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Influence of Plant Growth Promoting Bacteria in Helianthus annuus (sunflower) grown in Zn and Cd contaminated soils – effects on biomass production, growth parameters and metal accumulation

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Abstract

Phytoremediation - the use of plants to remove or immobilise contaminants - may offer a low cost method for the remediation of contaminated soil. *Helianthus annuus*, one of the most important crops worldwide, is a plant not only with food and energy value, but also with phytoremediation potential - sunflower is a documented metal accumulator and its growth on contaminated land is thus possible. Recent studies also show that sunflower seeds of plants grown in contaminated soils do not have significant levels of metals (when compared to control specimens) and their application in biodiesel production is a possibility.
The obtainment of further economic value through the valorisation of this plant species should be taken into account. Therefore the need to maximize biomass production, allowing not only to revert degraded soil, but also the further use of the biomass produced for other activities from which economical gains can be achieved, such as energy production. The use of plant growth promoting rhizobacteria (PGPR) may constitute a biological alternative to increase crop yield. The enhancement of plant growth using PGPR is documented and more recently these organisms have been used to reduce plant stress associated with phytoremediation of contaminated soils.
A greenhouse experiment was carried out to assess the influence of the inoculation with selected PGPR on the growth, biomass production and metal accumulation by *Helianthus annuus* in Zn (0, 100, 500 and 1000 mg Zn kg^{-1} spoil) and Cd (0, 10, 20, 30 mg Cd kg^{-1} soil) contaminated soils. Bacterial isolates used in this work have previously been characterized as having plant growth promotion abilities and identified as ECP37 and 1C2, corresponding to strains within the genera *Chryseobacterium humi* (ECP37) and *Ralstonia* (1C2).
Zn and Cd accumulation in plant tissues and plant fresh and dry biomass were determined, as well as N and P plant uptake, in order to conclude on the influence of the bacterial inoculation and degree of metal exposition on plant development parameters and remediation capacities. Microbial dynamics were followed by using molecular tools such as denaturated gradient gel electrophoresis (DGGE).
This work will contribute to the research concerning the importance of the synergy between plant species and soil microorganisms as a valuable biotechnological resource of great use on the re-vegetation and achievement of economical value from under-exploited soils, namely those contaminated with heavy metals.