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S4: Soil Architecture - oral

Crust formation and runoff of a red clay soil from subtropical China: effect of rainfall kinetic energy

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Abstract: Red clay soils from subtropical China (Ultisol) are not considered currently as sensitive to crusting and erosion by water. However, recent field data showed erosion can be significant. To investigate the sensitivity of red clay soil to crusting and runoff, a laboratory rainfall study was carried out. Because rainfall kinetic energy is known to have an important effect on aggregate breakdown and therefore crust formation, two treatments were applied: high kinetic energy (HKE) and low kinetic energy (LKE). Air-dried soil was packed in a soil box (50 cm × 50 cm) and was subjected to 38 mm.h⁻¹ rain for 90 min (3 replicates per treatment). Samples were taken for preparing soil thin sections and runoff, splash, and percolation were measured during the rain. Crusts formed after 40 min and 60 min of rain for the HKE and LKE treatment, respectively. Runoff for the HKE treatment started after 25 min of rain and reached a steady state after the crust well formed (50 min). While for the LKE, runoff started after 40 min of rain and kept increasing to a final runoff rate similar to the HKE treatment. Percolation started after 57 min of rain for the LKE treatment while no percolation occurred for the HKE treatment. The total mass of splashed material was 12 times higher for the HKE treatment than for the LKE treatment and significantly more soil was eroded for the HKE treatment. Stability tests gave mean weight diameters of 0.55 mm, 1.48 mm, and 1.74 mm for the fast wetting, mechanical stirring, and slow wetting, respectively, indicating red clay soils are very sensitive to slaking. The results show that Ultisol is prone to crusting and that kinetic energy is a major driver of their crust formation. Reducing the rain kinetic energy can preserve aggregate structure and delay the development of crust, which subsequently increase infiltration and decrease runoff and erosion on red soils.