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Phytotoxkit® and Ostracodtoxkit® tests for assessing the toxicity of sediment samples with high concentration of heavy metals

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To estimate the risk of contaminants, chemical methods need to be complemented with biological methods. Ecotoxicological testing may be a useful approach for assessing the toxicity as a complement to chemical analysis. The aim of this study was to evaluate the sensitivity and applicability of two bioassays representing multiple trophic levels, for the preliminary ecotoxicological screening of sediments from sites contaminated by mining activities: a chronic toxicity test with the ostracod Heterocypris incongruens and a phytotoxicity test using Lepidium sativum, Sorghum saccharatum and Sinapis alba seeds.

For this study, 30 soils samples were collected from the Sierra Minera (Murcia, SE Spain) for general analytical determinations and the total metal content (Pb, Zn, Cd and As) was determined.

The Phytotoxkit® test measures the decrease in (or the absence of) seed germination and of the growth of the young roots after 3 days of exposure of seeds of selected higher plants to a contaminated matrix compared with the controls germinated in a reference soil. The plants selected for the Phytotoxkit® microbiotest were: the monocotyl Sorghum saccharatum (Sorgho) and the dicotyls Lepidium sativum (Garden cress) and Sinapis alba (mustard) (Phytotoxkit®, 2004). The percent inhibition of seed germination (SG) and root growth inhibition (RI) for each plant were calculated.

Ostracodtoxkit® test consists of placing freshly hatched ostracod neonates in multiwell cups in 2 ml synthetic freshwater, with 300 μl sediment and 3x107 algal cells (Selenastrum capricornutum). After 6 days, incubation at 25 ºC in darkness, the mortality of test organisms was determined (Ostracodtoxkit® FTM, 2001) and growth inhibition was calculated.

Soil samples showed a mean pH value of 6.0 in water and 5.7 in KCl. The EC varied from 1.0 dS m-1 to 56.2 dS m-1, with a mean value of 17.7 dS m-1. The mean value for Pb was 0.84 mg kg-1, 10593 mg kg-1 for Zn, 23.18 mg kg-1 for Cd and 0.16 mg kg-1 for As.

As regards the phytotoxicity test, an influence on seed germination was observed. Correlation analysis between heavy metal concentration, soil characteristics and plant test results showed that growth inhibition in the plant species was negatively correlated with pH and calcium carbonate content and was positively correlated with Eh, EC and total arsenic content in soil samples. All three species chosen for this assay showed greater sensitivity to Cd than As and Pb (in that order).

Correlation analysis showed that the mortality of ostracods was positively correlated with Eh and EC and negatively correlated with pH and calcium carbonate content. As in the case of plants, the sensitivity of ostracods was greatest for Cd, followed by As and Pb.