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VERMICOMPOSTING PRODUCTION TECHNOLOGY – A CRITICAL REVIEW

Karthick Vikram.P and Regis Anton Roy.J
Agricultural College and Research Institute,
Tamilnadu Agricultural University, Madurai, Tamilnadu - (625104), India
Corresponding email: karthickvikram555@gmail.com, antonroy30701@gmail.com

Abstract
Now a days, the increasing demand for food goes on increasing with the increasing population. Hence, various techniques are needed to utilize the available resources. Even the wastes we dispose could be utilized efficiently. The wastes that are degradable are categorized and are to be exploited for the usage as manures. A technology that utilizes earthworms for the conversion of biodegradable wastes into organic manure called vermicompost that is rich in nutrients is called Vermicomposting. Through this efficient technology, major wastes are recycled into manures thereby creating an ecofriendly environment.

Keywords : biodegradable , earthworms , vermicompost , wastes

Introduction

Earthworms are wonder organisms that are present in earth over 20 milllion years. They play a very important vital role in the environment in various manner. They feed on the dead and decaying organic matter thereby converting all types of wastes into organic nutrients need for the crop ecosystem. This is a simple process called vermicomposting. Vermicomposting is a process wherein the wastes and debris with the action of earthworms gets converted into worm castings that could be used as a form of manure to the crops. The resultant product is called vermicompost which is nothing but the excreta of the earthworm that is highly useful to plants. This article briefs about the entire process of vermicomposting in a detailed manner.

Materials Required for Vermicomposting

- Any type of biodegradable wastes

- Crop residues, weed biomass, vegetable wastes, wastes from agro industries, household wastes, urban and rural wastes, etc...

- Earthworms

- **African earthworm (*Eudrillus euginiae*)**
- Red worms (*Eisenia foetida*)
- Composting worm (*Peronyx excavatus*)

Phases of Vermicomposting

Phase 1: Collection of wastes like agriculture wastes, vegetable wastes and household wastes; shredding them and removing any harmful substances.
Phase 2: Partial digestion of these wastes is done for easy consumption by earthworm
Phase 3: preparation of earthworm bed and introducing the worms into it
Phase 4: Collection of earthworm after vermicompost collection. The partially composted material will be again put into vermicompost bed.
Phase 5: Storage in proper place

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Essentials for earthworms:

- A good bedding
- Adequate moisture
- Proper food source
- Adequate aeration
- Protection from extreme weather conditions

Vermicompost Production methodology

Selection of suitable earthworm

The surface dwelling earthworms which lives in the top of the soil are preferred rather than the ones that lives below the surface of the soil. The African earthworm (*Eudrillus engenial*) (Fig.1), Red worms (*Eisenia foetida*) (Fig.2) and composting worm (*Peronyx excavatus*) (Fig.3) are promising worms used for vermicompost production. Among these three worms, the African earthworm (*Eudrillus engenial*) is preferred, because it produces higher production of vermicompost in short period of time

Fig.1 African earthworm

Fig.2 Red worms

Fig.3 composting worm

Selection of site for vermicompost production

The highly suitable place for vermicompost production should have high humidity, must be shady and cool. Abandoned cattle shed, poultry farms could be used. In case of an open area, the place must be shady enough with a thatched roof across it in order to protect it from environment.

Containers for vermicomposting

A cement tub may be constructed to a height of 2½ feet and a breadth of 3 feet (Fig.4). The length may be fixed to any level depending upon the size of the room. The bottom of the tub is made to slope like structure to drain the excess water from vermicompost unit. A small sump is necessary to collect the drain water. In another option over the hand floor, hollow blocks / bricks may be arranged in compartment to a height of one feet, breadth of 3 feet and length to a desired level to have quick harvest. In this method, moisture assessment will be very easy. No excess water will be drained.

Fig.4 cement tub

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Vermiculture bed

A vermiculture bed or worm bed (3 cm) can be prepared by placing after saw dust or husk or coir waste or sugarcane trash in the bottom of tub / container. A layer of fine sand (3 cm) should be spread over the culture bed followed by a layer of garden soil (3 cm). All layers must be moistened with water. The below table 1 shows various bedding materials and their absorbency, bulking potential and C:N ratio.

Bedding Material	Absorbency	Bulking Pot.	C:N Ratio
Horse Manure	Medium-Good	Good	22 - 56
Peat Moss	Good	Medium	58
Corn Silage	Medium-Good	Medium	38 - 43
Hay – general	Poor	Medium	15 - 32
Straw – general	Poor	Medium-Good	48 - 150
Straw – oat	Poor	Medium	48 - 98
Straw – wheat	Poor	Medium-Good	100 - 150
Paper from municipal waste stream	Medium-Good	Medium	127 - 178
Newspaper	Good	Medium	170
Bark – hardwoods	Poor	Good	116 - 436
Bark -- softwoods	Poor	Good	131 - 1285
Corrugated cardboard	Good	Medium	563
Lumber mill waste -- chipped	Poor	Good	170
Paper fibre sludge	Medium-Good	Medium	250
Paper mill sludge	Good	Medium	54
Sawdust	Poor-Medium	Poor-Medium	142 - 750
Shrub trimmings	Poor	Good	53
Hardwood chips, shavings	Poor	Good	451 - 819
Softwood chips, shavings	Poor	Good	212 - 1313
Leaves (dry, loose)	Poor-Medium	Poor-Medium	40 - 80
Corn stalks	Poor	Good	60 - 73
Corn cobs	Poor-Medium	Good	56 - 123
Paper mill sludge	Good	Medium	54
Sawdust	Poor-Medium	Poor-Medium	142 - 750
Shrub trimmings	Poor	Good	53
Hardwood chips, shavings	Poor	Good	451 - 819
Softwood chips, shavings	Poor	Good	212 - 1313
Leaves (dry, loose)	Poor-Medium	Poor-Medium	40 - 80
Corn stalks	Poor	Good	60 - 73
Corn cobs	Poor-Medium	Good	56 - 123

Table 1. Various bedding materials

Putting the waste in the container

The predigested waste material should be mud with 30% cattle dung. The moisture level should be maintained at 60%. Over this material, the selected earthworm is placed uniformly. For one-meter length, one-meter breadth and 0.5-meter height, 1 kg of worm (1000 Nos.) is required. There is no necessity that earthworm should be put inside the waste. Earthworm will move inside on its own.

Watering the vermibed

Daily watering is not required for vermibed. But 60% moisture should be maintained throughout the period.

Harvesting vermicompost

In the tub method of composting, the castings formed on the top layer are collected periodically. The collection may be carried out once in a week. With hand the casting will be scooped out and put in a shady place as heap like structure. The harvesting of casting should be limited up to earthworm presence on top layer. This periodical harvesting is necessary for free flow and retain the compost quality. Otherwise the finished compost get compacted when watering is done.

In small bed type of vermicomposting method, periodical harvesting is not required. Since the height of the waste material heaped is around 1 foot, the produced vermicompost will be harvested after the process is over.

Harvesting earthworm

After the vermicompost production, the earthworm present in the tub / small bed may be harvested by trapping method. In the vermibed, before harvesting the compost, small, fresh cow dung ball is made and inserted inside the bed in five or six places. After 24 hours, the cow dung ball is removed. All the worms will be adhered into the ball. Putting the cow dung ball in a bucket of water will separate this adhered worm. The collected worms will be used for next batch of composting.

Storing and packing of vermicompost

The harvested vermicompost should be stored in dark, cool place. It should have minimum 40% moisture. Sunlight should not fall over the composted material. It will lead to loss of moisture and nutrient content. It is advocated that the harvested composted material is openly stored rather than packed in over sac. During selling time, it is packaged as a packet and sold out. Fig.5 shows a packet of vermicompost that is ready for sale.

Fig.5 Vermicompost packet

Proposed methods for evaluating the stability & maturity of compost:

- Colour
- Odour
- pH
- EC

- C/N ratio
- Plant nutrient content
- Humification index
- Phytotoxic compounds

Nutritive value of compost

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
Copper : 2 – 9.50 mg kg-1
Iron : 2 – 9.30 mg kg-1
Zinc : 5.70 – 11.50 mg kg-1
Sulphur : 128 – 548 mg kg-1

Advantages of Vermicomposting

- Vermicompost is rich in all essential plant nutrients.
- Provides excellent effect on overall plant growth, encourages the growth of new shoots / leaves and improves the quality and shelf life of the produce.
- Vermicompost is free flowing, easy to apply, handle and store and does not have bad odour.
- It improves soil structure, texture, aeration, and waterholding capacity and prevents soil erosion.
- Vermicompost is rich in beneficial micro flora such as a fixers, P- solubilizers, cellulose decomposing micro-flora etc in addition to improve soil environment.
- Vermicompost contains earthworm cocoons and increases the population and activity of earthworm in the soil.
- It neutralizes the soil protection.
- It prevents nutrient losses and increases the use efficiency of chemical fertilizers.
- Vermicompost is free from pathogens, toxic elements, weed seeds etc.
- Vermicompost minimizes the incidence of pest and diseases.
- It enhances the decomposition of organic matter in soil.
- It contains valuable vitamins, enzymes and hormones like auxins, gibberellins etc.

Conclusion

Vermicomposting has gained popularity in both industrial and domestic settings because, as compared with conventional composting, it provides a way to treat organic wastes more quickly. In manure composting, it also generates products that have lower salinity levels. Thus this amazing technology should become an alternative for nutrient source thereby creating a pollution free environment.

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