

Investigating the Effect of Plant Root Exudates and of Saponin on Polycyclic Aromatic Hydrocarbons Solubilization in Brownfield Contaminated Soils

Authors : Marie Davin, Marie-Laure Fauconnier, Gilles Colinet

Abstract : In Wallonia, there are 6,000 estimated brownfields (rising to over 3.5 million in Europe) that require remediation. Polycyclic Aromatic Hydrocarbons (PAHs) are a class of recalcitrant carcinogenic/mutagenic organic compounds of major concern as they accumulate in the environment and represent 17% of all encountered pollutants. As an alternative to environmentally aggressive, expensive and often disruptive soil remediation strategies, a lot of research has been directed to developing techniques targeting organic pollutants. The following experiment, based on the observation that PAHs soil content decreases in the presence of plants, aimed at improving our understanding of the underlying mechanisms involved in phytoremediation. It focusses on plant root exudates and whether they improve PAHs solubilization, which would make them more available for bioremediation by soil microorganisms. The effect of saponin, a natural surfactant found in some plant roots such as members of the Fabaceae family, on PAHs solubilization was also investigated as part of the implementation of the experimental protocol. The experiments were conducted on soil collected from a brownfield in Saint-Ghislain (Belgium) and presenting weathered PAHs contamination. Samples of soil were extracted with different solutions containing either plant root exudates or commercial saponin. Extracted PAHs were determined in the different aqueous solutions using High-Performance Liquid Chromatography and Fluorimetric Detection (HPLC-FLD). Both root exudates of alfalfa (*Medicago sativa* L.) or red clover (*Trifolium pratense* L.) and commercial saponin were tested in different concentrations. Distilled water was used as a control. First of all, results show that PAHs are more extracted using saponin solutions than distilled water and that the amounts generally rise with the saponin concentration. However, the amount of each extracted compound diminishes as its molecular weight rises. Also, it appears that passed a certain surfactant concentration, PAHs are less extracted. This suggests that saponin might be investigated as a washing agent in polluted soil remediation techniques, either for ex-situ or in-situ treatments, as an alternative to synthetic surfactants. On the other hand, preliminary results on experiments using plant root exudates also show differences in PAHs solubilization compared to the control solution. Further results will allow discussion as to whether or not there are differences according to the exudates provenance and concentrations.

Keywords : brownfield, *Medicago sativa*, phytoremediation, polycyclic aromatic hydrocarbons, root exudates, saponin, solubilization, *Trifolium pratense*

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