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Particle size conditions water repellency in sand samples hydrophobized with stearic acid

F.A. González-Peñaloza (1,2), A Jordán (2), N Bellinfante (2), G Bárcenas-Moreno (2), J Mataix-Solera (3), A.J.P. Granged (2,4), J Gil (5), and L.M. Zavala (2)

(1) Soil Erosion and Degradation Research Group (SEDER), Department of Geography, University of Valencia, Valencia, Spain, (2) MED_Soil Research Group, Department of Christallography, Mineralogy and Agricultural Chemistry, University of Sevilla, Sevilla, Spain, (3) GEA Group. Department of Agricultural Chemistry and Environment, University Miguel Hernández, Elche, Alicante, Spain,, (4) Department of Applied Physics, University of Sevilla, Sevilla, Spain, (5) Department of Agricultural Chemistry and Soil Science, University of Córdoba, Córdoba, Spain

The main objective of this research is to study the effects of particle size and soil moisture on water repellency (WR) from hydrophobized sand samples. Quartz sand samples were collected from the top 15 cm of sandy soils, homogenised and divided in different sieve fractions: 0.5 - 2 mm (coarse sand), 0.25 - 0.5 mm (medium sand), and 0.05 - 0.25 mm (fine sand). WR was artificially induced in sand samples using different concentrations of stearic acid (SA; 0.5, 1, 5, 10, 20 and 30 g kg-1). Sand samples were placed in Petri plates and moistened with distilled water until 10% water content in weight. After a period of 30 min, soil WR was determined using the water drop penetration time (WDPT) test. A set of sub-samples was placed in an oven (50 oC) during the experimental period, and the rest was left air-drying at standard laboratory conditions. Water repellent soil samples were used as control, and the same treatments were applied. WR was determined every 24 h. No changes in WR were observed after 6 days of treatment.

As expected, air-dried fine sand samples showed WR increasing with SA concentration and decreasing with soil moisture. In contrast, oven-dried samples remained wettable at SA concentrations below 5 g kg-1. Fine sand oven-dried samples showed extreme WR after just one day of treatment, but air-dried samples did not show extreme repellency until three days after treatment. SA concentrations above 5 g kg-1 always induced extreme WR. Medium sand air-dried samples showed hydrophilic properties when moist and low SA concentration (£ g kg-1), but strong to extreme WR was induced by higher SA concentrations. In the case of oven-dried samples, medium sand showed severe to extreme WR regardless of soil moisture. Coarse sand showed the longest WDPTs, independently of soil moisture content or SA concentration. This behaviour may be caused by super-hydrophobicity. Also, it is suggested that movements of sand particles during wetting, contribute to expose new intact hydrophobic surfaces in contact with water, causing longer WDPTs. The re-organization of polar molecules in the hydrophobic coating of particles may contribute to develop extreme WR. Soil WR from control samples varied between strong and severe WR, and did not show strong differences with soil moisture content.