



16-17 November 2023

THE IMPORTANCE OF WATER REGIME IN IRRIGATION SCHEDULING

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Abstract: Soil water regime gives insight into the amount of water stored in the soil and depends on soil properties and water balance. Soil properties important in irrigation scheduling are bulk density, infiltration rate, soil texture and structure and complete water regime in the soil. The change in water content may be positive (rainfall or irrigation) or negative (the amount of water used by plants, evaporation, surface and deep runoff). Water balance is the foundation for irrigation scheduling as well as the drainage of agricultural lands. It gives insights into the maximum soil water capacity (MSWC), field water capacity (FWC), management allowable depletion (MAD), and wilting point (WP). Estimation of soil water content is the groundwork for determining how much water to apply in one irrigation event and when to irrigate. Irrigation is an agricultural practice that enables the maintenance of optimal water content, that is readily available water. The soil water characteristics are fundamental concepts that give insight into the amount of water retained in the soil, that is the easily available water which is the basis for irrigation scheduling. Despite recent requirements of crop production, i.e., agricultural production in general, soil and water conservation practices can contribute to a long-term agricultural sustainability and balance.

• Introduction

Water is one of the most important chemical compounds in agroecosystem and its value is equal for humans, animals, plants and soil. The role of water in plant organisms is multiple, for example: water is transporter and solvent of nutrients, the reactant in the photosynthesis process and many physiological processes in plant. Apart from importance for plants, water is integral part of the soil. According to NGO-CONG ET AL. (2021) disturbance in plant-soil-water processes can significantly affect soil functions and crop productivity by changing soil hydraulic properties which additionally influence nutrient availability, uptake by plants, and water losses. MARKOVIĆ ET AL. (2021) confirmed the dependence on plant-available water and numerous physiological processes that are directly or indirectly affecting plant growth. Recent requirements of farming, amelioration, landscape-specified agriculture practices and different types of land use are facing problems of soil water regime optimization (BOLOTOV, 2019).

• Discussion

The role of water in the soil

Soil water content (SWC) is usually expressed as a mass (%) fraction or a volume (%) fraction relative to the absolute dry soil and that is called soil moisture, which represents the percentage of water content in the observed soil. For most purposes, expression as a volume fraction is more useful, since multiplying volumetric soil water content (VWC) by the soil depth gives a figure with the same dimensions used to express rainfall, evaporation, transpiration, drainage, and irrigation (GARDNER ET AL., 2000). Water that occurs as a result of precipitation or flooding is called surface water and it causes soil erosion and landslides. Onwards, water in the soil occurs as bound water and as a free water.

Soil moisture characteristics

Field water capacity (FWC), management allowable depletion (MAD), wilting point (WP), and maximum soil water capacity (MSWC) are the most important soil moisture characteristics. Field water capacity (FWC) is defined as the amount of water held in the soil after the gravitational drainage and after the rate of downward movement of water has decreased (ASSOULINE AND OR, 2014). MAD is a soil moisture characteristic that separates bound water (unavailable) from free (available) water in the soil and represents SWC for irrigation time. The wilting point (WP) is the amount of water in the soil at which plants cannot perform their physiological functions that are important for growth.

Determination of soil water content

The knowledge of SMC is necessary for irrigation scheduling, i.e. when calibrating soil water sensors. Before applying a particular method or sensor, the device must be calibrated with the gravimetric method which is considered one of the most accurate methods for measuring SWC. The thermogravimetric method contains the following procedures:

- Taking soil samples
- Weighing on a precise digital scale
- Drying to a constant weight (105 °C)
- Calculation of the SWC (%)

Calibration of the device by thermogravimetric method is done with the following expression:

$$\text{mass\%} = \frac{\text{wet weight} - \text{dry weight}}{\text{dry weight}} \times 100$$

Volumetric soil water content (vol%) is determined by the following expression:

$$\text{vol\%} = \text{mass\%} \times \rho_v$$

Irrigation rate is determined by the following expression:

$$\text{IR} = 100 \times \rho_v \times d (\text{FWC} - \text{SWC})$$

Where is:

IR = Irrigation rate (m³/ha)

ρ_v = Bulk density (g/cm³)

d = Soil depth (m)

FWC = Field water capacity (mass%)

• Conclusions

Soil water content, i.e., soil moisture is an important element in plant production that affects the processes of plant germination and growth, nutrition, decomposition of organic matter, microorganisms lifecycle, etc. Determination of soil water content is necessary in the planning and applying ameliorative measures such as irrigation and drainage.

The movement of water in the soil and its accessibility, water constants and the amount of water in irrigation rate are essential for health of plants, soil and sustainable agriculture.

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