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Variation in soil strength, bulk density and gravel concentration along a toposequence in Abeokuta, south-western Nigeria.

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Abstract

This study was carried out at Abeokuta, south-western Nigeria, to understand the variation in soil strength, gravel distribution, and bulk density along a toposequence. In 2003, a 120-m transect on a fallowed land was sampled at every 1 m for topsoil bulk density measurement by excavation (3278 [cm.sup.3] pits), while soil strength was measured at every soil depth increment of 25 mm to 0.50m depth. Total dry ([[rho].sub.t]) and fine earth (<2 mm) ([[rho].sub.f]) bulk densities were determined. Soil water content was also determined. Gravel was divided into classes of 2-4, 4-8, 8-16, and >16 mm. In 2006, four 100-m transects were considered; two each on adjacent fallowed and cultivated lands. Soil strength and water content were measured. The fine earth fraction of topsoil ranged from 62 to 90.6%. Gravel in the 2-4 mm class was dominant with a range of 0.8-35.7%. Thus, cores [greater than or equal to] 50mm could be used in the topsoil to obtain reliable estimates of bulk density.

Total bulk density ([[rho].sub.t]) was reduced by 4-19% when corrected for gravel to obtain [[rho].sub.f]. Soil strength of the lower slope was highest in 2003 (1981-4482 kPa) and lowest in 2006 (1546 kPa). In spite of the apparent significant influence of water content on soil strength, the relationship was weakly expressed by regression analysis, as only 35% of variation in soil strength was explained by water content at 0.10-0.15 m soil depth in 2003. No relationship was found in 2006; the cultivated segment had higher soil strength (2045 kPa) than the fallowed segment (1970 kPa) even though the water contents were similar. Also, only the 2-4 mm gravel significantly influenced [[rho].sub.t]. Land use, soil depth, and slope position significantly affected soil strength. Root-limiting soil strength (>2000 kPa) would certainly be encountered below 0.20 m soil depth in the wet season irrespective of land use. Management of this gravelly landscape must be based on the heterogeneous nature of soil physical properties along the toposequence, and this could be made effective by grouping the soils according to slope position and taking interest in the few portions of the landscape with extreme values of gravel distribution and high soil strength.

Additional keywords: penetrometer resistance, rock fragments, fallow, cultivation, compaction.