Anyone Can Compost

Presented by Samuel Nderitu

GROW BIOINTENSIVE CENTRE KENYA G-BIACK

And you can compost any materials

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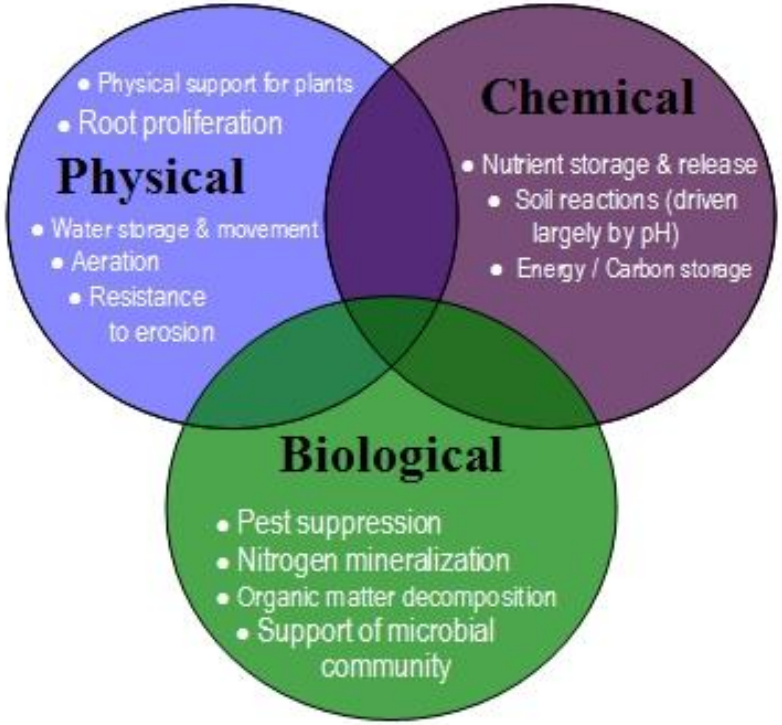
Definition

- Compost is a mixture of **ingredients** used as plant fertilizer and to improve soil's physical, chemical, and biological properties. It is commonly prepared by decomposing plant residues, food waste, recycling organic materials, and **"manure"**. The resulting mixture is rich in plant nutrients and beneficial organisms, such as bacteria, protozoa, nematodes, and fungi



The difference between compost and manure

The key difference between manure and compost is that manure is typically animal dung and is a byproduct of livestock farming (FYM) or human waste (Humanure), whereas compost is a mixture of various components and is a collection of different waste materials from dead plants and animals.

GOAL

Maximize quality and quantity of cured compost produced per unit of compost built and maximize microbiodiversity.

- In nature, living things die and their death allows life to be reborn. Both animals and plants die on forest floors to be composted by time, water, microorganisms, sun and air to produce a soil improved in structure and nutrients.

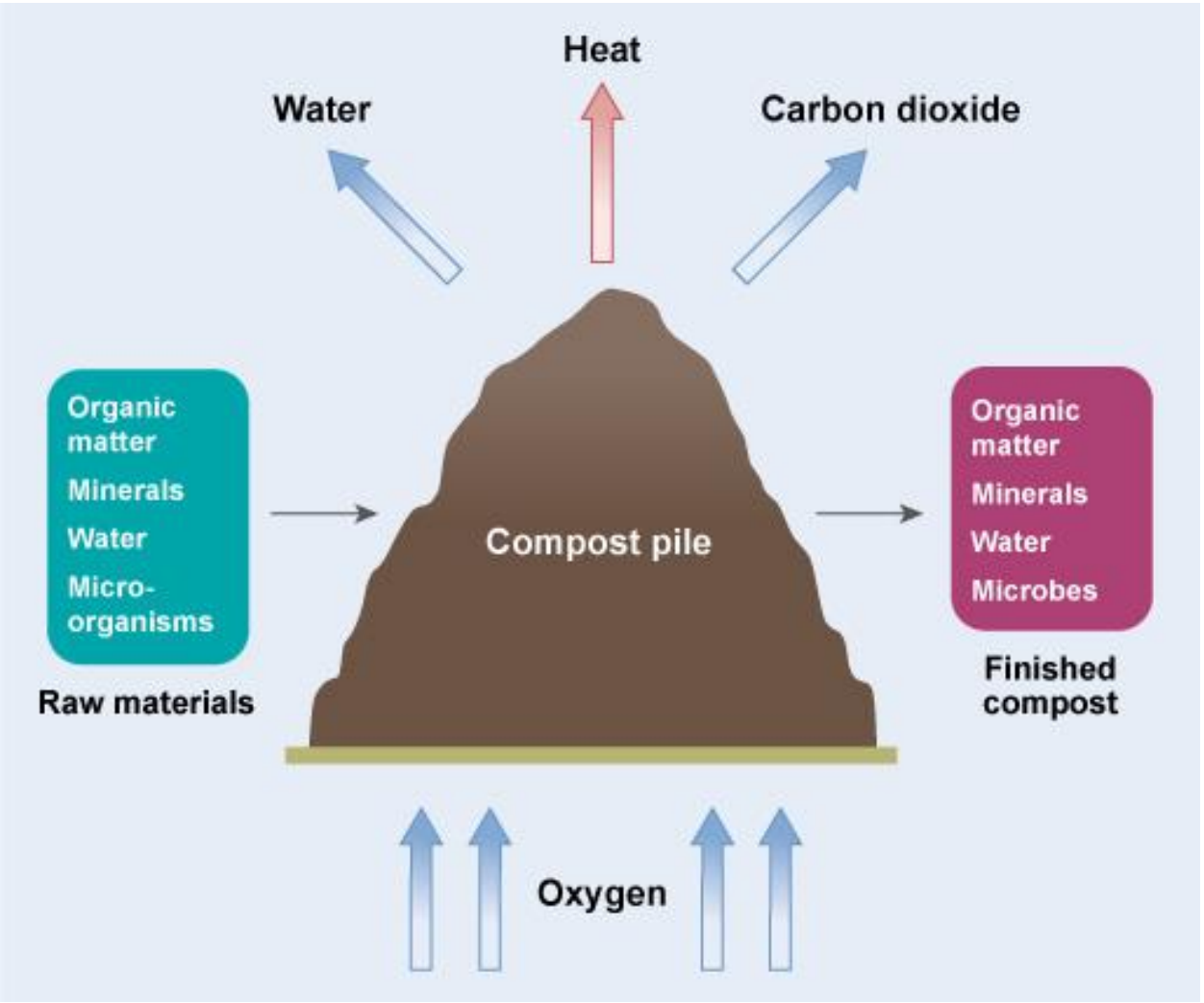
Composting in nature occurs in at least three ways

1. In the form of **manures**, which are plant and animal foods composted inside an animal's body including earth worms and the further aged outside the animal by the heat of fermentation /decomposition.

2. In the form of animal and plant bodies that decay on top of and within the soil in nature and in **compost piles**

3. In the form of **roots and root hairs** and microbial life-forms that remain and decay beneath the surface of the soil after harvesting

The Composting Process



Why Does Composting Happen?

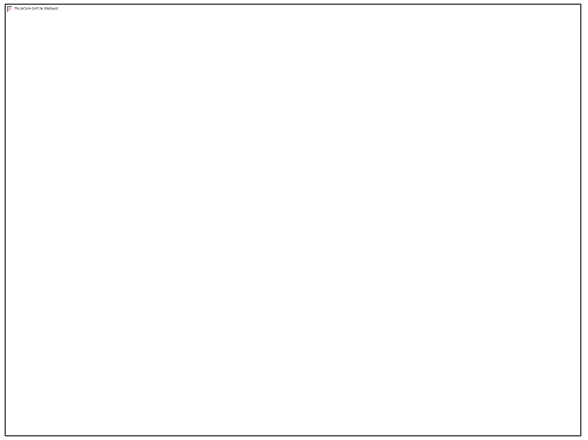
- Microbes consume feedstocks to obtain energy & nutrients
- Their activity creates heat
- Heat gets trapped in pile and accelerates process

What Microbes Need

1. Carbon (sugars) fuels their metabolism
2. Nitrogen (protein) makes enzymes used in decay process
3. Moisture transports and supports life functions
4. Oxygen
5. Hospitable environment

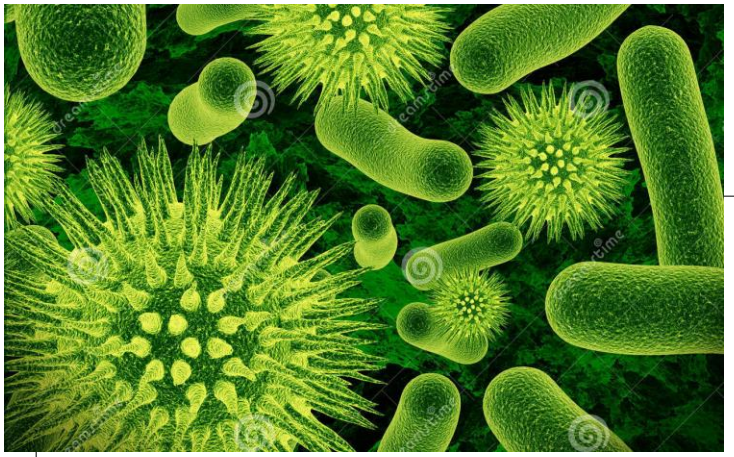
Microorganisms Involved in the Composting Process

- Bacteria
- Fungi
- Actinomycetes
- Protozoa
- Rotifers



Bacteria

- Smallest living organisms
- 1 teaspoon soil has 100 million – 1 billion
- Consume simple carbon compounds
- About 80-90% of the microorganisms in a compost pile are bacteria
- Responsible for most of decomposition and heat generation in compost

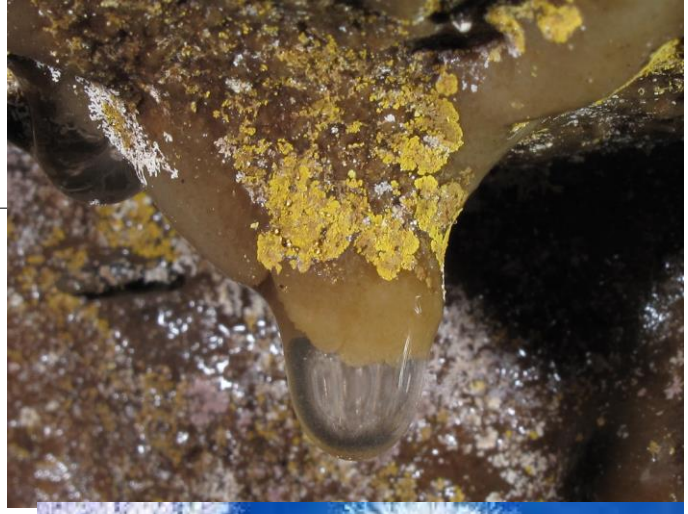


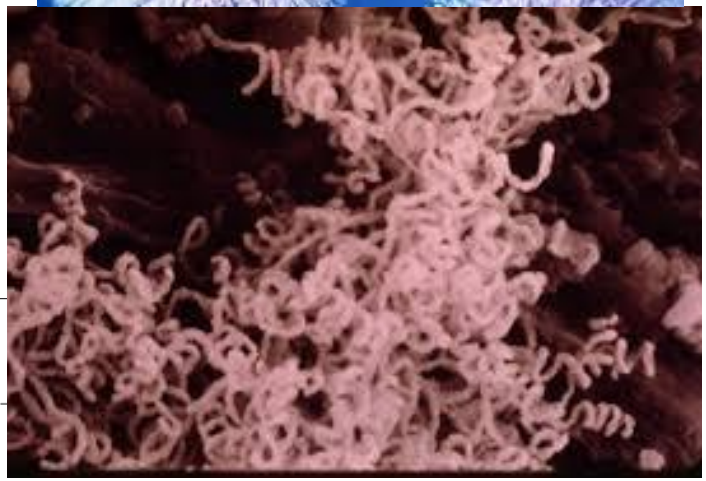
Fungi

- Molds, yeasts, mushrooms
- **<u>Numerous during mesophilic phases</u>**
- When temperatures are high, most fungi live in outer layer of compost
- Break down tough organic debris
- Cellulose, hemicellulose, lignin
- Can decompose materials too dry, acidic, or low in nitrogen for bacterial activity

Actinomycetes

- Cause earthy smell
- Bacteria with filaments (resemble fungi)
- Look like gray spider webs
- Degrade cellulose, lignin, chitin, proteins
- Live in wider range of pH than other bacteria
- Some species in thermophilic phase, others in curing phase



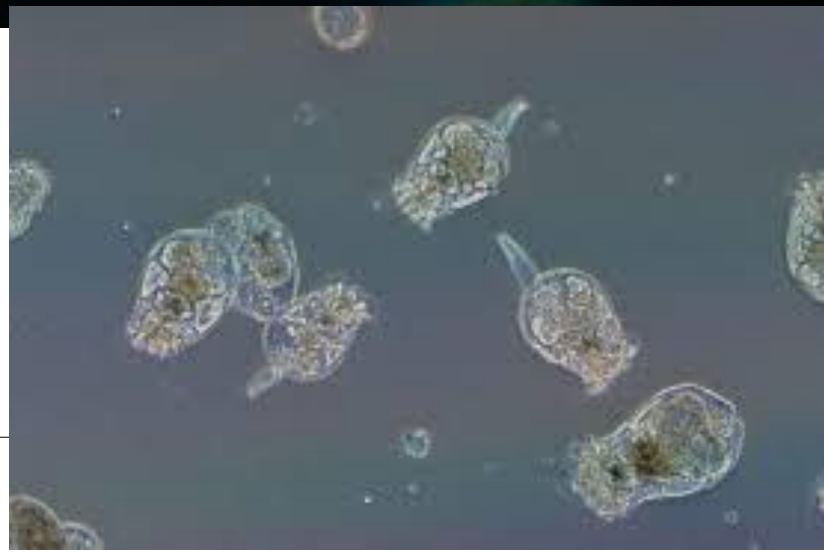


Protozoa

- One-celled microscopic animals
- Live in water droplets in compost
- Play minor role in decomposition
- Feed on organic matter, bacteria and fungi

Rotifers

- Microscopic multicellular organisms
- Also found in water drops in compost
- Also eat organic matter, bacteria and fungi



Top Reasons to Compost

- ✓ Reduces need for chemical fertilizers,
- ✓ Reduces need for mulch.
- ✓ Improves the structure of your soil.
- ✓ Reduces yard waste going to landfill.
- ✓ Slows storm water run-off.
- ✓ Decreases water use in your land.
- ✓ It's easy. Good exercise!

IMPORTANCE OF COMPOST IN THE SOIL

- Soil physical health alteration
- Soil acidity management
- Crop yield and productivity enhancement
- Increase water availability
- Soil micronutrients mineralization
- Influence plant physiological parameters
- Soil quality and fertility management
- Soil chemical property modification
- Sequester soil carbon
- Nutrient retention and absorption

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Nitrogen storage –Compost pile is a store house for nitrogen.

a) Because it is tied up during the compost breakdown process, water soluble nitrogen does not leach out or oxidize into the air for a period of 3 to 6 months or more depending on how the pile is built and maintained

b) PH buffer

c) Nutrients released slowly bit by bit

d) Food for microbial life

e) The ultimate in recycling

A healthy soil produces healthy plants better able to resist insect and disease attack.

- Most insect look for sick plant to eat.

- The best way to control insect and disease in plants is with a living healthy soil faster than with poisons that kill beneficial soil life.

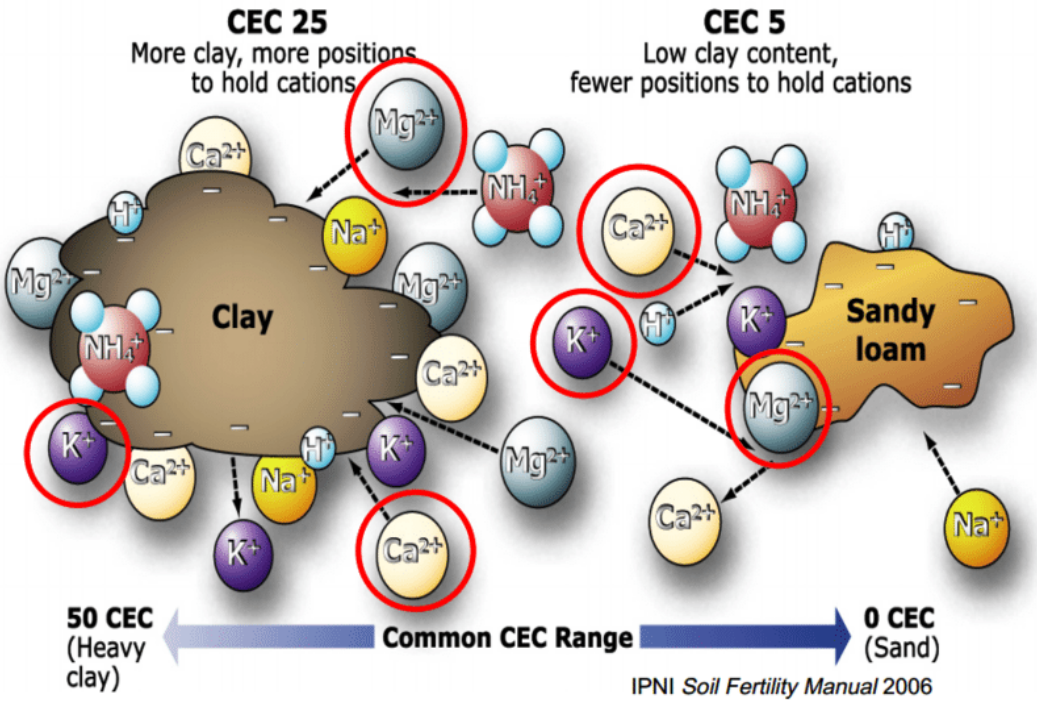
Compost keeps soil at maximum health with minimum expenses.

- Healthy soils produce healthy crops that in turn nourish people and animals. Indeed, soil quality is directly linked to food quality and quantity.

Contains Organic matter, humus and some undecomposed organic matter. Humus also acts as site of nutrients absorption (accumulation of nutrients on its surface) and exchange for plants in soil .

The surface of humus particles carry a negative electric charge. Many of the plant nutrients such as calcium, sodium magnesium, potassium and more trace minerals carry a positive charge in the soil solution and are thereby attracted to and adhere to the surface of humus.

As plant roots grow through the soil in search of nutrients, they feed on humus. Each plant root is surrounded by halo of hydrogen ions that are a by-product of the roots respiration. These hydrogen ions also carry a positive electric charge.



Cation exchange capacity (CEC)

•Cation exchange capacity is the maximum amount of total cations that a soil sample is capable of holding at a given pH.

What is Organic Matter?

- Derived from living organisms
- Always contains carbon
- Source of energy for decomposers
- Contains various amounts of other elements

- Nitrogen
- Phosphorous
- Oxygen, Hydrogen
- Sulfur
- K, Mg, Cu, Cl, etc.

Key Organic Matter Functions

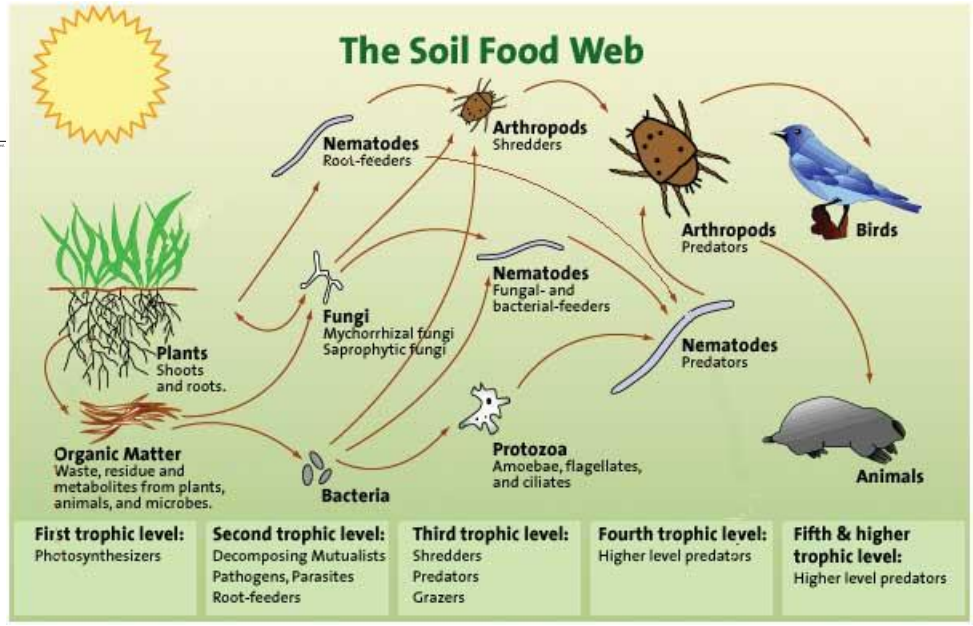
1. Organic matter feeds plants through nutrients exchange and through nutrients upon its decomposition.
2. It is a continual slow release source of nutrients for plants.
3. Organic acids in the humus help dissolve minerals in the soil, making the mineral nutrients available to plants. Organic acids also increase the permeability of the root Membranes and therefore promote the plant roots uptake of water and nutrients.

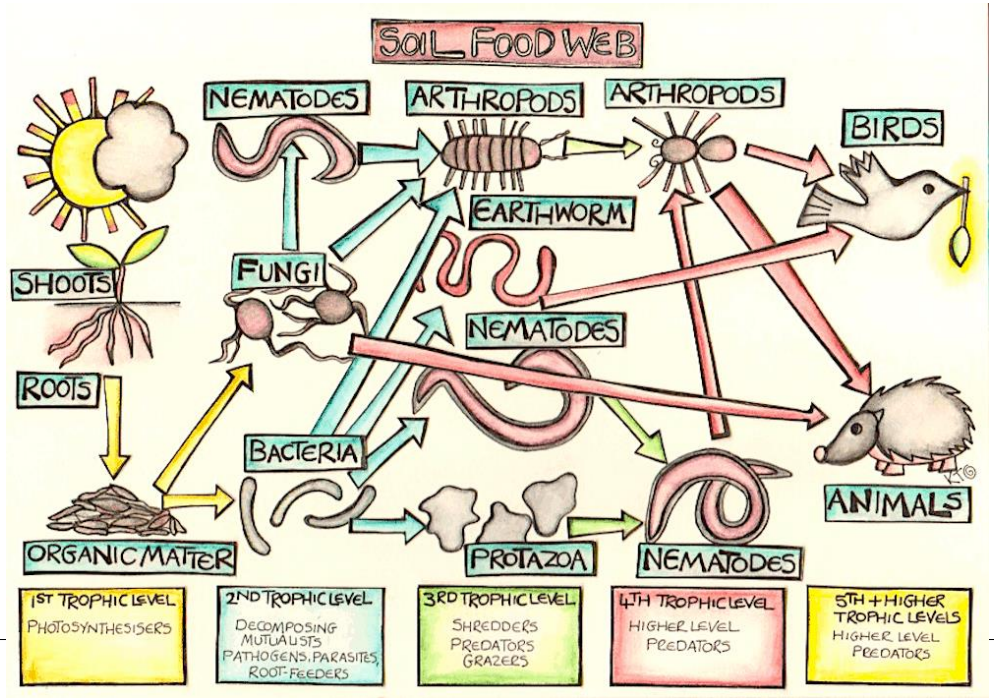
4. Organic matter is the energy source of the soil microbial life form which are integral part of soil health.

5. The microbes that feed on organic matter in the soil temporally bind the soil particles together.

SOIL FOOD WEB

- If you are composting for the first time, you may be surprised by the size and complexity of the community of small organisms that take up residence in your compost pile. These organisms, which include many insects, bugs, slugs, bacteria, and fungi, form what is called a "food web." In the food web, each organism has a job to do in turning your organic waste into dark, crumbly finished compost.





The food web decomposition process is divided into three levels:

- Level One (primary consumers) is comprised of the organisms that shred organic matter and the microscopic organisms that eat the shredded organic residues.
- Level Two (secondary consumers) is comprised of the organisms that eat level one organisms.
- Level Three (tertiary consumers) is comprised of the organisms that eat level two organisms.

What goes in your Compost

Carbon: Mature materials

dried leaves, straws etc

Nitrogen: Immature materials

Green plants

Water: moisture

Oxygen

Carbon	Nitrogen
BROWNS	**GREENS**
Mature leaves	Kitchen scraps
Straws/grass	Coffee grounds & filter
Organic Shredded papers	immature grass/straws
Mature stalks	Fresh garden trimmings
Mature trash	immature trash
Sawdust	Manure (from herbivores:
Peanut shells	poultry, cattle, goat)

Compost Crops

Farming Carbon, Growing Soil









- A Plant is 96% Carbon and only 4% water and soil!
- Maize, sorghum, amaranthus, millet, artichok

A Few Things to Avoid

- Meat, bones
- Dairy products
- Fats and oils
- Pet feces (*dog, cat, other carnivores*)
- Wood ashes???

These can attract critters you don't want, may create odd odors, or contain harmful bacteria/parasites.

Stages of Composting

- **First stage:** Mesophilic – **FERMENTATION stage** (68° – 104°F; 20°- 40°C)

- it is the breaking down of organic materials
- break down soluble, readily degradable compounds (sugars and starches)

- **Second stage:** Thermophilic (105°-150°F; 40.6° – 65.6°C)

- Break down proteins, fats; work with actinomycetes to begin breaking down cellulose and hemicellulose

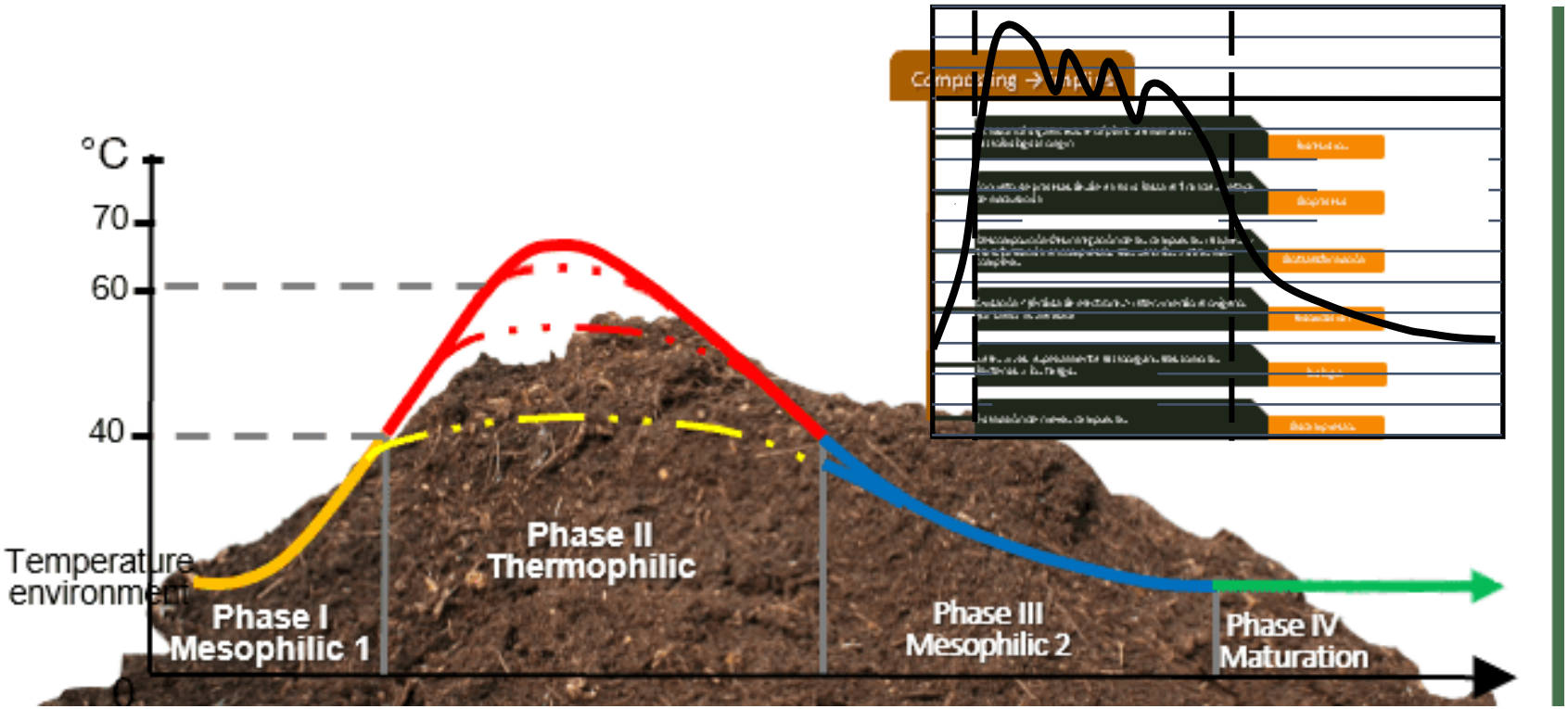
- **HUMUS BUILDING** is the synthesis /breaking down of organic matter into the simpler substances known as humus which increases the surface area for nutrient release

Stage 3 Third stage: Mesophilic (<105°F; <40.6°C) **Activity**

This is the curing stage

- Actinomycetes and fungi are important during curing phase in attacking most resistant compounds
- **MINERALIZATION** -organic matter continue to oxidize/burn up and the compost becomes mineralized which results to low organic matter (8% to 10%) thus lower in nutrient or fertilizer value and this stage should be avoided as this lowers the quality of compost.

- Mesophilic microbes return to active state
- Proteins and carbs diminish
- Metabolic activity decreases
- Temperatures in pile drop
- Lignin (most resistant plant component) decayed by actinomycetes, fungi

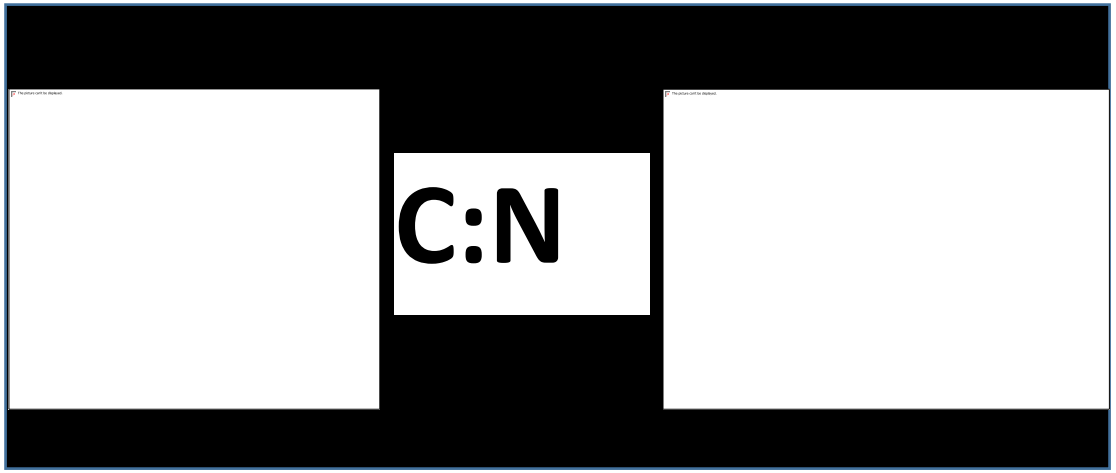

°C
70
60
40
Temperature environment
Phase I
Mesophilic 1
Phase II
Thermophilic
Phase III
Mesophilic 2
Phase IV
Maturation

Summary: Succession of Microbial Communities During Composting

- **Mesophilic bacteria** break down soluble, readily degradable compounds (sugars and starches)
- **Thermophilic bacteria** break down proteins, fats; work with actinomycetes to begin breaking down cellulose and hemicellulose
- Actinomycetes and fungi are important during curing phase in attacking most resistant compounds

Carbon to Nitrogen Ratio (C:N)

- Ratio of total mass of elemental carbon to total mass of elemental nitrogen
- Expressed as *how much more carbon than nitrogen*, with N = 1
- Does NOT account for availability, which is affected by:
  - Degradability
  - Surface area
  - Particle size



C:N Ratio

- **Low C:N**

< 20:1 results in net N release (as ammonia)

- **"Ideal"** starting range: **25:1 - 35:1**

- **Medium C:N**

> 45:1 medium composting process (Medium N)

- **High C:N**

=60:1 slow composting process (Optimum N)

Physical Factors Affecting Decomposition

Particle size and Structure

- Decomposition happens on surface
- Smaller particles = more surface area
- Very fine particles prevent air flow
- Rigid particles provide structure & help aerate

Pile Moisture

- Required by microbes for life processes, heating and cooling, place to live
- Optimum is 45-60% moisture
- > 65% can become anaerobic
- < 40% fungus can dominate
- difficult to re-wet
- < 35% dust problems

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TYPES OF COMPOST

1. Hot compost-**30:1 compost**

- This is a type of compost whereby we use more immature materials than mature in the ratio and in volume
- The hot compost piles cures at around 60°C. This take less than 3 months to decompose. The nutrients in them are readily available to the soil and plants but they as well get lost more easily as well. They are also digested quickly by the plants

Cool compost **45:1 compost**

- This is Compost where all the materials are equal. Mature and immature are used equally.
- It takes about 3 month to 6 month to cure

Cold compost-**60:1 compost**

- The mature materials are more or large amount. Such piles make greater use of course materials. This means some less nitrogen in the pile and lower temperature

How to use your Compost

- **You can use your compost to build healthier soil, prevent soil erosion, conserve water, and improve plant growth in your garden and yardMulch** for the garden, fruit trees
- **Top dressing** on flowering plants
- **Soil improvement**, helps change structure
  - Enhances moisture retention
  - Improves drainage in clay soil
  - Attracts earthworms which aerate soil

Troubleshooting

Materials not decomposing:

Add water, turn pile to add oxygen, add more greens

Ammonia odor:

Add carbonaceous materials such as leaves, straw

Rotten odor:

Turn pile, add coarse dry materials.

composting the empire