

Impact of Natural Conditioners on Water Retention, Infiltration and Evaporation Characteristics of Sandy Soil

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Abstract: Soil conditioners i.e., natural deposits and organic fertilizer are used for alleviate some of poor physical properties of sandy soils such as low water retention and inefficient water use, especially in arid and semi-arid regions such as in Saudi Arabia conditions. The present study aims to investigate the impact of clay deposits and organic fertilizer on water characteristics, cumulative infiltration and intermittent evaporation of loamy sand soil. Soil sample was collected from surface layer (0-30 cm depth) of the Agricultural Experiment and Research Station at Dierab, 40 km south west of Riyadh, Saudi Arabia. Two samples of clay deposits (CD#22 and CD#23) collected from Khyleis area, Jeddah-Madina road in addition of commercial Organic Fertilizer (OF) were used in the present study. The experiments were done during August to December 2005 in soil physics laboratory, the soil was mixed with clay deposits and organic fertilizer at rates of 0, 1, 2.5, 5.0 and 10.0% (w/w). The transparent PVC columns were packed with soil to depth of 30 cm every 5.0 cm intervals to insure a homogeneity of soil in columns. The clay deposits (CD#22 and CD#23) and Organic Fertilizer (OF) mixed with the soil were packed in the upper 0-5.0 cm of each soil column. The infiltration experiment was done using a flooding apparatus (Marriot device) with constant head of 3.0 cm over the soil surface. The cumulative infiltration and wetting front depth as a function of time were recorded. The evaporation experiment was conducted in 40 cm long transparent sectioned Lucite cylinders (5.0 cm ID). Fifty millimeters of tap water were applied weekly for three wetting/drying cycles. Cumulative evaporation against time was measured daily by weighing each soil column. The soil moisture distribution at the end of the experiment was determined gravimetrically for each 5.0 cm interval. The results indicated that the three conditioners significantly increased the water constants of mixed soil (i.e., SWC, FC, PWP and AW), but the CD#22 has a superior effect. The results clearly indicated that increasing the application rate of conditioners significantly decreased the cumulative infiltration (D). The decrease in D more pronounced at higher rates. The CD#22 was more effective in reducing the cumulative infiltration. The relationship between (D) as a function of Time (T) was done by fitting the data to the Kostiakov and Philip equations. Increasing the application rate of natural conditioners restricted the wetting front movement and need more time to reach 30 cm depth. The natural conditioners significantly reduced the cumulative evaporation throughout the 3 evaporation cycles. The reduction significantly increased with increasing the application rate, except for the higher rate (10%), which increases the cumulative evaporation under the present conditions. The improvement of soil hydro-physical properties and reduction in water infiltration and cumulative evaporation are good practices for plant growth in region limited in water such as most regions in Saudi Arabia.