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VERMICOMPOST AS A PROMISING ALTERNATIVE TO INORGANIC FERTILIZER

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Introduction

Vermicomposting is a biotechnological environmentally-friendly process of converting organic waste into useful products using certain species of earthworms. It is a mesophilic process, utilizing microorganisms and earthworms that are active at 10-32°C (not ambient temperature but temperature within the pile of moist organic material).This process is faster than composting because the material passes through the earthworm gut where the resulting earthworm castings are rich in microbial activity and plant growth regulators and fortified with pest repellence attributes as well (Nagavallemma *et al.*, 2004). The worm casts are also rich in humic acids that condition the soil and have a perfect pH balance. Vermicompost is non-burning and it contains high amounts of nitrogen, potassium, phosphorous, calcium, magnesium and sulphur having good aeration, porosity, structure, drainage and moisture holding capacity. Vermicomposting process has several positive impacts on plant-soil systems and also enriches the fertility of soil. This organic fertilizer is therefore increasingly considered in agriculture and horticulture as a promising alternative to inorganic fertilizers.

Nutritive value of vermicompost : Nutrient content in vermicompost vary depending upon the waste materials that is being used for compost preparation. The commonly available nutrients in vermicompost are as follows (Table 1).

Table 1. Nutrient composition of vermicompost

Nutrient content	Percentage
Organic carbon	9.5-17.98%
Nitrogen	0.5-1.50%
Phosphorous	0.1-0.30%
Potassium	0.15-0.56%
Sodium	0.06-0.30%
Calcium and Magnesium	22.67 to 47.60 meq/100g
Sulphur	128-548 mg/kg
Copper	2-9.50 mg/kg
Iron	2-9.30 mg/kg
Zinc	5.70-11.50 g/kg

Source: Anonymous (2016)

Advantages of vermicompost : Vermicompost provides the macro and micro nutrients in readily available form and also enhances uptake of nutrients by plants. Sreenivas *et al.* (2000) carried out a study on integrated effect of application of fertilizer and vermicompost on soil available nitrogen (N) and uptake of ridge gourd (*Luffa acutangula*) at Rajendranagar, Andhra Pradesh, India and found significantly increased soil available N with increasing levels of vermicompost. N uptake was highest at 50% fertilizer + 10 t/ha vermicompost. Jadhav *et al.* (1997) also found highest uptake of nitrogen

(N), phosphorus (P), potassium (K) and magnesium (Mg) when fertilizer was applied in combination with vermicompost in case of rice (*Oryza sativa*) plant. Vermicompost improves growth and yield of vegetable, fruit, flower and field crops. Higher germination (93%) was recorded in mung bean (*Vigna radiata*) by the application of vermicompost compared to the control (84%). Further, the growth and yield of mung bean was also significantly higher with vermicompost application (Karmegam *et al*., 1999; Karmegam and Daniel, 2000). The yield of pea (*Pisum sativum*) was also higher with the application of vermicompost (10 t/ha) along with recommended N, P and K than with these fertilizers alone (Reddy *et al*., 1998). The fresh weight, number of flowers per plant (26), flower diameter (6 cm) and yield (0.5 t/ha) of *Chrysanthemum chinensis* were maximum with the application of 10 t/ha of vermicompost along with 50% of recommended dose of NPK fertilizer. Besides, the combined application of vermicompost at 15 t/ha and 50% recommended dose of NPK fertilizer increased the vase life of flowers for upto 11 days (Nethra *et al*., 1999). Vermicomposting reduces the C: N ratio of waste converted into compost that retains more N than the other composts (Gandhi *et al*., 1997). Earthworms also play a vital role in the recycling of N in different agro-ecosystems, especially under jhum (shifting cultivation) where the use of agrochemicals is minimal. Vermicompost has significant effects on soil pH, microbial population and soil enzyme activities (Maheswarappa *et al*., 1999). It also helps in reducing the toxicity of heavy metals and improves soil structure, texture, aeration and water holding capacity of soil. Vermicompost reduces population of pathogenic microbes and minimizes the incidence of pest and diseases.

Materials required for vermicomposting

a) A range of agricultural residues (animal manures, dairy and poultry wastes, food industry wastes, municipal solid wastes, biogas sludge and bagasse from sugarcane factories also serve as good raw materials for vermicomposting)
b) Cow dung
c) Water
d) Earthworms

Method of preparation

Selection of site : Vermicompost can be produced in any place with shade, high humidity and cool place. A thatched roof may be provided to protect the process from direct sunlight and rain. The waste heaped for vermicompost production can be covered with coconut/ arecanut fronds, banana leaves or with moist gunny bags.

Vermicompost production process : Production process may involve the following steps depending upon the area available :

i) A pit size of measurements 20'x4'x 2½' or any convenient length 4'x 2½' is dug in soil.
ii) Thick layer of cow dung slurry is covered over the cut pieces of arecanut/ coconut fronds or banana dry leaf materials over which the ratio of 80% waste and 20% cow dung should be maintained.
iii) Repeat the process of layering and then cover the pit with thin layer of cow dung.
iv) Leave it for 25 to 30 days depending on the climatic conditions for partial decomposition.
v) This process helps in partial digestion/ decomposition of the material and fit for earthworm consumption.
vi) Pit should be kept moist by sprinkling water daily depending on climatic condition by covering with gunny bags.

vii) Earthworms *viz*. *Eisenia foetida* (Red earthworm), *Eudrilus euginiae* (Nightcrawler), *Perionyx excavates* etc are released to the pit.
viii) Pits should be turned once after 30 days for maintaining aeration and proper decomposition.
ix) Compost gets ready layer by layer in 45 to 60 days depending on the quantity of biodegradable waste or number of earthworms released.

Harvesting of vermicompost

i) When vermicompost is completely decomposed and ready, it appears black, quite light weight and has a pleasant earthy smell.
ii) The vermicompost should be kept over a heap of partially decomposed cow dung so that earthworms could migrate to cow dung.
iii) The harvested vermicompost should be stored in dark, cool place.
iv) It should have minimum 40% moisture.
v) Sunlight should not fall over the composted material. It will lead to loss of moisture and nutrient content.
vi) The harvested compost material is openly stored rather than packed in over sac.
vii) Packing can be done at the time of selling. It is stored in open place, periodical sprinkling of water may be done to maintain moisture level and also to maintain beneficial microbial population.

Preventive measures : Minimum 25-30 days are needed for decomposition of cow dung and biomass to remove excess heat. Organic wastes should always be free from plastics, stones, glass pieces, chemicals, pesticides and metals. Proper aeration and 18-28^{o}C temperature with 30-40% moisture level should be maintained for proper growth and multiplication of earthworms, and decomposition of biomass. The African species of earthworms (*Eisenia fetida* and *Eudrilus eugenae*) are ideal for the preparation of vermicompost. Most Indian species are not suitable for the purpose. After completion of the process, the vermicompost should be removed from the bed at regular intervals and replaced by fresh waste materials.

Table 2: Dosage for different horticulture crops:

Sl. No.	Crops	Dosage
Vegetable crops	Cole crops and tomato	3 t/ha
	Others	2 t/ha
Fruit crops	Sapota, Mango, Grapes	3 kg/plant
	Papaya, Banana, Pomegranate	2 kg/plant
	Others	1.5 kg/plant
Flower crops	Rose, Jasmine, Chrysanthemum	2.5 t/ha
	Others	2 t/ha
Plantation crops	Coconut	2 kg/plant
	Arecanut and others	1 kg/plant

How to Use Vermicompost ?

For field crops, vermicompost (2-3 t/ha) is used by mixing with seed at the time of sowing or by row application at 12-15 cm seedling stage followed by light irrigation. In case of fruit crops, the amount of vermicompost ranges from 5 to 10 kg/tree depending on the age of the plant. A ring of 15-18 cm height can be made around the plant for efficient application. A thin layer of vermicompost (2-5 kg)

along with dry cow dung, bone meal and water is sprayed on the surface after covering with soil. For vegetables, vermicompost is applied at the rate of 1 t/ha in the nursery bed to get healthy and vigorous seedlings. But for transplants, vermicompost is applied initially at the time of planting at the rate of 400-500 g/plant and 45 days after planting followed by normal irrigation. In flowers also vermicompost is applied at 750-1000 kg/ha rate by covering with soil.

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