Irrigation Engineering

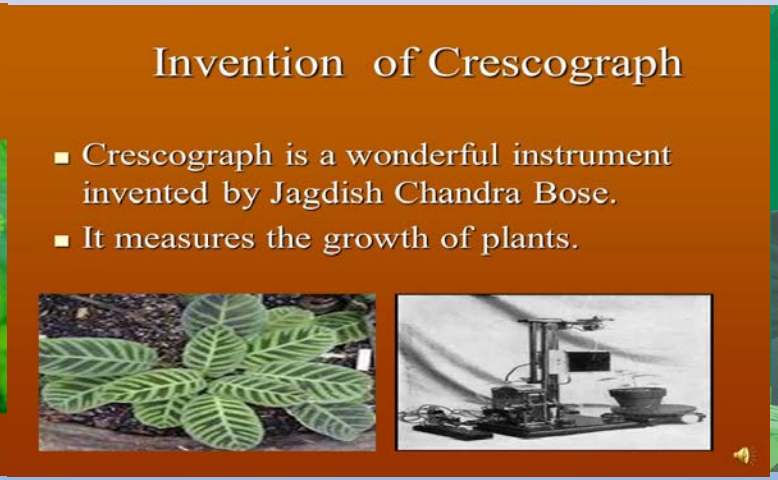
Guided by: Dr. M. K. Tiwari
Prepared by: Er. Duda Balas

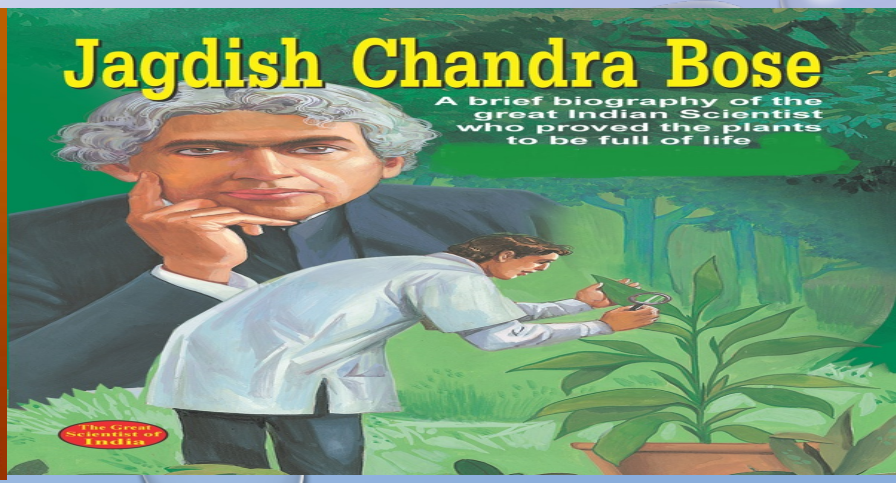
IDE-2.4.7

DEPARTMENT OF IRRIGATION AND DRAINAGE ENGINEERING
COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY
ANAND AGRICULTURAL UNIVERSITY
GODHRA - 389001

Requirements of plant

- Human beings and animals are required air, water and soil to make their own food & for survival of live.
- Plant need water, air and soil for their own growth (proved by Dr. Jagdish Chandra Bose).
- Air from surrounding atmosphere (for breathing).
- Water from rainfall (for energy production).
- Soil from earth's surface (for standing/staying).
- Plants require adequate (sufficient) moisture content (water) from sowing to before harvesting of crop to survive their life and to make their own food.





What is irrigation ?

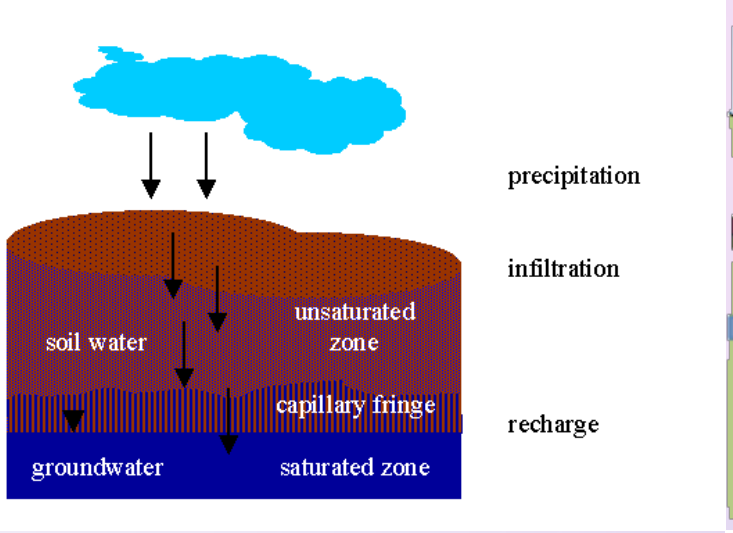
- ***It can be define as an artificial application of water to the soil to meet the crop water requirements for development and better crop production.***

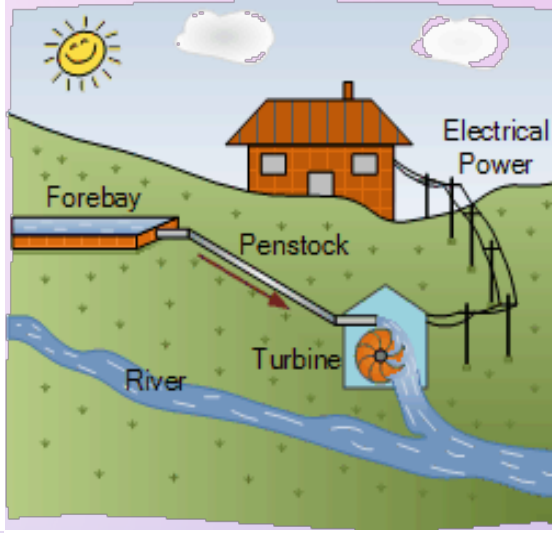
Why irrigation ?

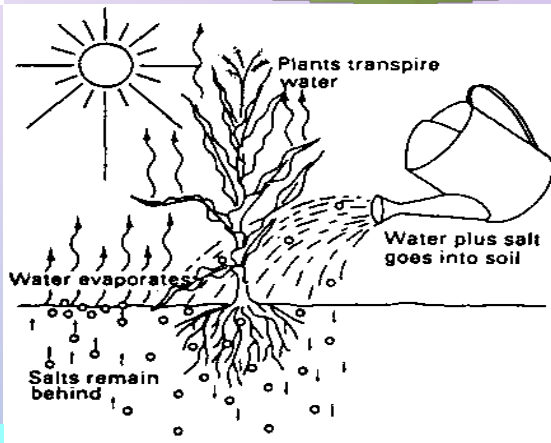
- Rainfall water is less than the crop water requirement.
- Uneven distribution of rainfall even if rainfall is sufficient.
- To develop high yield variety or in other words for better crop production.
- To grow the crop in off season.

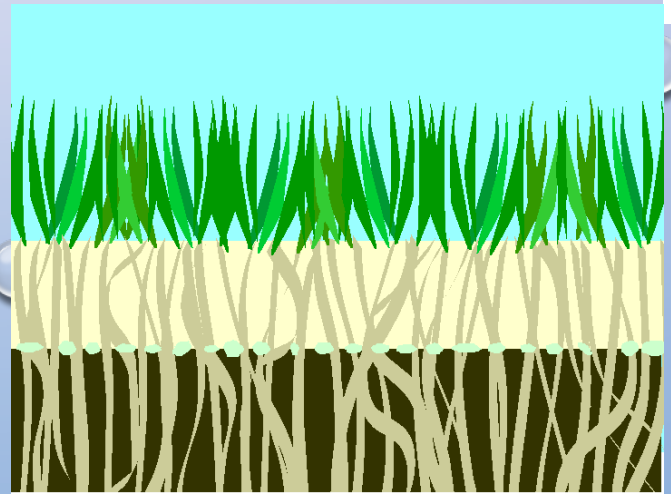
Advantages of irrigation

- To increase the food production
- To improve the ground water storage
- To generate the hydro-electric power
- To supply the water for domestic & industrial purposes
- To increase the value of land
- To increase the labor employment
- To modify the soil media by leaching
- To reduce the afforestation
- To eliminate the mixing of crop
- To get the optimum benefits









Disadvantages of irrigation

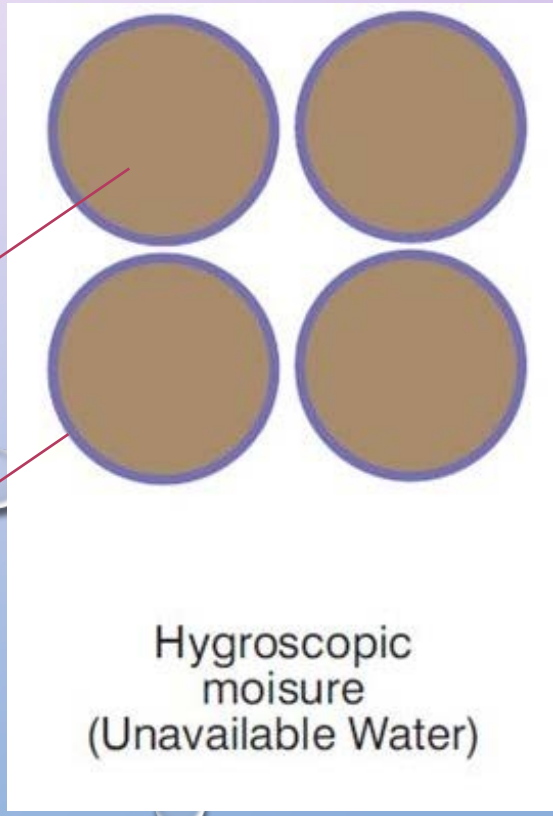
- Pollution of water because of fertilizer utilization
- Problem of water logging
- Spreading of diseases like malaria & dengue because of colder & humid climate
- Standing water in rice field produce methane gas which is harmful
- Salinity & alkalinity problems in soil because of saline & alkaline water uses
- Reduce the soil aeration
- It is complex & expensive

Classes of soil water

1. Hygroscopic water
2. Capillary water
3. Gravitational water

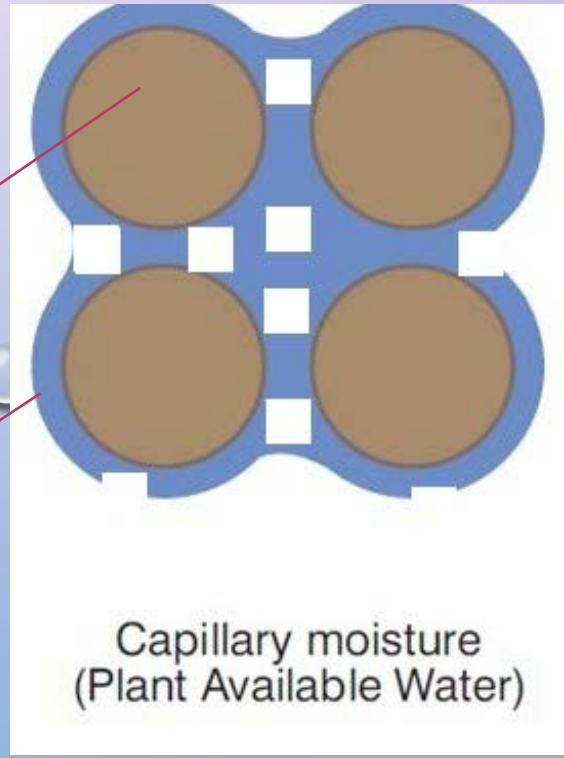
1. Hygroscopic water

- ✓ The water which tightly bound with soil particles by ***adsorption*** forces is called hygroscopic water
- ✓ It can not be move by gravity or capillary forces
- ✓ It is not useful for plant
- ✓ It is tightly held by ***adhesion***
- ✓ It is held on the surface of soil particle
- ✓ It is held at 31 bars tension in the soil
- ✓ This condition occurs at permanent wilting point



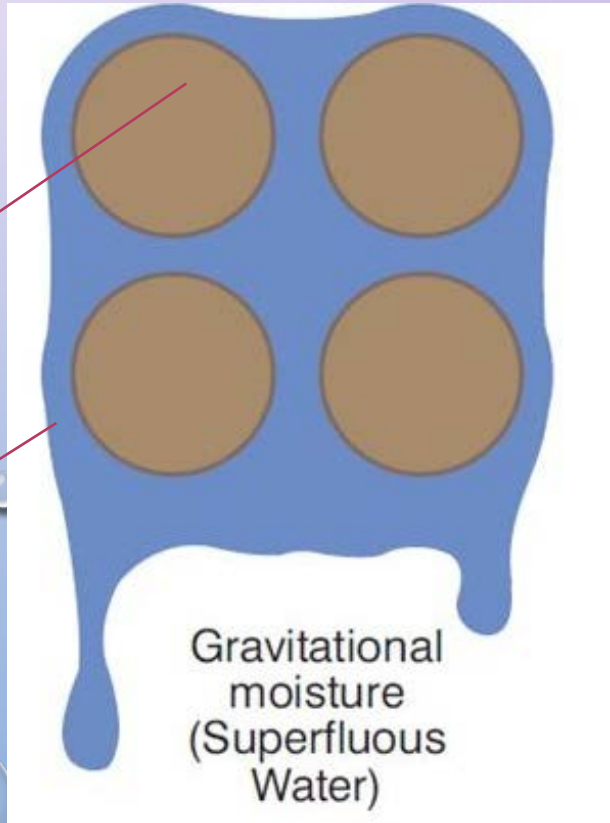
2. Capillary water

- ✓ The water held in the porous against the force of gravity because of adhesion & cohesion is called capillary water
- ✓ It is useful for plants
- ✓ It is held at 1/3rd to 31 bars tension in the soil
- ✓ This condition occurs at field capacity



3. Gravitational water

- ✓ The water which moves downward freely under the force of gravity & drain out easily from the soil is called gravitational water
- ✓ It is also called as free water
- ✓ It is found in the macro pores
- ✓ It is not useful for plants because it prevent the entry of air
- ✓ It is held at below 1/3rd bars tension in the soil
- ✓ This condition occurs at saturation when all the pores are fully filled with water



Classes of soil water

1. Hygroscopic water
2. Capillary water
3. Gravitational water

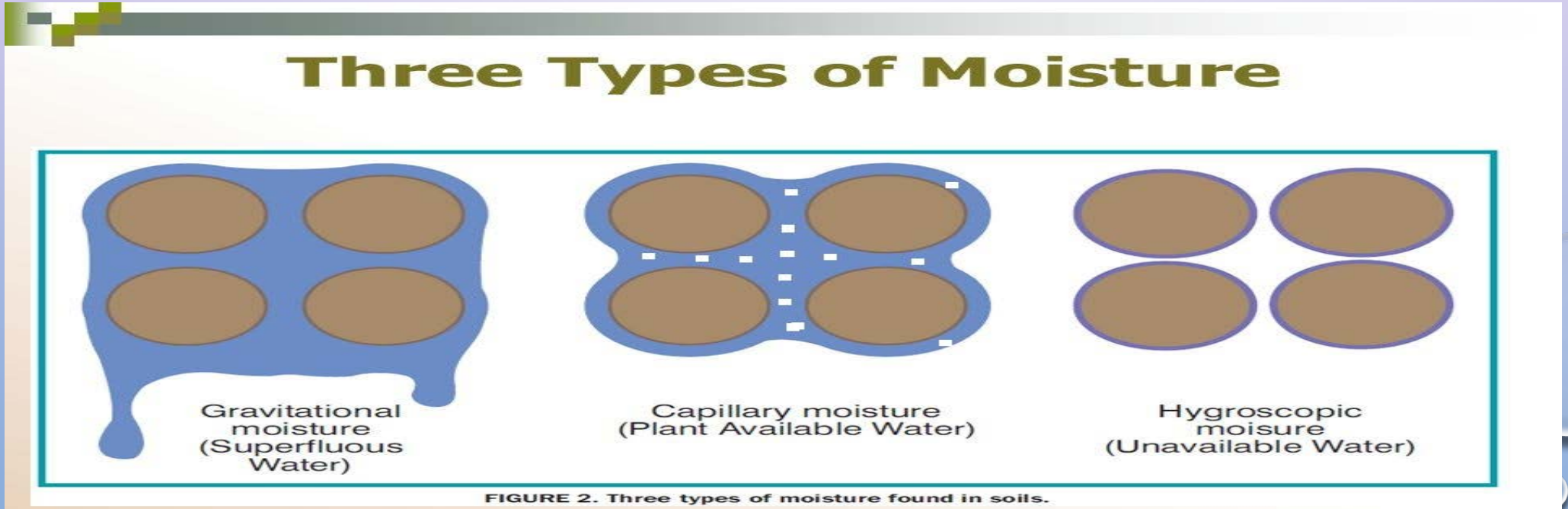


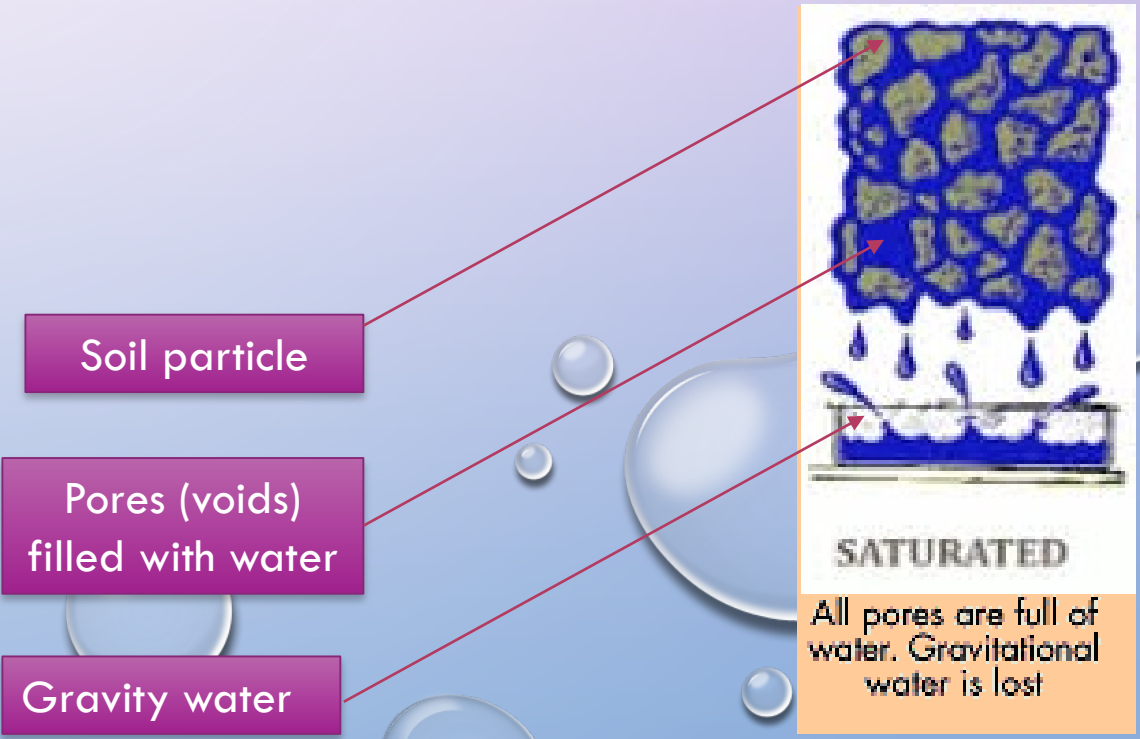
FIGURE 2. Three types of moisture found in soils.

Soil moisture constants

1. Saturation capacity
2. Field capacity (FC)
3. Permanent wilting point (PWP)
4. Ultimate wilting point (UWP)
5. Available water (AW)
6. Readily available water (RAW)
7. Moisture equivalent
8. Soil moisture deficiency

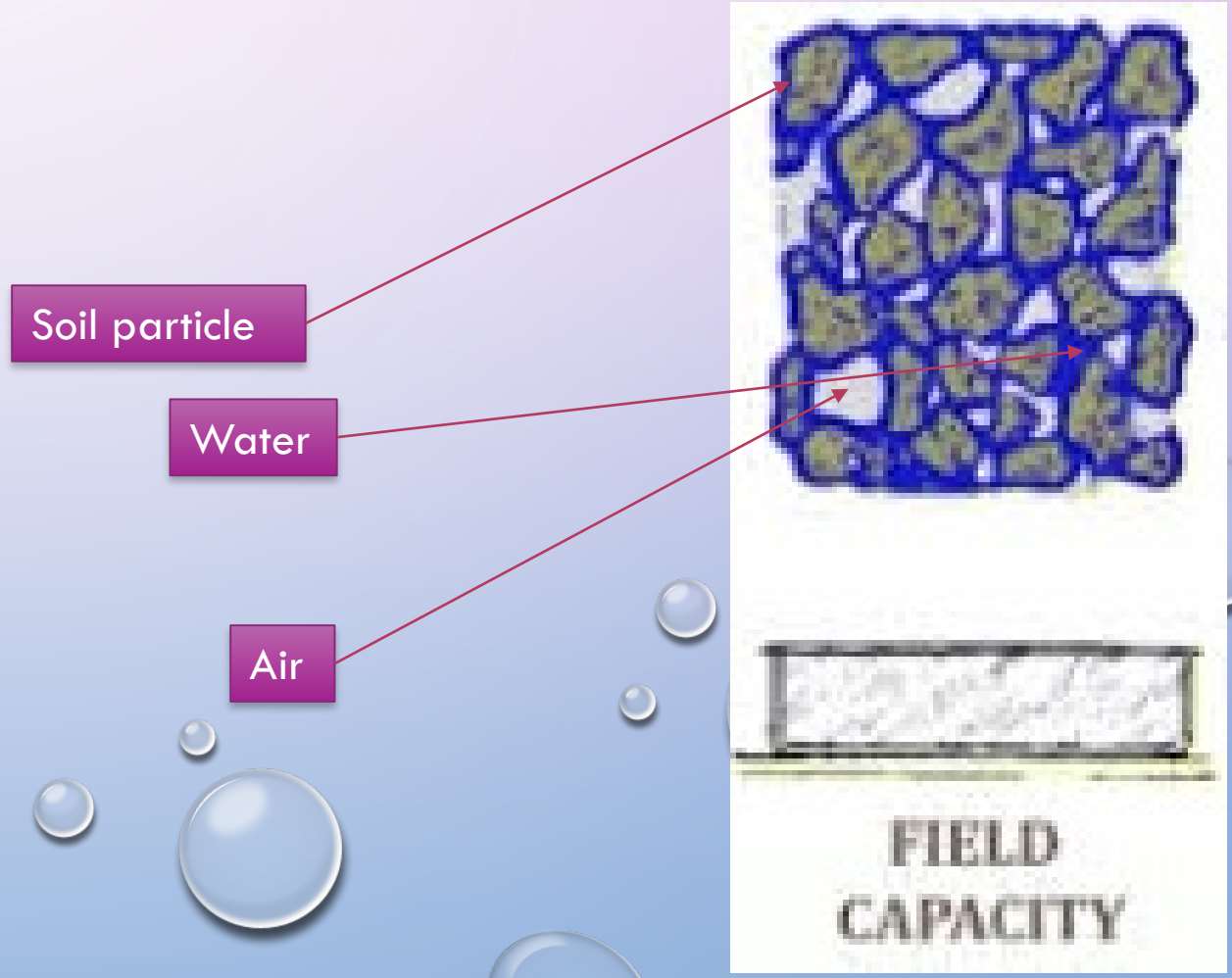
1. Saturation capacity

- ✓ When all the pores (voids) are filled with water then the soil is said to be in saturation capacity
- ✓ At saturation capacity the soil has their maximum ability to store the water inside it
- ✓ It is the upper limit of moisture content
- ✓ Not available for plants
- ✓ Tension at this point is almost 0 (zero)



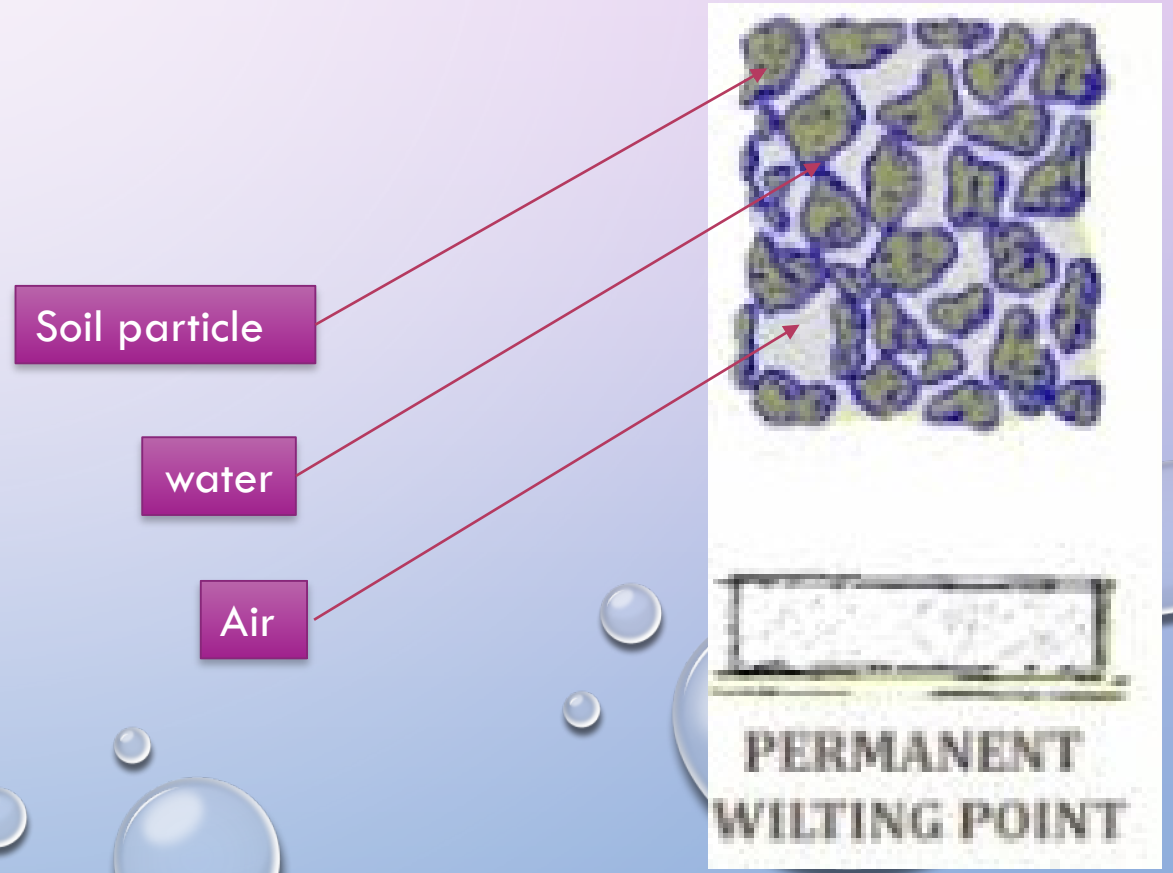
2. Field capacity (FC)

- ✓ When water is freely drained because of gravity & become stable then the moisture content in the soil is said to be in field capacity
- ✓ It is also known as field carrying capacity of soil
- ✓ This situation becomes after 2-3 days after saturation
- ✓ In this condition the larger pores (macro) are filled with air & smaller pores (micro) with water
- ✓ Available for plants
- ✓ Tension at this point ranges from 1/10th to 1/3rd bar



3. Permanent wilting point (PWP)

- ✓ When plant can not longer extract sufficient water from soil for its growth then the moisture content of the soil is said to be in permanent wilting point
- ✓ It is also known as permanent wilting coefficient
- ✓ It is the lower limit of the available water
- ✓ At this condition, if we add water in the soil then plant can regain their original position
- ✓ Tension at this point ranges from 7-32 bar

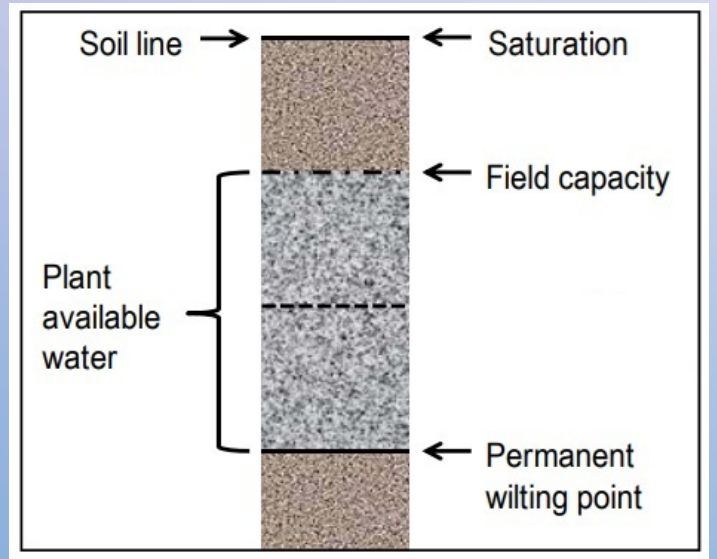


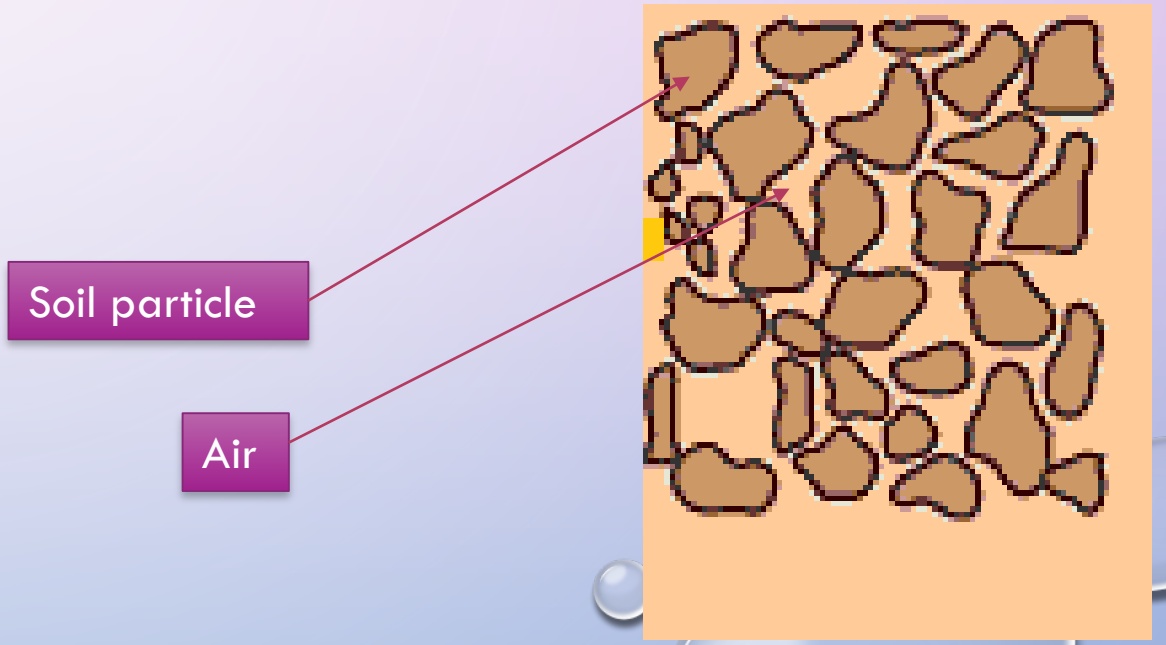
4. Ultimate wilting point (UWP)

- ✓ When plant is die because of unavailability of water then the moisture content in the soil is said to be in ultimate wilting point
- ✓ At this condition, if we add water in the soil then plant cannot regain their original position
- ✓ Tension at this point is 60 bar
- ✓ This condition occurs at hygroscopic water content so it is also known as hygroscopic coefficient

5. Available water (AW)

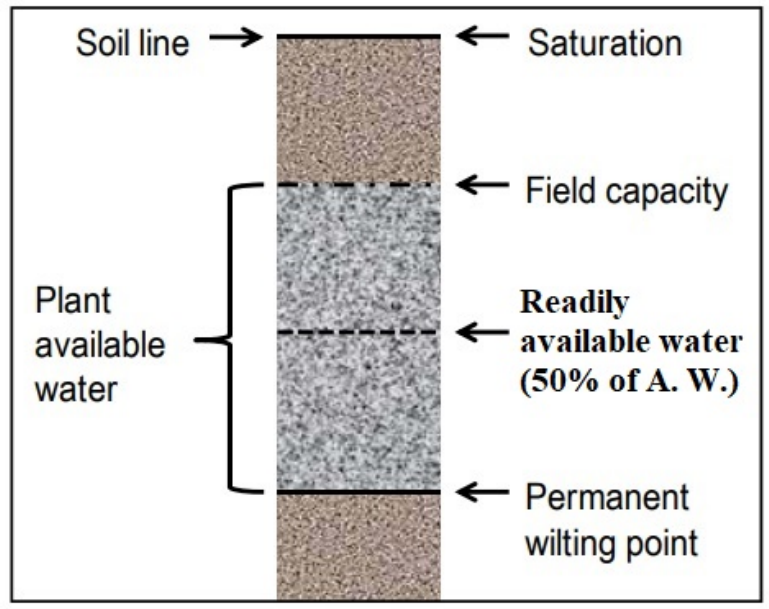
- ✓ The difference in water content between field capacity & permanent wilting point is known as available water
- ✓ A. W. = F. C. – P. W. P.
- ✓ Tension at this point is 1/3rd to 15th bar
- ✓ This condition occurs at capillary water

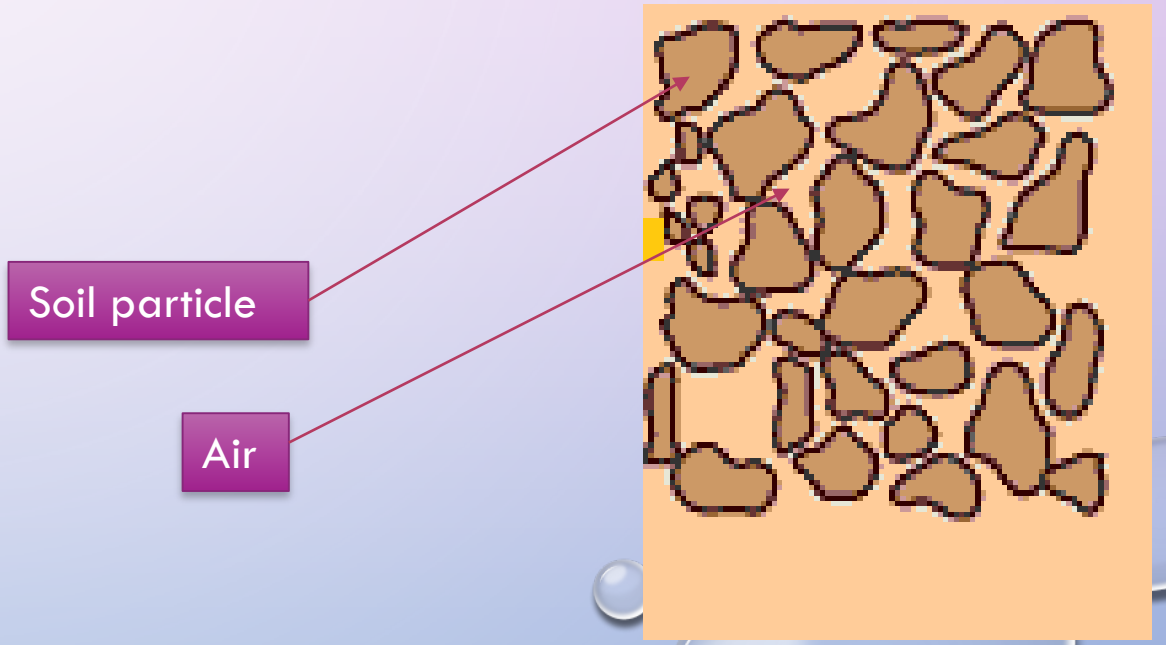




6. Readily available water (RAW)

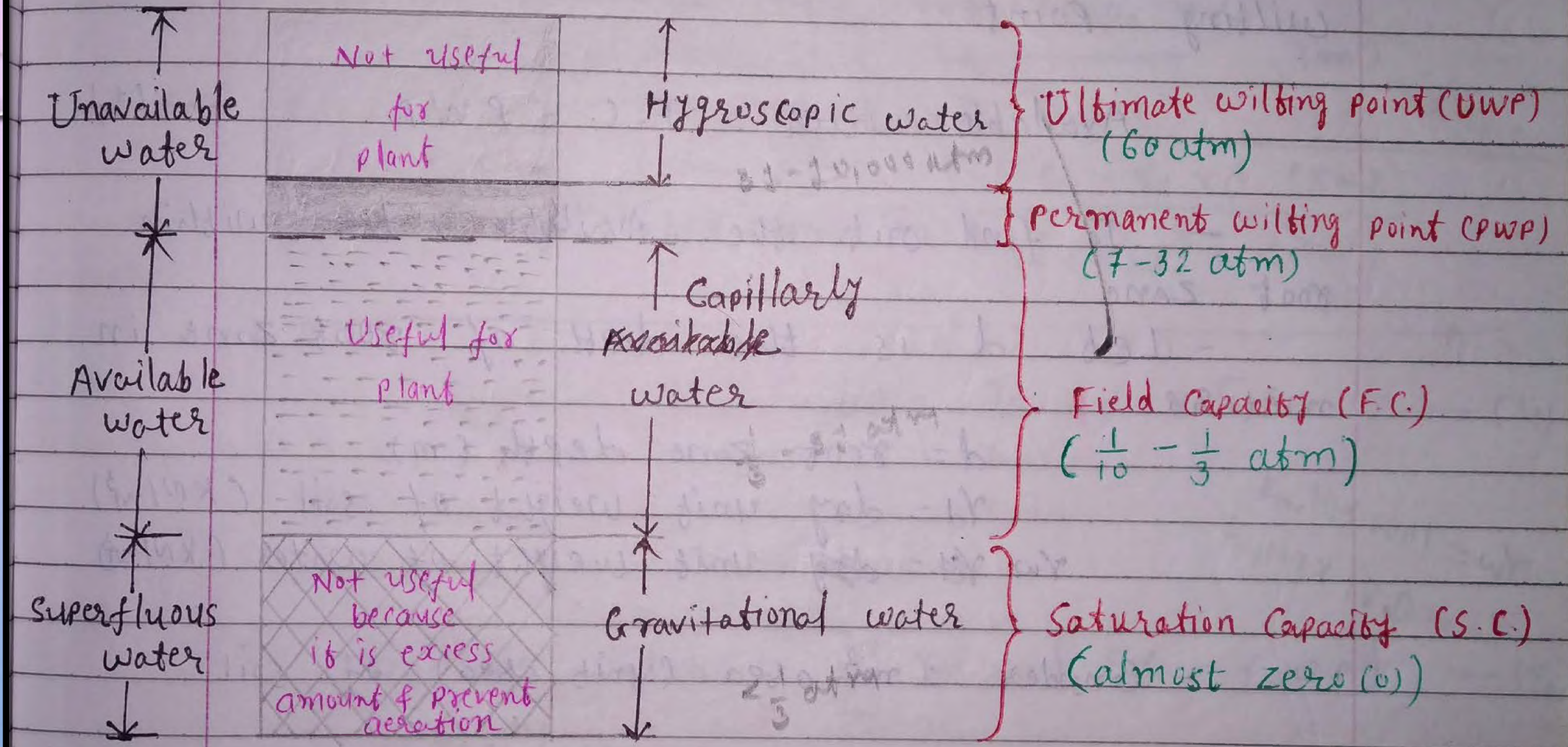
- ✓ The portion of the available water which can be easily extracted by plant is called readily available water
- ✓ It is approximately 50 % of available water
- ✓ R. A. W. = 50 % of A. W.





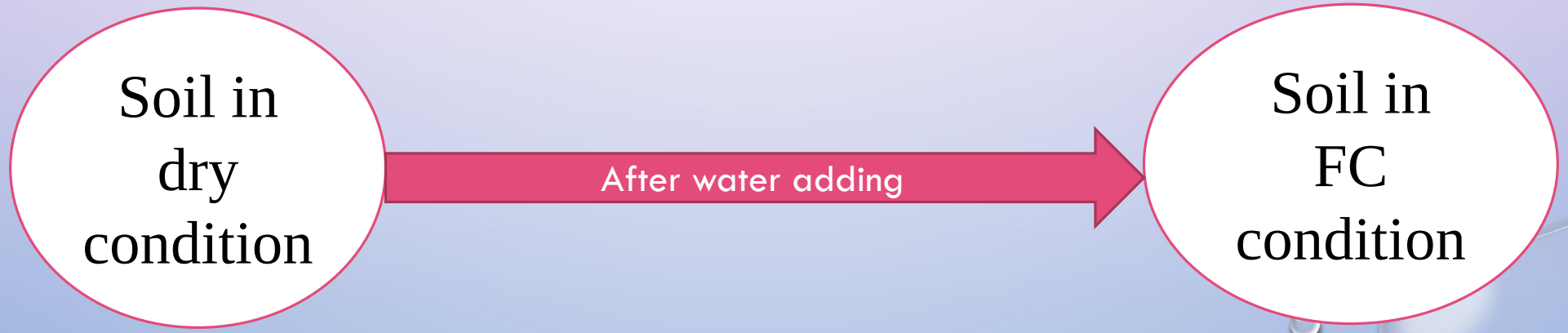
7. Moisture equivalent

- ✓ When the saturated soil sample is kept in a centrifugal apparatus & it is centrifuged at 1000 rpm for 30 minutes then the remaining moisture content in the soil is said to be moisture equivalent
- ✓ It is used to compute the field capacity of soil
- ✓ In medium soil field capacity = moisture equivalent
- ✓ In sandy soil field capacity > moisture equivalent
- ✓ In clay soil field capacity < moisture equivalent


Unavailable water
Available water
Superfluous water
Not useful for plant
Useful for plant
Not useful because it is excess amount & prevent aeration
Hygroscopic water
Capillarly Available water
Gravitational water
Ultimate wilting point (UWP)
(60 atm)
Permanent wilting point (PWP)
(7-32 atm)
Field Capacity (F.C.)
(1/10 - 1/3 atm)
Saturation Capacity (S.C.)
(almost zero (0))

8. Soil moisture deficiency

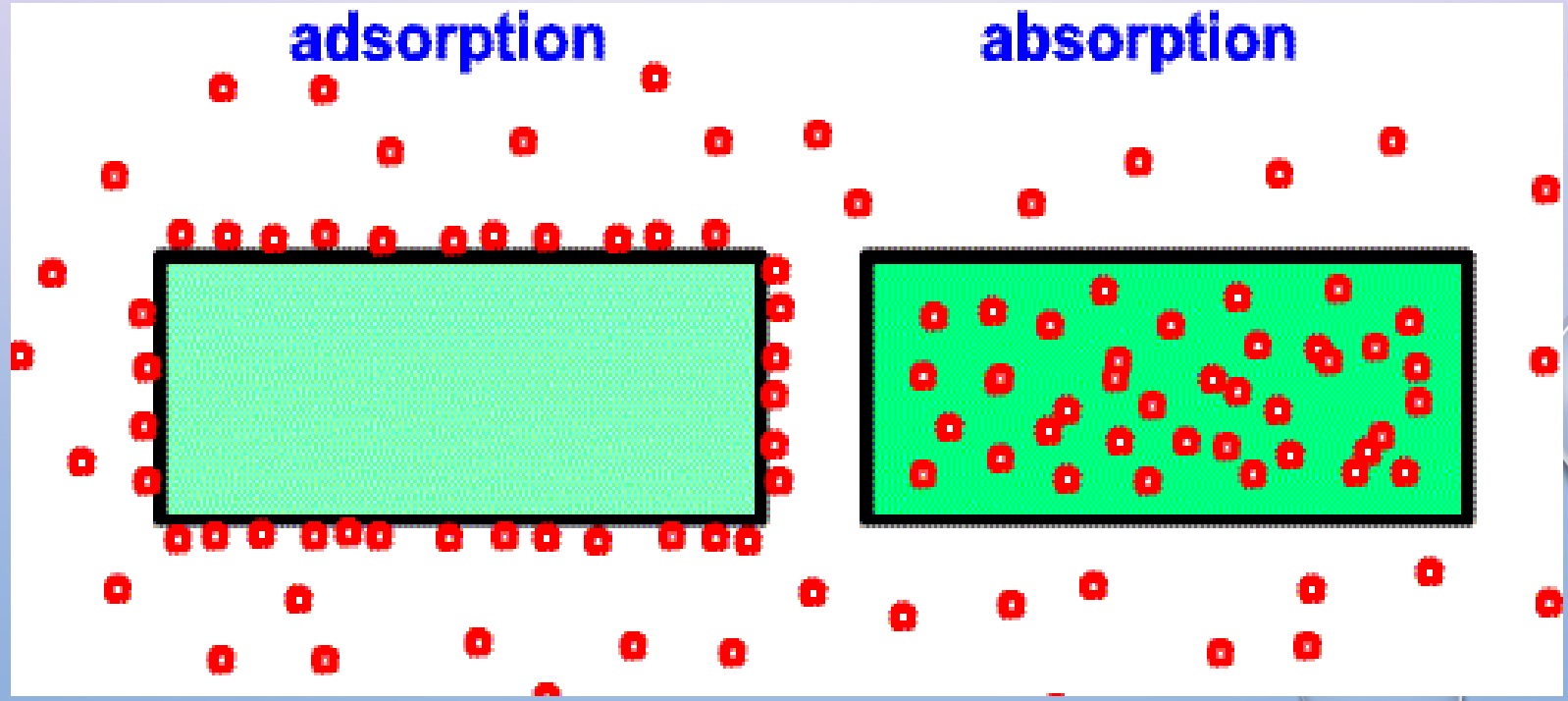
✓ The water requirement to bring the soil in field capacity is called soil moisture deficiency



Thank You So Much

Adsorption & Absorption

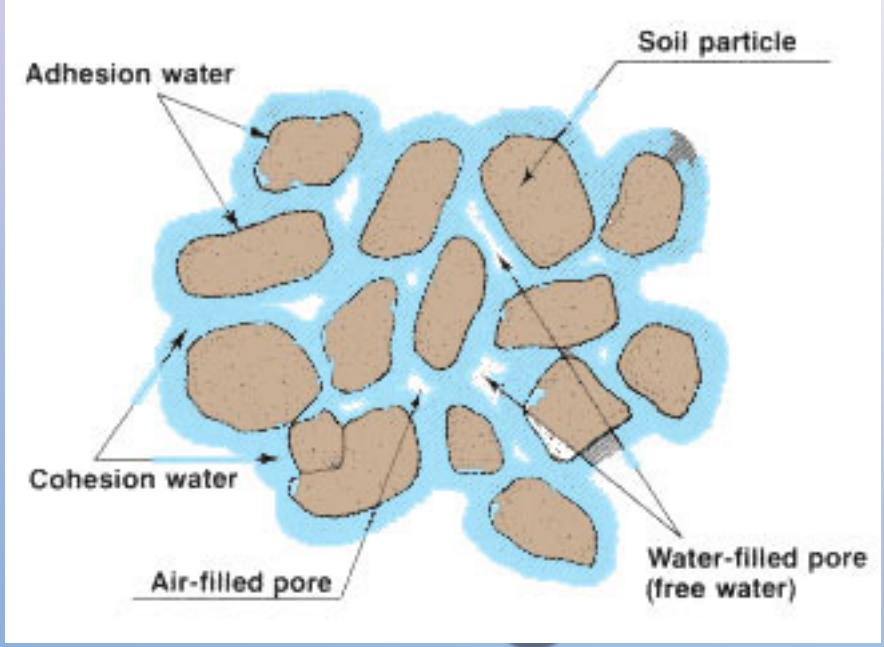
- ✓ **Adsorption:** the substance is only retained on the surface and does not go into the bulk or interior of the solid or liquid
- ✓ **Absorption:** the substance is uniformly distributed, through the body of the solid or liquid

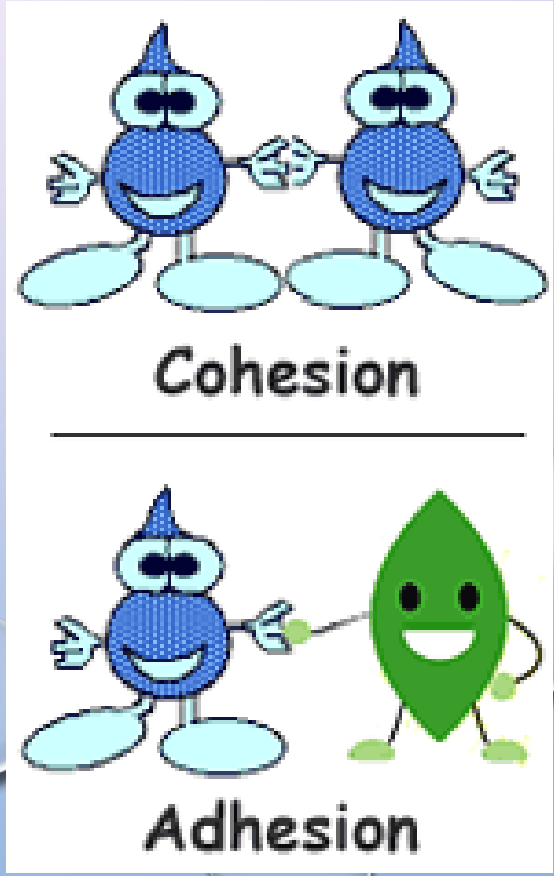


Adhesion & Cohesion

✓ **Adhesion:** attraction between dissimilar particles (e.g. soil and water)

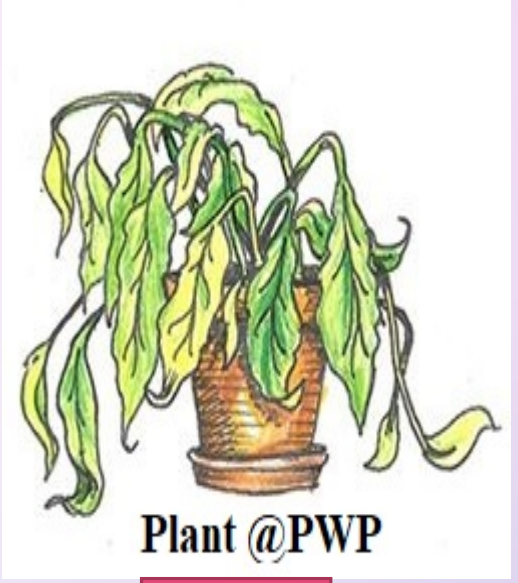
✓ **Cohesion :** attraction between similar particles (e.g. soil and soil, water and water)





After 2-3 days

Not sufficient water



Water added

Not sufficient water for longer duration

Water added