Composting

Compost

Introduction

The controlled biological decomposition of organic materials

Compost is organic matter that has been decomposed and recycled as a fertilizer and soil amendment.

In nature , nothing is considered as a waste--- everything is food for something else.

Compost

Nutrient profile of Compost

S. No.	Parameters	Quantity
1.	Organic matter	70 %
2.	pH	7.5
3.	Organic carbon	33.11%
4.	Nitrogen	1.82 %
5.	Phosphorus	1.29 %
6.	Potassium	1.25 %
7.	Fe (ppm)	1019
8.	Mn (ppm)	111
9.	Cu (ppm)	180
10.	Zn (ppm)	280

Compost

Benefits of Compost

Compost improves the quality of soil, and for this reason it is considered as a soil conditioner.

It contains a variety of the basic nutrients required for healthy growth of plants.

In addition to, nitrogen, phosphorous, and potassium, certain micronutrients *viz.* manganese, copper, iron, and zinc also found in compost which helps them to control diseases and insects.

Compost improves the structure and texture of the soil enable them to retain nutrients, moisture, and air for the betterment of growth of plants.

Parameters in Composting

- Carbon: nitrogen ratio → 30:1
- Ideal moisture → 50 – 60%
- Ph → 6 – 8
- Temperature 55 – 75C (thermophile range)
- Oxygen availability → 5 -15%

Compost

Mechanism of Composting

Composting is a biochemical process in which aerobic and anaerobic microorganism decomposes organic matter into valuable manure called as compost.

Release heat

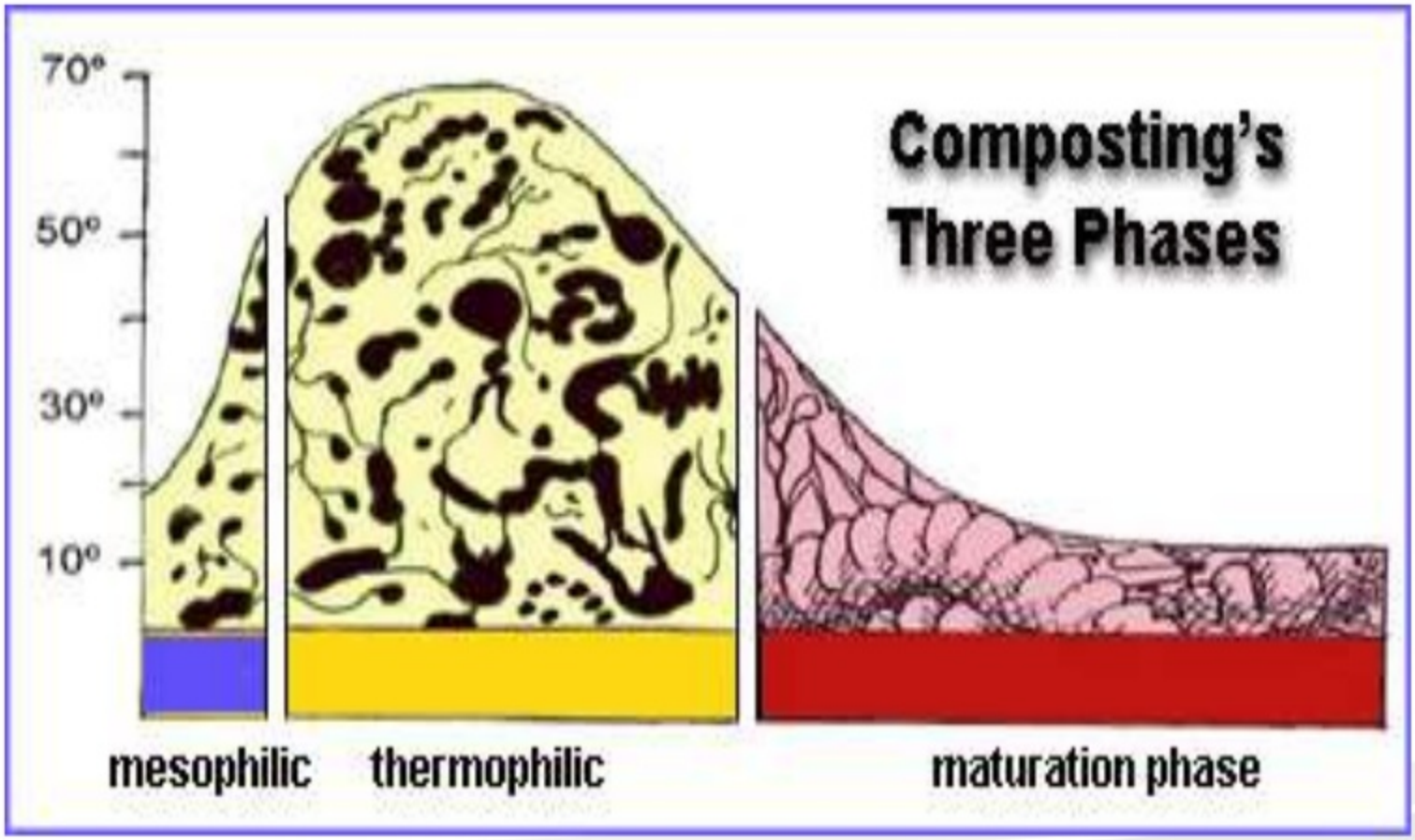
(Thermophilic state, which helps to destroy pathogens)

Organic matter → Organic matter → compost

Temp 55-60° c

(Mesophilic state ,Temp. 25-30o c, promote mesophilic microbes for rapid decomposition)

Phase of Composting



Phases of Composting

- Initial decomposition is carried out by mesophilic microorganisms, which rapidly break down the soluble, readily degradable compounds.
- As the temperature rises above about 40℃, the mesophilic are replaced by thermophilic, At temperatures of 55℃ and above, many microorganisms that are human or plant pathogens are destroyed.
- During the thermophilic phase, high temperatures accelerate the breakdown of proteins, fats, and complex carboydrates like cellulose and hemicellulose, the major structural molecules in plants.
- temperature gradually decreases and mesophilic microorganisms once again take over for the final phase of "curing" or maturation of the remaining organic matter.

Organisms involved in composting

Bacteria

- are the smallest living organisms and the most numerous in compost; they make up 80 to 90% of the billions of microorganisms typically found in a gram of compost
- responsible for most of the decomposition and heat generation in compost.
- At the beginning of the composting process (0-40℃), mesophilic bacteria predominate. heats up above 40℃, thermophilic bacteria take over.
- dominated by members of the genus Bacillus.
- At the highest compost temperatures, bacteria of the genus *Thermus dominates.*
- *Eg: Bacillus brevis, B. subtilis*

Actinomycetes

- characteristic earthy smell of soil is caused by actinomycetes.
- organisms that resemble fungi but actually are filamentous bacteria.
- play an important role in degrading complex organics such as cellulose, lignin, chitin, and proteins.
- Their enzymes enable them to chemically break down tough debris such as woody stems, bark, or newspaper.
- Some species appear during the thermophilic phase, and others become important during the cooler curing phase.
- Eg: *Actinobifida chromogena, Microbispora bispora*

Fungi

- they are responsible for the decomposition of many complex plant polymers in soil and compost.
- they break down tough debris, enabling bacteria to continue the decomposition process once most of the cellulose has been exhausted.
- Fungal species are numerous during both mesophilic and thermophilic phases of composting.
- Most fungi live in the outer layer of compost when temperatures are high.
- Eg: *Aspergillus fumigatus, Humicola grisea*

Protozoa

- Protozoa are one-celled microscopic animals.
- They are found in water droplets in compost but play a relatively minor role in decomposition

Rotifers

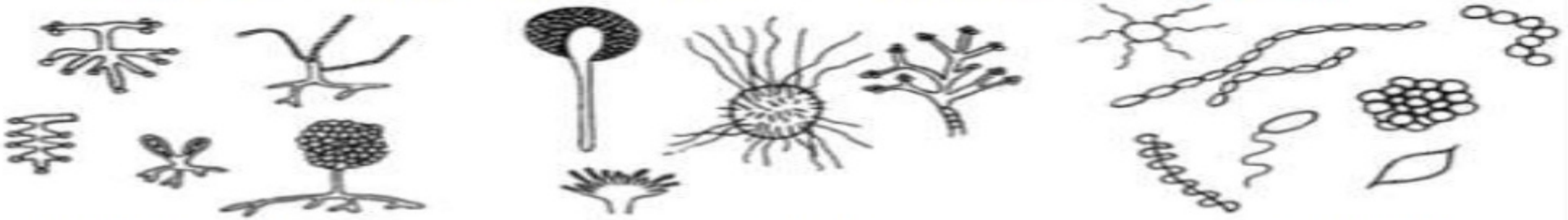
- Rotifers are microscopic multicellular organisms also found in films of water in the compost. They feed on organic matter and also ingest bacteria and fungi.

Earthworms

- Earthworms are the most important of the large physical decomposers in a compost pile.
- Earthworms ingest organic matter and digest it with the help of tiny stones in their gizzards.
- The worms leave dark, fertile castings behind. A worm can produce its weight in castings each day.
- These castings are rich in plant nutrients such as nitrogen, calcium, magnesium, and phosphorus that might otherwise be unavailable to plants.

Figure 3.3

COMPOST MICROORGANISMS MAGNIFIED 1,000 TIMES

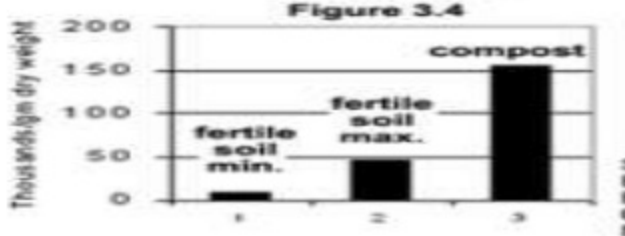


Actinomycetes	Fungi	Bacteria
100 thousand - 100 million per gram of compost	10 thousand - 1 million per gram of compost	100 million - 1 billion per gram of compost

Reproduced with permission from On-Farm Composting Handbook. NRAES-54, published by NRAES, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, New York 14853-5701. (607) 255-7654. Quantities of microorganisms from: Sterritt, Robert M. (1988). Microbiology for Environmental and Public Health Engineers. p. 200. E. & F. N. Spon Ltd., New York, NY 10001 USA.

Fungi Populations in Fertile Soil and Compost

Figure 3.4



Source: U.S. EPA (1998). EPA53 0-B-98-001 March, 1998

Bacteria Populations in Fertile Soil and Compost

Figure 3.5

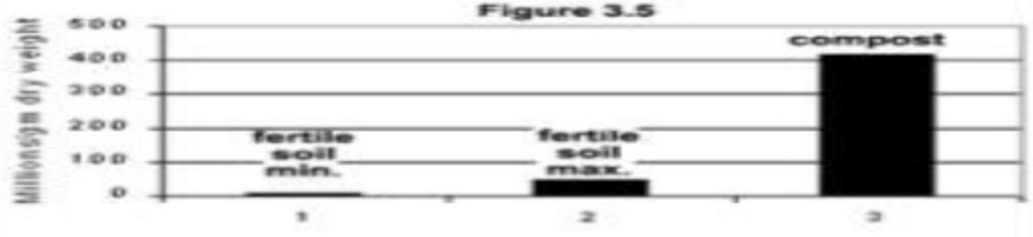


Table 3.6

MICROORGANISMS IN COMPOST

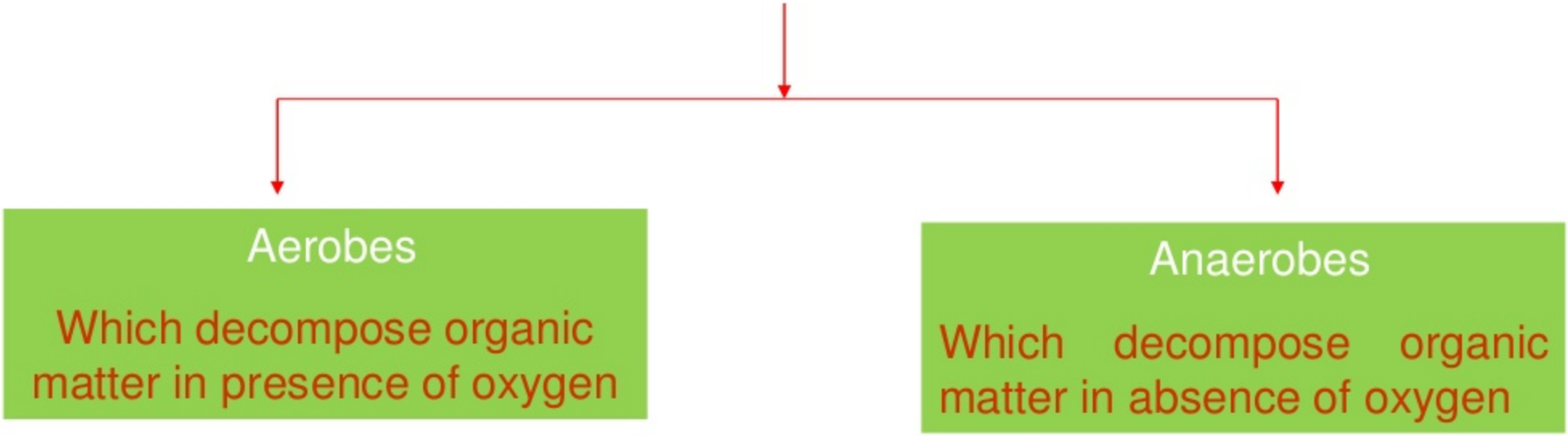
Actinomycetes	Fungi	Bacteria
Actinobifida chromogena	*Aspergillus fumigatus*	*Alcaligenes faecalis*
Microbispora bispora	*Humicola grisea*	*Bacillus brevis*
Micropolyspora faeni	*H. insolens*	*B. circulans* complex
Nocardia sp.	*H. lanuginosa*	*B. coagulans* type A
Pseudocardia thermophilia	*Malbranchea pulchella*	*B. coagulans* type B
Streptomyces rectus	*Myriococcum themophilum*	*B. licheniformis*
S. thermofuscus	*Paeciliomyces variotti*	*B. megaterium*
S. thermoviolaceus	*Papulaspora thermophila*	*B. pumilus*
S. thermovulgaris	*Scytalidium thermophilim*	*B. sphaericus*
S. violaceus-ruber	*Sporotrichum thermophile*	*B. stearothermophilus*
Thermoactinomyces sac chari		*B. subtilis*
T. vulgaris		*Clostridium thermocellum*
Thermomonospora curvata		*Escherichia coli*
T. viridis		*Flavobacterium* sp.
		Pseudomonas sp.
		Serratia sp.
		Thermus sp.

Source: Palmisano, Anna C. and Barlaz, Morton A. (Eds.) (1996). Microbiology of Solid Waste. Pp. 125-127. CRC Press, Inc., 2000 Corporate Blvd., N.W., Boca Raton, FL 33431 USA.

Compost

Microorganism Involved in Composting

Two type of microbes which help in composting process are:



Vermicomposting

- Worm composting is using worms to recycle food scraps and other organic material into a valuable soil amendment called vermicompost.
- It is a mesophilic process, utilizing microorganisms and earthworms that are active at 10–32°C.
- The process is faster than composting; because the material passes through the earthworm gut,whereby the resulting earthworm castings ie, rich in nutrients.
- Earthworms consume various organic wastes and reduce the volume by 40–60%.

Earthworms are invertebrates.

- mainly divided into two types: (1) burrowing; and (2) non-burrowing.
- The burrowing types Pertima elongata and Pertima asiatica live deep in the soil.
- the non-burrowing types Eisenia fetida and Eudrilus eugenae live in the upper layer of soil surface.
- The non-burrowing earthworms eat 10% soil and 90% organic waste materials; these convert the organic waste into vermicompost faster than the burrowing earthworms.
- They can tolerate temperatures ranging from 0 to 40℃ but the regeneration capacity is more at 25 to 30℃ and 40–45% moisture level in the pile.
- The burrowing type of earthworms come onto the soil surface only at night. These make holes in the soil up to a depth of 3.5 m and produce 5.6 kg casts by ingesting 90% soil and 10% organic waste.

Compost

Material required for Composting

Farm refuses

- Weeds
- Stubbles *bhusa*
- Crop residues
- Remnents of fodder
- Hedge clipping

Animal dung

- Cow dung
- Buffalo dung
- Poultry dung

Town refuse

- Night soil
- Street refuse
- Municipal fuse

Compost

Methods of Preparation of Compost

Indore Method

This method was developed by A. Howard and Y. D. Wad at the Institute of Plant industry, Indore, India

Bangalore Method

This method was worked out by L. N. Acharya at Indian Institute of Science, Bangalore.

NADEP Method

Demonstration of this method at large scale was initiated at J. N. Krishi Vidyalaya, Indore.

Coimbatore method

Introduced by manickam 1967

Compost

Indore method

Size of the pit

Raw materials

Methods of filling the pits

Turning

Compost

Indore method

Size of the pit

Breadth - 6-8 feet

Depth - 2-3 feet (not more than 3 feet)

Length - 10 feet or more as per requirement

Compost

Indore method

Raw material

Mix plant residues, weeds, sugarcane leaves, grass, wood ashes, bran etc.

Animal dung

Wood ashes

Water

Urine soaked mud