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Characterizing infiltration and internal drainage of South African dryland soils

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Surface infiltration and internal drainage properties of five soil types from arid drylands of South Africa were studied under double ring infiltrometer, rainfall simulation plots (1 m2) and instantaneous drainage plots (9 m2). Changes in soil water content during 40 min rainfall simulation for a rainstorm with average intensity of 1.61 mm min-1 and 30 day drainage period were measured at various depths by 1.5 m long capacitance soil water measuring (DFM) probe. Different ($P<0.05$) mean surface steady infiltration rate ranged from 0.05 to 4.47 mm min-1 and had a negative power relationship ($R2 = 0.65$) with horizon clay plus fine silt content. Power regression ($R2 \geq 86\%$) described rainstorm infiltration and obtained steady rates within an average time of 15 min. Mean total infiltrated soil water content was lowest ($P<0.05$) from surface horizons with either 47.7% clay plus fine silt content or bulk density of 1.91 gcm-3 and exchangeable sodium of not less than 44 mgkg-1. Surface horizons with lower surface bulk density and total sand fraction of more than 72% had infiltrated depth and mean total infiltrated soil water content up to 40 cm deeper and 0.55 mm mm-1 greater, respectively. Drainage rate at drained upper limit calculated from the Wilcox drainage model ($R2\leq0.97\%$) was 0.2 mm day-1 or less were from underlying horizons with either clay plus fine silt of 45% or soft calcium carbonate. Higher drainage rate with accumulative drainage amount greater than 60 mm were from soil profile horizons with clay plus fine silt content of less than 20% and above unity steady infiltration rates. Rainstorm infiltration and drainage rates was shown to depend on permeability and coarseness of the respective soil surface and subsurface horizons; a phenomenon critical for harnessing rain and flood water to recharge groundwater.

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