Geophysical Research Abstracts
Vol. 12, EGU2010-6023, 2010
EGU General Assembly 2010

The role of rock fragments in soils hydric properties

Marion TETEGAN (1,2), Isabelle COUSIN (1), Alain BOUTHIER (2), and Bernard NICOULLAUD (1)

(1) INRA, UR 0272 Science du Sol, Centre de recherche d'Orléans, 2163 Avenue de la Pomme de Pin, CS 40001 Ardon 45075 Orléans Cedex 2, France (marion.tetegan@orleans.inra.fr), (2) Arvalis – Institut du Végétal, Domaine expérimental du Magneraud 17700 Saint Pierre d'Amilly, France (a.bouthier@arvalisinstitutduvegetal.fr)

Stony soils contain rock fragments, called stones, which limits some tillage operations. These soils often thin cover about 30% of the surface soils of Western Europe and 60% in Mediterranean areas. Though stony soils are widely spread and create problems to agriculture production, they have been little studied. As stones characterization is difficult, the stony phase is often neglected in the characterization of the properties of stony soils. However, some authors have demonstrated that the rock fragments could modify the physical, chemical and hydrodynamic properties of soils, and affect the behaviour and characteristics of agricultural soils. Indeed, the stony phase may participate in the water supply of crops and change the storage capacity of soil water. All these previous studies suggest some water transfers between the rock fragments and fine earth in soil. The objective of this work was to study the contribution of stony phase to the soil hydric properties by characterising the structure and the water retention capacity of rock fragments from different types of stony soils.

The stones were sampled in the cultivated horizon (0 - 30 cm) of different types of stony soils in the Central part of France. Only the pebble fraction (2 cm < stone diameter < 5 cm) was studied. Most of the stones were collected when the soil was at field capacity. The pebbles were sampled in soils developed over sedimentary rocks and were of the following types: gaize, chalk, chert, flint, and limestone.

The structure of each dry pebble was characterized by measurements of bulk density and density of solid, and by calculation of the void ratio of the sample. The porosity, but also bulk density and void ratio varied according to the type of stone, and within a single type of stone, and especially for the limestones.

The hydric properties were determined by measurements of gravimetric water content when the pebbles were at saturation or after they were equilibrated at -100 hPa and -15000 hPa in pressure plates during seven days. Water content measurements showed that all types of studied pebbles can retain water, and the saturated water content can reach more than 60% for gaize. Two results were remarkable:
(i) For the different materials studied here, a simple relationship exists between the humidity of pebbles at -100 hPa and at field capacity. Whatever the type of pebble, the water content at field capacity was very close to the water content at -100 hPa (Student test with r =0.99, P < 0.00001 and = 0.05).
(ii) The water content at wilting point was, on average, equal either to half or three quarters of the water content at field capacity, depending on the pebble type. These relationships were validated statistically by a Student test. From these two results, we derived a simple and useful pedotransfer function to calculate the Available Water Content (AWC) in pebbles contained in stony soils:
$AWC = W(-100) - W(-15000) \approx \ W(fc)$
where W(-100) represents the water content at -100 hPa, W(-15000) represents the water content at -15000 hPa, W(fc) represents the water content at field capacity and is a parameter depending of the type of stone.

This pedotransfer function has been validated over a large range of types of stones in sedimentary rocks. It is robust and uses a very simple measurement: the water content at field capacity. The next step would consist in determining pedotransfer functions in the fine earth to characterize its contribution to the Available Water Content. In the future, these pedotransfer functions will be used to map the Available Water Content of stony soils over large areas.