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Soil-Structural Stability as Affected by Clay Mineralogy, Soil Texture and Polyacrylamide application

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Soil-structural stability (expressed in terms of aggregate stability and pore size distribution) depends on (i) soil inherent properties, (ii) extrinsic condition prevailing in the soil that may vary temporally and spatially, and (iii) addition of soil amendments. Different soil management practices alter shrinking and swelling stresses and may enhance breakdown of aggregates and subsequently the collapse of soil pores. Two sets of experiments were conducted to to study the role of (i) the soil predominant clay mineral (smectitic, illitic and kaolinitic), and texture for >50 samples collected from the top cultivated layer (0-20 cm) of humid and arid regions, and (ii) anionic polyacrylamide (PAM) application for 12 selected samples (loam and clay texture), on soil-structure and aggregate stability using the modified non-traditional high energy moisture characteristic (HEMC) method. In this method, the wetting process of the aggregates is accurately controlled, and the energy of hydration and entrapped air are the main forces responsible for aggregate breakdown. Parameters of structural or aggregate stability are obtained by quantifying differences in the moisture characteristic or pore-size distribution curves near saturation (at 0-50 cm tension) and drainable porosity of soils under two extreme (fast and slow) rates of wetting. The results showed that aggregate stability and macro pore size distribution near saturation strongly depended on soil clay mineralogy and texture, conditions prevailing in the soil and amendment used. Structural or aggregate stability increased with (i) the increase in clay content, a trend that was more clear in the smectitic soils; (ii) the following order of clay mineralogy smectitic<illitic<kaolinitic, and (iii) the use of soil amendment. Concerning the latter, the effectiveness of PAM addition in improving aggregate stability decreased in the order: smectitic>illitic>kaolinitic samples. Detailed analyses of the results provided also valuable information on inter- and intra- aggregate porosities that may have vital bearing on water, solutes and particles transport processes (vertical and horizontal) in different soil types under various management practices.