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Biological soil crusts (BSC) in the Sahelian zone. Can they impact soil C and N cycles?

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Biological soil crusts (BSC) are key component of arid and semiarid ecosystems due to their ability to incorporate C and N from atmosphere to soil. However, while BSC characteristics and impact on water cycle or N fixation fluxes in Sahelian zone were studied, the turnover of the fixed C and N in soils was not studied yet. The aim of this study is to assess the quantitative impact of BSC on C and N cycles through the contribution of both autotrophic and heterotrophic microorganisms. Our research is also based on the distinction between the impact of the abiotic part (underlying physical crust) and that of the biotic part of BSC (microbial components).

Biological crust and soils were sampled (up to 5 cm depth) in February 2009 at two locations according a climatic gradient (500 and 700 mm/year) in Western Niger. The samples were characterised before incubation for their C and N contents, particle size, C biomass, mineral N, chlorophyll a content and sugar monomers contents. The microbial diversity of BSC was also determined. C and N fluxes of fixation and mineralization were measured by incubating BSC at 28 ˚C in dark and light conditions with adapted moisture.

Higher C and N content and C biomass were found in superficial crust samples compared to the underlying soil samples. Values obtained on BSC for C ranged from 6.88 to 15.74 g.kg^{-1} vs 1.10 to 4.14 g.kg^{-1} within soils. We demonstrated that C fixed under light conditions by autotrophic biomass from BSC is either assimilated or accumulated under a polysaccharide form, with C fixation fluxes values ranging from 7.41 to 24.65 μgC.m^{-2}.s^{-1} in average. These polysaccharides are partly mineralized with a related rate comprised between 2.95 and 5.83 μgC.m^{-2}.s^{-1}. Therefore, the net C balance is positive, contrary to net N balance. Indeed, N fixation fluxes measured with an isotopic method, ranged from 1.32.10^{-3} to 8.47.10^{-2} mgN.m^{-2}.h^{-1}, whereas mineralization fluxes were from 0.47 to 1.01 mgN.m^{-2}.h^{-1}. Carbon cycle was related with the presence of *Proteobacteria* and *Actinobacteria* for the fixation part and rather of *Chloroflexi* for the mineralization part. The distribution of both of these species was correlated with BSC fine particles content. Interestingly, the distribution of *Cyanobacteria*, the major specie encountered within BSC (45.3 to 70.9 %) was not related either to C or N fluxes.