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Plant-growth promoting bacteria from extreme environments

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Chile is topographically and climatically diverse. A wide array of diverse undisturbed extreme environments are represented in the country, such that native plants are highly adapted to local conditions. We have explored the i) bacterial community structures, ii) bacterial alkaline phosphomonoesterases (APases), and iii) putative plant growth-promoting (PGP) bacteria in the rhizosphere of plants grown in representative Chilean extreme environments (Atacama Desert, Andes Mountain, Patagonia and Antarctica). Molecular approaches (DGGE, 454-pyrosequencing and qPCR) revealed the presence of Proteobacteria, Bacteroidetes, and Actinobacteria as the dominant phyla in the rhizosphere soils of native plants. The results also showed the occurrence of bacterial APase genes (phoD and phoX) in all studied soils. Differences in total and APase-harboring bacterial populations between extreme environments and between plant species were also observed. In general, the significant lowest bacterial diversities, APase gene abundances, and APase activities were observed in soils from Atacama Desert. The APase gene abundances were positively correlated among them and with APase activity of soils, but negatively correlated with phosphorus (P) availability in rhizosphere soils. Finally, some culture isolates showed PGP traits (organic P hydrolyzing, 1-aminocyclopropane-1-carboxylate (ACC) deaminase activity and production of auxin) and their inoculation stimulated the growth of wheat plantlets under differing growth conditions, soil type and water shortage. Further studies are needed to determine which environmental factors regulate the structures of rhizobacterial communities, and how (or if) specific bacterial groups may contribute to the growth and survival of native plants in each extreme environment. Our studies also evidence possible applications of bacteria from extreme environments to improve wheat growth in soils under water shortage conditions by adverse climate events.