The use of willows in phytoremediation of PAH-contaminated soils

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Five different willow clones were compared with respect to growth and degradation of PAHs (and diesel) in contaminated soil, with and without application of additional nutrients.

The aims of this study were to reveal possible clone-specific properties among *Salix* in degradation of soil contaminants and to study the effect of nutrients present, on biodegradation of PAHs and diesel.

Aged creosote and diesel-fuel contaminated soil originating from Resecentrum, Uppsala (Central Railway Station) was collected at Hovgården Deposit Plant. Three kinds of soil were included in this study: creosote and diesel contaminated soil (undiluted); mixed soil 1:1 (diluted with non-contaminated soil) and control soil (non-contaminated). The initial total concentration in contaminated soil was 10 ppm (mg/kg) of PAHs and 1,150 ppm of aliphatic and aromatic hydrocarbons (i.e. diesel components). The *Salix* clones used were Tora, Björn, Orm, 78138 and 78112 and as nutrient additive Blomstra® fertilizer was used. During four months, no obvious difference was found between the five willow clones regarding shoot growth except that Orm grew less well in creosote and diesel contaminated soils. Root biomass increased and the Shoot/Root ratio (S/R) decreased for most clones at the higher concentrations of creosote and diesel contaminants. Degradation was almost similar for all clones although 78112 and Orm had somewhat lower PAH degradation capacities as compared to the three other.

None of the five clones, however, showed higher degradation than treatment without plants in this experimental layout. On the contrary, the presence of plants in the creosote and diesel contaminated soil, retarded the degradation of most PAHs as compared to the treatment without plants. This was probably due to interference of the root exudates with the use of diesel as carbon source for the microorganisms. The latter hydrocarbons could act not only as carbon sources but also co-substrates that are needed in the co-metabolic degradation of PAHs. In the choice between the two, many microbes probably prefer the former more easily metabolizable compounds. The degradation of PAHs in the creosote soil treatments without plants was even higher in treatments with nutrients added, especially for the high molecular weight PAHs, such as benzo(b)fluoranthene (94.7%) and benzo(a)pyrene (100%) as compared to the initial values and the control treatment. This is likely to be a result of stimulation of specific PAH degraders by the higher nutrient level.

The bacterial counts were significantly higher in both the treatment with plants and the unplanted treatment with nutrients, as compared to the initial soil and the control treatment. Eight bacterial strains with the ability to degrade phenanthrene were isolated from the undiluted creosote and diesel contaminated soil.

The value of planting *Salix* as compared to other treatments in different kinds of soils with single contaminants or a combination of several different will be further discussed.