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***2025-2026***

**((Soil microbiology))**

**Stage(-3-)**

**Lec-((4))**

**By**

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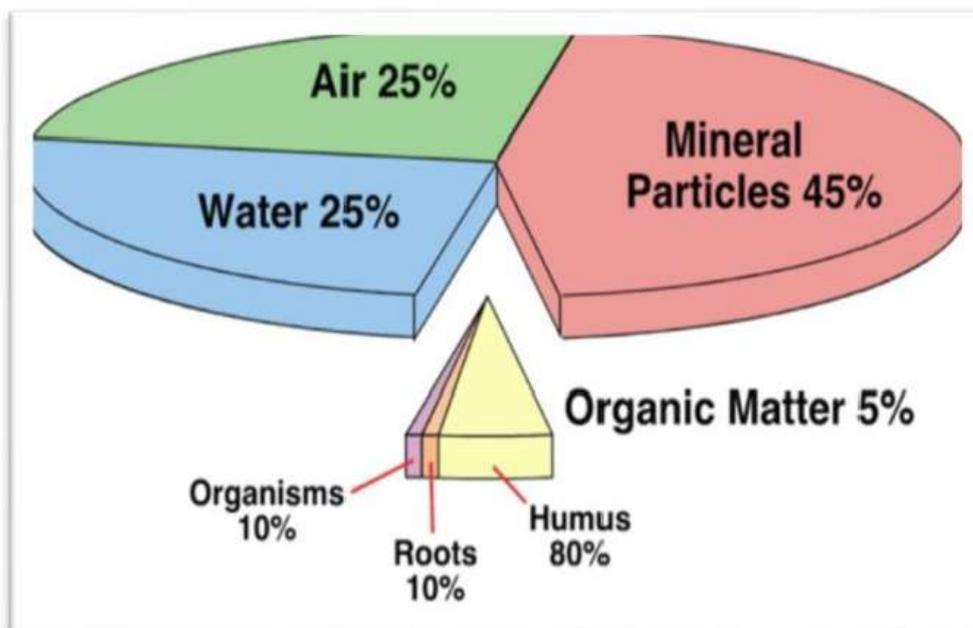


**Soil structure;** is the arrangement of soil particles into grouping. These grouping are called pads or aggregates, which often form distinctive shapes typically found within certain soil horizons. For example, granular soil particles are characteristic of surface horizon. Soil aggregation is an important indicator of the workability of the soil. Soil that are well aggregated are said to have "good soil tilth"

### Soil Composition

Soils are made up of four basic components: mineral particles, air, water, and organic matter

Solid materials ( organic and inorganic ) , which represent around half of soil content and spaces filled with air and water, each of them are important to life, four basic components: minerals, air , water, and organic matter



**(Figure - 3) Soil composition**



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### Inorganic materials

In most soil types inorganic materials (mineral particles) represent about 45% of total soil volume. The mineral portion formed from the rock bed by weathering and biogeochemical factors, mineral portion consist of three distinct soil particles sand, silt, and clay Particles.

Based on chemical nature the mineral portion of soil can be divided into two groups,:

#### **\*Non — Silicate**

Includes; Oxides, hydroxides, sulfates, chlorides, carbonates, and phosphates.

#### **\*Silicate group**

Are very complex in structure, vary in its stability and resistance to decomposition, among these group **SiO<sub>2</sub>** is the most abundant one. It may contain about 70% of total soil mass, except of organic soil.

Most soil influential particles are clay, it play a significant role in determining the availability of nutrient and water to different life forms

Clay particles are negatively charged, due to exchange of SiO<sub>2</sub> and Al<sub>3</sub>



Net particles charge depends on soil microorganisms metabolic activities and pH of soil solution.

### **Water and Air**

Soil particles pack loosely, forming a soil structure filled with pore spaces, these pores contain soil solution (water} and gas (air). Water and air in soil vary significantly with soil texture, weather, and plants uptake of water, but their percentage together in most of soil types is about 50 % of total soil volume. Soil pore space doesn't change depends on soil texture and structure , but after rain the soil pore space will have a high percentage of of water in relation to air, once the



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**Soil water:** Comes from rain, snow, dew or irrigation. Soil water serve as solvent

and a carrier of nutrient for plant growth. The microorganisms inhabiting in the soil also require water for their metabolic activities. Soil water thus, indirectly affects plant growth through its effects on soil microorganisms. Percentage of soil water is about 25 % total volume of soil.

Soil water amount affected by many factors;

### **Porosity:**

Soil porosity refers to the space between soil particles, which consists of various amounts of water and air, porosity depends on both soil texture and structure, for example, a fine soil has small but numerous pores than coarse soil. A coarse soil has bigger particles than a fine soil, but it has less porosity. Water can be held tighter in small pores than in large one, so fine soils can hold more water than coarse soil.

### **filtration:**

Water infiltration refers to the movement of water from soil surface to the soil profile. Soil texture structure, slope, and gravitation has the largest impact on filtration rate, water move by gravity into the open pore space in the soil, the size of soil particles and their spacing determines how much water can flow in.

### **Permeability:**

Soil permeability refers to the movement of air and water through the soil, which is important because it affects the supply of root — zoon.

Water holding capacity is controlled permeability, by the combination effects of soil texture and organic matter, soil with smaller particle (silt and clay) have large surface area than those with large sand particles, so the first one has a high water holding capacity and allow a soil to hold more water than the second type.



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**Soil air:** Apart of soil pores which not occupied with water are filled with air. Compared with atmospheric air, soil is lower in oxygen and higher in carbon dioxide, because CO<sub>2</sub> is continuous

recycled by microorganisms during the process of decomposition of organic matter. Soil air comes from external atmosphere and contains nitrogen, oxygen, CO<sub>2</sub>, and water vapor (CO<sub>2</sub> > O<sub>2</sub>).

CO<sub>2</sub> in soil air is (0.3 — 1.0) more than atmosphere air (0.03%). Soil aeration plays

important role in plants growth, microbial population, and microbial activity in soil. A good aerated soil types lead to complete oxidation of organic matter, and characterized with high redox potential capacity, which offer e<sup>-</sup> and H<sup>+</sup> donor and acceptors, results in thrive of aerobic and facultative microorganisms, but poor aerated soil types (saturated soils), which featured by low redox potential capacity cause continues release of NO<sub>3</sub><sup>-</sup> and SO<sub>4</sub><sup>2+</sup> and accumulation of some harmfully intermediates like CH<sub>4</sub>, that affected soil fertility and increase of anaerobic microorganisms population.

### **Organic matter**

Soil organic matter (SOM) is one of the most important components of soil ecosystem, in its broadest sense, and complex combination of living organisms and non — living organic matter ( fresh organic residues, actively decomposing material, and humus). Generally the proportion of SOM in the soil ranging from 3 — 5 % of total soil volume.

Non — living organic matter can be considered to exist in two distinct pools:

**Nonhumic Substances:** Its particulate matter represents microbial metabolites products, all with identifiable structure, like polysaccharides , amino acids, organic phosphorus. This organic matter can constitute from a few percent up to 25% of total organic matter in soil.



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**Humic Substances:** Carbon decomposition, successive decomposition of dead material, and modified organic matter results in the formation of undefined organic matter called humic substances or humus, by a process is called humification. Humus comprise both organic molecules of identifiable structure like proteins and cellulose, and molecules with no identifiable structure, like plants residues such as lignin, remains of animal carcasses (waxes, hair, nail, wool, and feather), also humin ,humic acid, and fulvic acids are major components of humus. Humus is very stale,

long lived pool of organic matter in soil ( with turnover rate of 100 — 500 years), which makes it a effective way to requester excess carbon. Humus affects soil properties, as it slowly decomposes, it colors the soil d ker, offer spongy appearance , encourages aggregate formation , increase water and nutrient retention and contributes to N, P, S, and other nutrients.

### **Soil Living organic matter (Soil Biota) 5.Soil microorganisms:**

Soil is an excellent culture media for the growth and development of various microorganisms. Soil is not an inert static material but a medium pulsating with life. Soil is now believed to be dynamic or living system. Soil contains several distinct groups of microorganisms and amongst them bacteria, fungi, actinomycetes, algae, protozoa and viruses are the most important. But bacteria are more numerous than any other kinds of microorganisms. Microorganisms form a very small fraction of the soil mass and occupy a volume of less than one percent. In the upper layer of soil (top soil up to **10-30** cm depth i.e. Horizon A), the microbial population is very high which decreases

with depth of soil. Each organisms or a group of organisms are responsible for a specific change ttransformation in the soil. The final effect of various activities of microorganisms in the soil is to make the soil fit for the growth & development of higher plants.



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**Living organisms present in the soil are grouped into two categories as follows**

**1. Soil flora (micro flora)** e.g. Bacteria, fungi, Actinomycetes, Algae and

**2. Soil fauna (micro fauna)** animal like eg. Protozoa, Nematodes, earthworms, moles, ants, rodents. Relative proportion to percentage of various soil microorganisms are: Bacteria-aerobic (**70%**), anaerobic (**13%**), Actinomycetes (**13%**), Fungi and others (Algae, Protozoa, viruses) **0.2-0.8%**. Soil organisms play a key role in the nutrient transformations.