Geophysical Research Abstracts
Vol. 19, EGU2017-315-2, 2017
EGU General Assembly 2017

Using rainfall simulations to understand the relationship between precipitation, soil crust and infiltration in four agricultural soils

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Rainfall simulation experiments were carried out in order to study soil crust formation and its relation with soil infiltration parameters—sorptivity (S) and hydraulic conductivity (K)—on four common agricultural soils with contrasted properties; namely, Cambisol, Gypsisol, Solonchak, and Solonetz. Three different rainfall simulations, replicated three times each of them, were performed over the soils. Prior to rainfall simulations all soils were mechanically tilled with a rototiller to create similar soil surface conditions and homogeneous soils. Rainfall simulation parameters were monitored in real time by a Thies Laser Precipitation Monitor, allowing a complete characterization of simulated rainfall microphysics (drop size and velocity distributions) and integrated variables (accumulated rainfall, intensity and kinetic energy). Once soils dried after the simulations, soil penetration resistance was measured and soil hydraulic parameters, S and K, were estimated using the disc infiltrometry technique. There was little variation in rainfall parameters among simulations. Mean intensity and mean median diameter (D50) varied in simulations 1 (∼0.5 bar), 2 (∼0.8 bar) and 3 (∼1.2 bar) from 26.5 mm h-1 and 0.43 mm (s1) to 40.5 mm h-1 and 0.54 mm (s2) and 41.1 mm h-1 and 0.56 mm for (s3), respectively. Crust formation by soil was explained by D50 and subsequently by the total precipitation amount and the percentage of silt and clay in soil, being Cambisol and Gypsisol the soils that showed more increase in penetration resistance by simulation. All soils showed similar S values by simulations which were explained by rainfall intensity. Different patterns of K were shown by the four soils, which were explained by the combined effect of D50 and intensity, together with soil physico-chemical properties. This study highlights the importance of monitoring all precipitation parameters to determine their effect on different soil processes.