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Biodegradation of Agricultural Residue

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Introduction:

Biodegradation of agricultural waste such as leaves, soybean straw, wheat straw, and cotton stalks is a severe problem, so developing a plan to deal with these waste is critical. The majority of the time, these waste products are burned on the field; however this results in the emission of dangerous gases such as CO2, CO2, NO2, and other pollutants, as well as negative influence on the ozone layer. Composting allows these agricultural wastes to break down or biodegrade completely in a shorter amount of time. Fungi, in particular, can accelerate the decomposition process since they have the ability to consume wood. *Aspergillus, Penicillium*, and *Trichoderma* are fungal species that play an essential role in the degradation of diverse waste materials. Fungi are responsible for the decomposition of over 80% of cellulose. Remains of plants and animals in various stages of decomposition.

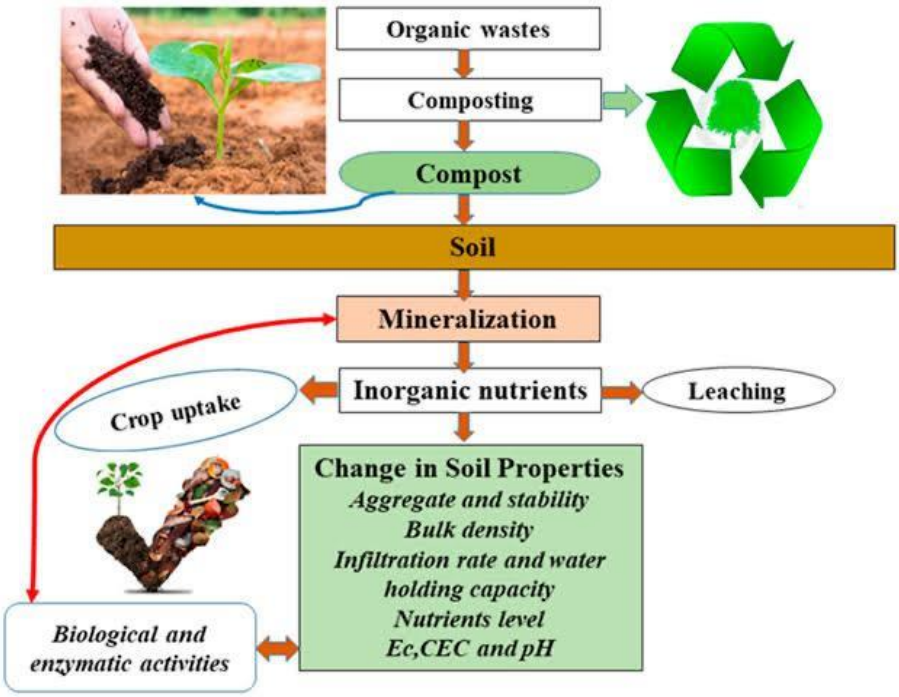

Fig. 1: Schematic diagram of compost mineralization after application to soil. EC: Electrical conductivity, CEC: Cation exchange capacity

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Dead roots, root exudates, leaves, and the carcasses of soil creatures like insects and worms are all sources. Insects, bacteria, fungi, and other soil creatures use it as a primary source of energy and nutrients. The nutrients released from the leftovers are available for utilization by growing plants after decomposition. Soil humus is organic matter that has completely decomposed and is stable. Soil organic matter's most reactive and significant component. Organic matter is a type of soil organic substance that is commonly listed on soil testing reports as "organic matter."

Organic Matter Versus Soil Organic Matter

Organic Matter (OM) is the stuff that makes up organisms. The substance might be alive or dead, and it could be found in the atmosphere, creatures, water, or soil.OM can come from C-rich plant or animal tissues. Organic matter comes in a variety of forms, with varying levels of carbon. Fraction of the soil composed of anything that once lived. The term "Soil organic matter" (SOM) has been used in different ways to describe the organic constituents of soil. Originally created by plants, microbes, and other organisms, these compounds play a variety of roles in nutrient, water, and biological cycles.

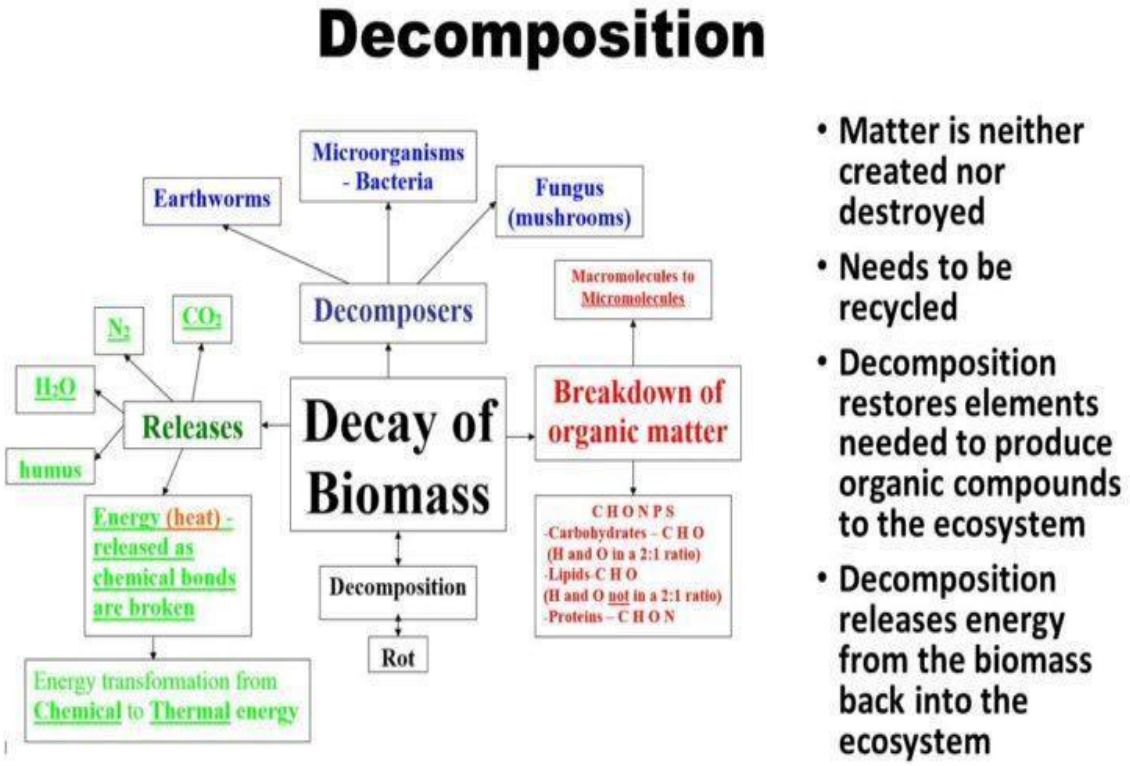

Fig. 2: Decomposition of Organic Matter and Recycling of Nutrients Through Humus

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Proximate Constituents of Som

1. **Carbohydrates** (5-25%) - Pentoses, Pentosans, Hexoses, cellulose & early decomposition products
2. **2. Hydrocarbons** - Paraffin
3. **Proteins/peptides/amino acids**- (9-16%)
4. **4. Lipids** - (1-6%)
5. **5. Alcohols** - Mannitol
6. **6. Esters** - Glycerides of Caproic and Oleic acid
7. **Aldehydes** - Vannins, Salicylaldehyde

What is Bio-degradation

The breakdown or alteration of chemical substances by microorganisms using the substance as carbon or energy source is known as biodegradation. Nature's process of recycling wastes, or breaking down organic matter into nutrients that may be used and reused by other species, is called biodegradation.In the microbiological sense, "biodegradation" refers to the disintegration of all organic materials by a diverse group of organisms, mostly bacteria, yeast, and fungi, as well as maybe other creatures.

The biologically mediated reduction in complexity of chemical compounds is known as biodegradation. The process of biodegradation is called "mineralization" when it is completed. Understanding how biodegradation works necessitates knowledge of the microorganisms that make it possible. The material is transformed by microbial organisms through metabolic or enzymatic mechanisms. Growth and cometabolism are the two processes on which it is founded. An organic contaminant is employed as the only source of carbon and energy during growth. Organic contaminants are completely degraded (mineralized) as a result of this process. The metabolism of an organic substance in the presence of a growth substrate that serves as the principal carbon and energy source is known as cometabolism.

Type of bio-degradation:

1. Aerobic biodegradation:
2. Anaerobic biodegradation:

Aerobic Biodegradation

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When there is oxygen present, microorganism's break down organic pollutants. Aerobes, which are aerobic bacteria, rapidly breakdown organic pollutants in aerobic conditions. Aerobes use oxygen to oxidize substrates (such as carbohydrates and lipids) in order to obtain energy, a process known as cellular respiration. The chemical reactions that break down tiny molecules into water and carbon dioxide utilize oxygen. Energy is also released as a result of the reactions.

Sr. No.	Gram Negative Strains	Gram Positive Strains
1.	*Pseudomonas* spp.	*Nocardia* spp.
2.	*Flavobacterium* spp.	*Mycobacterium* spp.
3.	*Xanthomonas* spp.	*Arthrobacter* spp.
4.	Acinetobacter spp.	Bacillus spp.

Table 1: Different types of bacterial strains

Anaerobic Biodegradation

Anaerobic digestion occurs when the anaerobic microbes are dominant over the aerobic microbes widely used to treat wastewater sludge and biodegradable waste because it provides volume and mass reduction.

Example: *Clostridia*, *Eubacterium* spp.

Conclusion

Organic matter serves as a nutrient store that can be released into the soil. Per pound of organic matter in the soil, 20 to 30 pounds of nitrogen, 4.5 to 6.6 pounds of P2O5, and 2 to 3 pounds of sulfur are released each year. Water-Holding Capacity: Organic matter has the ability to absorb and hold up to 90% of its weight in water, similar to a sponge. Organic matter's water-holding capacity has the added benefit of releasing the majority of the water it absorbs to plants. Clay, on the other hand, can contain a lot of water, but most of it is unavailable to plants. Organic matter causes soil to clump and form soil aggregates, which enhances soil structure. Permeability (water infiltration through the soil) improves with improved soil structure, which improves the soil's ability to absorb and hold water. Erosion prevention is a little-known feature of organic materials. Because of increased water infiltration and stable soil aggregate formation induced by organic matter, increasing soil organic matter from 1% to 3% can reduce erosion by 20 to 33%, according to data used in the universal soil loss equation.