Chapter 3: Water ----------

Adhesion: bonding of water to the surfaces of solid particles.

Cohesion: bonding of water molecule to another water molecule.

Mass water content: equals to mass of water divided by the total mass of O.D. soil.

Volumetric water content:

Free Energy: ability to do work.

Soil water potential: the work the water can do as it moves from its present state to the reference state.

Matric Potential: The effects of surface adsorption on the ability of water to do work. Negative.

Solute Potential: The effect of dissolved substances on the ability of water to do work. Negative.

Pressure Potential: The effects of pressure on the ability of water to do work due to gas presume or overhead water. Zero or positive.

Gravitational Potential: the effect of vertical position on the ability of water to do work. Positive or negative deepening on whether water is above or below reference plane.

Water Potential: sum of matrix, solute, and pressure potentials without gravitational potential.

Water Gradient Flow: the difference in total water potential between two locations in the soil, divided by the distance between the two locations.

Unsaturated flow: the water movement in soils that are unsaturated with water. Dominated by matrix potential.

Saturated Flow: gravitational potential is strongest.

Gravitational water: water held more loosely than -33 kPa. Drains easily from soil.

Field Capacity: the amount of water in the soil when the water potential equals -33 kPa. Greatest amount of water a soil can store under conditions of complete wetting followed by free drainage.

Permanent Wilting Point; the amount of water in the soil when the water potential is equal to -1500 kPa. Water is held so strangely and plants cannot extract it fast enough for their needs.

Available water capacity: The amount of water that would be available to plants if the soil were at field capacity. It is equal to the difference in water content between field capacity and the PWP.

Capillary Water: held tightly in small capillary pores by hydrogen bonding.

Saturation percentage: the water content of soil when all pores are filled with water. Double the amount of water at field capacity.

Percolation: movement of more water through wetted soil.

Leaching: process of removing soluble components in percolating water.

Soil Permeability: the property of the soil to transmit water and air. The more permeable the soil, the greater the seepage.

Passive Absorption: the pulling force on soil water by the continuous water column up through the plant cells as water is lost due to respiration.

Active Absorption: occurs when plants expend energy to absorb water. Requires good aeration.

Epiphytes Plants: plants that absorb water from the air.

Evapotranspiration: The loss of water via evaporation from soil and transpiration from plants.

Potential Evapotranspiration: the maximum ET loss that occur when the soil were kept near field capacity.

Consumptive use: is the quantity of water lost by evapotranspiration plus that contained in plant tissues. *Evapotranspiration* + *plant tissue*.

Water Use Efficiency: The amount of water required (transpiration + plant growth + evaporation from soil + drainage loss) to produce a unit of dry weight material (ex. kg of lettuce).

Transpiration Ratio: the amount of water used per unit of dry matter produced. Weight of water transpired devided by the weight of dry plant material produced.

Mulches: transparent and opaque plastic sheeting.

Fallow: the act of keeping land unplanted for several years to accumulate extra water.

Chapter 4 Physical Properties ----------

Colloid: Any solid substance whose particles are very small, they stick things together (humus and clay).

Sol: a suspension formed by colloids dispersed in a fluid medium.

Clay: a particle size fraction composed of mineral particles less than 2 microns; a name for a group of minerals of specific composition; a soil textural class.

Clays Minerals: newly formed crystals, reformed following partial dissolution of other minerals.

Clay types depending on Origin:

Inherited Clays: deposited as clay sediments; formed in different climates long ago.

Modified Clays: changed by further weathering of original clays.

Neoformed Clays: new clays formed by crystallization of ions from solution.

Amorphous: clays of irregular structure; noncrystalline clays.

Isomorphous Substitution: the substitution during clay genesis of one cation for another of similar size and usually lower positive valence.

Cation Exchange Sites: Negetiveyly charged locations.

Micelle: clay formed by adhesion of layers.

Mica: a mineral that separates easily into small flat transparent pieces of rock.

Silicate Clays:

Amorphous silicate clays (allophane): mixtures of silica and alumina that lack crystallinity.

Kaolinite & Halloysite: residues from extensive weathering in high rainfall acidic soil, has one silica and one alumina layers (1:1 latice clay), doesn't swell. Have high hydrogen bonds.

Montmorillonite & Saponite: swelling, sticky clays belonging to smecties. They have two silica and one alumina (2:1 lattice). Expands and swells because of the water penetration.

*Bentonite***:** an impure deposit of montmorillonite or other swelling clay.

Hydrous mica, Illite, & Fine grained mica: Illite is a 2:1 lattice (similar to that of Montmorillonite). Have large potassium ions holding adjacent layers not allowing water penetration. Slight-moderate swelling and expanding.

Vermiculites: a 2:1 clay similar to Illite but without potassium interlay. Held together by hydrated magnesium and Al (Al is dominant). Swell very little

Chlorites: hydrated Mg and Al silicates. A 2:1:1 clay, having two silica, one Mg substitutes for Al, and one bonded interlayer. No swelling at all.

Sesquioxide Clays: remnant materials have low solubility. Clays of iron and aluminum. Formed in humid, hot, well drained soils. Doesn't swell and are not sticky.

Humus: product of decomposition of plants and animals remains. Organic colloid consists of Carbon atoms.

Fulvic Acid: humus molecules soluble in both acid and base.

Humic Acid: Humus molecules soluble in base only.

Cation Exchange Capacity: Quantity of exchangeable cation sites per unit weight of dry soil. Measured in centimoles of cations per kilogram of soil

Chapter 8 Acidic Soils & Salt Affected Soils ----------

Sources of H+ ions:

- Carbonic Acid from CO2 dissolved in rainfall
- Dissolved CO2 from humus decomposition and root respiration
- Release of H+ from NH4+ fertilizers
- H+ ions released from roots
- Acid Raid
- Crop removal of the basic cations

Liming Material:

Calcic limestone CaCO3

Dolomitic limestone: a ground limestone high in magnesium

Quicklime CaO: burned limestone

Hydrated lime Ca(OH)2: Lime from quicklime that has changed to the hydroxide form as a result of reaction with water.

Marl CaCO3: Results from the bottom of small freshwater ponds that has accumulated by precipitation from water high in lime.

Chalk CaCO3: Results from soft limestone deposited long ago in oceans.

Gypsum: is a moderately soluble source of the essential plant nutrients, calcium and sulfur, and can improve overall plant growth.

Salt: ionic compound made of anions and cations.

Soluble salt: salt that are more soluble than gypsum (2.4g/L)

Table Salt: has solubility 150 times more than gypsum.

Osmotic Effect: When the plant cell is placed in a hypotonic solution, it takes up water by osmosis and starts to swell, but the cell wall prevents it from bursting.

Salinity: determined by measuring electrical conductivity.

ESP:

SAR: used to evaluate sodacity of a soil.

Saline Soil: soil with enough salt at some position within the root zone interface with growth.

Sodic Soil: **nonsaline**, caused by salt imbalance where sodium is the dominant rather than calcium. Has SAR >= 13 ---- ESP >= 15.

Saline-Sodic Soil: high in salinity and high in proportion of sodium relative to calcium and magnesium.

Salt Balance: exists when outgoing salt is equal to the incoming salt.

Leaching Requirement: minimum leaching fraction that the crop can tolerate without yield production.

Leaching Fraction: ratio of electrical conductivity of applied water to that of drainage water.

Reclaiming Salty Soil: internal drainage, replace excess exchangeable salts, leach out most of the soluble salts.

Gypsum Requirement: The amount of gypsum required to reclaim a soil.

Chapter Taxonomy----------

Soils with large proportion of Organic Matter

Histosols: soils that are dominantly organic, most are sutured year round, but few are drained. They form from decomposed plant remains in water. Microbial process s accelerated if these soils are drained and exposed to air.

Soils with poorly developed Horizons or no Horizons, capable of mineral alteration

Entisols: soils that have little or no evidence of development of horizons. They occur in areas of recently deposited parent materials or in areas where erosion rate is faster than development rate.

Inceptisols: soils of semiarid to humid that generally exhibit moderate degrees of soil weathering and development. Have altered horizons that have lost bases or iron and aluminum but retain some weather able minerals.

Andisols: soils that are formed from weathering process that generate some minerals with little crystalline structure. High water and nutrient holding capacity. These soils are highly productive. They are common in cool areas with moderate to high precipitation especially areas with volcanic material.

Soils with well-developed Horizons or fully weathered minerals

Ardisoils: soils that are too dry for mesophytic plants to grow. The lack of moisture restricts the intensity of weathering processes and limits most soil development process. Accumulate materials that are easily leached such as gypsum, salt, calcium carbonate... Very productive when irrigated.

Mollisols: soils that have dark surface horizon rich in organic matter. Form under grass in climates that have moderate to pronounced seasonal moisture deficit. Among most fertile soils in the world.

Vertisols: soils that have high content of expanding clay material. They undergo changes in volume with changes in moisture. They have cracks that open and close periodically and show evidence of soil movement in the profile. They move water very slowly because they swell. Fairly high in natural fertility.

Alfisols: soils result from weathering process that leach clay minerals from the surface soil to the sub soil where they can hold and supply nutrient and moisture for plants.

Spodosols: soils formed from weathering processes that strip organic matter combine with Al from the surface layer and deposit them into the subsoil. Occur under areas of coarse texture deposits under humid regions. acidic and fertile.

Ultisois: soils in humid areas. They formed due to weathering and leaching processes ending in clay enriched subsoil dominated by minerals such as quartz.

Oxisols: soils that are highly weathered in tropical or subtropical regions. Mixture of quartz, kaolin, free oxides and organic matter. Occurs in land surface that have been stable for long time. They have low natural fertility and low capacity to retain additions of lime and fertilizers

Gellisols Tundra: soils that have permafrost near the soil surface, may be saturated with water. Common in higher elevations.