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Soil surface crusts as a major indicator of their hydro-physical potentiality

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The knowledge of the surface state of natural and cultivated landscapes is very important for their appropriation by local populations and the sustainability of all strategies contributing to the alimentary safety. The surface state is a physical and biological factor discriminating and essential of the degradation risks of ecosystems submitted to anthropogenic practices and climatic change. This surface state open or close conditions the soil behaviour and their hydrological functioning. The occurrence of physical and/or microbiological crusts that is the principal factor of closing or sustainability of the medium is a good indicator of the soil degradation in arid to semi-humid area. Despite the importance of their actions, the role of soil crusts is relatively not well understood principally because of their small size; the physical microhorizons and the mycrophytes are seldom visible but to the microscope. The role of these crusts on the hydrological functioning of ecosystems is inverse; the microbiological crusts contribute to the soil stability against the climatic erosion, favour the infiltration of water whereas the physical crusts have a negative effect on the infiltration and favours the run-off and the erosion, at different scales. At the scale of the slope as at the scale of the field a fraction of the run-off called hydrological report can be used a a naturel irrigation, complementary and simultaneously to the rain that generated as a function of topographical and micromorphological conditions with a complementary transfer of fertility". Thus it has a pedo-agricultural key-role.

The study of the crusts was undertaken on soils along the Sy-Daria river (Kazakhstan) for 800 km, integrating a large variety of soils under a large climatic range (stepic to desertic). The study was on the micro-pore analysis with SEM and optical microscopy.

Results show a large variability for the crusts correlated to their porosity. The knowledge of the nature of the pores, of their size, distribution and spatial repartition can predict their behaviour and hydrological functioning. In fact the hydrological debit that goes across these crusts is proportional to the square of the diameters of the pores (Poiselle's law). However the different predictive values need to be verified by in situ infiltration experiments but also by a complementary study on the poral variability of all the samples analysed.

The knowledge of the hydrological functioning of crusts should give researchers, agricultural managers and peasants the keys to understand the hydrological (dys)functioning of ecosystems and their fragility at different scales, from the aggregate to the watershed. This understanding of the effects of crusts on the infiltration but also on the hydrological report and the processes controlling its genesis at the scale of the field and the watershed is necessary as far a sustainable development is foreseen.