

Soil texture, mineralogy, and organic matter effects on structural stability and soil loss of selected Trinidad soils after rainfall

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Clay and organic matter both have cementing and binding abilities that play crucial roles in the formation and stability of soil aggregates. The interactions of clay and organic matter on the extent of differential swelling and the volume of entrapped air in soil aggregates during fast wetting both in the presence and in the absence of rainfall were investigated. The influence of clay mineralogy was also examined. The parameters assessed in the study were water-stable aggregates (WSA), final infiltration rate (FIR), runoff (Q), and soil loss (E). Samples from the surface (0–10 cm) of six agricultural soils in Trinidad with three levels of clay (low, <20%; medium, 20–45%; and high, >45%) and two of organic matter (low, ≤3% and high, >3%) were used. Generally, aggregate stability and infiltration rate increased while seal formation, runoff, and soil loss decreased with increasing clay content. The high clay, high organic matter sample dominated by high activity clay yielded the highest WSA (68.8%) and the smallest E (0.99 kg m⁻²), whilst the low clay, low organic matter sample dominated by low activity clay minerals had the lowest WSA value (5.3%). The high cation exchange capacity (20.2 cmol kg⁻¹) of Oropuna, a high clay, low organic matter content soil, classified as kaolinitic, indicates the presence of appreciable quantities of smectites. Therefore, the significantly lower WSA (56.5%) and FIR (3.2 mm h⁻¹) and higher Q (100.6 mm) and E (5.59 kg m⁻²) of Oropuna over Montserrat (WSA = 61.5%; FIR = 109.9 mm h⁻¹; Q = 6.3 mm; and E = 3.06 kg m⁻²) and Godineau (WSA = 68.8%; FIR = 60.7 mm h⁻¹; Q = 41.3 mm; and E = 0.99 kg m⁻²) medium and high clay smectitic soils high in organic matter demonstrates the importance of organic matter in alleviating clay dispersion and slaking in soils predominated by high activity expanding clays. The results also demonstrate that there is a threshold clay content above which the support of organic matter is required to weaken disruptive forces and below which organic matter and slow wetting are not effective in diminishing disruptive forces.

Keywords: Aggregate stability; Aggregate slaking; Seal formation; Fast wetting; Low and high activity clay; Clay content; Organic matter content; Simulated rainfall

High aggregate stability is crucial for the maintenance of adequate pore space for infiltration and when disruptive forces overcome cohesive ones