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Does shallow water table depth influence structural crust formation ? An analysis of bulk density profiles from X radiography of crusts generated under high water content conditions.

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The intensification of agriculture has been accompanied by the widespread use of artificial drainage, particularly in North America and Europe. Consequently in winter, bare or partially covered soils are exposed to the direct impact of raindrops while the water table is usually close to the soil surface despite the presence of drain pipes. The resulting crust and soil compaction are therefore influenced by both soil stability and high water table conditions.

To understand the role played by these particular moisture conditions, we investigated the crust formation on a soil prone to surface crusting and close to saturation. A 80*40*100 cm^3 tank was packed with aggregates of < 2 cm and 2 initial water table depths were tested : 30 cm and 70 cm from the soil surface. A deep horizon was left in place between experiments, whereas the surface layer was added and then removed before and after each experiment, purposely less compacted to represent a seedbed or a ploughed layer. Soil surface was subjected to a 30 mm/h simulated rain for 40 min to generate structural seals. To obtain different crust formation stages, a third of the soil surface was shielded from raindrops after 15 min then another third after 30 min. Samples of the surface crusts (2 samples for each crust formation stage) were collected, dried, impregnated with resin and sliced to evaluate the bulk density profiles using calibrated X-ray radiography.

First results show that the bulk density decreases progressively with depth in relation

to the structural crust for all stages of the crust formation. However, some slices do not present such a decrease, which suggests that the high variability of the bulk density in the soil profile must be precisely described.

A total of 70 slices were analysed to characterise the effect of the initial water table depth on (i) the maximal compaction of the crust at the soil surface (ii) the evolution of the bulk density with depth and (iii) the slumping of the underlying layer.