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The stability and the hydrological behavior of biological soil crusts is significantly affected by the complex nature of their polysaccharidic matrix

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Biological crusts (BSCs) are complex microbial associations constituted by cells and microbial filaments embedded in a polysaccharidic matrix (EPS) that binds them together and with soil particles. EPSs of BSCs play a key role in structuring the soil and in affecting the hydrological processes taking place at the topsoil in desert environments. Recently, the amphiphilic nature of the EPSs, due to the contemporaneous presence in the macromolecules of hydrophilic and hydrophobic constituents, was put in relation with their capability to contribute to the structuring of the soil particles in BSCs and to hydrological behavior of the crusts. Indeed, in the EPSs the hydrophobicity due to the non-polar constituents (i.e. deoxysugars, ester-linked fatty acids, non polar aminoacids) was associated with the adhesion of the microbial cells to solid surfaces and to the clogging of micropores in the crusts. On the other hand, the hydrophilic constituents of the EPSs (i.e. acidic sugars, ketal-linked pyruvic acid, sulphate groups etc) were suggested to determine the final water content and distribution in the soil. The presence of BSCs facilitates the uptake of moisture from the atmosphere and at the same time contributes to enriching the soils with organic matter.
In this lecture, the role of the EPSs in affecting the hydrological behavior of BSCs will be discussed by comparing the results obtained with natural and artificially induced BSCs also in relation with the texture of the soils.
Furthermore, the contribution to the structuring of the soils of the polysaccharidic matrix of the crusts will be discussed moving from the different characteristics of two operationally-defined EPS fractions, the colloidal (C-EPS) and the EDTA extractable (tightly bound, TB-EPS) fractions. In BSCs, C-EPSs are loosely bound to cells and sediments while TB-EPSs are tightly bound to the crustal biotic and abiotic constituents of the crusts. The results obtained in a recent study suggest that the colloidal fraction of the EPSs, which is more dispersed in the soil, is more easily degradable by the microflora residing in the crusts, while the EPS fraction tightly bound to the soil particles, which is characterized by a high molecular weight, plays a key role in giving a structural stability to the BSCs and in affecting the hydrological behavior of the soil covered by the crusts.