



## Agro waste management through vermicomposting using to *Eisenia fetida* and *Eudrilus eugeniae*

M Kokila<sup>1\*</sup>, P Ganesh<sup>2</sup>, K Kolanjnathan<sup>2</sup>, K Sivasubramani<sup>2</sup>, K Veenayohini<sup>3</sup>

<sup>1</sup> Assistant Professor, Department of Microbiology, Sacred Heart College, Tirupattur, Tamil Nadu, India

<sup>2</sup> Assistant Professor, Department of Microbiology, Faculty of Science, Annamalai University, Chidambaram, Tamil Nadu, India

<sup>3</sup> PhD Research Scholar, Department of Microbiology, Faculty of Science, Annamalai University, Chidambaram, Tamil Nadu, India

### Abstract

Vermicompost produced with such locally accessible composting material at a significantly lower cost might be of substantial value to end users like farmers for replacing chemical fertilizers and obtaining better pricing for organic produce. The by-products of many food sectors that have not been recycled or used for other reasons include agricultural wastes, including wastes from food processing. Due to their high rate of biodegradability, these agri-horticultural wastes pose a significant issue in municipal landfills. The *Eisenia fetida* earthworm is one of the most common species used in vermicomposting. The production of high-yielding varieties of crops and their following crop wastes, such as straw, leaves, twigs, and stubbles, together with significant numbers of grasses and weeds, have been facilitated by advances in agricultural biotechnology. Earthworms and aerobic microorganisms work together to stabilize organic waste throughout the vermicomposting process. Vermicomposting is a cost-effective and environmentally beneficial way to manage agricultural waste.

**Keywords:** agricultural waste, *Eisenia fetida*, vermicomposting, bagasse waste

### Introduction

It has been challenging to manage agricultural and livestock waste because of the extensive farmland, including rice fields, livestock, and the growing population. Such garbage can break down organically in the environment. However, breakdowns could lead to environmental contamination or health ailments. One of the most common approaches to waste management is recycling garbage into organic fertilizer. According to a study from 1994, India's cities and rural areas produce close to 700 million tonnes of organic garbage each year, which is either burned or dumped (Bhiday, 1994) [2].

The issue with environmental management typically results from farmers selling their agricultural products without first cleaning and grading them. As a result, there is an increase in organic waste in the market area, which puts pressure on and upsets the agricultural waste management ecosystem. The majority of the uncollected rubbish begins to rot at the market location. As a result, there are sanitary issues and risks to people's health (Mane and Rasker, 2012) [6].

Thus, it can be shown that improper management of organic wastes can result in the spread of illness and hurt the ecosystem. Vermicomposting is a desirable alternative to traditional environmental management techniques, as seen above. In addition, it reduces the negative consequences of improper organic waste management while producing protein for use in animal feed in the form of worm biomass (Gupta *et al.*, 2019) [5].

The biological activity of earthworms, which eat mostly organic items like food preparation leftovers and residues, scrap paper, animal manure, crop residues, including organic by-products from industries, and yard trimmings, results in the development of vermicomposting. As a result, wastes are transformed into beneficial biofertilizers that can

be added to soil to improve the environment for plants and crops (Anwar *et al.*, 2015) [1].

Since it is a vital public demand and is extremely necessary to protect our environment, numerous strategies have been established in conjunction with waste management to protect our environment from harmful contaminants. Vermicomposting is one of those methods used in agriculture, where it is a sustainable, socially safe, and cost-effective alternative (Darwin and Seward 1903) [3].

Worms have historically been utilized as both fishing bait and an animal protein source. According to numerous research on various animals, birds, and fish, feeding animals with worms produces great results (Guerrero, 2005) [4], and earthworms are thought to be a natural food source for birds and other creatures in the wild. Worms, which act as cleaners by biologically and safely degrading wastes, have recently demonstrated their capacity to change waste into a usable product and their ability to be employed as a great tool for enhancing the health of agriculture (Sam angina, 2011) [7]. Vermicomposting also increases soil nutrients, increases plant nutrient availability, enhances soil structure and drainage, promotes plant development, and reduces plant disease and insect pest attacks (biocontrol). Vermicompost is therefore one of the effective methods for managing and reducing environmental pollution issues (Waleed, 2016) [8].

### Role of Vermicomposting in Agricultural Waste Management

#### Earthworms used in Vermicomposting

- Earthworms are used in composting process, because they live in the soil, mixing it, making it porous as they help decompose soil organic matter.

**Table 1:** Various types of Raw Materials and Earthworm Species Used in Vermicomposting (Gupta *et al.*, 2019) <sup>[5]</sup>

S. No	Raw material	Earthworm species
1	Agricultural residues	<i>Eudrilus eugeniae</i>
2	Agriculture waste and sugar cane thrash	<i>Eudrilus eugeniae</i> , <i>Perionyx excavates</i>
3	Board mill sludge	<i>Lumbricus terrestris</i>
4	Canteen waste & vegetable waste	<i>Eisenia fetida</i>
5	Cattle manure	<i>Eudrilus eugeniae</i>
6	Deciduous forest waste, cow-dung	<i>Eisenia fetida</i> , <i>Perionyx excavatus</i> and <i>Dicogaster bolau</i>
7	Different mammalian animal waste	<i>Eisenia fetida</i>
8	Domestic waste + cow-dung	<i>Perionyx excavates</i> , <i>Perionyx sansibaricus</i>
9	Fly ash + cow dung	<i>Eisenia fetida</i>
10	Municipal solid waste	<i>Eisenia fetida</i> , <i>Eudrilus eugeniae</i>
11	Municipal, agricultural, and mixed solid waste	<i>Eudrilus eugeniae</i> , <i>Perionyx excavates</i>
12	Onion residue/waste	<i>Eisenia fetida</i> , <i>Eudrilus eugeniae</i>
13	Organic matter, moistened peat moss, crushed leaves, dried yard waste	<i>Eisenia fetida</i> , <i>Lumbricus rubellus</i>
14	Organic wastes	<i>Lumbricus rubellus</i> , <i>Eisenia fetida</i> , <i>Eisenia andrei</i> , <i>Dendrobdena rubida</i> , <i>Eudrilus eugeniae</i> , <i>Perionyx excavatus</i> and <i>Eiseniella tetraedra</i> .
15	Bagasse, sugar cane trash	<i>Drawidiella willsi</i>
16	Sago waste	<i>Lampito mauritii</i> , <i>Eisenia foetida</i>
17	Shredded paper or newspaper, coir (coconut husk fiber)	<i>Perionyx excavates</i>
18	Sugar cane residues	<i>Pheretima elongate</i>
19	Vegetable waste + floral waste	<i>Eudrilus eugeniae</i> , <i>Eisenia foetida</i> , <i>Perionyx excavates</i>
20	Pig manure, food wastes, leaf wastes, yard wastes, bark wastes, chicken manure	<i>Eisenia fetida</i>
21	Potato peels	<i>Pheretima elongate</i>

### Management of Flower Waste by Vermicomposting

Another expansion of its use is managing flower wastes using vermicomposting. A recent study evaluated how floral debris was managed at the temples of Indore, India. The trash from the temples is typically abundant in organic material and consists primarily of plant matter, including flowers, leaves, fruits, sugar, jaggery, cereals, milk and milk derivatives, and water. These wastes are often biodegradable and easily accessible for microbial development. Without any additional treatment, these wastes are either directly dumped in available land areas or released into nearby water bodies. Serious environmental contamination and health risks resulting from this. To handle temple garbage, vermicomposting technology was used. Cow dung is mixed with waste solids from temples as part of the process, which is then left to disintegrate for 45 days at 30 °C. *Eudrilus eugeniae* earthworm species are added to the garbage after it has partially decomposed (Kohli and Hussain 2016) <sup>[15]</sup>.

### Management of Bagasse waste by Vermicomposting

Bagasse and other agro-industrial wastes are pre-decomposed for 40 days, and then vermicomposting is carried out for 30 days using *Eisenia fetida* at a temperature of 26 °C and a moisture level of 62–82 percent. The earthworm species uses its digestive enzymes to break down the organic material, and in the process, they produce castings that serve as important fertilizers. Crop enhancement, disease elimination (biocontrol), increased soil water holding capacity, and the creation of plant growth regulators are some additional benefits of vermicomposting. All these elements contribute to enhanced soil physical, chemical, and biological characteristics, as well as enhanced crop development and production (Jaybhaye and Bhalerao 2016) <sup>[16]</sup>.

### Management of Banana Agro-Waste by Vermicomposting

Bananas produce a significant amount of garbage because they are a major cash crop in India. A study was done to

find out whether banana agro-waste could be composted (dried leaves and pseudo-stem biomass). Using the earthworm *Eudrilus eugeniae* to mix organic waste with cow dung, it was discovered that the ratio of 200 g banana waste to 800 g cow dung combination produced the best development and reproduction. Additionally, the combination of 200 g of banana waste and 600 g of cow dung showed favourable growth and reproduction. Additionally, it was shown that the earthworm could not survive in treatments containing 1000 g of banana waste alone, 800 g of banana waste mixed with 200 g of cow dung, or 600 g of banana waste mixed with 400 g of cow dung. Thus, the aforementioned research demonstrated that increased levels of banana waste in feed combinations are harmful to earthworm growth and reproduction. Banana waste can therefore be effectively controlled through vermicomposting if combined in the right amounts with cow dung (Kavitha *et al.*, 2010) <sup>[17]</sup>.

### Management of Agro-Industrial Waste Water through Vermicomposting

Vermicomposting has been used to control agro-industrial effluent in several studies. The wastewater produced by palm oil mills was absorbed into amendments (soil or rice straw) and used as a source of food for the earthworm *Eudrilus eugeniae*. Additionally, all treatments slowed the growth of the earthworms. It was found that the best quality vermicompost with a high nutritional status was produced by a treatment using a mixture of 1 part rice straw and 3 parts palm oil mill effluent (w/v) (Lim *et al.*, 2014) <sup>[18]</sup>. Another study compared the chemical properties of vermicompost made from filter cake, orange peel, and cow dung. Three compost piles were arranged in the following ratios: 2:1 filter cake plus and cattle dung, and 3:1 orange peel and cattle manure. After composting the heaps for the first 60 days, earthworms were added to start the vermicomposting process (Pigatin *et al.*, 2016) <sup>[19]</sup>.

### Advantages of vermicompost over chemical input

1. Waste from plants and animals is used to create compost. Therefore, it decomposes quickly. In contrast to the excessive use of chemical fertilizers, which pollutes the soil and water, it does not contribute any hazardous compounds to the soil (Dominguez, 2018) <sup>[9]</sup>
2. In contrast to artificial fertilizers, vermicompost is an organic fertilizer that can manufacture some crucial minerals for promoting plant growth (Esmaeili *et al.*, 2020) <sup>[10]</sup>
3. Clear the natural environment and increases the amount of organic carbon and nitrogen. Improves soil structure and increases the water-holding capacity of the soil. It is a valuable soil amendment (Kokila Muniyandi and Ganesh Punamalai, 2021) <sup>[20]</sup>.
4. The survival of beneficial microorganisms in the soil is aided by vermicompost. It lessens your plant's demand for insecticides (Amouei *et al.*, 2017) <sup>[11]</sup>.
5. According to reports, the biggest advantage is that earthworm compost's nutrients are relatively simple for plant roots to absorb (Bhat *et al.*, 2018) <sup>[12]</sup>.
6. It is preferable to utilize compost rather than chemical fertilizers when using vermicompost. enhances microbial activity, which assists in the release of soil nutrients for plant uptake (Borges *et al.*, 2017) <sup>[13]</sup>.
7. decreases the need for expensive, perhaps environmentally hazardous chemical fertilizers. Chemical fertilizers release toxic chemicals into the environment, which pollutes it and slows plant development. Vermicompost eliminates toxic elements from the soil that lead to plant illnesses (Ganiger *et al.*, 2020) <sup>[14]</sup>.

### Conclusion

A technology that emphasizes resource conservation and sustainable use are vermicomposting. The treatment of food waste, paper, cardboard, manures, and bio-solids can all be done through the use of vermicomposting. It is applicable as a soil amendment. Additionally, vermicomposting could contribute to the creation of jobs. In greenhouse applications, vermicompost can be used to create new plants, such as rootstock in vineyards. Vermicompost can be used to produce crops for both horticulture and agriculture. However, there are still a lot of research gaps that need to be filled, like the lack of a comprehensive scientific study on how to speed up earthworm growth.

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