



## Composting and Vermicomposting

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### INTRODUCTION

Composting and vermicomposting are eco-friendly biological processes that convert organic wastes into nutrient-rich organic manure. These practices play a vital role in sustainable agriculture by improving soil fertility, enhancing soil structure, and reducing dependence on chemical fertilizers. With increasing concerns about soil degradation, waste management, and environmental pollution, composting technologies are gaining global importance. They transform agricultural residues, kitchen waste, and farm by-products into valuable resources, thereby promoting circular economy and sustainable soil health management.

### 2. Composting: Concept and Process

Composting is the process of breaking down organic materials such as food scraps and yard waste by microorganisms under controlled conditions of moisture, temperature, and aeration. The end product, compost, is a dark, crumbly, humus-like substance rich in organic matter and nutrients. Besides improving soil fertility, compost also enhances soil structure, water-holding capacity, and microbial activity.

#### 2.1 Raw Materials Used

- Crop residues
- Animal manure
- Kitchen waste
- Garden litter and weeds
- Agro-industrial wastes

Balanced carbon and nitrogen ratio (C:N < 25:1) is essential for efficient composting.

#### 2.2 Methods of Composting

Composting can be carried out through several practical methods depending on scale, availability of materials, and management intensity:

### A. Pit or Trench Method

Organic wastes are placed in pits dug in the ground and covered with soil. Decomposition occurs slowly due to limited aeration, but this method conserves moisture and nutrients. It is commonly used in rural areas where space is available and labor costs are low.

### B. Heap or Pile Method

Organic residues are heaped above the ground in layers of crop waste, animal dung, and soil. Proper turning of the heap ensures aeration and faster decomposition. This is one of the most widely adopted methods because it is simple and requires minimal infrastructure.

### C. Windrow Composting

In this method, organic materials are arranged in long rows (windrows) and turned periodically using tools or machinery. It is suitable for large-scale compost production such as municipal waste management and commercial farming due to better temperature control and faster breakdown.

### D. NADEP and Indore Methods

These are improved traditional methods widely practiced in India. They involve systematic layering of organic residues, cow dung slurry, and soil to accelerate microbial activity and

produce nutrient-rich compost within a few months.

## 3. Stages of Decomposition in Composting

### 3.1 Mesophilic Stage (Initial Stage)

This stage begins immediately after pile formation. Mesophilic microorganisms (bacteria and fungi) actively decompose simple sugars and amino acids at temperatures ranging from 20–40°C. Heat generation starts due to microbial respiration.

### 3.2 Thermophilic Stage (Active Stage)

Temperature rises to 45–70°C, favouring thermophilic microbes. Rapid breakdown of complex organic compounds such as cellulose and proteins occurs. Pathogens, weed seeds, and harmful organisms are destroyed in this phase, making compost safer.

### 3.3 Cooling Stage

As easily degradable materials decline, microbial activity slows and temperature decreases. Fungi and actinomycetes dominate, decomposing resistant compounds like lignin.

### 3.4 Maturation (Curing) Stage

The compost stabilizes and humus formation takes place. The material becomes dark brown, odorless, and nutrient-stable. This stage ensures compost safety and nutrient availability.

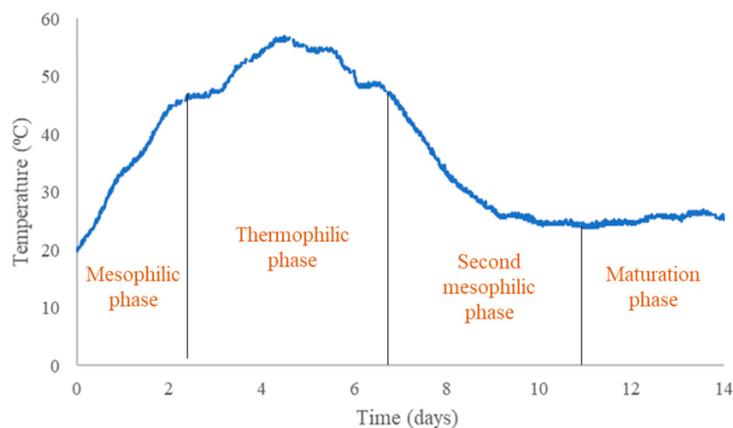


Figure: Composting Temperature Curve

## 4. Vermicomposting: Concept

Vermicomposting is the biological degradation of organic waste using earthworms and microorganisms. Earthworms ingest organic matter, fragment it, and enhance microbial activity, resulting in a finely divided, nutrient-

rich product called vermicast or vermicompost. This method is faster than traditional composting and produces manure with higher microbial and nutrient content.

## 5. Important Earthworm Species Used

### 5.1 *Eisenia fetida* (Red Wiggler)

Most widely used species due to high reproductive rate and tolerance to environmental fluctuations.

### 5.2 *Eudrilus eugeniae* (African Nightcrawler)

Produces high-quality vermicompost but prefers warm tropical climates.

### 5.3 *Perionyx excavatus* (Indian Blue)

Common in tropical regions; efficient decomposer with rapid growth.

### 5.4 *Lumbricus rubellus*

Adaptable species suitable for temperate climates.

These worms are epigeic species, meaning they live on the soil surface and feed on organic residues rather than burrowing deep.

## 6. Nutrient Content of Compost and Vermicompost

Parameter	Compost (%)	Vermicompost (%)
Nitrogen (N)	0.5 – 1.5	1.5 – 2.5
Phosphorus (P)	0.4 – 1.0	1.0 – 1.5
Potassium (K)	0.8 – 1.5	1.5 – 2.0
Organic Carbon	12 – 20	15 – 25
Micronutrients	Moderate	High

Vermicompost generally contains higher available nutrients, plant growth hormones, enzymes, and beneficial microbes compared to traditional compost.

### 7. Benefits to Soil and Crops

- Improves soil structure and aggregation
- Enhances water holding capacity
- Increases microbial biomass and enzyme activity
- Supplies macro and micronutrients
- Reduces chemical fertilizer dependency
- Promotes better root growth and yield

### 8. Environmental Significance

Composting reduces landfill waste, greenhouse gas emissions, and pollution. Vermicomposting additionally supports biodiversity and waste recycling at household and farm levels. Both practices contribute to climate-smart agriculture and sustainable waste management.

### 9. Limitations and Challenges

- Requires space and labor
- Moisture and temperature management needed
- Odor issues if poorly managed
- Earthworms sensitive to extreme conditions

## CONCLUSION

Composting and vermicomposting are cost-effective, environmentally sustainable, and scientifically validated methods of organic waste management and soil fertility enhancement. Their integration into agricultural systems not only improves soil health and crop productivity but also supports ecological balance and resource recycling. As global agriculture shifts toward sustainability, these practices remain essential

pillars of organic and regenerative farming systems.

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