College of Agriculture Engineering Sciences

Soil and Water Dept. (Principle of Irrigation)

3rd stage Lecture (2)

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Soil Structure

Soil structure is the arrangement and organization of soil particles into natural units of aggregation or it is how soil particles are grouped or arranged.

Structure influences air and water movement, water intake, root development, and nutrient supply.

Texture, root activity, percent clay, percent organic matter, microbial activity, and the freeze-thaw cycle all play a part in aggregate formation and stability. Some aggregates are quite stable upon wetting, and others disperse readily.

Types of Soil Structure: There are six principal forms of soil structure.

1. Granular

2. Platy

3. Blocky

4. Prismatic

5. Columnar

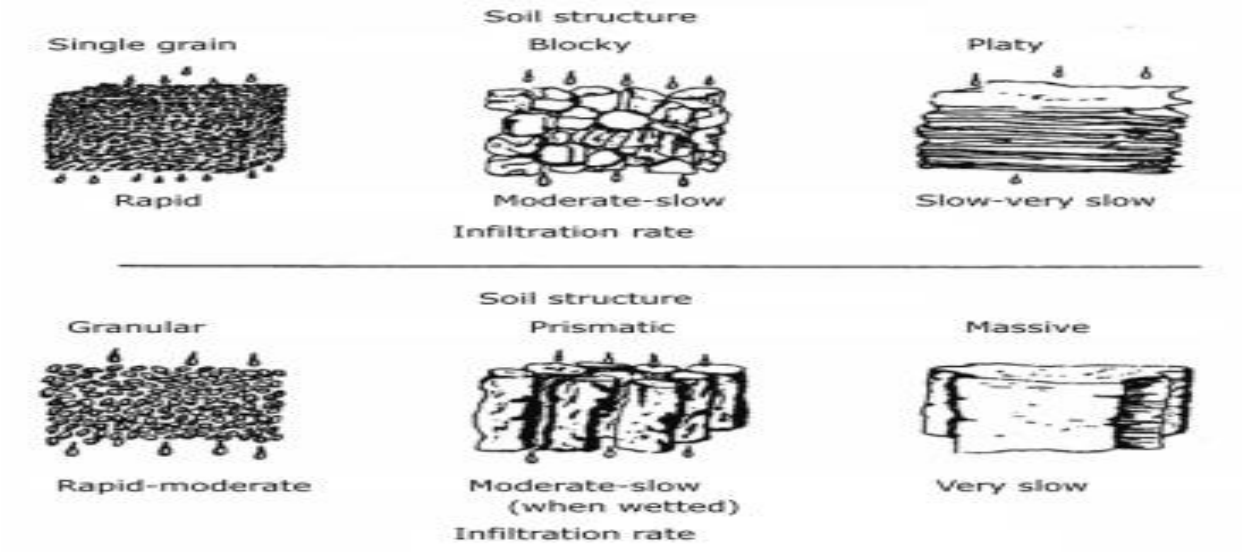
6. Massive

Influence of Soil Structures on Water Movement

When present in the topsoil, a massive structure blocks the entrance of water; seed germination is difficult due to poor aeration. On the other hand, if the topsoil is granular, the water enters easily and the seed germination is better.

In a prismatic structure, movement of the water in the soil is usually vertical and therefore the supply of water to the plant roots is usually poor.

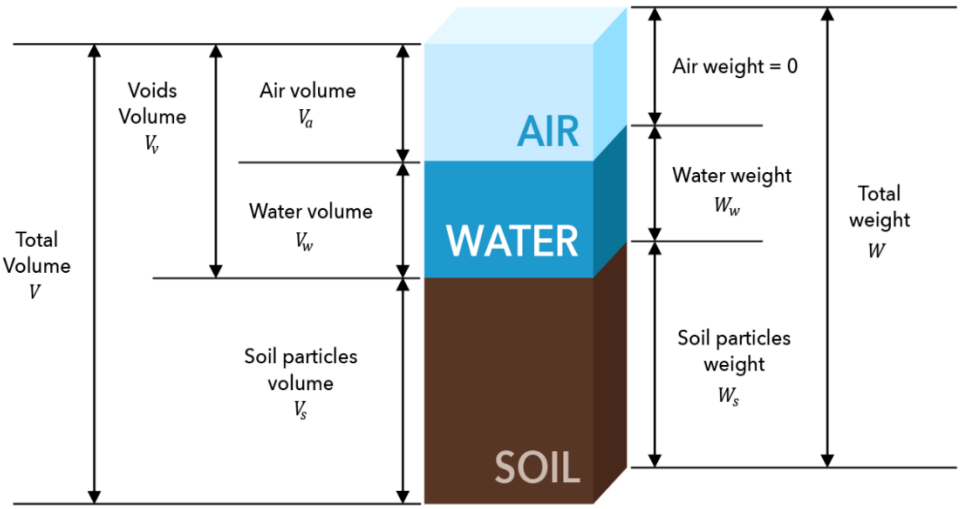
Unlike texture, soil structure is not permanent. By means of cultivation practices (ploughing, etc.), the farmer tries to obtain a granular topsoil structure for his fields.



Measuring of some soil properties

Density: Density of a substance is expresses as weight (mass) per unit volume.

$$density = \frac{Mass}{Volume}$$



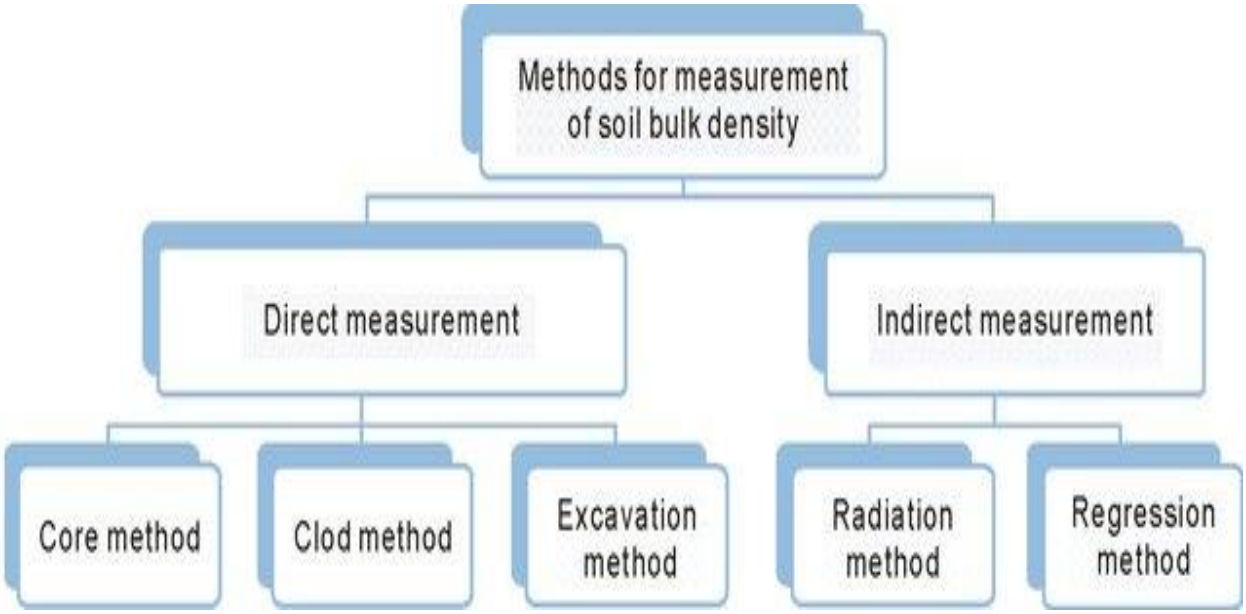
1. **Bulk Density (BD)**

$$\rho_b\,(BD) = \frac{M_s}{V_t}$$

The soil bulk density, also known as dry bulk density, is the weight of dry soil (M_{solids}) divided by the total soil volume (V_{soil}). The total soil volume is the combined volume of solids and pores which may contain air (V_{air}) or water (V_{water}), or both (figure).

- Soils with a bulk density higher than 1.6 g/cm^3 tend to restrict root growth.
- Bulk density increases with compaction and tends to increase with depth.
- Sandy soils are more prone to high bulk density.
- Higher bulk density cause to decrease flow water into to the soil and lower soil bulk density cause to increase flow water in to the soil.

Methods for Measurement of Soil Bulk Density



Step by Step Procedure of Soil Bulk Density

1. Carefully clear all residue then drive ring to a depth of soil with small mallet or weight and block of wood or plastic cap.
2. Excavate around the ring without disturbing or loosening the soil it contains and carefully remove it with the soil intact.
3. Remove any excess soil from the outside the ring and cut any plants or roots off at the soil surface with scissors.
4. Pour the soil into the plastic bag and seal the bag, marking the date and location where the sample was taken.
5. Wight the core with soil is (M1).
6. Put the core with soil in to the oven for 24 hours at 105℃ to remove the moisture.
7. After 24 hours put out the core with soil and again wight it is (M2).

Calculation

1. Calculate the volume of core is equal to the total volume of the soil.

$$\boldsymbol{v = \pi r^2\, h}$$

Where: v ($\boldsymbol{v_t}$) = volume of core ($\boldsymbol{cm^3}$), r = radius of cylinder (cm), h = height of cylinder (cm),

2. Calculate the wight of the dry soil (Ms).

$$\boldsymbol{Ms = M_2 - M_{core}}$$

3. Calculate the soil bulk density

$$\boldsymbol{\rho_b\,(BD) = \frac{M_s}{V_t} \quad g/cm^3}$$

location	Weight core	Weight core + soil	dry weight core + soil	Volume core	Bulk density

1. **Particle Density**

$$\boldsymbol{\rho_p(PD) = \frac{M_s}{V_s}}$$

A soil particle has no pore space, and is nothing more than a very small piece of rock. The weight per unit volume of the solid portion of soil is called *particle density*.

Generally, particle density of soils is 2.66 g/cm$^{3.}$

The particle density is higher if large amount of heavy minerals such as magnetite, limonite and hematite are present in the soil.

With increase in organic matter of the soil the particle density decreases. Particle density is also termed as true density.