



Variability of physicochemical and mineralogical characteristics of biological soil crusts at local scale in the Sahelian zone of western Niger

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Biological soil crusts (BSC) are organo-mineral complexes resulting from the colonisation of soil surface by living microorganisms, mainly cyanobacteria. Their form, structure and composition vary depending on characteristics related to soils, biological composition and external factors (climate conditions and land uses). This study focussed on the influence of soil characteristics and human activities on BSC properties.

BSC samples from Banizoumbou (Niger) taken on protected (ungrazed) and opened (grazed) fallow lands were analysed. BSC characteristics were investigated by using chemical and mineralogical techniques, microscopic and image analysis approach as well as measurements of chlorophyll a content. Hydrophobicity measurements were also performed by the water drop penetration time method.

On the basis of their colour, two types of crusts have been identified : black BSC, which occur in protected and unprotected fallow, and red BSC, which only occur in depression zones of the protected fallow. The black crusts are dominated by quartz grains trapped in the network of the filaments of Cyanobacteria. A sandy texture and a reverse grading of mineral particles are typical of physical soil crusts called sieving crusts. The dark surface coloration of the BSC is related to the high density of filamentous Cyanobacteria. Black crusts samples from protected fallow exhibit high biomass related to high cover, whereas samples from grazed fallow lands showed low biomass related to low surface cover. In both cases, hydrophobicity measurements revealed that these BSC are wettable to slightly water repellent. However, higher values of hydrophobicity were observed on ungrazed samples compared to their grazed counterpart. This variability is likely due to the difference of cover between the two types of samples. This type of BSC corresponds to a later successional stage than the red-coloured BSC. The red BSC has a loamy-sandy texture and a normal grading typical of physical soil crusts called depositional crusts. Its mineralogy differs from the black crusts by its higher proportions of clay minerals and iron oxides (higher amounts of Al_2O_3 and Fe_2O_3). A vertical succession of BSC leads to higher content of organic carbon. The trace elements contents are also higher in this type of crust. The red colour is related to the low surface cover by Cyanobacteria. High values of hydrophobicity were measured for the red crusts, which are slightly to strongly water repellent.

Compared to the underlying soil horizons, the two types of BSC differ granulometrically (higher proportions of clay and loam), mineralogically and chemically (lower SiO_2 content and higher Al_2O_3 , Fe_2O_3 , organic carbon and trace elements contents). These results will contribute to the understanding of water dynamics at the surface of soil in the Sahelian region of Niger. They will also contribute in understanding the potential ecological roles and the spatial extent of BSC in Sahelian environment.