Forest litter as a factor that modifies copper solubility and ecotoxicity of soil solutions in soils contaminated with emissions from a smelter

Ściółka leśna jako czynnik modyfikujący rozpuszczalność miedzi i ekotoksyczność roztworów glebowych w glebach zanieczyszczonych emisjami hutniczymi

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Leaf-litter transformations are vital processes in forest ecosystems, that involve partial decomposition of organic matter and its further humification. Their run depends on the kind of forest stand, soil properties, biological activity, and the presence of toxic components. Among the products of litter decomposition, several compounds such as polyphenols or low molecular-weight organic acids may be present that are capable of complexing or chelating metals, in particular Cu that indicates high affinity to organic matter. In effect, Cu present in contaminated soils that were formerly remediated via metal immobilization and afforested, may get remobilized and released to soil solution. Cu occurring in soil pore water in the form of complexed species may in various ways affect soil biota, including microbes, and plants.

This communicate presents the results of laboratory incubation experiments carried out with soils polluted by the emissions from a copper smelter Legnica. The area surrounding the smelter was successfully afforested with poplar, and now the forest stands are planned to be rebuilt to fit better to habitats, with relatively high contribution of beech. The aim of the study was to assess the influence of beech litter on the solubility of copper in soils and on ecotoxicity of soil solutions. Five soils highly differing in copper concentrations were mixed with beech litter and incubated over 30 days at constant moisture (ca. 80% of water field capacity). Soil pore water was regularly acquired using MacroRhizon porous samplers and examined on Cu concentrations, pH, dissolved organic carbon DOC, as well as several other components. Based on these results, Cu speciation in soil solutions was modeled using Visual MinteQ software. Soils solutions were also examined in two ecotoxicological tests: Microtox® (based on inhibition of *Vibrio fischeri* luminescence) and Phytotoxkit (based on inhibition of *Sinapis alba* seed germination and elongation of its roots and shoots seedlings).

It was found that application of forest litter to Cu-contaminated soils caused a considerable increase of Cu concentrations in soil solutions, and organic complexes were the predominant species of dissolved Cu. An additional factor that contributed to the process of Cu release from soil solid phase was a drop in pH, apparently caused by formation of low weight organic acids – the products of litter decomposition. The toxicity of soil pore water as measured in Microtox® test increased by ten-fold on average, compared to control soils, and considerable inhibition of *Sinapis alba* roots and shoots elongation was also observed. These effects were the strongest at the beginning of experiment and decreased with prolonged time of incubation. The temporary increase of ecotoxicity should be, however, considered as an important factor in a complex assessment of related ecological risk.