Fungal-bacterial consortia increase degradation of the phenylurea herbicide diuron in water-unsaturated systems
Lea Ellegaard-Jensen a,b, Berith E. Knudsen a,b, Anders Johansen c, Christian N. Albers a, Jens Aamand a, & Søren Rosendahl a,b

* Department of Geochemistry, Geological Survey of Denmark and Greenland (GEUS), Øster voldgade 10, DK-1350 Copenhagen K, Denmark.
* Department of Biology, Copenhagen University, Universitetsparken 15, DK-2100 Copenhagen Ø, Denmark.
* Department of Environmental Science, Aarhus University, Frederiksbergvej 399, DK-4000, Roskilde, Denmark. *LEP@GEUS.DK

MAIN FINDINGS
- We show that fungal-bacterial consortia enhance diuron degradation in a heterogeneous environment.
- This demonstrates new possibilities for creating efficient fungal-bacterial consortia for bioremediation.

AIM
The aim of this study is twofold:
1. To construct consortia of fungi and bacteria using different combinations of five diuron degrading organisms.
2. To investigate the interactions within the consortia to elucidate the controlling mechanisms leading to enhanced degradation.

METHODS
Consortia were constructed using different combinations of five diuron degrading organisms:
- The bacterial strains: Sphingomonas sp. SRS16, Variovorax sp. SRS16 and Arthrobacter globiformis D47.
- The fungal strains: Mortierella sp. LEJ702 and Mortierella sp. LEJ703.

In the experiments, sand was spiked with 14C-diuron to measure mineralization and production of metabolites (see setup in Fig 1). Microbial interactions were investigated by molecular methods and phospholipid fatty acids (PLFA).

DIURON
The phenylurea herbicide diuron is applied for control of broad-leaved weeds. It is discovered in surface and ground-water at concentrations above the EU limit of 0.1 μg/l. Diuron has serious effects in the environment and presumably also on human health, and it is therefore on the EU Water Framework Directive’s list of priority substances. Removal of diuron from the environment is mainly due to microbial degradation. Bioremediation is therefore suggested as a possible means to remove diuron contamination in the environment.

OUR RESULTS SHOW THAT...
- The three-member consortium with LEJ702, SRS16 and D47 achieved the overall highest mineralization (Fig. 2).
- Production of diuron metabolites by this consortium was minimal (Fig. 4).
- Molecular results suggest that bacteria were transported further by LEJ702 than by LEJ703.
- Growth of the two Mortierella fungi were inhibited in the presence of the bacterium D47 – but this effect was somewhat alleviated for Mortierella sp. LEJ702 when SRS16 was also present (Fig. 5).