

Lotus/Rhizobium symbiosis in contaminated soils. Importance and use for bioremediation

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The identification and characterization of contaminated areas are increasing all over the world and the pollution due to heavy metals and to arsenic had received a great attention within the last years. The main sources of heavy metals pollution are mining, industries and application of metal-containing pesticides, fertilizers and sewage sludge. Heavy metals such as Zn, Cu, Ni and Cr are essential or beneficial micronutrients for plants, animals and microorganisms, whereas others such as Cd, Hg and Pb have no known biological and/or physiological functions, being toxic even in small concentrations (Castro and Ferreira, 2006).

In polluted soils biodiversity of plants could decrease drastically and in some contaminated areas, the legume family is one of the most represented. Legumes and their associated rhizobial bacteria are important components of the biogeochemical cycles in agriculture and natural ecosystems. The fixation of atmospheric N₂ by the legume-*Rhizobium* symbiosis is a central element of the N-cycle. Also in polluted soils heavy metals have an important impact on diversity of the resident microflora, which seems to be much less variable, being some microorganisms more sensitive to heavy metals than plants growing on the same soil (Pereira *et al.*, 2007).

Compared to other legumes, *Lotus* species have a higher potential for adaptability to abiotic stresses, surviving often in rather extreme conditions.

For this work we use native and apparently well adapted to heavy metals and arsenic leguminous plants of *Lotus uliginosus* Sch. (= *L. pedunculatus* Cav.) growing in soils particularly affected by the release of liquid effluents from fertilizer and chemical industries for nearly 50 years. The objective of this research was to study rhizobial population isolated from these plants in reference to genetic diversity, efficiency to fix nitrogen and host specificity nodulation and also to assess the levels of tolerance to heavy metals and As. The presence of heavy metals resistance genes was also evaluated.

The results obtained showed that *Rhizobium* isolates from polluted soil are diverse when analyzed by ERIC-PCR. It was also demonstrated the presence of an effective rhizobial population for *L. uliginosus* in these polluted soils. The experiments used to study arsenic tolerance showed the existence of few numbers of isolates which tolerate the highest

concentration tested (i.e. 20 mg ml⁻¹). The search for arsenic resistance genes enable us to admit that some *Rhizobium* isolates from contaminated soils have the genetic information that allows them to survive in these harsh conditions (Sá-Pereira *et al.*, 2007).

The main impact of this study is the possible use of autochthones legume plants and their microsymbionts, such as the symbiosis *Bradyrhizobium sp./Lotus uliginosus*, for the bioremediation of contaminated soils helping his fertilization, for providing N to soils.

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