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Molecular and chemical features of the excreted extracellular polysaccharides in Induced Biological Soil Crusts of different ages

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Biological Soil Crusts (BSCs) are complex microbial associations widely distributed in arid and semiarid environments. These microbial associations have recently been acknowledged as important in restoration ecology (Bowker 2007). The primary colonization of cyanobacteria and other crust organisms after events such as fire or cessation of plowing is considered critical for later vascular plant establishment, due to the control of seed germination and due to the complex pathways that BSCs are capable to establish between plants and crust organisms and exudates (Rossi et al. 2013). In a ten year study carried out in the hyper-arid region of Inner Mongolia (China), introduction of man - made BSCs (induced BSCs, IBSCs) proved to be effective in producing a shift of the ecosystem state from high abiotic to low abiotic stress, evidenced by an increase in photothrophic abundance and subshrub cover.

The prerequisite for an efficient exploitation of crust organisms as soil colonizers is their capability to secrete large amount of exopolysaccharides (EPS) which are important, among the reasons, as they lead to soil and BSC stabilization and represent a noticeable source of C that can be respired by the crustal community. By these means, a deep chemical and physiological knowledge concerning these exudates is required. Notwithstanding the large amount of literature available, recently thoroughly reviewed by Mager and Thomas (2011), the chemical characteristics of EPS from BSCs, and in particular from IBSCs, have not been investigated yet.

We analyzed the monosaccharidic composition and the molecular weight distribution of two EPS fractions, the more soluble fraction and the fraction more tightly bound to cells, extracted from IBSCs collected in the Inner Mongolian desert, inoculated in different years (namely 4, 6 and 8 years before the sampling), thus characterized by different developmental stages. We thereafter investigated the degradation processes involving EPS, assessing the activity of two key enzymes for sugar degradation: dehydrogenase and sucrase.

The results obtained demonstrated a high complexity in terms of monosaccharidic composition and molecular weight, the latter resulting differently distributed between the two fractions. Enzymatic activity resulted mainly directed to the more soluble, low - molecular weight carbohydrates.

The data presented represent a first study of the biochemical processes involving carbon from EPS released by IBSCs on bare substrates after the colonization of soils by the inoculated cyanobacteria.

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