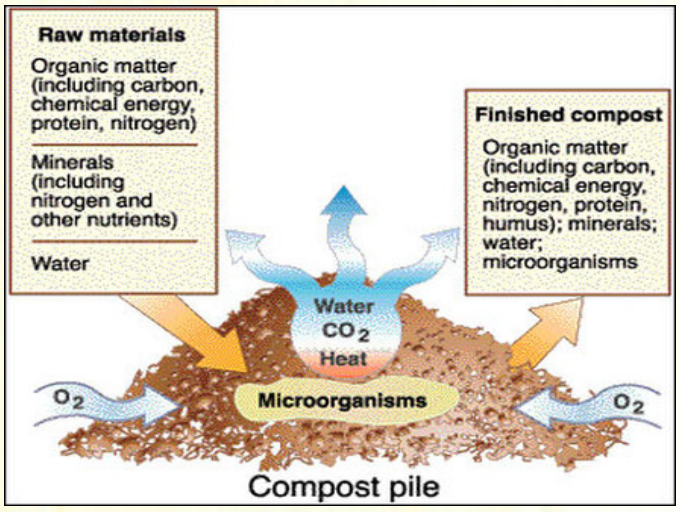
Technical Bulletin 5

Organic Farming

Composting & Methods

DAY – National Rural Livelihood Mission

COMPOSTING & METHODS



Composting is the natural recycling of organic waste into a nutrient-rich fertilizer. It is a natural biological process, carried out under controlled aerobic conditions. In this process, various microorganisms, including bacteria and fungi, break down organic matter into simpler substances. A composting process will convert organic matter into stable compost that is odor and pathogen free, and a poor breeding substrate for flies and other insects.

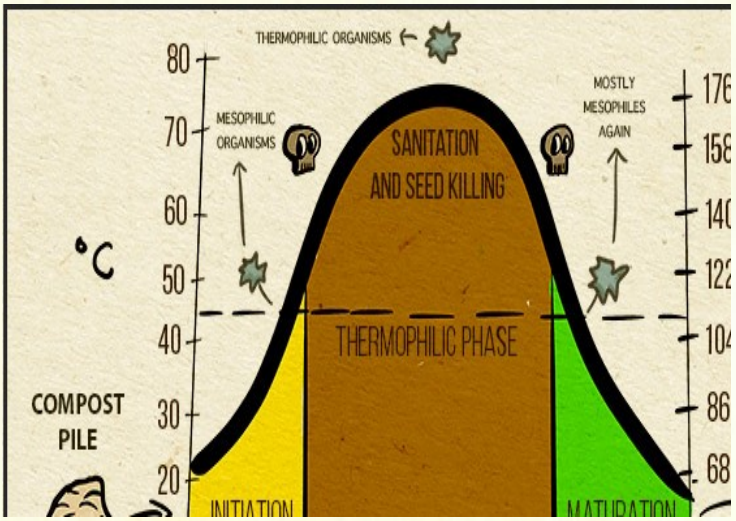
The decomposed matter, which looks like fertile garden soil, is called compost, also known as 'black gold'. Compost is rich in nutrients and can be used for gardening, horticulture, and agriculture.

Stages of Composting

Composting is all about decomposition of organic matter. It is a complex process involving a number of microbes and physical conditions. The composting is completed in three stages:

- **Mesophilic**
- **Thermophilic**
- **Maturation**

1. Mesophilic Phase



The heap of waste begins to heat up and the composting begins. In this stage, the temperature remains below 45OC and microorganisms multiply and break down easily available carbohydrates. The pH begins to drop as acids are produced. The pile become active and a series of processes are set in motion.

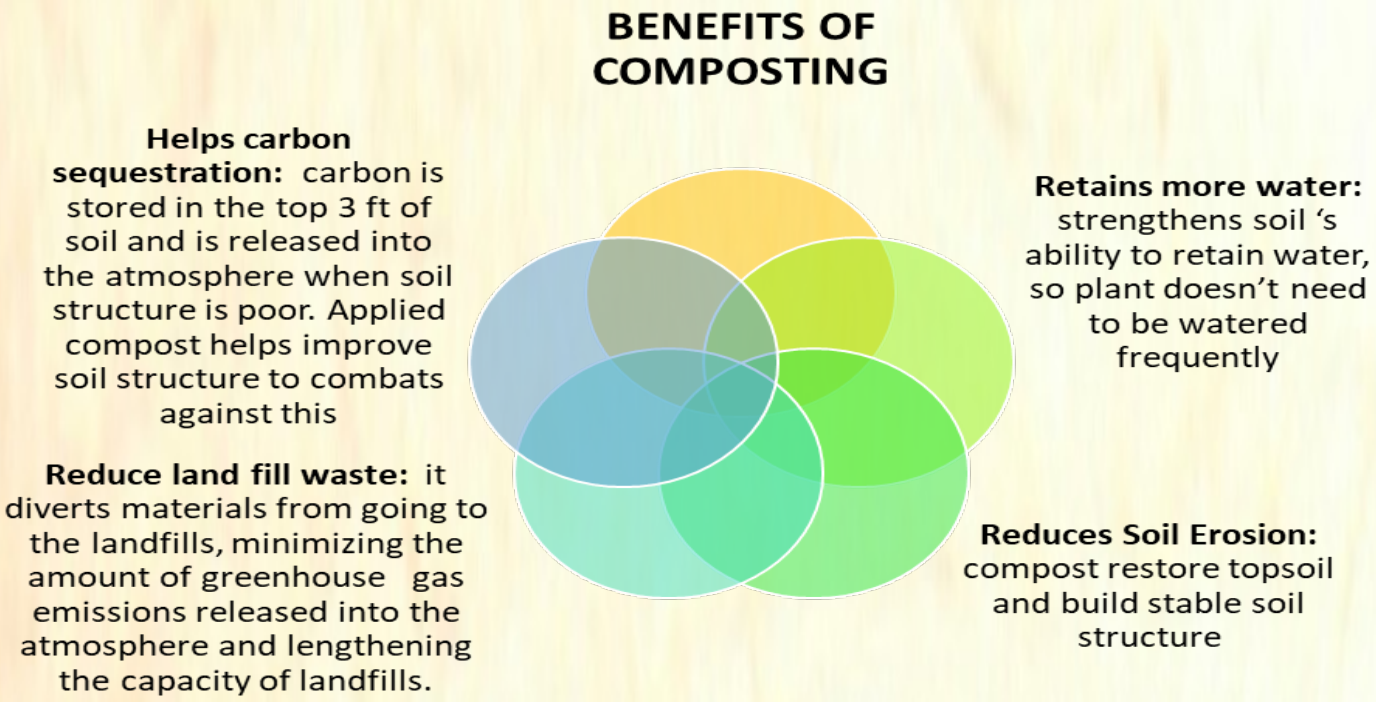
2. Thermophilic Phase

It can last for several weeks. As active composting takes place, temperature in the centre of pile rises to about 50-65^{0}C. At this temperature range, heat loving (thermophilic) bacteria vigorously degrade the organic materials. As the organic matter degrades, its particle size is reduced.

Pathogens are destroyed as the heat in pile is more (above critical temperature 55 ^{0}C). Fly larvae and weed seeds are destroyed when the temperature rises to 63^{0}C.

3. Maturation Phase

The growth of actinomycetes and fungi is enhanced, which digest hemicelluloses. This stage is critical' for developing disease-suppressiveness of composts.



TYPES OF COMPOSTING:

S.No.	Aerobic	Anaerobic
1	When organic materials are broken down in the presence of Oxygen	Microbe's breakdown organic matter through a process of reduction in the absence of oxygen
2	Turned weekly	Not turned
3	Large (at least 1 cubic meter)	Small (less than 1 cubic meter)
4	Quick (ready in weeks)	Slow (ready after 6 weeks)
5	Kill pathogen and weeds	Can spread pathogen and weeds
6	Odorless	Odorous

NUTRIENT COMPOSITION: Avg nutrient contents of farm compost are 0.5 % N, 0.15 % P_2O_5 and 0.5 % K_2O.

METHODS OF COMPOSTING

1. **Berkely Method/Hot Composting**
2. **Indore Method**
3. **Coimbatore Method**
4. **NADEP**
5. **Bangalore Method**

1. BERKELEY METHOD OF HOT COMPOSTING

(*developed by* Robert D. Raabe at University of California, Berkeley)

Time required for composting: **18 Days** **Type of Composting:** **Aerobic**

The requirements for hot composting using the Berkley method are as follows:

1. The C:N (carbon:nitrogen) balance in the composting materials is approximately 25-30:1
2. The compost heap needs to be 1m x 1m (3′ x 3′) wide and roughly 1.5m (5′) high
3. If composting material is high in carbon, such as tree branches, they need to be mulched properly.
4. Compost is turned from outside to inside and vice versa to mix it thoroughly.

Points to remember:

1. Build compost heap
2. 4days – no turning
3. Then turn every 2nd day for 14 days

Advantages:

i) Requires Less time for composting
ii) Odorless

Disadvantages:

i) Require regular turning to ensure proper aeration in the pits
ii) Need manpower for turning

2. INDORE METHOD OF COMPOSTING

(*developed by* A. Howard & Y.D. Wad at Institute of Plant Industry, Indore)

Time required for composting: **4 months** **Type of Composting:** **Aerobic**
Nutrient Composition: **N=0.8%, P=0.3%, K=1.5%**

RAW MATERIALS: Plant residues (all the weeds, pruning's, stalks, stems, fallen leaves, chaff, and fodder leftovers), Animal dung and urine, Wood ashes and Water

Procedure:

- The waste materials are cut into small pieces and spread in layers of 10-15 cm thickness either in pits or in heaps of 1 m wide, 1 m deep and of convenient length.

- It is properly moistened with cow dung using earth. To ensure 50 % moisture sufficient water should be sprinkled to wet the composting materials.
- Periodically three to four turnings are given.
- To get proper aeration, the material is covered with a layer of 2 to 3 cm soil. Under the aerobic process of decomposition 40 to 50 % organic matter and nitrogen are lost at initial stage.

Adequate level of moisture is to be maintained. The site of composting should be at the high level to avoid rain water stagnation.

Advantages:

i) Requires short period for stabilization of the materials
ii) Need less land space
iii) Odorless & Environment friendly

Disadvantages:

i) Requires regular turning to ensure proper aeration in the pits
ii) Composting pit needs to be at an elevated site, near to cattle shed and water source
iii) Associated with problems like moisture loss and breeding of flies.

3. COIMBATORE METHOD OF COMPOSTING

(*developed* by Manicam in 1967)

Time required for Composting: 4 – 5 months

Type of Composting: anaerobic decomposition to start with, following by aerobic fermentation.

Nutrient Composition: N=0.8%, P=0.3%, K=1.5%

RAW MATERIALS

1. Farm wastes (weeds, straw, leaves)
2. Vegetable refuse
3. Animal dung
4. Water

SIZE OF THE PIT:

1. Length: 3.6 m (according to the volume of the wastes)
2. Breadth: 1.8 m
3. Depth: around 1 m

Procedure:

- Fill crop residues & farm wastes in pits of 4m X 2m X 1m depth to a thickness of about 15 cm.
- 5 cm cow dung slurry is spread over this layer to increase its biodegradation.
- Follow the same in alternate layers till the height reaches 0.5 m above ground level.
- Cover this with with soil or mud to prevent the entry of rain water.
- After 35 to 40 days turning of material is done to make it an aerobic process. Thereafter the compost will be ready within 4 to 5 months.

Advantages:

i) Environment friendly & Odorless

Disadvantages:

i) Require regular turning to ensure proper aeration in the pits
ii) Need manpower for turning

4. NADEP METHOD OF COMPOSTING

(developed by N.D. Pandharipande from Maharashtra)

Time required for composting: 4 months
Nutrient Composition: N=0.8%, P=0.4%, K=1.5%

Type of Composting: Aerobic

RAW MATERIALS:

1. Agriculture waste (Weeds, crop residues, forest litter)
2. Cattle dung/biogas slurry
3. Fine sieved soil
4. Water

SIZE OF THE TANK:

1. Length: 10 feet
2. Breadth: 5 feet
3. Height: 3 feet

FILLING THE TANK:

- **First layer**: 4 - 6 inches of stems and sticks are spread at the bottom to facilitate aeration. It is followed by a 4 - 6 inches layer of agricultural wastes (about 10-100 kg).
- **Second layer:** Slurry that is made using 4 - 5 kg of cow dung and 100 - 125 liters of water is sprinkled over the dry wastes to facilitate microbial activity.
- **Third layer:** 60 kg of sieved dry soil is spread evenly over the second layer for moisture retention.

Procedure:

- The entire tank needs to be filled by the same process within 24 hours (not more than 48 hours) of time.
- After 15-30 days the volume of the materials gets reduced to 2 feet and is refilled with the layers of the dry wastes, slurry, and sand.
- The entire mass is covered with a thatched roof to prevent the loss of moisture from the tank.
- Leave it undisturbed for 3 months. Meanwhile, water is added for every 1 - 2 weeks to maintain the moisture percentage in the tank. If the tank develops any cracks, those can be filled with the slurry to maintain the quality of the compost.

Advantages:

i) A large quantity of Quality compost can be prepared with minimum human effort.

Disadvantages:

i) Requires regular turning to ensure proper aeration in the pits.
ii) Need manpower for turning.

6. BANGALORE METHOD OF COMPOSTING:

(*developed* by Dr. L. N. Acharya in 1939 at IISC Bangalore)

Time required for composting: 6-8 months **Type of Composting**: Anaerobic
Nutrient Composition: N=1.5%, P=1%, K=1.5%

PIT PREPARATION:

Pits/trenches should be dug 1 m deep while length and breadth can be varied according to the land availability and volume of wastes to be composted.

PROCEDURE:

- Wastes are dumped into the trenches to make a layer of 15 cm.
- Then night soil is discharged over this and spread to a layer of about 5 cm.
- The trench is filled with town waste and night soil in alternate layers, until it reaches to 15 cm above the ground level, with a final layer of town refuse on the top.
- It could be made dome shape and covered with a thin layer of soil to prevent breeding of flies and moisture loss. Sewage water may be sprayed over the layer of refuse.

This system provides a method of disposal of various kinds of waste including slaughter house waste, sewage, sludge etc. This heterogeneous mass is allowed to remain as such without turning and watering for about 3 to 4 months.

Advantages:

i) Compost is protected from altering weather conditions.
ii) Protected from rains
iii) No need of turning

Disadvantages:

i) Requires a long time for the stabilization of the materials.
ii) Need more load space.
iii) Expensive to follow.

Compost Enrichment

Farm compost is poor in P content (0.4-0.8 percent). Addition of P makes the compost more balanced, and supplies nutrient to micro-organisms for their multiplication and faster decomposition. The addition of P also reduces N losses. Compost can be enriched by:

- **Wood ash waste can also be added to increase the K content of compost**.
- **Addition of N-fixing and P-solubilizing cultures (IARI, 1989):**

The quality of compost can be further improved by the secondary inoculation of Azotobacter, Azospirillum lipoferum, and Azospirillum brasilence (N-fixers) and Bacillus megaterium or Pseudomonas sp. (P solubilizers). These organisms, in the form of culture broth or water suspension of biofertilizer products, can be sprinkled when the decomposing material is turned after one month. By this time, the temperature of the compost has also stabilized at about 35 °C. As a result of this inoculation, the N content of straw compost can be increased by up to 2 percent. This not only improves N content and the availability of other plant nutrients, but also reduces the composting time considerably.