Geophysical Research Abstracts, Vol. 7, 03740, 2005
SRef-ID: 1607-7962/gra/EGU05-A-03740
© European Geosciences Union 2005

Effects of hydrophobicity on aggregate stability, splash erosion and soil hydraulic conductivity for different sieve fractions

D. Fox (1), F. Darboux (2), and P. Carrega (1)

(1) UMR 6012 CNRS, Equipe G.V.E., University of Nice Sophia Antipolis, Nice 06204 France (fox@unice.fr), (2) INRA/SESCPF, Science du Sol, F-45166 Olivet cedex, France

The enhancement of hydrophobicity in forest soils after a major fire has been well documented. Volatile organic compounds released during combustion of organic matter condense within the soil near the surface and coat particles with hydrophobic substances. The presence of this water repellent layer has implications for both water infiltration and soil erodibility. However, little is known about the relationship between hydrophobicity and aggregate stability and the subsequent impacts on infiltration and erosion. On the one hand, aggregate stability can increase due to reduced slaking of hydrophobic aggregates; on the other, the combustion or volatilization of binding organic matter may reduce aggregate stability. In addition, aggregates of different size classes may react differently. The objectives of the study were therefore to quantify the effects of hydrophobicity on aggregate stability for different sieve fractions and to investigate the impacts of these changes on soil hydraulic conductivity and splash erosion rates. Soil was collected from the top 5 cm of an acid sandy loam beneath pine vegetation in France. Half the soil was subjected to a pine needle litter fire until a temperature of about 150°C was reached at a depth of 1.5 cm (total depth was 4 cm). Both the unburned and burned soil samples were then sieved to obtain sieve fractions of $<$ 0.4 mm (fine), 0.4-2.0 mm (medium), and 2.0-5.0 mm (coarse). Hydrophobicity (Water Drop Penetration Time) and aggregate stability (Mean Weight Diameter) were measured for each sieve fraction and the bulk soil. Samples of each sieve fraction and the bulk soil were placed in cylinders (i.d. 5.2 cm) and subjected to simulated rainfall with an intensity of 56 mm h-1 for a duration of 30 min. Total soil splash was measured during the simulation, and hydraulic conductivity measurements were performed on the cylinders afterwards. In all, 5 replicates of each of the

3 sieve fractions and the bulk soil were included for each of the 2 treatments (burned, unburned), giving a total sample size of 40 (5x4x2). Both soil hydrophobicity and aggregate stability were enhanced for the burned soil. Despite this, erosion rates were greater for the fine fraction of the burned soil as hyrophobicity decreased cohesion between sediments and micro-aggregates and impeded the formation of a surface crust. Differences in splash erosion were insignificant for the medium and coarse sieve fractions. Since much of the bulk soil was comprised of the fine fraction, erosion rates were significantly different for these samples with values lying between the fine and medium sieve fractions. Trends in hydraulic conductivity were slightly different than for splash erosion rates. Significant differences in hydraulic conductivity were measured for all sieve fractions, though the greatest difference was for the fine and bulk soil samples. The results support three main conclusions. The first is that the behaviour of the bulk soil is most sensitive to the percentage occupied by the finest soil fraction since it is the finest fraction that is most sensitive to hydrophobicity. The second is that the impacts on water infiltration and soil erodibility must be considered separately: it appears that changes in hydraulic conductivity are more significant than soil erodibility for the medium and coarse fractions. Finally, the usual indices of soil erodibility used in most soil erosion models are not appropriate for post-fire hydrophobic soils and new indices need to be developed for this specific context.