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The dynamics of soil aggregate breakdown in water in response to landuse as measured with laser diffraction technique

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The Mastersizer 2000G (Malvern Instruments) Diffraction Instrument was used to assess and quantify the breakdown of soil aggregates and compute wet aggregate stability indices. The study was aimed at evolving a novel rapid method of determining soil aggregate stability. Bulk surface (0-15 cm) soil samples were collected under 5 different land uses in the Teaching and Resrach Farm of Obafemi Awolowo University, Ile-Ife, Nigeria. About 0.5g of the soils aggregates (0.5 -1 mm diameter) were evaluated in the laser diffractometer with the stirrer operated at 500 rpm and the pump at 1800 rpm. The different size aggregates and particles of sand silt and clay were quantified periodically. Water stable aggregates greater than 250 μm (WSA>250), water stable aggregates less than 250 μm (WSA<250), water dispersible clay index (WDI), and mean volume diameter (MVD) among others were computed from the laser diffraction data. The values were compared with the classical Yoder wet sieving technique. The WSA>250 was significantly higher on the soils under Forest (FR), Cacao (CC), Teak (TK) and Oil Palm (OP) plantations, while it was significantly lowest under no-tillage (NT) and continuous cultivation (CT). The pasture (PD) was not significantly different from either the cultivated and the non-cultivated soils. Conversely, the WSA<250 and water dispersible clay index was highest in the cultivated soils (CT and NT) and lowest in the non-cultivated soils (FR, TK, CC and OP) while the PD was in-between. The MVD also followed a similar trend as the WSA>250. The wet sieving water stable aggregates index (WSI>250) was significantly correlated with WSA>250 (r = 0.75), MVD (r = 0.75), WDI (r = -0.68) and WSA<250 (r = - 0.73). All the laser diffraction measured aggregation indices were significantly correlated with the organic matter contents of the soils. Thus the laser diffraction promises a rapid and comprehensive method of evaluation of soil aggregate stability.