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Influence of soil surface characteristics and water repellence on soil infiltration and soil loss of Andisols (Canary Islands, Spain)

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Infiltration is a crucial process in the hydrological cycle, since it controls - among other things - the generation of run-off, erosion and aquifer recharge. Undisturbed Andisols are considered resistant to water erosion; a characteristic closely associated with their high porosity that permits a rapid rainfall infiltration and high structural stability. In spite of that, the high content of organic C on this type of soils, and the positive relation between this property and water repellence, could allow the presence of some soil surface characteristics that may change this behaviour. The aim of this work was to study the influence of these hydrophobic layers on water infiltration and soil loss on Andisols of Tenerife.

Twelve sites were chosen, all of which are located on the northern side of the island of Tenerife (Canary Islands, Spain), between 825-1400 m.a.s.l. The soils are allophanic Andisols (Typic/Lithic Hapludands and Typic Haplustands) and vitric Andisols (Typic Udivitrands) under pine forest. In each site, soil surface features with potential hydrological implications were described. To determine infiltration, a rainfall simulator with the following characteristics was used: 35 x 25 x 30 cm metal box with nozzles in the bottom, 2.5 cm apart (diameter of drops = 2-3 mm). The 4 box adjustable legs were set at 2 m height. Prior to installing the rainfall simulator, study zones were marked out using 30 cm-tall metal sheets. Each area measured approximately 875 cm2 and measurements were taken for slopes of 10 and 30% when it was possible. At the end of the slope a 25 cm-wide collector was semi-buried to collect runoff and sediment. Rainfall of variable intensity between 50-70 mmh-1 was simulated for periods of 30-45 minutes. Time to runoff (TR), volume to runoff (VR), steady-state infiltration rate (IR), runoff/rainfall ratio (RR), soil loss rate (SED) and sediment concentration (CSED) were measured.

For some of the studied soils, the formation of horizons made up with pine needles embedded with fungi mycelia was observed. These layers were highly water-repellent and could be easily detached from the underlying soil. When comparing the soils in which these are present with those devoid of them, the former showed an average decrease of 40% in TR and VR for both slopes. The IR suffered a decrease of nearly 40% and 30%, and the RR an increase of 40% and 20% for slopes of 10 and 30% respectively. Contradictory, soil loss showed a decrease in sites where this layer was present, 20% and 40% in SED, and 15% and 50% in CSED for slopes of 10% and 30% respectively. As a conclusion, despite the reduction in IR and the increase in RR, the presence of this layer in soils seems to provide them with a high resistance to drop impact, and a modification of water dynamics leading to a decrease of soil loss.