SUBJECT:

AGRICULTURAL SCIENCE

TOPIC

SOIL FORMATION AND PROFILE DEVELOPMENT

CLASS

SS3

BEHAVIOURAL OBJECTIVES

At the end of the class student should be able to;

- List the factors of soil formation (the parent rock, organisms, climate, topography and time);
- Outline of soil formation process, e.g., weathering process;
- Discuss Soil profile development.

DEFINITION OF SOIL

Soil can be defined as unconsolidated, weathered materials found in the uppermost layer of the earth surface on which plants grow.

In other words, soil refers to the uppermost layer of the earth's crust which provides support and nutrients for plant growth.

FACTORS OF SOIL FORMATION

Soil formation is greatly controlled by five major factors which are;

(a) climate;

(b) parent materials;

(c) topography;

(d) biotic (living organisms);

(e) time.

(A) **CLIMATE:**

Elements of climate such as rainfall, temperature, wind and pressure are all very important in soil formation.

i. **Temperature:** The alternating heating and cooling of rocks result in the continual expansion and contraction which eventually result in cracks in the rocks and its consequent breakdown into small pieces to form the soil.

ii. **Rainfall:** The action of running water from rain all causes the gradual wearing away of rocks during erosion to form soil.

Rainfall provides water for hydrolysis.

iii. **Wind:** High wind velocity in deserts carry with it other tiny rocks which collide with one another or other rocks, resulting in the breaking down of rocks into tiny pieces to form soil.

iv. **Pressure:** High pressure on a hanging rock may cause such rock to tall down and break into tiny pieces, resulting in the formation of Soil.

(B) **PARENT MATERIAL:**

Parent materials constitute the major materials from which soil is formed. They are igneous, sedimentary and metamorphic rocks. Parent materials determine the chemical composition of the soil that is formed.

It also contains different minerals which account for differences in the fertility of the soil formed from each of the different types.

Parent materials determine the physical characteristics of the soil. Hardness of parent material affects the rate of soil formation

(C) **TOPOGRAPHY:**

The shape of the ground in relation to the underlying rock of the earth's surface is known as topography. That is;

i.The shape of the land that influences the movement and amount of water in the soil.

ii. Hilly land sloppy surfaces which support erosion and encourage soil formation.

iii. A flat land exposes the whole surface to equal environmental factors and therefore delays soil formation.

(D) **BIOTIC FACTORS (LIVING ORGANISMS)**

The activities of living organisms help to speed up the process of soil formation.

i. Termite, earthworm, rodent mix the mineral and organic matter together, and this results in the formation of soil.

ii. They also allow water and air into the soil which eventually react with rocks to cause their breakdown into soil.

iii. The activities of man during tillage and other farm operations indirectly help to break rocks into tiny pieces to form soil.

iv. The decay of fallen leaves of trees with the aid of bacteria results in the formation of humus, and this is rich in plants food.

(E) **TIME:**

Time also plays an important role in soil formation. It takes a long time for mature soil to be formed.

i. It takes a long time for small pieces of rock to disintegrate into grains of soil.

ii. It also takes a long time for plants to decay and become part of the soil.

iii. It takes time for rainfall to leach chlorides, sulphates and carbonates from the soil.

iv. Time also determines whether or not the soil is well developed.

PROCESSES OF SOIL FORMATION

The process of soil formation is called **weathering**. Weathering is defined as the disintegration or break down of rocks into tiny pieces to form soil.

In other words, weathering can also be defined as the breaking down of rock masses (rock minerals) into simpler forms through the agents of physical, chemical and biological processes.

The processes of soil formation include:

- physical process;
- chemical process;
- biological process.

(1) **PHYSICAL PROCESS:**

Agents of physical weathering are temperature, ice, wind, water and pressure.

(2) **CHEMICAL PROCESS:**

Agents of chemical weathering include solution, carbonation, hydration, hydrolysis and oxidation.

EXPLANATION OF CHEMICAL WEATHERING OF ROCKS

i. Chemical weathering is the decomposition of rocks by chemical agents formed through the reaction of water with atmospheric gases such as air (oxygen and carbon dioxide).

ii. As some minerals in the rocks are dissolved and others change into new chemical products, therefore disintegration of rocks occurs.

(3) **BIOLOGICAL PROCESS**

This involves the activities of plants and animals in the breaking down of rocks to form soil.

i. It is caused by the action of animals like earthworms, termites and other soil organisms.

ii. Movements of these organisms cause) small fragments of rocks to disintegrate.

iii. Earthworms and termites burrow into the rocks and break off fragments of rocks. The roots of growing plants penetrate rocks through crevices, exerting pressures which split some rocks.

iv. The activities of man during farm operations such as ploughing and harrowing also break down rocks into tiny pieces.

COMPONENTS OF THE SOIL

The soil is made up of five components which are:

i. **Inorganic (mineral) matters;** e.g., gravel, sand, stones, silt, clay.

ii. **Organic matters:-** they are the remains of the decomposition of plants and animals when decayed in the soil. They are also known as “humus”.

iii. **Soil water:-** water in the soil as a result of rainfall or irrigation.

iv. **Soil air:-** the gases in the soil depending on the types of soil and the amount of living organisms.

v. **Living organisms:-** plant and animals that inhabits the soil. from microscopic organisms to bigger organisms, e.g., virus, bacterial, insects, reptiles etc.

- Mineral or inorganic matter, organic matter, water and air are collectively referred to as physical components of the soil, while living organisms are referred to as biological components of the soil.

PERCENTAGE OF SOIL COMPONENT BY VOLUME

The percentage of the various soil components by volume is as follows:

- Mineral matter = 45%
- Water = 25%
- Air = 25%
- Living Organisms = 5%
- Total = 100%

- **Properties of the Soil:**

  Properties of the soil include soil texture, soil structure, soil temperature, porosity, soil colour, water-holding/retaining capacity and soil pH.

The properties of the soil are grouped into two:

(a) **Physical properties of the Soil:**

These properties include soil texture, soil structure, soil temperature, porosity, soil colour and water holding/retaining capacity.

(b) **Chemical properties of the Soil:**

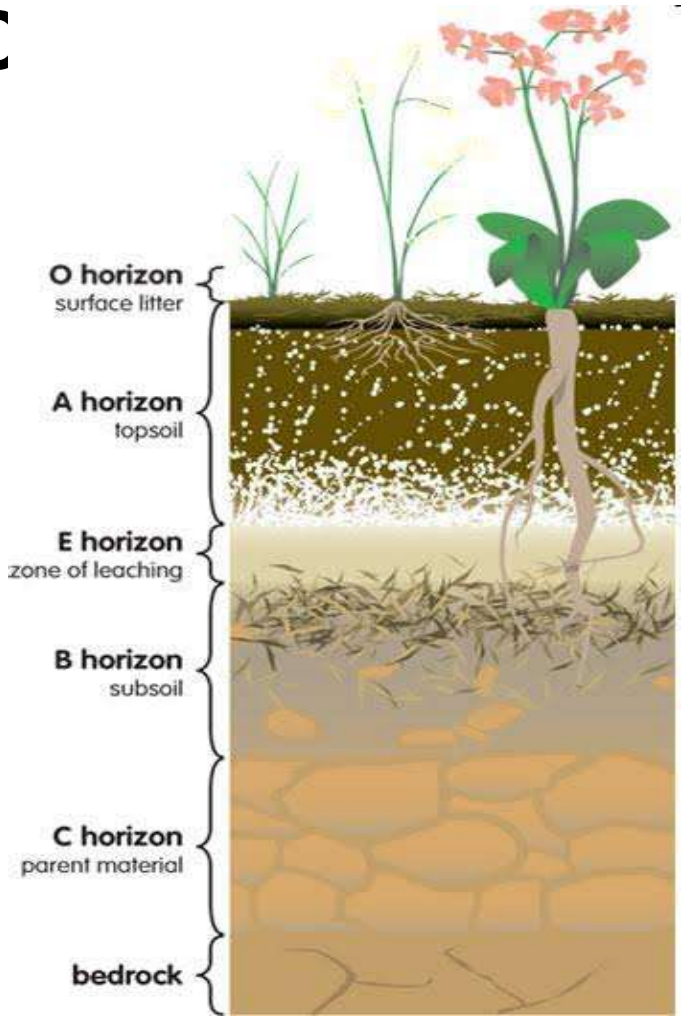
These include the soil pH and cation exchange capacity.

SOIL PROFILE

Soil profile is defined as the vertical section of the soil, showing series of horizontal layers of different types of soil.

These horizontal layers are called **horizons**.

IMAGE ILLUSTRATIC



IMPORTANCE OF SOIL PROFILE

The suitability of a soil for agriculture is determined by looking at the soil profile.

The importance of soil profile includes:

(1) **Level of soil fertility:** Soil profile determines the level of soil fertility. A thick top soil represents high level of soil fertility

(2) **To know the type of crop to grow:**

It helps the farmers to know the type of crop to grow. For example; shallow rooted crops like cowpea, groundnut, etc are grown in the top soil, while deep rooted crops are grown where the sub soil is thick.

(3) **Penetration of roots:** A loosely-packed sub-soil allows for easy penetration of roots of crops.

(4) **Level of drainage and aeration:** A loosely-packed sub-soil also allows for easy drainage and aeration.

(5) **Easy percolation:** A loosely-packed sub-soil also ensures easy percolation of water, thereby preventing the occurrence of erosion.

SOIL CLASSIFICATION

Soil is classified into three major groups, namely;

- zonal soil;
- intra-zonal soil and;
- azonal soil.

The classification is based on climate, vegetation, topography, nature of soil profile, presence of salt and soil types.

(A) **ZONAL SOIL:**

A matured soil having soil profile as a result of the influence of climate and vegetation. This soil is further sub-divided into:

i. Pedalfers: This is non-lime accumulating soil.

ii. Pedocals: This is lime-accumulating.

(B) **INTRA-ZONAL SOIL:**

This soil is formed under special circumstances and conditions such as inadequate drainage which results in waterlogging or salt-accumulation, leading to alkalinity. This may result in different types of soil.

(C) **AZONAL SOIL:**

This is soil formed by the climate. It is young soil and does not exhibit any profile.

EVALUATION

1. List factors of soil formation.

2. Make a sketch of a soil profile.

3. Discuss the basic principles of soil classification.

THANK YOU FOR WATCHING!!!