

Bioremediation of TNT contaminated soil with fungi

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Fungal treatment methods could provide new sustainable ways to treat soil contaminated by trinitrotoluene (TNT). White-rot and litter-decomposing fungi are known to be able to degrade recalcitrant aromatic compounds, such as TNT, with their non-specific oxidizing enzymes.

We studied the capability of selected fungi to grow in contaminated soil, to produce lignin modifying enzymes and to degrade TNT in soil. We used soil originating from a military storage area and six fungal strains deposited to Fungal Biotechnology Culture Collection (FBCC) of the Department of Food and Environmental Sciences, University of Helsinki. As the original TNT concentration of soil was as high as 12 g kg⁻¹, it was too toxic for the fungi. Consequently a dilution of soil had to be made with garden waste compost. When soil was diluted with the ratio 1:20 (soil:compost) and the TNT concentration was 1000 mg kg⁻¹, four fungal species, namely *Gymnopilus luteofolius*, *Kuehneromyces mutabilis*, *Phanerochaete velutina* and *Stropharia rugosoannulata*, were able to grow well in the soil. All of these fungi produced high amounts of manganese peroxidase (MnP) enzyme in TNT contaminated soil, and the most efficient fungus, *P. velutina*, degraded 80 % of TNT in 70 days. This fungus was selected for a further pilot scale experiment.

We performed the pilot scale experiment with 285 kg of diluted TNT contaminated soil and 10 kg of fungal inoculum growing on pine bark. *P. velutina* grew well in soil and degraded 70 % of TNT in 49 days. No further degradation occurred the following 58 days of incubation. Harmful fungal metabolites formed from TNT, namely 4-amino-2,6-diaminotoluene and 2-amino-4,6-diaminotoluene, accounted for less than 0.5 % of the original TNT concentration at the end of the incubation.

Fungal remediation of TNT contaminated soils is a promising biological treatment. A possible drawback could be extremely high TNT concentrations, which requires dilution prior to the remediation process.

References

- Anasonye F. (2012) Activity of lignin-modifying enzymes in TNT and dioxin contaminated non-sterile soil. Master's Thesis, Department of Biosciences, University of Helsinki.
- Valentin L., Kluczek-Turpeinen B., Oivanen P., Hatakka A., Steffen K., Tuomela, M. (2009) Evaluation of basidiomycetous fungi for pretreatment of contaminated soil, *J. Chem. Technol. Biotechnol.* 84, 851-858.
- Winqvist E., Valentin L., Moilanen U., Leisola M., Hatakka A., Tuomela M., Steffen K.T. (2009) Development of a fungal pre-treatment process for reduction of organic matter in contaminated soil. *J. Chem. Technol. Biotechnol.* 84, 845-50.