

Soil water potential

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The retention and movement of water in soils, its uptake and translocation in plants and its loss to the atmosphere are all energy related phenomenon. The more strongly water is held in the soil the greater is the heat (energy) required to remove it. In other words, if water is to be removed from a moist soil, work has to be done against adsorptive forces. Conversely, when water is adsorbed by the soil, a negative amount of work is done. The movement is from a zone where the free energy of water is high (standing water table) to one where the free energy is low (a dry soil). This is called soil water energy concept.

Free energy of soil solids for water is affected by

i) Matric (solid) force i.e., the attraction of the soil solids for water (adsorption) which markedly reduces the free energy (movement) of the adsorbed water molecules.

ii) Osmotic force i.e., the attraction of ions and other solutes for water to reduce the free energy of the soil solution.

Matric and Osmotic potentials are negative and reduce the free energy level of the soil water. These negative potentials are referred to as suction or tension.

iii) Force of gravity: This acts on soil water and the attraction is towards the earth's center, which tends to pull the water downward. This force is always positive.

The difference between the energy states of soil water and pure free water is known as soil water potential. Total water potential (P_t) Ψ_t is the sum of the contributions of gravitational potential (P_g) Ψ_g , matric potential (P_m) Ψ_m and the Osmotic potential or solute potential (P_o) Ψ_o .

$$P_t \Psi_t = P_g \Psi_g + P_m \Psi_m + P_o \Psi_o$$

Potential represents the difference in free energy levels of pure water and of soil water. The soil water is affected by the force of gravity, presence of soil solid (matric) and of solutes.