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Cyanobacteria pelletization: a biotechnological tool to restore arid degraded soils

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The role of cyanobacteria from soil biocrusts in re-establishing soil functionality of degraded land is gaining interest in recent years because of their critical role in enhancing soil fertility and preventing erosion. In order to fully exploit this biotechnological tool in large-scale restoration, the development of approaches that facilitates effective cyanobacterial application must be explored in order to face with harsh abiotic conditions. In this study, we propose an innovative technology to address these challenges by incorporating cyanobacteria cultures within extruded pellets. Three soil native cyanobacteria from two representative N-fixing genera (Nostoc and Scytonema) and a non-heterocystous filamentous genus (Leptolyngbya) were collected from the Pilbara region (north-west Western Australia), isolated, and cultured in BG11 medium (1). Fresh cultures of each strain alone and an equal mixed of them were added into a substrate composed of commercial bentonite powder and sand (1:10 weight ratio). The composed solution was extruded through a jerky gun with an extruder nozzle into pellets (1 cm diameter x 2 cm length) and dried at 30°C for 24h. Then, in a multifactorial microcosms experiment under laboratory conditions, we evaluated the survival and establishment of the cyanobacteria pellets over three soil substrates : a mine waste from an active mine site in the Pilbara region, a degraded soil from the Cobar Peneplain (New South Wales), and a soil from the Simpson Strzelecki Dunefields (South Australia). Chlorophyll a, soil spectral response and cyanobacteria coverage were periodically measured as a surrogate of cyanobacterial establishment, whereas soils exopolysaccharides and soil micro-aggregates were measured in order to assess biocrust influence in soil aggregation (2). Preliminary results showed that pellets dissolved completely and colonize almost the entire Petri dish surface in all treatments. Furthermore, Chlorophyll a maintained constant on inoculated samples during the study period, suggesting that cyanobacteria survived the pelleting process. Overall, our results showed that cyanobacteria can be successfully incorporated into extruded pellets, and quickly colonize and modify properties of degraded soil substrates. This technology is ready for further testing and refining through field trials, opening a wide range of opportunities to face with large scale restoration programs.

References

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