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Soil structure dynamics in seedbeds: Effects of soil texture and organic carbon content

Mats Larsbo, Nargish Parvin, and Maria Sandin
Swedish University of Agricultural Sciences (SLU), Soil and Environment, Uppsala, Sweden (mats.larsbo@slu.se)

The soil structure near the surface of agricultural soils changes with seasons mainly by land management together with climatic and biological factors. Quantitative analysis of post-tillage changes in soil structure and related hydraulic properties are necessary for evaluating and improving models of soil hydrological and transport processes. The objectives of this study were to quantify changes in soil seedbed structure induced by rainfall and drainage and to estimate the effects of soil texture and SOC on these changes. We collected samples from the harrowed layer of twenty-six fine to coarse textured Swedish mineral soils. Air-dried soil was placed in cylinders (5 cm high, diameter 5 cm) and exposed to simulated rainfall (5 mm h^{-1} for 4 h) and drainage (-50 cm pressure potential) cycles in the laboratory. We used X-ray tomography to quantify changes in pore networks in a thin surface layer and in the whole cylinder. Infiltration rates at -5 cm pressure potential were measured using a mini disc tension infiltrometer on replicate air-dried samples and on the samples included in the consolidation experiments at the final state. Total imaged specific pore volumes generally decreased from initial to final state and pore size distributions were shifted towards larger proportions of below image resolution pores (< 80 µm). There was a strong positive correlation between clay content and changes in the specific volume of pores<80 µm. Soils with high clay content and soil organic carbon (SOC) content often have strong aggregates that resist change. Nevertheless, both clay and SOC contents were negatively correlated with the changes in specific imaged pore volume. These results highlight the importance of swelling, which is largely controlled by clay content, for seedbed consolidation. In line with previous studies, when excluding coarse textured soil, the changes in surface porosity were negatively correlated with silt content. Changes in infiltration capacity were not significantly correlated to any basic soil properties. Our results suggest that shrinking-swelling should be a central part in any model for seedbed consolidation.