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CERTIFICATION COURSES

# Organic Farming for Sustainable Agricultural Production

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**Lecture 11 : Principles of Compost Production**

# What is compost?

- Compost is organic matter that has been decomposed and recycled as a fertilizer and soil amendment
- Compost is a key ingredient in organic farming.
- End product of the decomposition of organic matter
- Compost is rich in nutrients.
- Acts as a soil conditioner, a [fertilizer](#), addition of vital [humus](#) or [humic acids](#), and as a natural [pesticide](#) for soil.
- In [ecosystems](#), compost is useful for erosion control, land reclamation, wetland construction, and as landfill cover.
- Compost is called The Gardener's Gold because it is an invaluable partner in keeping the soil healthy.



# What is Humus?

Humus is a complex mixture of dark-brown, amorphous and colloidal substances modified from the original plant tissue or synthesized by various soil organisms and is resistant to microbial decomposition.

## Properties of soil humus:

- Humus particles become bonded to clay and other silicate surface leading to formation of soil humus complex
- **Humus stores and release soil N**
- Humus possesses buffering capacity
- **Humus possesses cation/anion exchange capacity**
- Humus adsorbs pesticide and other agricultural chemical





# WHAT IS COMPOSTING?

- Composting is a natural biological process, carried out under controlled aerobic conditions (requires oxygen). In this process, various microorganisms, including bacteria and fungi, break down organic matter into simpler substances.
- Composting is nature's way of recycling. Composting biodegrades organic waste. i.e. food waste, manure, leaves, grass trimmings, paper, wood, feathers, crop residue etc., and turns it into a valuable organic fertilizer.
- The effectiveness of the composting process is dependent upon the environmental conditions present within the composting system i.e. oxygen, temperature, moisture, material composition and the size and activity of microbial populations.

# Types of Composting

- Quick break down of organic waste
- Needs regular turning to maintain aeration in the system.
- Needs to maintain favorable moisture and temperature

## AEROBIC COMPOSTING

## VERMICOMPOSTING

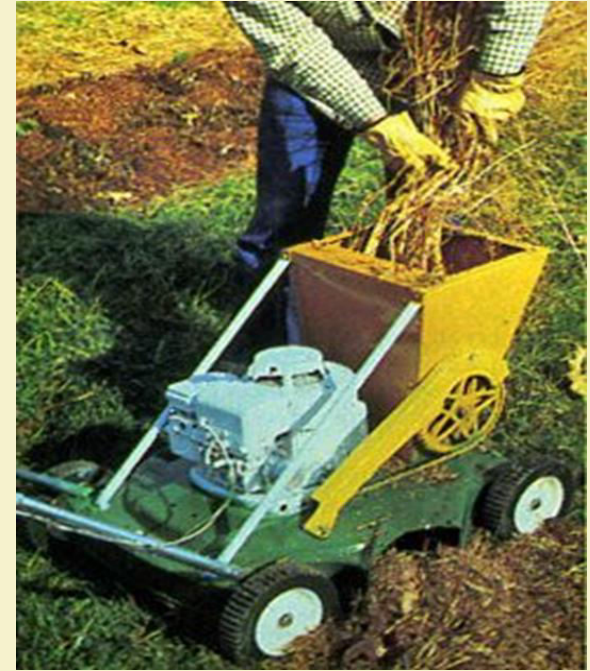
- Most effective composting
- Maintenance of oxygen and moisture for healthy compost.
- Earthworm are the workers

## ANAEROBIC COMPOSTING

- Takes long time for break down of organic wastes
- Needs less maintenance since made in closed pit
- Release of  $\text{NH}_3$  and  $\text{CH}_4$

# Principles of Composting

1. C: N ratio of organic residues
2. Mixing of organic materials
3. Size of residue
4. Moisture and temperature in the compost bed
5. pH in the compost bed
6. Microorganisms and microbial inoculants
7. Amendment with rock minerals



Shredding of waste materials

# Principles of Composting

## 1. C: N ratio of input residues:

- Microorganism require C for growth and N for protein synthesis.
- C:N ratio 30-40 is optimal for composting.
- If the material has high C:N ratio ( $>40$ ), it takes longer time for composting.
- If the material has low C:N ratio ( $<30$ ), the N is in excess of requirement of microbes, the loss of N takes place through  $\text{NH}_3$  volatilization.
- About 20-40% N is lost through  $\text{NH}_3$  in water hyacinth, animal dung, and immature green organic materials.

## 2. Mixing of organic materials

- Material having high C:N ratio ( $>40$ ), can be mixed with activated sewage sludge, legume residue, aquatic weeds, slaughter house wastes to maintain proper C:N.
- Material having low C:N ratio ( $<30$ ) can be added with dry soil at 5-10% to reduce the moisture content and absorb the  $\text{NH}_3$  in the material



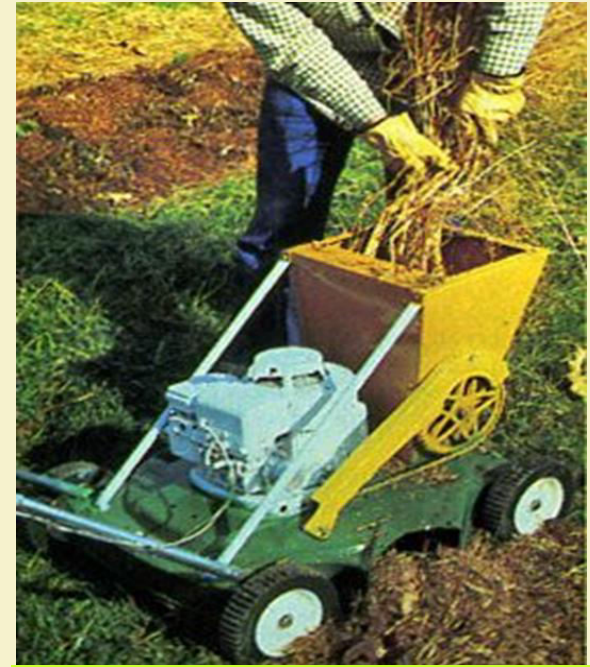
# Principles of Composting

## 3. Size of residue:

- The most desirable particle size is 3-5 cm.
- The period of composting of non-shredded materials is increased by 30 days.

## 4. Moisture and Temperature:

- The optimum moisture content is 50-60% for aerobic composting.
- When the temperature rises above  $40^{\circ}\text{C}$ , the mesophilic microorganisms are replaced by thermophilic microorganism.
- The thermophilic condition appear within 2-7 days of start of the composting operation, where the temperature rises up to  $55 - 70^{\circ}\text{C}$ . The decomposition is faster in this range.
- *Shigella* sp. which cause dysentery and *Escherchia coli* common in sewage are killed at  $60^{\circ}\text{C}$ . Tapeworm and hookworm are killed at  $55^{\circ}\text{C}$ . Common pathogens are killed at  $60^{\circ}\text{C}$ .



Shredding of waste materials



# Principles of Composting (cont..)

## 5. pH

Most of the microorganism grow under neutral pH. There will be drop in pH due to acid forming bacteria. But the pH will rise again due to formation of  $\text{NH}_3$  during the decomposition process. pH is auto regulated in the composting process.

## 6. Microorganism and microbial inoculants:

- Mesophilic bacteria are involved in consuming readily degradable carbohydrates and proteins. Thermophilic bacteria attack lipid and hemicellulose.
- Actinomycetes such as *Thermonosopra curvata* and many fungi involved in cellulose decomposition.
- Preparation sawdust compost with inoculation of cellulolytic fungi *Coprinus phemerus* hasten the composting from 1-2 years to 3 months.

# Principles of Composting (cont..)

## 7. Amendment with Rock minerals:

Application of rock phosphate (RP) at 5% besides improving P and N content also improves micronutrient content. Application of RP with paddy straw along with inoculation of *Aspergillus niger* and *Azotobacter chroococum* accelerates the process of composting and improves N and P content of the compost.

## Factors of composting

PARAMETER	DETAILS
C:N ratio	30-40
Particle size	3-5 cm
Moisture content	50-60%
Aeration	10-18% oxygen
Temperature	55-60°C for three days
pH control	Not necessary
Heap size	Any length, 2.5 m wide, 1.5 m high
Activators	Use efficient cellulolytic fungi



## Properties of good quality compost

Parameters	Good quality	Poor quality
Colour	Brown-Black	Vary
Smell	Pleasant and earthy smell	Bad odour
pH	6.5-8.0	<6 and >8
C:N	10-20	<10 and >20
Temperature	30-45°C	>45°C
Moisture	25-30 %	>30%
Humus	>4%	<4%
N	>1.25%	<1%

## Benefits of Compost

- It is a store house of energy for growth and multiplication of microbes and their activity in soil, which is vital for plant nutrient cycling.
- It supplies both macro- and micro-nutrients.
- It provides growth promoting substances which stimulates early plant growth.
- It acts as soil conditioner as it improves physical condition of soil such as tilth, water holding capacity, cation exchange capacity, etc.
- It is pathogen free as all pathogens are killed at high temperature.
- It increases biological activity of soil and produce crop growth with less disease