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Vermicomposting: How earthworms make soil

Tapasya Tiwari[1], Tripti Mishra[2] and Dharmendra Kumar[2]

Abstract

Recovering soil nutrients has become essential to preserving soil fertility. Soil contamination is a result of the use of certain organic and inorganic compounds in industrial and agricultural systems. The ability to create vermicomposting technology to break down specific organic and inorganic wastes in soils has been made possible by advancements in biological engineering. In order to break down organic and inorganic wastes in soils, three different earthworm clusters have been used: epigeic, anecic, and endogeic. However, the epigeic cluster—such as *Eisenia fetida*—has been used most frequently for vermicomposting because it is easily found on soil surfaces and can thrive in any type of environment. The given three possible earthworm clusters for the vermicomposting process, different kinds of organic and inorganic waste for the process, the vermicomposting procedure, the benefits of using vermicompost, the impact of materials, microorganisms, and treatments during the process, and the possibility of a bio-conversion product are the main topics covered in this article.

Introduction

Using earthworms to prepare enriched compost is known as vermicomposting. It is among the simplest ways to create high-quality compost and recycle agricultural waste. Earthworms eat biomass and expel it as worm castings, which are digested leftovers. Worm casts are known as "black gold" in popular culture. The casts have qualities that block pathogenic bacteria and are rich in nutrients, growth-promoting chemicals, and good soil microflora. Vermicompost is an organic manure with fine, stable grains that enhances the physical, chemical, and biological qualities of soil. It is very helpful for producing crops and nurturing seedlings. Growing in popularity as a key element of organic farming systems is vermicompost. Vermicomposting is an environmentally benign method that decomposes organic waste in soil and can also break down inorganic trash. Using earthworms as vermicomposting agents—which are utilized as soil conditioners in agriculture - is a widely recognized and reasonably priced method of increasing soil fertility. Only a small number of the more than 4,000 species

Tapasya Tiwari[1], Tripti Mishra[2] and Dharmendra Kumar[2]

[1]Department of Soil Science and Agril. Chemistry, CSAUA&T, Kanpur

[2]Department of Soil Science and Agril. Chemistry, ANDUA&T, Kumarganj, Ayodhya

of earthworms that are divided into the three ecological groups of epigeic, anecic, and endogeic have been used in the vermicomposting process. The epigeic *groups Eudrilus eugeniae* and *Eisenia fetida* are commonly employed in the vermicomposting process.

Furthermore, earthworms restore the soil's porosity, structure, texture, drainage, water-holding capacity, and aeration, as well as lessen erosion and balance the pH. Furthermore, additions like solid substrates and bacteria can strengthen the earthworm's involvement in improving soil conditions. These characteristics make earthworm species promising for the vermicomposting of both organic and inorganic wastes in soils, as well as for the bioconversion process, which can provide valuable products. Vermicompost's liquid elixir can also be used to make vermiwash. An enzyme cocktail comprising urease, phosphatase, amylases, and proteases has been discovered in vermiwash. Vermiwash has some phosphate-solubilizing bacteria as well as nitrogen-fixing bacteria such as Azotobacter sp., Agrobacterium sp., and Rhizobium sp., according to a microbiological analysis. A trial on a laboratory scale demonstrates the effectiveness of vermiwash on growth of plants.

Differences between vermicomposting and other composting methods:

- The main distinction is that vermicomposting uses a particular kind of worm to break down food scraps, rather than just bacteria and other microbes.
- Furthermore, a vermicomposting system needs some particular equipment that you can create or purchase because it houses the worms in a set of interlocking buckets or boxes.
- Vermicomposting has the benefit of being portable and really simple once you get it going, even though it does require a certain setup and worms that you'll need to purchase online or from a nearby garden supply store.

Methods of vermicomposting:

- **Bed Method:** This is a simple way for preparing beds of organic matter.
- **Pit Method:** The organic materials are gathered using this method in concrete pits. However, because of issues with inadequate aeration and waterlogging, this method is not widely used.

Earthworms are an essential part of the vermicomposting process:

Given the latest developments, earthworms are often recommended for vermicomposting problems in order to remove harmful pollutants from soils. In contrast to other living forms like bacteria, fungus, algae,

and archaea, earthworms are highly tolerant of their environment, including the acidity of the soil. The three groups of earthworms are called epigeic, anecic, and endogeic, based on the environments in which they reside. Most epigeic earthworms are found on the soil's surface.

Potential bioconversion of the vermicomposting process:

In addition to decreasing organic and inorganic waste, vermicomposting can improve soil structure, boost plant development, neutralize soil pH, collect biofertilizer, and produce bio-conversion products. Using earthworms in this process has various benefits. Prior research examined the amounts of carbon dioxide and methane produced during the vermicomposting of sewage sludge, which resulted in the release of up to 11.6% of CO2 and 0.6% of methane biogas.

Vermicomposting materials:

Composting materials are often made from decomposable organic wastes, such as farm residues, kitchen scraps, animal excrement, and forest litter. Generally speaking, the main basic materials are dried, chopped crop waste and animal manure, primarily cow dung. Vermicompost's quality is improved when non-leguminous and leguminous crop leftovers are combined. Earthworms come in several species, such as *Perionyx excavatus*, *Eudrilus eugeniae* (night crawler), and *Eisenia foetida* (red earthworm). Because red earthworms multiply quickly and can turn organic matter into vermicompost in 45–50 days, they are the preferred option. Being a surface feeder, organic materials are turned into vermicompost from the top.

The process of vermicomposting-

1. A concrete tank or a plastic tank can be used to prepare compost. The availability of raw materials determines the tank's size.
2. Gather the biomass and expose it to the light for a period of eight to twelve days. Now, use the cutter to chop it to the desired size.
3. To hasten the decomposition of the heap, make a slurry from cow dung and sprinkle it on top.
4. Add two to three inches of sand or dirt to the tank's bottom.
5. Next, make fine bedding by mixing dried leaves, partially decomposed cow manure, and other biodegradable wastes gathered from the kitchen and fields. Scatter them evenly throughout the layer of sand.
6. Fill the tank with chopped bio-waste and partially decomposed cow dung layer by layer until it reaches a depth of 0.5 to 1.0 feet.

7. Once all the bio-wastes have been added, scatter the earthworm species on top of the mixture and cover the compost mixture with gunny sacks or dry straw.
8. Regularly mist the compost with water to keep its moisture content stable.
9. Install a thatch roof over the tank to keep out ants, lizards, mice, snakes, and other critters while shielding the compost from sunlight and precipitation.
10. Check the compost often to prevent it from overheating. Sustain the right amount of moisture and warmth.

Advantages of vermicomposting:

1. It offers effective conversion of crop residues, animal wastes, and organic wastes.
2. It is a soil conditioner that is rich and sturdy.
3. It contributes to a decrease in the number of harmful bacteria.
4. It lessens the harmful effects of heavy metals.
5. It is a safe and affordable nutrient supplement for the production of organic food.
6. It is an inexpensive technology that is simple to use.
7. promotes the growth of plant roots.
8. enhances the soil's physical composition.
9. Vermicomposting improves the soil's water resistance and fertility.
10. promotes agricultural output, plant development, and germination.
11. provides plant growth hormones, such as gibberellic acid and auxins, to the soil.

Conclusion:

The green organic waste is turned into a dark, nutrient-rich soil through the process of vermicomposting. This is primarily due to microorganisms breaking down the soil and keeping it in a healthy state for plant growth. One of the very few environmentally beneficial methods for recycling biomass and organic matter wastes into compost that contains important nutrients is vermicomposting. Globally, there should be encouragement for environmentally responsible waste management practices.