

19.3 SOIL-WATER

Soil water is the water present within the soil pores and plays a vital role in supporting plant growth and sustaining soil life. It serves as a medium for transporting nutrients to plant roots and is essential for various physiological processes like photosynthesis and transpiration. Soil water exists in different forms—gravitational, capillary, hygroscopic, and chemically combined water—each varying in availability to plants. Among these, capillary water is the most accessible and useful for plants. The quantity and movement of soil water influence soil fertility, crop yield, and the health of ecosystems.

Gravitational Water

Gravitational water is the water that moves through the soil profile under the force of gravity. It occupies the macropores (larger soil pores) and is typically present after heavy rainfall or irrigation. This water percolates down to the water table and is generally not available to plants because it drains quickly beyond the reach of roots. While it is important for recharging groundwater reserves, excessive gravitational water can lead to waterlogging and leaching of nutrients from the soil.

Capillary Water

Capillary water is the most important form of soil water for plant use. It is held in the micropores of the soil, forming a thin film around soil particles due to surface tension and adhesion. Unlike gravitational water, capillary water is available to plants, as roots can absorb it easily. It moves slowly from wetter to drier areas in response to plant uptake or evaporation. The field capacity of soil — the maximum amount of water held after gravitational water has drained — represents the optimum level of capillary water.

Hygroscopic Water

Hygroscopic water forms a thin, tightly bound layer of water molecules around soil particles through adsorption. This water is held so strongly by electrostatic forces that it is unavailable to plants. It does not move or participate in plant uptake and is only removed through intense heating (not through natural evaporation or transpiration). Although present in all soil types, it contributes nothing to soil fertility or plant hydration.

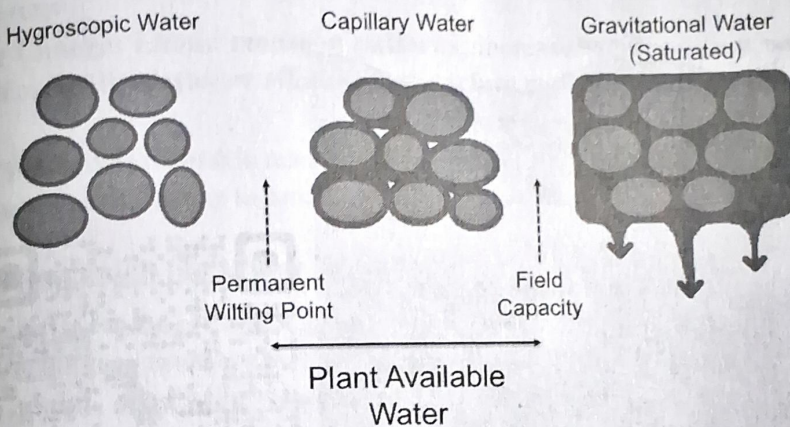


Fig. 19.3. Available soil-water for the plants.

Chemically Combined Water

Chemically combined water is integrated into the structure of minerals and organic compounds in the soil. It forms part of the crystalline structure of certain clay minerals and cannot be separated by natural physical means such as drying or heating. This type of water is not available to plants and does not take part in soil moisture dynamics, but it may be released slowly over geological time through weathering processes.

Runoff Water (Surface Water)

While not strictly a form of soil water, runoff water refers to the water that fails to infiltrate the soil and instead flows over the land surface. This occurs when the soil is saturated, impermeable, or when rainfall exceeds the infiltration rate. Though not absorbed, runoff water can influence erosion, nutrient loss, and recharge of water bodies like ponds and lakes. Effective soil management aims to reduce runoff to enhance infiltration and water retention.