Phytosystems for the treatment of wastewater and soil

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At Escola Superior de Biotecnologia, we are conducting studies on the ability of several plants collected from polluted sites or effluent discharge spots to remove contaminants from water and soil. Under that scope, phytosystems are being used at pilot-scale for the treatment of wastewater and soil, while fundamental studies for elucidating the underlying mechanisms are being conducted in the laboratory.

We have screened plants collected from soils contaminated with organic and inorganic pollutants, namely *Phragmites australis*, *Solanum nigrum*, *Rubus ulmifolius* and *Convolvulus* sp., for the uptake of zinc, arsenic, mercury and lead. We are also conducting studies on the role of Arbuscular Mycorrhizal Fungi (AMF) in phytoremediation of heavy metals (HM), aiming at assessing the effect of different isolates of AMF (obtained from HM contaminated soils) associated with *Solanum nigrum* on Zn uptake.

Two case studies of field application will be presented.
i) Phytosystems are being used to treat effluents derived from industrial activities, mainly from tannery sector. The effluent from the leather industry has a high organic load and, in most cases, chromium is present. The range of plants analysed for their potential to establish wastewater treatment systems included *Typha latifolia, Phragmites australis, Iris pseudacorus*, *Canna indica* and *Stenophrum secundatum.* They were all present at effluent discharge spots. Five pilot-scale units, which differ in respect to the substrate and the plant species, have been established. The main criteria for the design and sizing of the pilot-scale units were the organic matter removal. The pilot-scale units are operating since February 2003. During this time the systems operated with different hydraulic loadings. For an organic loading rate of ca.500 $KgCODha^{-1}d^{-1}$, removal efficiencies of up to 70% were obtained for the systems with *Typha latifolia* and *Phragmites australis*, and up to 60% for *Iris psedacorus*. For ca.1300 $KgCODha^{-1}d^{-1}$ and 2900 $KgCODha^{-1}d^{-1}$, it was possible to accomplish removal efficiencies up to 75% and 50%, respectively, for *Typha latifolia, Phragmites australis* and *Iris psedacorus.* The pilots with *Canna indica* and *Stenophrum secundatum* were left behind because of the difficulties of adaptation.
ii) We have been conducting a field trial for the phytorestoration of highly alkaline anthropogenic sediments, resulting from industrial activities. The study involved the use of trees, namely *Alnus glutinosa, Acer negundo e Salix atrocinerea*, inoculated with a mixture of stress adapted mycorrhizal fungi. Plant inoculation has proven to be beneficial for reducing mortality at early stages of transplanting.

Acknowledgements
This work was supported by Fundação para a Ciência e Tecnologia, Projecto-POCTI/CTA/39111/01, and research grants of R. Oliveira (SFRH/BD/1464/2000), A. Marques (SFRH/BD/7030/2001) and C.Calheiros (SFRH/BDE/15507/2004)