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Inés E. García de Salamone & Fabricio Darío Cassán
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Nitragin
El número uno en inoculantes y promotores de crecimiento.

Phytostabilization of mine tailings aided by plant growth-promoting bacteria

de-Bashan, Luz E.[1,2]; Hernandez, Juan Pablo[1,2]; Moreno, Manuel[1] y Bashan, Yoav [1,2]

1 Grupo de Microbiología Ambiental, Centro de Investigaciones Biológicas del Noroeste (CIBNOR). Mar Bermejo 195. Colonia Playa Palo de Santa Rita, C.P. 23090. La Paz, B.C.S. México
2 The Bashan Foundation, Corvallis, OR, USA

In most deserts around he world, large mounds of mine tailings, the main waste product of mineral ore processing of abandoned and productive mines, are potentially a health hazard to nearby urban populations and the well being of the environment in the form of wind-blown dust and ground water sources. This happens because tailings, lacking plant cover and soil structure, easily degrade by wind and rain action and serve as a continuous source of metal pollution. Phytostabilization, using native plants has been proposed as an economic strategy to reduce these hazards. The phytostabilization involves creation of a plant cover on the tailings that is sufficient to prevent erosion. A major challenge is that some of these tailings cannot serve, in their natural state, as growth substrate for most plant species because of metal toxicity, low pH, lack of essential minerals, lack of clay and organic matter to retain water, lack of soil structure, lack of a seed bank of nearby native plants, or some combination of these environmental parameters. Thus, tailings can remain devoid of plants for decades or have only a slight plant cover. A partial solution and an upgrade of this inhospitable substrate to a «soil-like» status can be accomplished by adding large quantities of compost, biosolids, and irrigation. The drawback of the compost-water strategy is that applying large quantities of compost is often not economically feasible because of the extensive area of tailings and the remoteness of the sites. Furthermore, water and irrigation facilities are largely absent in deserts, especially at long-abandoned mines. Inoculation with plant growth-promoting bacteria (PGPB) is proposed to aid in establishment of plants on tailings at reduced compost concentrations.

Four plant growth-promoting bacteria (PGPB; *Bacillus pumilus* ES4 and RIZO1, and *Azospirillum brasilense* Cd and Sp6) were tested in controlled greenhouse experiments for their ability to enhance plant growth and development of the native Sonoran Desert shrub quailbush (*Atriplex lentiformis*) and the tree species yellow palo

verde (*Parkinsonia microphylla*) and mesquite amargo (*Prosopis articulata*) and for their effect on the native bacterial community in three types of tailings: i) moderately acidic, high-metal content, ii) neutral, low metal content natural tailings and, iii) in tailings from a phosphate mine. Inoculation of quailbush with all four PGPB significantly enhanced plant growth parameters, such as germination, root length, dry weight of shoots and roots, and root/shoot ratio in both types of tailings. In phosphate mine tailings only mesquite amargo responded positively to inoculation. The effect of inoculation on the indigenous bacterial community by the most successful PGPB *B. pumilus* ES4 and *A. brasilense* Sp6 were evaluated by denaturating gradient gel electrophoresis (PCR-DGGE) fingerprinting of 16S rRNA PCR amplicons and by excision and sequencing of the appropriate DGGE band. Root colonization was followed by specific fluorescent *in situ* hybridization (FISH). Inoculation with these strains significantly changed the bacterial community over a period of 60 days. FISH analysis showed that the preferred site of colonization was the root tips and root elongation area.

These data indicate that in an extremely stressed environment such as mine tailings of arid zones, an inoculated PGPB can not only persist and stimulate plant growth, but can directly or indirectly influence rhizobacterial community development and that inoculation of native perennial plants with PGPB can be used for developing technologies for phytostabilizing mine tailings.