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Laboratory assessment of soil sealing affecting water infiltration through rainfall simulation experiments and Beerkan infiltration tests

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Soil surface sealing is a major cause of decreased infiltration rates and increased surface runoff and erosion during rainstorms. The objective of this paper is to quantify the effect of surface sealing on water infiltration for 3 soils with different textures. We determined saturated soil hydraulic conductivity, K_s, values from rainfall simulation and Beerkan infiltration experiments carried out pouring water at different distances from the soil surface (BEST-H versus BEST-L runs, with a High and Low water pouring heights, respectively). Rainfall simulations carried out on soil layers having different depths allowed to demonstrate that the infiltration process was mainly driven by the less permeable layers and that K_s estimates were representative of the seals. Mean K_s values ranged from 13.9 to 26.2 mm h^{-1}. Soil sealing determined an increase in soil bulk density varying from 38.7 to 42.1%, depending on the type of soil. Rainfall-deduced K_s data were used as targeted values and compared with those estimated by the Beerkan runs. The predictive potential of the three BEST algorithms (BEST-slope, BEST-intercept and BEST-steady) to yield a proper K_s estimate for the seal was also investigated. BEST-slope yielded negative K_s values in 87% of the cases for BEST-H runs. Positive values were obtained in 100% of the cases with BEST-steady and BEST-intercept. However, a poor fit of the experimental data was obtained with the latter algorithm. Comparing K_s data estimated by applying different procedures to analyze the same infiltration run (the three BEST algorithms) and independent rainfall-deduced estimates allowed to identify BEST-steady as the more appropriate algorithm to analyze a BEST-H run. The method proposed in this study could be used to easily measure the seal's field saturated hydraulic conductivity of an initially undisturbed bare soil directly impacted by water with minimal experimental efforts using low cost Beerkan methods and BEST-Steady algorithm.