average yield
1.	OC+(NPK) 100	16.4
2.	VC+(NPK) 100	21.8
3.	VC+(NPK) 75	18.5
4.	VC+(NPK) 50	19.7
5.	Control	6.8

OC =ordinary compost, VC=Vermicompost . 100, 75, 50 indicate % of standard NPK doses

Protocol for vermicompost preparation:

- The compost can be prepared in concrete tank. The size of the tank should be 3 ft. breath, 1.5-2 ft. high, suitable plastic tube basin structure may be used.
- The available bio-waste (kitchen, farm waste crop versidues, vegetable wastes, green squatant leaves) are to be collected and to be hiped under sun for about 7-10 days and be chopped if necessary.
- Springling of cowdung slurry to the heap may be also done.
- A thin layer of surface soil/sand 1-2 ft.
- Fine bedding materials such as partially decomposed cowdung or chopped leaves are to be placed over the soil.
- Placed the chopped weed or wet biomass and partially decomposed cowdung layer wise 10-20 ft. The bio-wastes: cowdung ratio should be 60:40 on dry weight basis.
- Add about 2-3 kg. earth worms of the efficient spp. Eisenia Foetita, Amylantnus diffringnes, Endrius enginae etc. over the mixture.
- Cover the materials in the pith, container by dry straw gunny cloth bag.
- Sprinkle of water should be done as necessary to maintain 70-80 per cent moisture content.
- Provision of a shade over the compost mixture is essential to prevent entry of rain water and direct sunlight.
- Sprinkling of water should be stopped when 80-90 per cent bio- wastes is decomposed. Maturity of the product or mixture manure could be judge visually, by observing the formation of granular structure of the compost at the surface of the tank.
- Harvest the vermicompost by scrapping layer wise from the top of the tank and heap gunder shade. This helps in earthworm separation from compost sining may also be done to separate the earthworm and compost.

Vermicompost in future agriculture and sustainable agriculture:

Sustainable agriculture:

The word sustainable means refers to "Keeping and effort going continuously, the ability to keeping from failing". In the content of agriculture 'sustainability' basically refers to the capacity to remain productive while maintaining the resource base. FAO defines sustainable agriculture as "the management and conservation of the resource base and the orientation of technological and institutional changes in such a manner as to ensure attainment and continued satisfaction of human needs for future and present generation. Such sustainable development is environmentally non degrading, technically appropriate economically viable and socially acceptable".

Growing production:

It contains high level of different micro or macro nutrient in balance form which has great importance in production.

Economically viable:

Vermicompost is prepared form different wastages which is cheap and early available. So cost of production is very low so it is economic than use of high cost inorganic fertilizer.

Eco-friendly:

Vermicompost preparation is a natural recycling process. It is prepared by using all natural resources in possible means. Without hampering environment, bio-diversity and eco-system.

Conclusion:

Recycling of organic wastes is not only ecological necessity but in a country like ours, it is an economical compulsion also, since India produces about 363 mt of wastes

annually from all field crops. Earthworms are natural bio-reactor and their activities stimulate the rate of decomposition of organic residue by increasing both surface area and aeration of the substrate. Vermicompost is formed from the bio oxidation and stabilization process of organic material which involves the joint action of earthworms and microorganisms and does not involve a thermophilic stage. Vermicompost is a peat like material with excellent structure, porosity, aeration, drainage and moisture holding capacity.

Coopted Authors' :

SUBIR KUMAR SINHA, Department of Agricultural Economics and Agricultural Statistics, Palli Siksha Bhavana, Institute of Agriculture, Visva Bharati, SRINIKETAN (W.B.) INDIA

REFERENCES

Anonymous (1960). BARI (Bangladesh Agricultural Research Institute) Annual report (1960-1961), B.A.R.I., Joydebpur (GAZIPUR) BANGLADESH. 75 p.

Bhawalkar, U.S. and Bhawalkar, U.V. (1993). Vermiculture biotechnology. In: *Organics in soil health and crop production* (Ed. P.K. Thampan), Peekay Tree Crops Development Foundation, Cochin. pp. 65-85.

Bouche, M.B., Al-Addan, F., Cortez, J., Hammed, R., Heidet, J.C., Ferriere, G., Mazaud, D. and Samih, M. (1997). Role of earthworms in the N cycle: a falsifiable assessment. *Soil Biol. Biochem.*, **29**(3/4): 375-380.

FAO (Food and Agriculture Organization of the United Nations). (1985). *The world meat economy in figures*. FAO Economic and Social Development Paper 49. FAO, ROME (ITALY). 192 pp.

Kale, R.D., Mallesh, B.C., Bano, K. and Bagyaraj, D.J. (1992). Influence of vermicompost application on the available macronutrients and selected microbial populations in a paddy field, *Soil Biol. Biochem.*, **24**: 1317-1320.

Pattnaik, S. and Reddy, M.V. (2010). Assessment of municipal solid waste management in Puducherry (Pondicherry), India. *Resour. Conserv. Recycl.*, **54**(8):512–520.

Roy, S.J., Das, B.S. and Bora, L.C. (1998). Non pesticidal management of damping off of cabbage caused by *Rhizoctonia solani* kuehn. *J. agric. Sci. Society of North East India*, **11**(2): 127-130.

Shinde, P.H., Naik, R.L., Nazirkar, R.B., Kadam, S.K., and Khaire, V.M. (1992). Evaluation of vermicompost, National Seminar on Organic Farming, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar (M.S.) INDIA. pp. 54-55.

****
******