Soil hydraulic properties of a nitisol in Kabete, Kenya

Karuku, G.N.; Gachene, C.K.K.; Karanja, N.; Cornelis, W.; Verplancke, H.; Kironchi, G.
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Abstract

Water relations are among the most important physical phenomena that affect the use of soils for agricultural, ecological, environmental, and engineering purposes. To formulate soil-water relationships, soil hydraulic properties are required as essential inputs. The most important hydraulic properties are the soil-water retention curve and the hydraulic conductivity. The objective of this study was to determine the soil hydraulic properties of a Nitisol, at Kabete Campus Field Station. Use of an internal drainage procedure to characterize the hydraulic properties and soil and water retention curves allowed for the establishment of the moisture and matric potential at field capacity and permanent wilting point. The Bt2 (84 -115) and Bt3 (115 - 143 cm) had the highest clay contents of 619 compared to Ap, AB and Bt1 horizons. The PWP was attained at soil moisture contents of 0.223, 0.284, 0277, 0.307 and 0.314 m3m-3 in the Ap, AB, Bt1, Bt2, and Bt3 horizons, respectively. Horizontal saturated hydraulic conductivity (Ksat) was high at 6.0 cm hr-1 in Ap horizon and decreased to 0.4 cm hr-1 in the subsurface horizon (Bt3). Ksat in the vertical direction was higher than horizontal and ranged from 8.3 cm hr-1 in surface layer to 0.6 cm hr-1 in Bt3 horizon, with exception of Bt1 and Bt2 where horizontal Ksat was greater than vertical. The Ap horizon also had the highest crop extractable water. Though the AB and Bt1 had the same water content at low matric suction, the variation was very wide as the SWRC approached saturation point. Bt1 and Bt2 also had similar water contents at suction range of – 7kPa after which Bt1, tended towards Bt3. Bt3 had the narrowest range of crop extractable water and thus was attributed to texture. The Bt3 retained the most amount of water at 0.314 m3m-3concluding that ?PWP increased with depth. The total available water capacity between FC and PWP in the profile was 79.2 mm m-1. The study observed that the field capacity, crop available water contents and hydraulic conductivities were influenced positively by soil organic matter. The Van Genuchten parameters of air entry value (a) and pore size distribution (n) indicated that pore size distribution was not even in the AP and AB horizons. The field capacity was attained at higher matric potential at -5kPa for Bt1 while Bt2 and AP, AB, Bt2 and Bt3 was at -10kPa.The functional relationship, K(?) = a?b that deals with water redistribution as a result of soil hydraulic properties and evaporative demand of the atmosphere was highly correlated to soil moisture content and texture with R2 values > 0.85.