Soil requirements and field crops:

Although it is less important than climate, soil texture and soil reaction (acidity) play major role in determining which crops are grown. So Crops are different in their favorite soil to survive and thrive and grow well to give high yield.

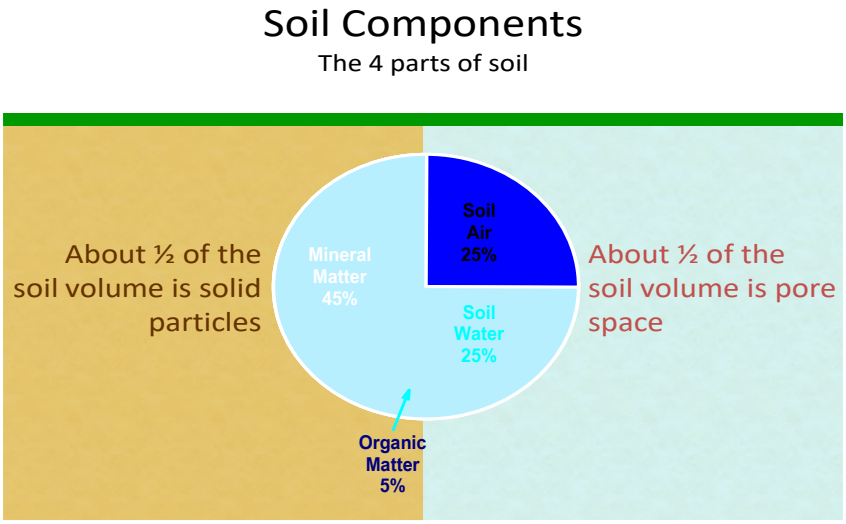
Functions of Soil

1. Provide physical support for plants
2. Provide nutrients
3. Provide water
4. Support biological activity of microbes, earthworms, etc.
5. Root support

What is soil?

A typical soil has four principal constituents -

- Minerals from weathered rock
- Organic matter
  - Decaying plants
  - Decaying animals
  - Decaying microbes
- Water
- Air
- Living Organisms

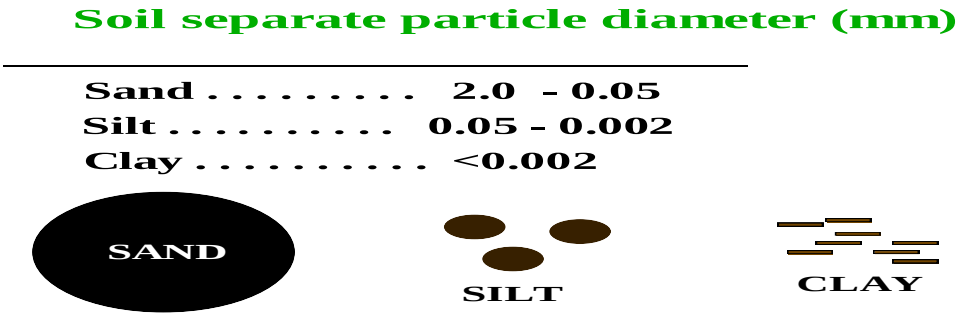


Physical properties of soil

Physical Soil It is related to soil texture , porosity , and reaction , their water holding capacity , that determine irrigation schedule , in addition to
soil nutrients and fertility.

Soil texture

Soil texture has an important influence upon crop adaptation. The relative percentage of sand, silt, clay in a soil (or) . It refers to the size and distribution of its individual grain or particles, grouped on the basis of diameter.



An agricultural soil normally contains all three soil textural classes.
1- Coarse textured, loose (more sand, less clay). Water percolates more quickly and more deeply which help check rainfall. Rye, corn and sorghum plants cannot thrive (grow).
2- Fine textured, heavy (more clay, less sand). Have a greater water storage capacity by volume. In most soils the fine clay and colloidal fraction contain most of the available nutrients.
3- Loamy (more even mix of sand, silt and clay. Grasses, wheat, and oats

Note:

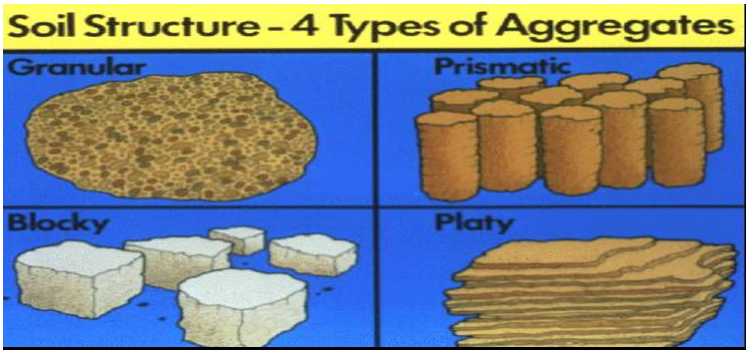
- Root crops favor soils of light texture (loamy sandy) to allow root growth and expansion freely.
- Grasses crops and small grain favor heavy soils so that Rice favor heavy with slightly impervious subsoil to retain water or to prevents excessive water losses from leaching.
- Heavy soil content more nutrients than light soil and give more profitable returns from crops which don't require much cultivation of the soil.

Soil property	Sandy soil	Loam soil	Clay soil
Aeration	Excellent	Good	Poor
Drainage(Permeability)	Excellent	Good	Poor
Nutrient Holding Capacity	Low	Medium	High
Water Holding Capacity	Low	Medium	High
Workability(Tillage)	Easy	Moderate	Difficult

Soil structure

It refers to the manner in which the individual particles are arranged.
An aggregated or compound structure, in which the particles are grouped into granules from 1-5 mm in diameter, provides irregular spaces with larger pores through which water

and air can circulate soil aggregation, normally occurs when ample organic matter is present.



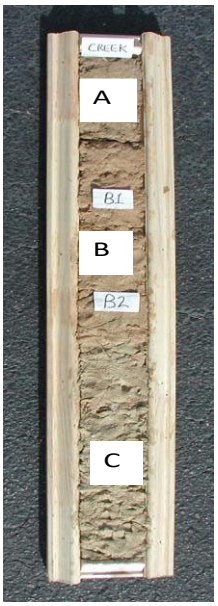
Soil should have aggregates

Individual particles of clay, silt, and sand stick together into larger particles called aggregates. Aggregates can take on many shapes and sizes, but in good topsoil they tend to be small crumb-like particles.

Importance of soil structure

- Improves air &water relationships
- Improves root penetration.
- Improves water infiltration.
- Reduced erosion.
- Ease to tillage.
- Reduced crusting.

Soil profile



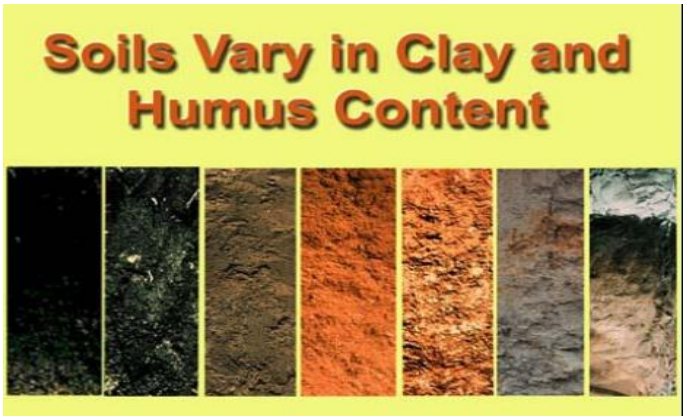
0 – 25 in. Roots, highest biological activity, microbes, OM

25 – 36 in. Accumulation from A, more mineral, less OM, less oxygen, less biological activity

36 + in. Weathered parent rock

BEDROCK

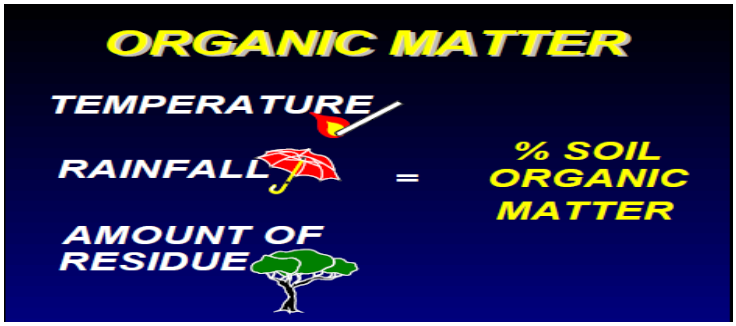
Soil color



Soil color gives important clues about soils chemical and physical environment.
Dark color – indicates high organic matter content
Red and brown – indicates good aeration and little water logging.
Grey/ olive indicate soil that is regularly waterlogged and lacks iron.

SOIL CHEMISTRY

Organic matter
Soil PH
Saline soil
Acidic soil



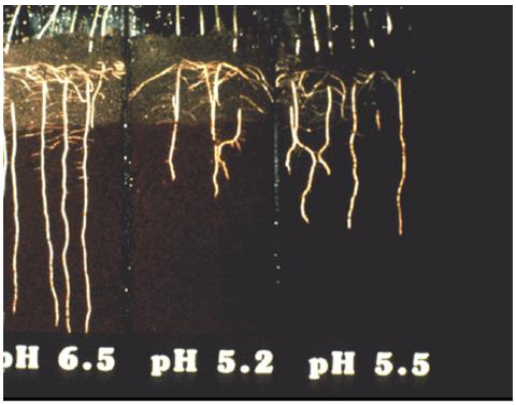
Organic matter properties

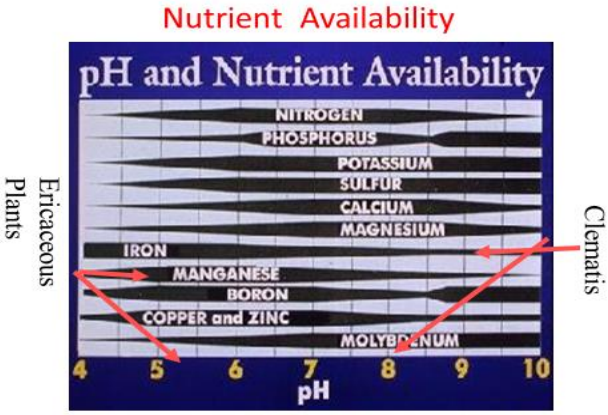
- Improve soil physical condition.
- Reduced erosion.
- Improves water infiltration.
- Improves water holding capacity.
- Increase soil cation exchange capacity.
- Source of nutrients.

Soil pH

pH = -Log(H^+)

- pH is a term used to describe the (H^+) activity and or concentration in soil.
- pH is detrimental factor in crop production,
- pH is measure of acidity or alkalinity on a 0–14 scale. The ability of plant roots to take up water and nutrients depends on the pH although the specific range of pH varies between different plant species.
- Most plant crops are comfortable with a neutral to slightly acidic soil (pH: 7–6).
- Most plants will tolerate a wide range in pH: 5.5–8.3.
- pH: 6.0 – 6.5 is considered optimal for good plant growth.
- Certain woody plants (pin oak, red maple, river birch, etc.) growing on high acid
- pH soils frequently show iron or manganese deficiency symptoms.





Soil acidity

Acidity is measured as hydrogen –ion activity, developed in area with high rainfall

- Soil with pH of 7 is natural, there are more Ca comparing with the other cat ions (Mg, K, Na), our soil is natural.

- Soil higher than 7 is alkaline, it contains more Na exchangeable.
- Soil below 7 is acidic soil. In these soils, the H+ is most dominant.
- Soil acidity affects nutrient availability, the acider soil more Al which is toxic to plants.
- Most crop plants perform pH between 6.5- 6.8
  Some crops:
  1. Require neutral soil (wheat). which contain more Ca comparing with the other cations (Mg, K, Na), our soil is natural.
  2. Require alkali or tolerate alkaline soil barely.
  3. Require tolerate acidic soils rice.
  4. (Tobacco) ----- Alfalfa (7-8) .

Field crops classification according to acidic soil		
low resistance to acidity	(6 -6.5)	sugar beet, medicago
Crops with moderate resistance to acidity	(5.5 -6)	. cotton, soy bean, sorghum.
Crops with high resistance to acidity	(5 – 5.5)	wheat, barley, corn.

Soil salinity

Soil salinity refers to the presence of excessive amount of soluble salts (Na^{+}, Mg^{+2}, and Ca_{2}, Cl^{-1} , SO_4^{-2} in the soil . This is a soil solution from the root zone contains as much as 0.8-1.6 % salts (8-16 milliohms).

Soil type	Rate of salts	Field crop tolerate
High tolerant	The salt content should not exceed 0.8- 1.6 %	Barley, sugar beet, rape, cotton..
Medium tolerant	the salt content should not exceed 0.8%	Most of the other field crops.
Low tolerant تحمل	Low tolerant تحمل The salt content should not exceed (0.3 - 0.4%)	Low tolerant تحمل Wheat, white, red and alsike clovers and field beans

Soil water

Soil water is critical to plant growth and development; it is the solvent in which soil nutrients are dissolved before they can be absorbed by plant roots.

Water in Saturation point H.C.W	S.P	Field Capacity F.C	Wilting point W.P	Hygroscopic moisture H.C
0 Bar	0.3 Bar	15 Bar	31 Bar	1000 Bar
	Capillary ↔↔↔	↔↔water		
Not available Water	Available water	Not available water	Not available water	

Water occurs in three liquid forms:

1. Capillary water:

Is the water mainly used by plants, when the plants will, the soil may still contain 2-17 %moisture, depending upon its texture and humus content.

2. Gravitational water:

Is that which moves downward by gravity and may percolate beyond reach of the roots of crop plants.

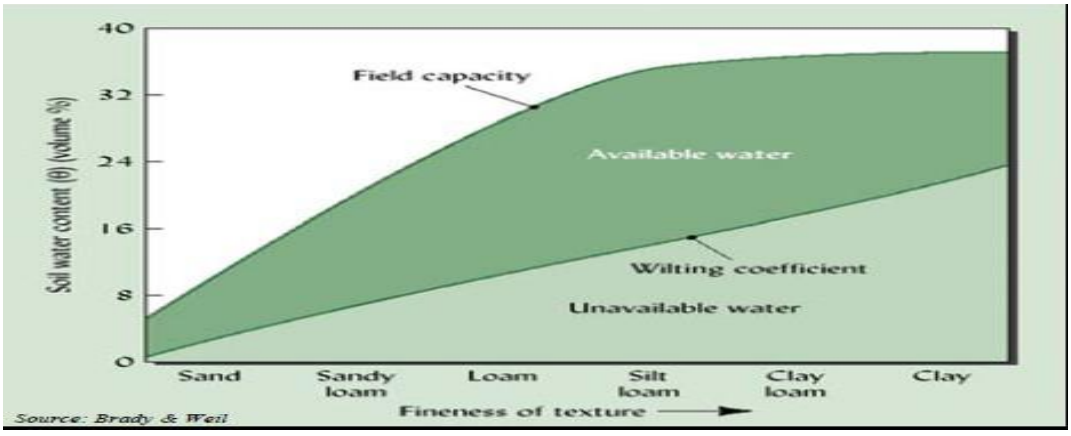
3. Hygroscopic water:

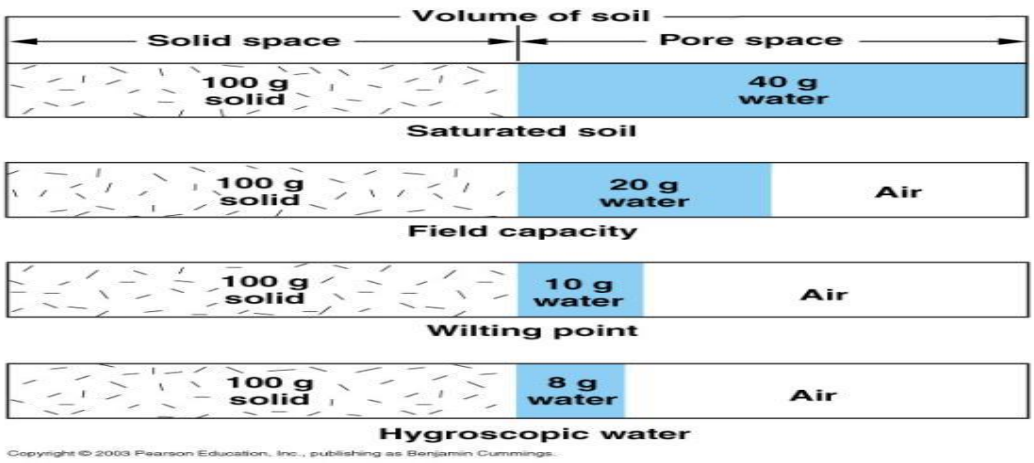
Which is retained by an air –dry soil kept in a saturated atmosphere .is absorbed on soil particles with such force that it is not available to plant.

4. **Field capacity:**

Is the amount of water held by a soil against the force of gravity.

Most soils at field capacity will hold between 25-50 mm of plant available water in each foot of soil.





Soil air

Air which constitutes from 20-25 % by volume of an ordinary moist soil supplies the oxygen necessary for root growth and for oxidation of organic matter and other soil constituents.

It supplies oxygen for respiration in the plant as well as for the chemical and biological processes in the soil, and nitrogen indirectly.

Aeration may be supply of plant nutrients is essential for the growth of crop plants about 25-30 chemical element are found in plants.