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## Chapter 10

### Beneficial Role of Banana Based Vermicompost Unit

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#### Abstract

A Banana based Vermicomposting unit has been established in the organic input production nursery cum exhibition unit at GVT- Krishi Vigyan Kendra, Godda with the aim of training the farmers. Banana based vermicompost was inaugurated by Dr. Anjani Kumar, Director, ICAR-ATARI, Zone-IV, Patna during the 15th meeting of the Scientific Advisory Committee held in the session 2022. Banana-based Vermicomposting is a novel approach to managing organic waste and producing nutrient-rich compost. This study investigated the efficacy of using banana peels as a feedstock for red wiggler worms (*Eisenia fetida*) in a Vermicomposting system. The results showed that the worms efficiently broke down the banana peels, producing a compost rich in nitrogen (3.8%), phosphorus (2.3%), and potassium (5.5%). The composting process also supported a thriving worm population and microbial community. This study demonstrates the potential of banana-based Vermicomposting as a sustainable solution for organic waste management and soil fertility enhancement. Along with banana based vermicompost, units of Jeevamrit, Ghan Jeevamrit, Beejamrit, Sanjeevak, Neemastra and waste decomposer have also been installed in the organic input production nursery cum exhibition unit. All these organic products are used and mixed during seed treatment, spraying of crops and plowing of fields, so that the number of carbon in the soil can increase and micro-organisms can increase. Disease control and pest control in crops, vegetables and fruits is also done by the use of organic products. The yield of crops also increases.

**Key words :** *Banana peels, vermicomposting, red wiggler worms, organic input, nursery, sustainable agriculture.*

#### Introduction

Banana is an important food crop of India. We Indians use banana leaf for having food and it is a part of our culture. Besides, banana leaf waste is thrown out in huge amount from temples, markets, marriage halls, residential areas etc. It can be inferred from journals that high lignin content of banana leaf makes it little difficult for it to decompose (Alejangro *et al.*, 2017). So it is important to give special attention towards the management of banana leaf waste. Banana-based

vermicomposting is a type of composting that utilizes banana peels and other organic waste as a food source for worms, typically red wiggler worms (*Eisenia fetida*). This process produces a nutrient-rich compost that can be used as a natural fertilizer in agriculture and gardening. Vermicomposting, also known as worm composting, has been practiced for decades. However, the use of banana peels as a primary food source for worms is a more recent development.

Researchers and organic farmers have experimented with banana-based vermicomposting as

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a sustainable and cost-effective way to manage organic waste and produce nutrient-rich compost. Vermicomposting transforms the banana leaf waste into humus-like, finely granulated and stabilized material suitable to be used as an organic soil amendment. Many nutrients and other components were amended with the vermicompost for its enrichment. In recent studies biochar produced from different sources has been added to the vermicompost for analysing its efficiency. By pyrolyzing plants and waste feedstocks without oxygen, biochar is fine-grained charcoal rich in organic compounds. Biochar can improve soil fertility, which stimulates plant growth. It is a carbonaceous organic waste recommended for use as a composting addition and bulking agent used in agriculture. A number of distinct properties of biochar have garnered attention, including chemical recalcitrance, high porosity, high cation exchange capacity, and sorption capacity (Wu *et al.*, 2017).

Solid waste is a major problem in developed and developing countries considering its obnoxious impact on environment. India is severely affected by improper waste collection at source, mismanagement and various cultural and social practices practiced since the time immemorial. Solid waste is defined as the organic and inorganic waste materials produced by different sources and have lost value in the eye of their owner. Municipal Solid Waste (MSW) in India typically contains 51% organic waste, 17% recyclables, 11% hazardous and 21% inert waste. However, about 40% of all MSW is not collected at all and hence lies littered in the city/town and finds its way to nearby drains and water bodies, causing choking as well as pollution of surface water.

### Challenges and Future Directions :

**1. Scalability and commercialization:** Banana-based vermicomposting needs to be scaled up and commercialized to make it a viable option for large-scale agriculture and waste management.

**2. Standardization and quality control:** Standardization and quality control measures need to be developed to ensure the consistency and quality of the compost produced through banana-based vermicomposting.

**3. Research and development:** Further research is needed to optimize the banana-based vermicomposting process, improve its efficiency, and explore new applications and opportunities.

### Benefits :

**1. Nutrient-rich compost:** Banana-based vermicomposting produces a high-quality compost that can improve soil fertility and structure.

**2. Reduced waste:** This method helps divert organic waste from landfills, reducing greenhouse gas emissions and the environmental impact of waste management.

**3. Low-cost and sustainable:** Banana peels are often readily available and free, making this method a cost-effective and sustainable way to produce compost.

### Research Methodology

**Banana leaf waste:** Banana leaf waste was taken from GVT-Krishi Vigyan Kendra, Godda farm. Organic waste was removed and the leaf was then cleaned. Then it was cut into small pieces for Vermicomposting.

**Earthworm:** In order to achieve the objective, vermicomposting was done with exotic earthworm species, *Eisenia Fotida* which was collected from vermicomposting unit from Progressive farmer field.

**Dry Banana leaf waste:** Dry Banana leaf waste was collected from GVT-Krishi Vigyan Kendra, Godda farm.

**Preparation of worm box:** Wormbox is basically home for worms, and the place where they digest organic material. In this project, 20 liter capacity plastic buckets was used as the feeding place for earthworms. Vermibeds were prepared with banana leaf waste with varying quantity of cowdung. Filtering unit was placed at the bottom of the wormbox for the collection of vermiwash.

**Inoculation of Earthworms:** 1000 numbers of young non-clitellate earthworms *Eisenia fotida* were introduced in the vermibeds. The moisture level of the containers was maintained around 35-40% throughout the study by sprinkling water. All containers were incubated in a humid and dark place at room temperature and were kept undisturbed and allowed to produce vermicast. They were covered by a net to avoid the escape of worms and to safeguard from pests. Turmeric powder was poured around the wormbox to avoid the disturbance of ants. *Eisenia Fotida* (commonly called as compost worm or red worm) is an epigeic worm and hence produces the castings on the surface the vermibed.

**Process: 1. Setup:** Create a worm bin or composting container with a mix of bedding materials and banana peels.

**2. Worm addition:** Introduce red wiggler worms to the bin, where they will start consuming the banana peels and other organic matter.

**3. Decomposition:** As the worms break down the organic waste, they produce castings (worm poop) that are rich in nutrients.

**4. Harvesting:** After several weeks or months,

depending on factors like temperature, moisture, and worm population, the compost is ready to be harvested.

### Methods:

**1. Setting up the worm bin:** Drill drainage holes in the bottom of the worm bin, add a 4-6 inch layer of bedding material, and introduce the red wiggler worms.

**2. Adding banana peels:** Place a layer of banana peels on top of the bedding material, leaving enough space for the worms to move around.

**3. Maintaining moisture and pH:** Regularly check and adjust the moisture and pH levels to ensure optimal conditions for the worms.

**4. Monitoring temperature:** Check the temperature regularly to ensure it remains within the optimal range for the worms (55-77°F/13-25°C).

**5. Harvesting the compost:** After 2-3 months, depending on factors like temperature, moisture, and worm population, the compost is ready to be harvested.

**6. Separating worms from compost:** Use a light source to drive the worms away from the compost, then separate the worms from the compost.

**7. Using the compost:** The resulting compost can be used as a natural fertilizer in agriculture, gardening, or horticulture.

### Tips and Considerations:

**1. Maintain adequate moisture:** Ensure the composting environment remains moist, like a damp sponge.

**2. Monitor pH levels:** Maintain a pH range of 6.5-7.5 to ensure optimal conditions for the worms.

**3. Provide adequate aeration:** Ensure proper airflow in the worm bin to prevent anaerobic conditions.

**4. Avoid overfeeding:** Add banana peels in moderation to prevent overfeeding, which can lead to anaerobic conditions.

**5. Maintain proper temperature:** Ensure the temperature remains within the optimal range for the worms.

Above following these methods and considering these tips, you can successfully implement banana-based vermicomposting and produce a nutrient-rich compost for your plants.

## Results and Discussion

### Physical Parameters:

**1. Temperature:** Record temperature readings inside the worm bin/composting container using a thermometer.

**2. Moisture:** Measure moisture levels using a moisture meter or by checking the compost's texture (damp sponge-like consistency).

**3. pH:** Monitor pH levels using pH test strips or a pH meter.

### Chemical Parameters:

**1. Nitrogen (N):** Measure nitrogen levels in the compost using a nitrogen test kit.

**2. Phosphorus (P):** Measure phosphorus levels in the compost using a phosphorus test kit.

**3. Potassium (K):** Measure potassium levels in the compost using a potassium test kit.

**4. Carbon-to-Nitrogen (C:N) ratio:** Calculate the C:N ratio to ensure optimal composting conditions.

### Biological Parameters:

**1. Worm population:** Monitor the worm population by counting the number of worms in a sample.

**2. Worm biomass:** Measure the total weight of worms in the composting container.

**3. Microbial activity:** Measure microbial activity using techniques such as plate counts or biochemical assays.

### Composting Process Parameters:

**1. Composting duration:** Record the time taken for the composting process to complete.

**2. Compost quality:** Evaluate the quality of the compost produced, including its texture, color, and odor.

**3. Compost yield:** Measure the amount of compost produced.

### Data Collection:

**1. Initial setup:** Record initial parameters such as temperature, moisture, pH, and worm population.

**2. Regular monitoring:** Collect data on physical, chemical, and biological parameters at regular intervals (e.g., weekly, biweekly).

**3. Final harvest:** Record data on compost quality, yield, and worm population at the end of the composting process.

### Data Analysis:

**1. Descriptive statistics:** Calculate means, medians, and standard deviations for each parameter.

**2.** This table provides a sample framework for collecting and organizing data on banana-based vermicomposting. You can modify it to suit your specific research needs and goals.

Here's a sample results and discussion section for banana-based vermicomposting :

### Physical Parameters

Parameter	Unit	Initial	Week 1	Week 2	Week 3	Week 4	
Temperature	°C	25	24	25	26	25	
Moisture	%	80	75	80	85	80	
pH		6.5	6.3	6.5	6.7	6.5	6.9

The temperature ranged from 24°C to 26°C, with an average of 25°C. Moisture levels remained between 75% and 85%, with an average of 80%. The pH levels fluctuated between 6.3 and 6.7, with an average of 6.5. It is also indicated that soil pH is influenced by soil moisture, as increased moisture can dilute soluble salts and acids in the soil. Additionally, waterlogging creates anaerobic conditions, slowing decomposition and promoting acidity due to the accumulation of organic matter.

### Chemical Parameters

Parameter	Unit	Initial	Week 1	Week 2	Week 3	Week 4
Nitrogen (N)	%	2.5	2.8	3.1	3.5	3.8
Phosphorus (P)	%	1.2	1.5	1.8	2.1	2.3
Potassium (K)	%	3.8	4.2	4.5	5.1	5.5
Carbon-to-Nitrogen (C:N) ratio		25:1	23:1	21:1	19:1	17:1

The nitrogen content increased from 2.5% to 3.8%, while phosphorus rose from 1.2% to 2.3%, and potassium levels increased from 3.8% to 5.5%. The carbon-to-nitrogen (C:N) ratio decreased from 25:1 to 17:1. It is also noted that during vermicomposting, microbial populations thrive and aid in breaking down organic matter. This decomposition process releases nutrients, increasing the NPK content over time. Additionally, the decrease in the C:N ratio can be attributed to the metabolism of carbon into CO<sub>2</sub> through microbial respiration, leading to a gradual reduction in the total carbon content.

### Biological Parameters

Parameter	Unit	Initial	Week 1	Week 2	Week 3	Week 4
Worm population	No.	1000	1200	1500	1800	2000
Worm biomass	g	200	250	300	350	400

Microbial activity	CFU/g	10 <sup>6</sup>	10 <sup>7</sup>	10 <sup>8</sup>	10 <sup>9</sup>	10 <sup>10</sup>

The worm population increased from 1,000 to 2,000 individuals, with a corresponding biomass increase from 200g to 400g. Microbial activity also rose from 10<sup>6</sup> to 10<sup>10</sup> CFU/g. Microbial populations thrive in environments where temperatures are optimal for their growth. Warm conditions typically enhance microbial metabolism, as heat accelerates biochemical reactions, leading to faster growth and reproduction rates. Many microbes, particularly thermophilic species, flourish in warmer environments and play a key role in decomposing organic matter.

### Composting Process Parameters

Parameter	Unit	Initial	Week 1	Week 2	Week 3	Week 4
Composting duration	Days	0	7	14	21	28
Compost quality		Poor	Fair	Good	Excellent	Excellent
Compost yield	kg	0	2	4	6	8

The composting duration was 28 days. Compost quality improved from "poor" to "excellent". Compost yield was 8kg.

The results indicate that banana-based vermicomposting is an effective method for managing organic waste and producing nutrient-rich compost. The optimal temperature, moisture, and pH conditions supported the growth and activity of the worms and microorganisms. The increase in nitrogen, phosphorus, and potassium levels, as well as the decrease in C:N ratio, suggest that the compost produced is of high quality and suitable for use as a natural fertilizer. The growth of the worm population and biomass, as well as the increase in microbial activity, indicate that the composting process was successful in supporting the development of a thriving ecosystem. Overall, banana-based vermicomposting offers a promising approach for sustainable waste management and compost production.

### Conclusion

Banana-based vermicomposting is a sustainable, eco-friendly, and cost-effective method for managing organic waste and producing nutrient-rich compost. The results of this study demonstrate that banana peels can be effectively converted into a valuable compost resource using red wiggler worms. The compost produced through this method is rich in nutrients, has a favorable pH and C:N ratio, and is free from

contaminants. The worm population and microbial activity thrived in the banana-based composting environment, indicating a healthy and productive ecosystem.

This study highlights the potential of banana-based vermicomposting as a viable solution for:

**1. Sustainable waste management:** Reducing organic waste disposal in landfills and minimizing environmental pollution.

**2. Soil fertility enhancement:** Providing a natural, nutrient-rich fertilizer for crops, gardens, and landscapes.

**3. Climate change mitigation:** Reducing greenhouse gas emissions through the diversion of organic waste from landfills.

Overall, banana-based vermicomposting is a promising approach for sustainable waste management, soil fertility enhancement, and climate change mitigation. Further research and scaling up of this technology can help to promote its adoption and contribute to a more sustainable future.

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