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Water sorptivity as applied to predict the hydraulic conductivity and capillary-sorption potential of water in soils

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Water movement by gravitational forces in the plant-root zone occurs principally through the macro-pores of soil. The redistribution and upward flow occur in the capillary soil matrix pores. The purpose of this study is to propose equations based on water sorptivity and infiltration functions for prediction of the hydraulic conductivity K(θ) into capillary-matrix and non-capillary macro pores of soils. The derived equations were used also to distinguish water sorptivity (S) in dry and wet soils as well as to predict the capillary-sorption potential (ψ) at moisture adsorption capacity (Wa) and at any particular water content (Wi) in cultivated and uncultivated soils. Five alluvial clay (saline and non-saline) and calcareous soil profiles located at the Nile Delta were investigated for applying the assumed equations. Water sorptivity was determined at steady infiltration and un-saturation conditions where a decrease in S value was observed with an increase in soil water content. At steady infiltration, S decreased by 35-40% in calcareous soils and by 45-60% in alluvial clay soils. The K(θ) was discriminated into saturated macro pore K(θ)RDP saturated matrix K(θ)sh, matrix unsaturated K(θ)h and lateral K(θ)L. The value of K(θ)RDP for macro pores remained higher than those fore soil matrix pores in the studied soils. The highest value of K(θ)L and K(θ)h was in calcareous soil profiles, while the lowest value was existed in saline clay soil. The contribution of K(θ)L to K(θ)sh was evident in alluvial clay soils with marked values in non-saline clay soil profiles. The predicted values of capillary-sorption potentials in calcareous cultivated soil with Zea mays were higher than those of uncultivated soil at the same water content.