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# IRRIGATION ENGINEERING

[BTAI 2201]

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# Soil Water/Soil Moisture

The soil profile lying below the soil surface up to the impervious strata/bed rock can be divided in to (i) zone of aeration (also called as unsaturated zone) and (ii) zone of saturation.

Soil water is defined as the suspended water in the zone of aeration. It includes

**Gravitational water,**

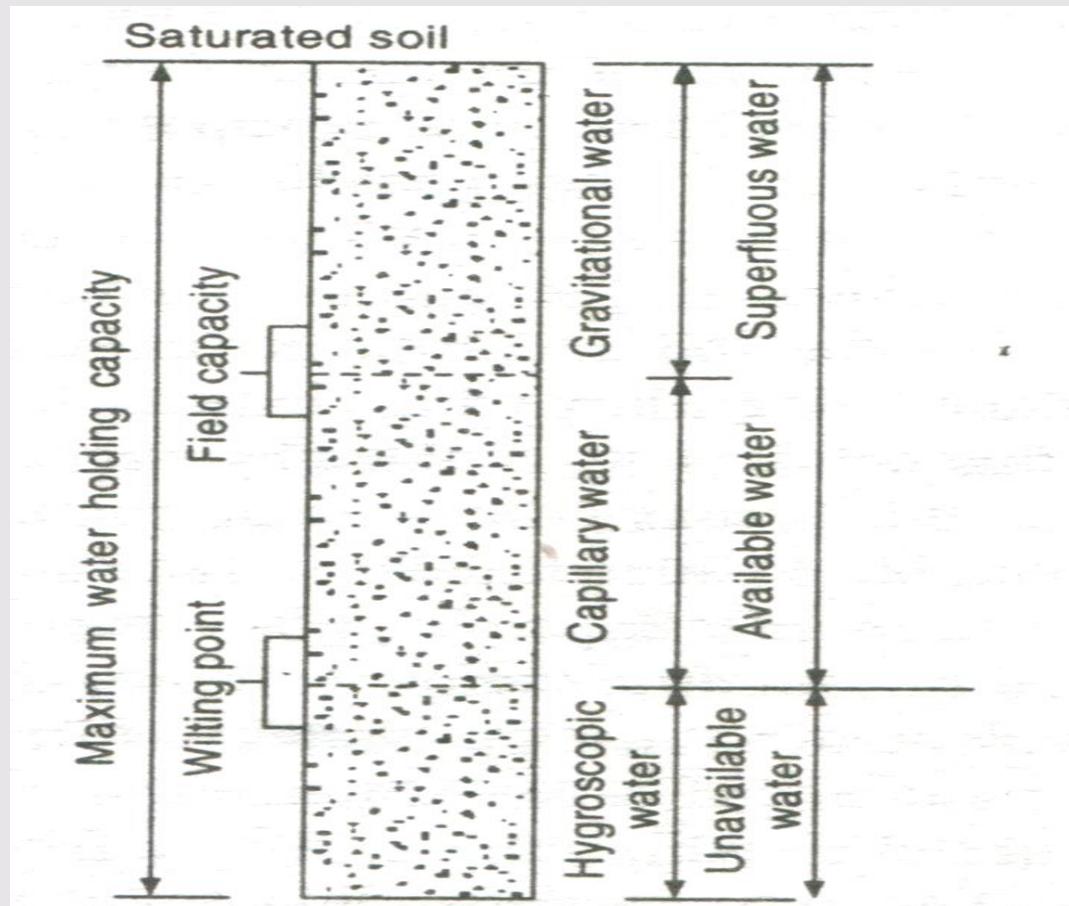
**Capillary water and**

**Hygroscopic water.**

**Fig. 6.4 represents the classification of soil moisture.**



# Classification of soil moisture





Zone of aeration is important from the point of view of plant growth. Zone of aeration comprises of (i) soil water belt, (ii) intermediate belt and (iii) capillary zone.

Soil water belt refers to the zone of water adjacent to the ground surface consisting of top soil and the sub soil

Gravitational water is the water in the unsaturated zone in excess of hygroscopic & capillary water which moves out of the soil under favourable drainage condition.

Water held in the capillary spaces by surface tension is called as capillary water. This water moves freely under the influences of capillary forces and is available to the plants. Hence the capillary water is also called as available water.

Hygroscopic water is the water held in static state with the atmospheric water vapour. It is not capable of any movement by gravity or capillary forces and hence, is not available for use to plants.



# Saturation and Maximum Water Holding Capacity

In a soil sample, some space is occupied by water & rest is occupied by air. When soil gets wet either because of rainfall or irrigation, macro & micro pores gradually get filled with water & volume of air in soil decreases.

When all pores are filled with water, the air content in void space becomes zero. Under such cases, soil is said to be fully saturated (sometimes simply called as saturated). Degree of saturation of a fully saturated soil is 1.0 (100%).

Thus, for a perfectly dry soil sample there is. zero degree of saturation. At saturation, soil moisture potential is maximum i.e. zero & moisture held by the soil is also maximum.

Capacity of the soil to hold moisture at saturation is called as maximum water holding capacity.



# Field Capacity

Field capacity (FC) is defined as the amount of water held by the soil after excess water has been drained away by gravity. At FC, the rate of downward movement of water has been materially decreased to negligible value which takes place two to three days after irrigation.

At FC, the macro pores are filled with air whereas micro pores are filled with water.

FC is the upper limit of available water (0.33 bar).

When crops are to be irrigated, care should be taken such that the soil moisture content comes to FC level and any addition of water beyond FC is a loss since it is drained out to the layer below the crop effective root zone & adds to percolation.



# Permanent Welting Point (PWP)

PWP refers to the lowest limit of available SMC below which water extraction by a given plant is not sufficient to meet the ET requirement of the plants.

Irrigation to crops is to be provided before this stage reaches. It is to be remembered that PWP is not a fixed point on soil moisture potential curve; rather it refers to a range.

Crops start wilting at matric potential of wilting point varying from -12 to -23 bars. For most of the mesophytes (considering their growth and development), PWP refers to the matric potential of -15 bars.



# Available Soil Moisture (ASM)

As stated earlier, soil water at FC(potential = 0.33 bars) is the upper limit of available soil moisture for the plants. Similarly, soil water at PWP (potential = -15 bars) is the lower limit of available soil moisture. The soil moisture between these two values is called as ASM.



# Readily Available Soil Moisture

Readily available soil moisture sometimes also called as relatively available moisture is that portion of available soil moisture that can be easily extracted by the plants. It varies from 75-80% of the available moisture.

ASM of different soils are given in Table below.



| Soil types      | Mechanical composition |          |          | Available soil moisture (%) |
|-----------------|------------------------|----------|----------|-----------------------------|
|                 | Sand (%)               | Silt (%) | Clay (%) |                             |
| Coarse sand     | 94                     | 4        | 2        | 3                           |
| Sand            | 89                     | 5        | 6        | 3                           |
| Loamy sand      | 82                     | 10       | 8        | 6                           |
| loam            | 63                     | 22       | 15       | 10                          |
| Fine sandy loam | 59                     | 24       | 17       | 12                          |
| Loam            | 40                     | 36       | 24       | 17                          |
| Sandy clay loam | 50                     | 21       | 29       | 14                          |
| Clay loam       | 37                     | 28       | 33       | 16                          |
| Clay            | 31                     | 23       | 46       | 16                          |



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