MYCOREMEDIATION OF POLYCHLORINATED BIPHENYLS CONTAMINATED SOIL FROM A DUMPSITE IN SOUTHERN CZECH

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INTRODUCTION

Polychlorinated biphenyls (PCBs) are stable synthetic compounds, the widespread use of which led to an extensive environmental contamination. These molecules possess teratogenic, carcinogenic and endocrine-disrupting features (Ross, 2004; Gregoraszczuk *et al*., 2013; Kojima *et al*., 2010). At present, physical treatments are the most commonly applied procedures for the removal of PCBs. Despite their effectiveness, these processes are expensive and hazardous, thus researchers have been focusing on biotreatments as a suitable alternative. Since white-rot fungi were shown to have a great bioremediation potential (Šašek *et al*., 2003; Hamman, 2004), the main aim of this work was to investigate the use of such organisms for the clean-up of an aged PCB-contaminated soil.

MATERIALS AND METHODS

Long-term PCB-contaminated soils were collected from Lhenice dumpsite (South Bohemia, Czech Republic): non-vegetative soil (or bulk soil referred to as SOIL A), vegetative soil (or topsoil referred to as SOIL B) and *Salix* rhizosphere soil (referred to as SOIL C). Bioaugmentation and biostimulation treatments were applied on three different soil samples (A, B and C). *Pleurotus ostreatu*s and *Irpex lacteus* were pre-grown on pellets and mixed with the soil (bioaugmentation), whereas, for biostimulation treatment, the soil was mixed with non-inoculated pellets. Non-amended and non-inoculated soil samples were referred to as incubation controls. The residual concentration of PCB was determined after 0, 2, 6 and 12 weeks of incubation using Accelerated Solvent Extraction and Gas Chromatography-Mass Spectrometry techniques.

RESULTS AND DISCUSSIONS

The three polluted matrices target of our study are mostly contaminated with the PCB mixtures Delor 103 and Delor 106. Therefore, the chemical characterization of the soil samples was mainly aimed at the quantification of the congeners which are known to be present in the aforementioned mixtures. The concentration of PCBs was evaluated in all soil samples. The bulk soil (soil A) was the most heavily contaminated among the three soil samples, with an overall PCB concentration of 705.95 mg Kg^{-1}, while the less contaminated sample (169.36 mg Kg^{-1}) was the rhizosphere soil (soil C). In all cases, the contamination mainly consisted of tetrachloro-biphelys (70%, 72% and 74% in soil A, B and C, respectively) and the congener n.56 (2,3,3',4'-tetrachlorobiphenyl) was the most abundant compound in all samples (17%, 21% and 22% in soil A, B and C, respectively). Interestingly, the congener n.118 (2,3',4,4',5-pentachlorobiphenyl), mainly present in Delor 106, is the most abundant among the pentachloro-biphenyls in soil A and B. This congener displays "dioxin-like" properties, referring both to its toxicity and structural features which makes it similar to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin. Concerning the mycoremediation experiment, as for the most contaminated soil (Soil A), no decrease in PCBs concentration was observed within the first 6 weeks of incubation, regardless of the treatment applied. A modest removal was obtained only in *P. ostreatus*- and *I. lacteus*-augmented microcosms after 12 weeks (18.5 and 19.3%, respectively). Concerning soil B, the PCB removal was 41.3 and 39.4% in the presence of *P. ostreatus* and *I. lacteus*, respectively, at the same time interval. Despite the comparable degradation performances of the two bioaugmented fungi, the removal of PCBs in soil B was faster with *I. lacteus* than with *P. ostreatus* within the first 2 weeks (16.9 *vs* 9.3%). On the contrary, *P. ostreatus* was better than *I. lacteus* during the further 4 weeks of incubation (30.4 *vs* 24.3%). In the rhizosphere soil (Soil C), the highest depletion of PCB (50.5%) with respect to the original contamination was achieved in *P. ostreatus*-augmented soil, while *I. lacteus* promoted a degradation of 30.3%. Regardless of the soil typology, the extent of PCB removal in biostimulation treatments was invariably lower than that achieved in bioaugmented microcosms after 12 weeks of incubation.

SUMMARY

None of the treatment under study promoted a significant degradation of PCB in the most contaminated soil (A) after 12 weeks of incubation. *P. ostreatus*-bioaugmented microcosm was able to bring about a PCB removal of 42 % and 51% in soil B and C, respectively. Pollutants degradation efficiency of *I. lacteus* was comparatively high in soil B, accounting to 40%. No significant PCB depletion was observed in biostimulation treatments with respect to incubation controls.

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