Influence of some soil physical properties on infiltration rate and hydraulic conductivity of 3 salt affected soils in Kenya

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Abstract

Infiltration rate (IR) is the volume flux of water flowing into the profile per unit of soil surface area (Parr and Bertrand, 1960) when the soil is subjected to a shallow depth of ponding at the surface (Ghildyal and Tripathi, 1987) or when the water supply is not limiting (SSSA, 1975). IR is generally expressed in cmlh (Schwab et al, 1981). The term infiltration capacity is frequently used in hydrology to refer to IR (Ghildyal and Tripathi, 1987). It is generally observed that under continued ponding, IR is high at the beginning, decreases rapidly and then more slowly until it approaches a constant rate asymptotically. Infiltration rate affects many aspects of hydrology and agriculture including runoff and water content of the soil, and is related to evapotranspiration (Marshall and Holmes, 1988). Most soil profiles are differentiated into horizons thus, water distribution during infiltration is not uniform. Examples include a loose ploughed layer overlaying compact subsoil and a surface crust with higher bulk density and lower hydraulic conductivity (HC) than the underlying soil mass. Where a coarse layer overlays a finetextured layer, the initial IR and the final IR are controlled by the coarse and the fine-textured layer respectively (Hillel, 1980). It has been conclude that in such a case, it is the layer of the lowest HC that controls the process of infiltration (Hillel, 1982). As in the case of a crusted soil where the HC of the surface layer is lower than that of the subsoil, the crusted layer determines the initial IR. The IR values of crusted soils or soils with a seal depend on the HC of the crust or seal (Shainberg and Levy, L996). For this reason some researchers have tried to measure the HC of soil surface seals. Mclntyre (1958) found that the HC of the upper and lower layers of the seal of a sandy loam soil were 2000 and 200 times lower than the HC values recorded for the undisturbed soils. Bresler and Kemper (1970) measured a HC value of 1.5 x 10-a mm,/sec in the upper 2-3 mm of a sealed clay loam soil. However, the crust is a very thin layer and it is very difficult to determine its HC. Consequently, IR is widely used to characterise water entry into the soil, particularly when seal formation is involved (Shainberg and Levy, 1996). Kazman et al. (1983) studied the effect of exchangeable sodium percentage (ESP) on IR and seal formation of 4 smectitic soils of varying textures using distilled water. Infiltration rate was found to be highly sensitive even to low levels of ESP. Shainberg (1985) concluded that seal formation depends on the electrolyte concentration of the applied water. Furthermore when sufficient electrolye is provided with water, chemical dispersion is low (Aggasi et al., 1981). The effect of clay content on the IR of soils was studied by Ben-Hur er a/. (1985). Soil samples with clay contents between 3 and 607o were chosen from smectitic and non-semetitic soils. For both categories of soils, soils with 10 - 3O7o clay were most susceptible to seal formation and had the lowest IR. The objectives of this study were (1) to compare the IR and HC of 3 salt-affected soils and (2) determine the influence of organic matter, soil texture and bulk density on IR and HC of the salt-affected soils.