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Identifying key soil cyanobacteria easy to isolate and culture for arid soil restoration

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Drylands represent an important fraction of the Earth land's surface. Low cover of vascular plants characterizes these regions, and the large open areas among plants are often colonized by cyanobacteria, mosses, lichens, algae, bryophytes, bacteria and fungi, known as biocrusts. Because these communities are on or within the soil surface, they contribute to improve physicochemical properties of the uppermost soil layers and have important effects on soil fertility and stability, so they could play an important role on soil restoration. Cyanobacteria appear to be a cross component of biocrusts and they have been demonstrated to enhance water availability, soil fertility (fixing atmospheric C and N), and soil aggregation (thanks to their filamentous morphology and the exopolysaccharides they excrete), and significantly reduce water and wind erosion. Besides, they are able to tolerate high temperatures and UV radiation. All these features convert cyanobacteria in pioneer organisms capable of colonizing degraded soils and may be crucial in facilitating the succession of more developed organisms such as vascular plants. Therefore, the use of native cyanobacteria, already adapted to site environmental conditions, could guarantee a successful restoration approach of degraded soils. However, previous to their application for soil restoration, the most representative species inhabiting these soils should be identified. The objective of this study was to identify (morphologically and genetically) and isolate representative native cyanobacteria species from arid soils in SE Spain, characterized for being easily isolated and cultured with the aim of using them to inoculate degraded arid soil.

We selected two study areas in Almería, SE Spain, where biocrust cover most of the open spaces between plants: El Cautivo experimental site located in the Tabernas desert and a limestone quarry located at the southeastern edge of the Gádor massif. The first site is characterized by scarcely developed soils with low thickness, poor structure and low organic matter content, while soils in the second site present high degradation due to human activities. Cyanobacterial biocrust at different developmental stages were collected and maintained in the laboratory under dry and dark conditions until they were processed. Different culture media, with and without N, were used to isolate single trichomes, in order to have representatives of N fixing and non-fixing cyanobacteria. The isolated strains were morphological and genetically characterized by sequencing the 16S rRNA gene and phylogenetic analyses.

Results from cultures of several soil samples with different media show that the most representative soil cyanobacteria genera in these areas and easiest to maintain under laboratory conditions were: *Scytonema*, *Tolypothrix*, *Leptolyngbya* and *Trichocoleus* from the El Cautivo experimental site; and *Nostoc*, *Tolypothrix* and *Leptolyngbya* from the limestone quarry.

In this study, we present a description of some of the cyanobacteria colonizing biocrust in these area, which are easy to be isolated and cultured under laboratory conditions, as a previous step to design a restoration method for their inoculation on degraded soils.