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Assessment of the use of bacterial inoculants for improving the agromining potential of Ni-hyperaccumulating plant species at field-scale

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The synergistic activity between plants and microorganisms may contribute to the implementation of soil management strategies in natural metal-enriched soils. Inoculation of plants with plant growth-promoting bacteria (PGPB) can induce beneficial effects on plant growth, health and resistance to stress, as well as increasing nutrient availability and changing metal solubility in soil. The present study aimed to assess the potential use of PGPB for improving the establishment and yield of the Ni-hyperaccumulating Mediterranean species *Alyssum murale* for agromining purposes at field scale. Experimental plots of 4 m^2 were established in an ultramafic outcrop of Santiso (NW Spain) and seedlings of previously inoculated two-month-old *A. murale* were transplanted (4 plants m^{-2}) in three replicate plots. The inoculation treatments included: (i) non-inoculated plants (NI); (ii) Arthrobacter sp. strain LA44; (iii) *Arthrobacter* sp. strain SBA82; and (iv) *Variovorax paradoxus* strain AB30 all originally isolated from rhizosphere of Ni hyperaccumulating plant species). After four months, soil pH and extractable-Ni concentrations were not modified by plants, but inoculated plants (especially LA44 and SBA82 strains) increased the soil CEC and water-soluble organic C content. The composition of soil bacterial communities of LA44- and SBA82-soils was like that of untreated soils, but the structure of AB30-soils was different to other soils. LA44 and SBA82 strains increased plant coverage and reduced the levels of some antioxidant enzymes activities compared to NI-plants (CAT and SOD). LA44 strain also enhanced aerial-biomass production of *A. murale*, obtaining a productivity 5-fold higher than NI-plants. All plants had similar Ni concentrations in their shoots (3.7-4.1 g kg^{-1}), however the phytoextracted Ni per plant and Ni yield was significantly increased by LA44 and SBA82 strains. Therefore, the inoculation of *A. murale* with LA44 and SBA82 strains improved the agromining success without modifying the structure of soil bacterial communities, and shows the potential of PGPBs in agromining systems.

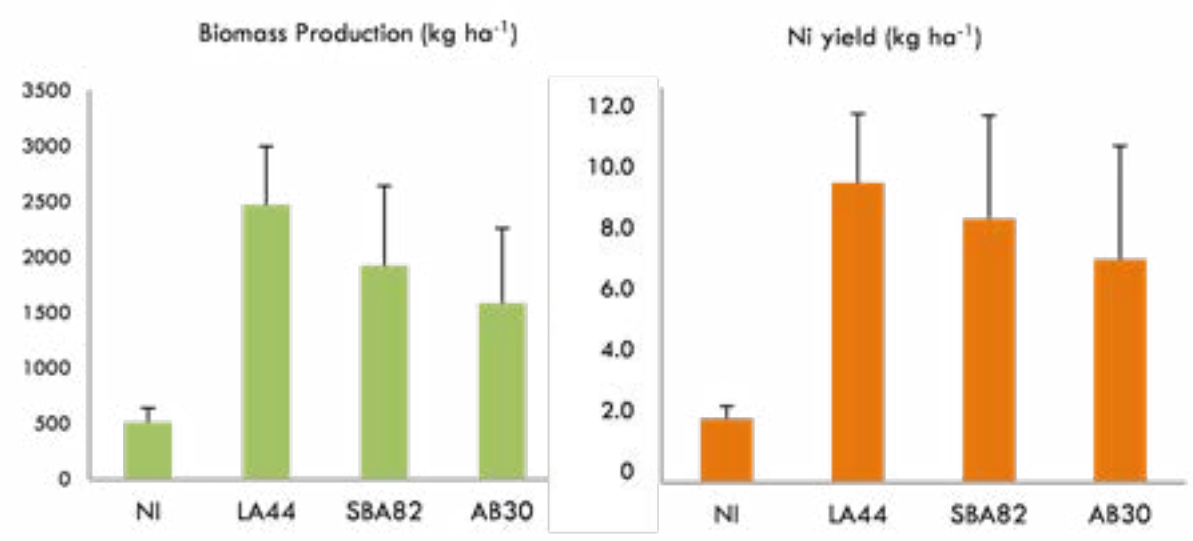

Figure 1.

Aerial biomass production and Ni yield of A. murale after four months of growth at field.

Recent Publications:

1. T Pardo, M P Bernal and R Clemente (2017) The use of olive mill waste to promote phytoremediation. In: Olive Mill Waste: Recent Advances for Sustainable Management. Charis M Galanakis (Ed.) Elsevier S&T Books, Academic Press, Oxford 183 – 204.
2. Pardo T, Bernal M P and Clemente R (2017) Phytostabilisation of severely contaminated mine tailings using halophyte species and field addition of organic and inorganic amendments. Chemosphere 178:556-564.
3. Pardo T, Martínez Fernandez D, de la Fuente C, Clemente R, Komarek M and Bernal M P (2016) Maghemite nanoparticles and ferrous sulfate for the stimulation of iron plaque formation and arsenic immobilization in Phragmites australis. Environmental Pollution 219:296 – 304.
4. Pardo T, Bes C, Bernal M P and Clemente R (2016) Alleviation of environmental risks associated to severely contaminated mine tailings using amendments: Modelling of trace elements speciation, solubility and plant accumulation. Environmental Toxicology and Chemistry 35(11) 2874-2884.
5. Kidd P, Barceló J, Bernal M P, Navari-Izzo F, Poschenrieder C, Shilev S, Clemente R and Monterroso C (2009) Trace element behaviour at the root–soil interface: Implications in phytoremediation. Environmental and Experimental Botany 67:243–259.

Biography

Tania Pardo is a young researcher and specialized in the remediation of trace element-contaminated soils through phytotechnologies. She obtained her PhD degree in 2013. Her main research activities have been focused on the study of the suitability of different organic composts, pig slurry, digestate, biochar and inorganic (Fe oxides, nano-oxides, lime, red mud derivatives, etc.) amendments, and selection of plants species, for the phytoremediation of trace element-contaminated soils. Particular emphasis has been on the study of the treatments effects on the availability and speciation of trace elements in soil; the uptake and translocation of these elements in plant, and; the soil quality and associated environmental risks. Currently, her research is focused on the optimization of cropping systems of Mediterranean Ni-hyperaccumulating plant species to produce Ni-rich biomass for phytomining purposes, and the combined use of soil amendments and microbial inoculants for the phytoremediation of Cu contaminated mine soils.

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