Soil Water Potential Explained

Overview

The Relationship between Soil Water Tension (or Potential)
and Moisture Content of Soil

Moisture retention characteristics curve illustrates the relationship between soil water tension (or potential) and moisture content of soil.

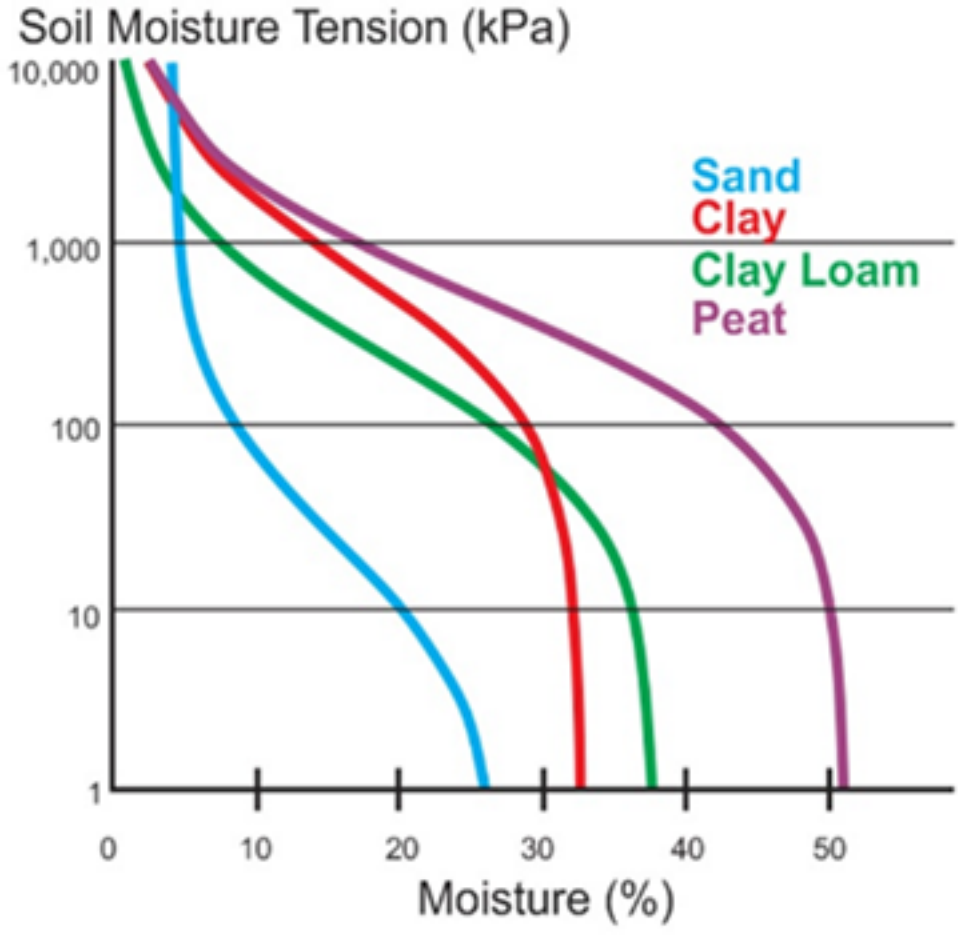
Soil water potential tells us how tight water is attached to soil matrix. A soil that is completely saturated has zero soil water potential.

The potential of water in an unsaturated soil is considered to be negative. As the soil dries , the water potential progressively becomes more negative as the large and small pores drain of water. More negative water potential are also associated with decreasing thickness of water films covering the surfaces of soil particles.

The total soil water potential can be considered as comprising a component due to mutual attraction between water and soil particles (matric potential), a component due to gravity (gravitational potential) and a component due to soluble salts (osmotic potential).

These affect the movement of water in soil and the way soil retains and releases water in the soil-plant-atmosphere continuum.

(HP Cresswell et al., Soil Physical Measurement and Interpretation for Land Evaluation, CSIRO 2002)



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Examples of soil water characteristic curves for sand, clay, clay loam and peat (SEC https://www.soilmoisture.com/Complete-Lab-Systems/)

The soil water characteristic is the relation between volumetric water content and matric potential. This is a characteristic property of a particular soil layer and is necessary, but not sufficient, for prediction of both equilibrium water contents and flow of water in the soil. Consequently it has many practical applications, for example with matric potentials near to saturation it is important in the design of irrigation and drainage systems. The slope of the soil water characteristic (sometimes referred to as the water capacity) is used to calculate soil water diffusivity and it is often used in the modelling of water uptake by plants.

The amount of water retained in soil at matric potentials near zero (0 to 10m) depends mainly on capillarity and pore size distribution. Soil macrostructures strongly affect the soil water characteristics over this range. At more negative potentials, water retention is controlled mainly by adsorptive forces and is influenced by the total surface area of particles per unit mass and charge density. These are closely related to particle size and mineralogy, respectively.

(HP Cresswell et al., Soil Physical Measurement and Interpretation for Land Evaluation, CSIRO 2002)