5th Meeting

SOIL CHEMICAL PROPERTIES

Part II

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Chemical Properties of Soil

01
Plant Nutrients

02
Soil pH

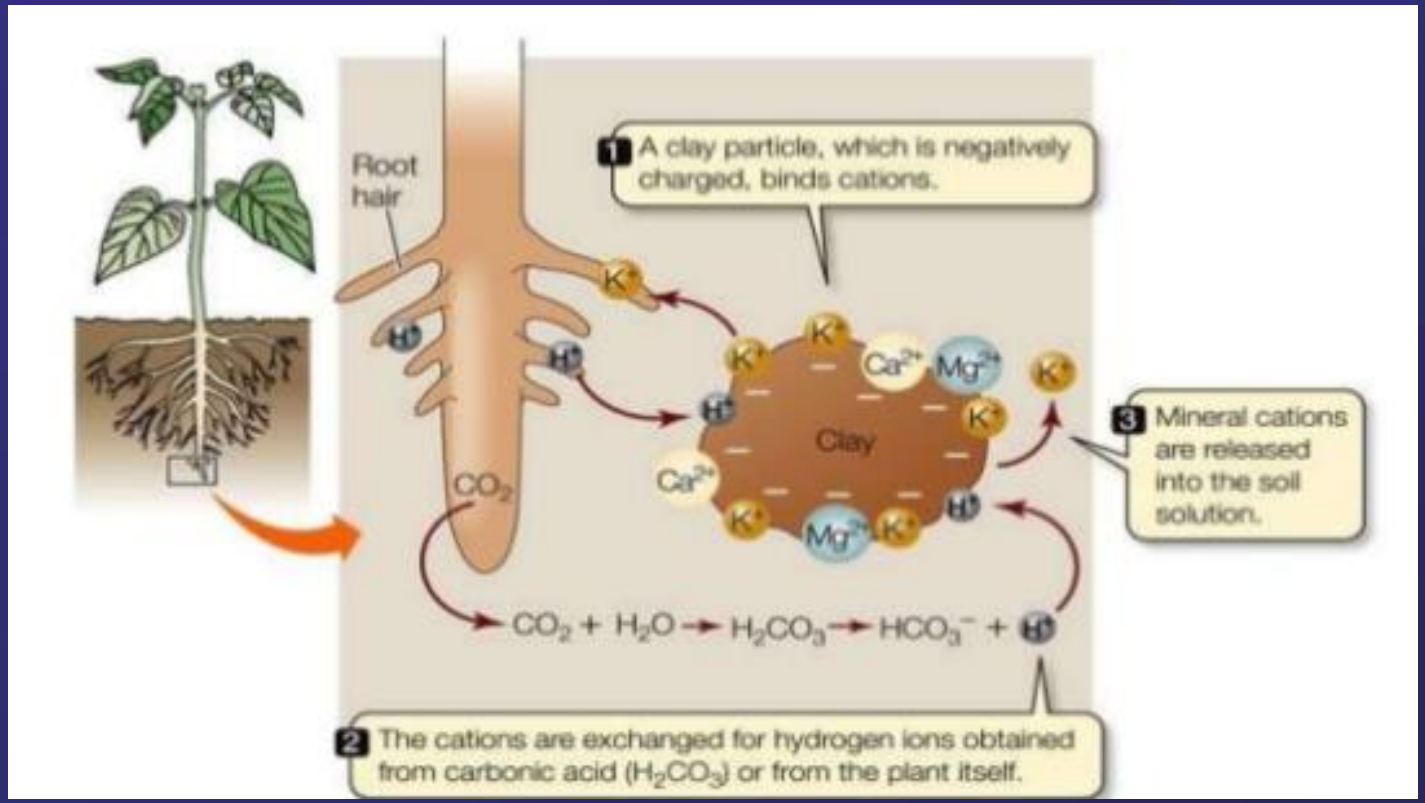
03
Cation Exchange Capacity

04
Base Percentage Saturation

05
Soil Colloid Properties

Review

Cation Exchange Capacity (CEC)



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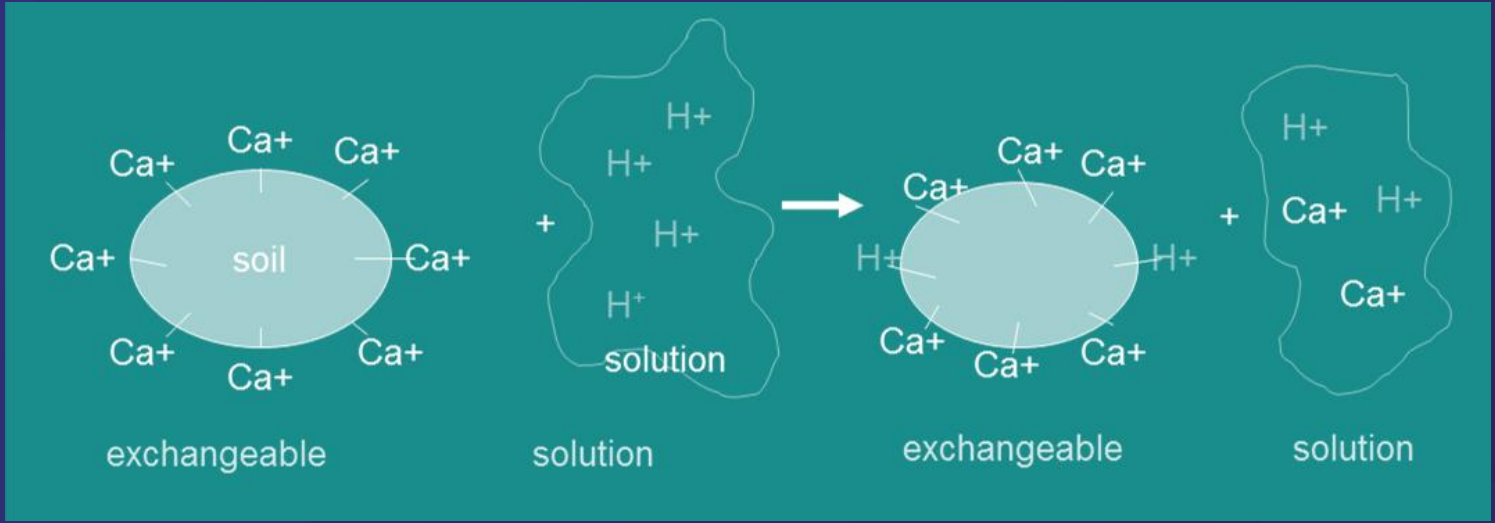
Ion exchange example:

Add H^+ ions to soil :



Energy of adsorption

Strong ----------Weak

$Al^{+3} > Ca^{+2} > Mg^{+2} > [K^{+} = NH_4^{+}] > Na^{+} > H^{+}$

(based on charge and hydrated radius)

Base Percentage Saturation

- There are **acid-forming cations** (hydrogen and aluminum) and there are **base-forming cations** (calcium, magnesium, pottasium, and sodium)
- Base saturation is the fraction of exchangeable cations that are base cations.
- It is expressed as percentage and hence the name percentage base saturation

Base Percentage Saturation

$$Percentage\ base\ saturation = \frac{Number\ of\ adsorbed\ exchangeable\ base}{CEC\ of\ the\ soil} x100\%$$

Soil Colloids

- Definition : are very small organic and inorganic parties present in the soil which are responsible for potential fertility of the soil determine the physical and chemical properties of the soil
- Some of the many types :
  - Layer silicate clays
  - Iron and Aluminum oxide clays
  - Alophane and associated amorphous clays
  - Organic soil colloid : humus

Layer Silicate Clays

Si-Tetrahedron

→ A unit composed of one silicon atom surrounded by four oxygen atoms

Eg : Olivine

Al-Octahedron

→ The key cations surrounded by six oxygen atoms or hydroxyl group giving an eight sided building block termed octahedron

....(Cont) Layer Silicate Clays

- Type 1 : 1 → Strong bond, good physical properties but have limiting holding capacity for nutrients. Eg : Kaolinite.
- Type 2 : 1 → Shrinking and swelling constantly. Poor physical characteristics, but rich in nutrients. Eg : Montmorillonite, illite, and vermiculite.
- Type 2 : 2 → Strong bond, good physical properties. Eg : Chlorite

Iron and Aluminum Oxide Clays

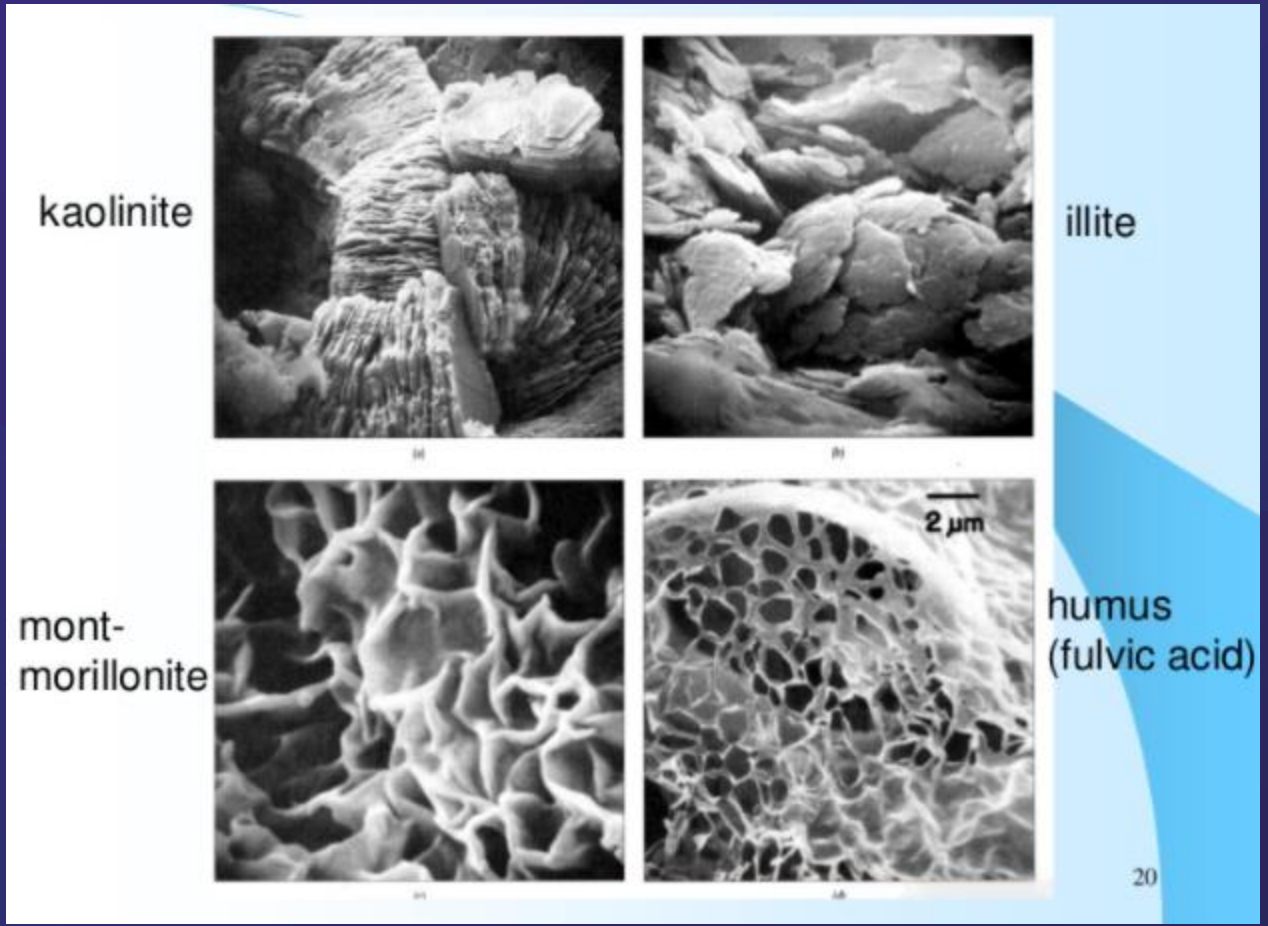
- Under conditions of extensive leaching by rainfall and long time intensive weathering of minerals in humid warm climates. Modified octahedral sheets with substitutions.
  - Which have lower solubility are called sesquioxides
  - Eg : Gibbsite Al (OH)3 → Oxisol and Ultisol
    Geothite (FeOOH) → Yellow Brown Color
    Hematite Fe2O3 → Red Color

Allophane and Other Amorphous Minerals

- They are amorphous in nature
- These clays are common in soils forming from volcanic ash (Eg : Allophane). These clays have high anion exchange capacity or even high cation exchange capacity

Organic soil colloid : Humus

- Humus is amorphous, dark brown to black, nearly insoluble in water, but mostly soluble in dilute alkali solutions
- It is a temporary intermediate product left after considerable decomposition of plant and animal remains
- The negative charges of humus are associated with partially dissociated hydroxyl (-OH), carboxyl (-COOH), and Phenolic groups
- Composed of 3 types : Fulvic Acid, Humic Acid, Humin



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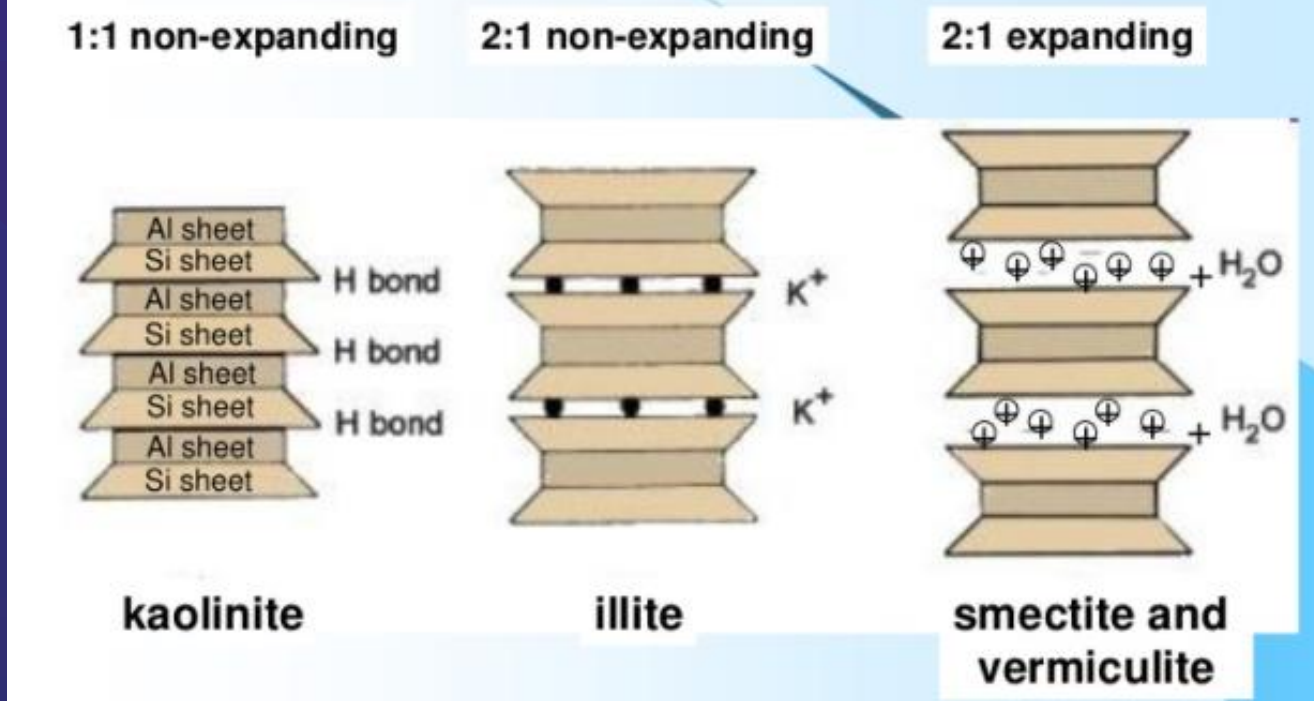
Sheets and Layers



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THANK YOU

Stay Safe and Healthy everyone..!!