Changes of pore systems and infiltration analysis in two degraded soils after rock fragment addition

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Many soils in arid and semi-arid environments contain high amounts of rock fragments as a result of both natural soil forming processes and human activities. The amount, dimension and shape of rock fragment strongly influence soil structure development and therefore many soil processes (e.g. infiltration, water storage, solute transport, etc.).

The aim of this work was to test the effects on both infiltration process and soil pore formation following an addition of rock fragments.

The test was performed on two different soils: a clayey soil (Alfisol) and a clay loamy soil (Entisol) showing both a natural compact structure and water stagnation problems in field.

Three concentrations of 4-8mm rock fragments (15%, 25% and 35%) were added to air-dried soils and the repacked samples have been subject to nine wet/dry cycles in order to induce soil structure formation and its stabilization.

The process of infiltration was monitored at -12 cm of pressure heads imposed at the soil surface and kept constant for a certain time by a tension infiltrometer. Moreover, k(h) was determined imposing -9, -6,-3 and -1 cm at soil surface and applying a steady-state solution.

After the hydrological measurements the soil samples were resin-impregnated and images of vertical sections of the samples, acquired at 20 µm resolution, were analyzed in order to quantify the pore size distribution. This latter was calculated using the “successive opening” approach.

Image analysis showed in both soils first a decrease of porosity at 15% RF concentration and then an increase of porosity at increasing RF concentration. Such an increase respect to the control was evident starting from 25% RF concentration in the Entisol and at 35% in the Alfisol. Comparison of Pore size distributions showed in both soils an increase of larger pores in a range starting from 150µm to 300µm, more evident in the Entisol samples which showed also a reduction of porosity in the smaller pore size classes.

Overall, the results showed that only after addition of 35% of rock fragments to the Alfisols and 25% to the Entisol a physical restoration was reached.