SNS COLLEGE OF TECHNOLOGY

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Coimbatore – 35

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DEPARTMENT OF AGRICULTURAL ENGINEERING

19AGB303 – IRRIGATION AND DRAINAGE ENGINEERING

III – YEAR VI SEMESTER

UNIT 1 – SOIL WATER TENSION AND MEASUREMENT OF SOIL WATER

TOPIC 1 – ROOTING CHARACTERISTICS, SOIL WATER TENSION AND SOIL WATER STRESS

Irrigation

- Irrigation is the application of water to ensure sufficient soil moisture is available for good plant growth throughout the growing season. Irrigation, as practiced in North Dakota, is called "supplemental irrigation" because it augments the rainfall that occurs prior to and during the growing season.
- Irrigation often is used on full-season agronomic or high-value specialty crops to provide a dependable yield every year. It also is used on crops such as potatoes, flowers, vegetables and fruits where water stress affects the quality of the yield.

HOW PLANTS GET WATER FROM SOIL

- Water is essential for plant growth.
- Without enough water, normal plant functions are disturbed, and the plant gradually wilts, stops growing and dies.
- Plants are most susceptible to damage from water deficiency during the vegetative and reproductive stages of growth.
- Also, many plants are very sensitive to salinity during germination and early growth stages.
- Most of the water that enters the plant roots does not stay in the plant. Less than 1% of the water withdrawn by the plant actually is used in photosynthesis (assimilated by the plant).
- The rest of the water moves to the leaf surfaces, where it transpires (evaporates) to the atmosphere.
- The rate at which a plant takes up water is controlled by its physical characteristics, the atmosphere and soil environment.
- As water moves from the soil into the roots, through the stem, into the leaves and through the leaf stomata to the air, it moves from a low water tension to a high water tension.
- The water tension of the air is determined in large part by the relative humidity and always is greater than the water tension in the soil.

HOW PLANTS GET WATER FROM SOIL

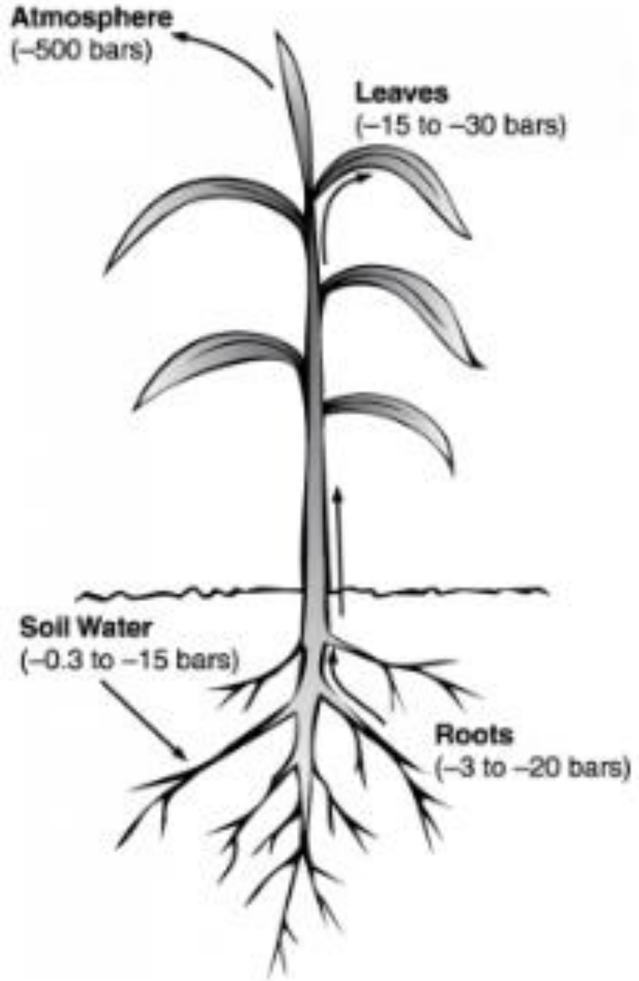


Illustration of the energy differentials that drive the water movement from the soil into the roots, up the stalk, into the leaves and out into the atmosphere. The water moves from a less negative soil moisture tension to a more negative tension in the atmosphere.

During the course of a growing season, plants will extract about 40% of their water from the top quarter, 30% from the second quarter, 20% from the third quarter and 10% from the bottom quarter of the root zone.

INTERACTION BETWEEN SOIL AND WATER!!!!

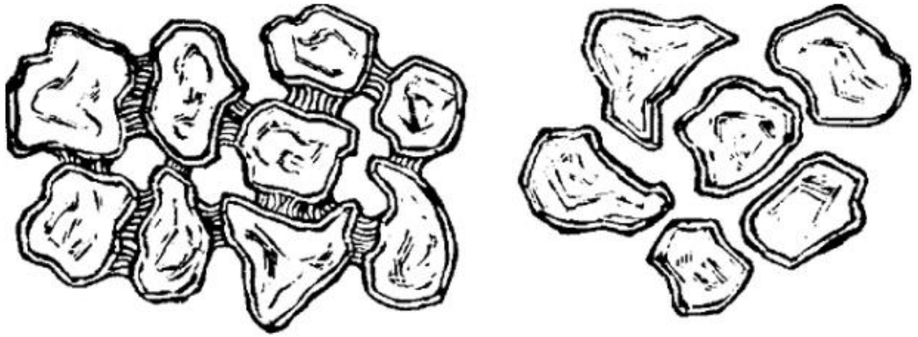
- Soil is a medium that stores and moves water.
- If a cubic foot of a typical silt loam topsoil were separated into its component parts, about 45% of the volume would be mineral matter (soil particles), organic residue would occupy about 5% of the volume and the rest would be pore space.
- The pore space is the voids between soil particles and is occupied by air or water.
- The quantity and size of the pore spaces are determined by the soil's texture, bulk density and structure.
- Water is held in soil in two ways: as a thin coating on the outside of soil particles and in the pore spaces.
- Soil water in the pore spaces can be divided into two different forms: gravitational water and capillary water

INTERACTION BETWEEN SOIL AND WATER!!!!

The two primary ways that water is held in the soil for plants to use are capillary and gravitational forces.
1. Gravitational water- The pore spaces are filled with water more than their capillary capacity, and the excess, or gravitational water, drains downward.

2. Capillary water is held in the pore space against the force of gravity.

WATER HOLDING CAPACITY OF SOILS!!!!



Soil moisture available to plants is the amount held between field capacity and wilting point.
Left: Field capacity.- the capillary pores are full and the remaining pore space is filled with air.
Right: Wilting point. The water available to plants is exhausted.

- The four important levels of soil moisture content reflect the availability of water in the soil. These levels commonly are referred to as 1) saturation, 2) field capacity, 3) wilting point and 4) oven dry.

- When a soil is saturated, the soil pores are filled with water and nearly all of the air in the soil has been displaced by water. The water held in the soil between saturation and field capacity is gravitational water. Frequently, gravitational water will take a few days to drain through the soil profile and, thus, some can be absorbed by roots of plants.

SOIL MOISTURE TENSION!!!!

- The degree to which water clings to the soil is the most important soil water characteristic to a growing plant. This concept often is expressed as soil moisture tension. Soil moisture tension is negative pressure and commonly expressed in units of bars.
- A soil that is saturated has a soil moisture tension of about -0.001 bars or less, which requires little energy for a plant to pull water away from the soil. At field capacity, most soils have a soil moisture tension between -0.05 and -0.33 bars.
- Soils classified as sandy may have field capacity tensions around -0.10 bars, while clayey soil will have field capacity at a tension around -0.33 bars.
- At field capacity, removing water from the soil is relatively easy for a plant.
- The wilting point is reached when the maximum energy exerted by a plant is equal to the tension with which the soil holds the water.
- For most agronomic crops, this is about -15 bars of soil moisture tension. To put this in perspective, the wilting point of some desert plants has been measured to be between -50 and -60 bars of soil moisture tension.

Reference Videos

https://www.youtube.com/watch?v=zF_CAR-qRyI

See You at Next Class!!!!