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Problems in evaluating contamination of soils with heavy metals

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Contamination of soils by urban, agricultural or industrial waste usually implies the addition of large amounts of heavy metals. The presence of these metals at concentrations that are toxic to microorganisms may have negative effects on the functioning of the edaphic system and, more specifically on the biological and biochemical activities of the soils. The aim of the present study was therefore to find a biochemical parameter that may be used to assess heavy metal contamination of soils. For this, a laboratory experiment was carried out in which samples of the Ah horizon (0-10 cm) of an Inceptisol under scrub (pH in water, 5.03; total carbon, 9.19 %; loamy texture) were artificially contaminated with different doses of copper (50, 500 and 5000 mg kg^{-1}), zinc (150, 1500 and 15000 mg kg^{-1}), nickel (30, 300 and 3000 mg kg^{-1}) or lead (50, 250 and 500 mg kg^{-1}). To compare the different effects of each metal on the soil properties studied, the ED_{50} value (i.e. the amount of metal required to reduce the value of a certain property by half) was calculated for each.

The effect of copper was most apparent in microbial biomass carbon and urease activity. Basal respiration and phosphomonoesterase activity also decreased, but to a lesser extent. The ED_{50} values were very variable (between 630 and more than 5000 mg kg^{-1}), with the lowest ED_{50} value corresponding to soil biomass.

The effects of zinc were similar to those of copper, although the effect on the microbial biomass carbon was not as acute and the decrease in urease activity was greater. The ED_{50} values corresponding to zinc were similar for biomass, basal respiration and urease activity (5500 mg kg^{-1}), while that for phosphomonoesterase activity was much higher (10000 mg kg^{-1}).

The effects of nickel were most apparent in basal respiration and urease activity, both of which clearly decreased with increasing doses of metal, and for which the ED_{50} value was 3000 mg kg^{-1} in both cases. The microbial biomass C was only slightly affected by the highest dose of nickel.

Lead had almost no effect on the properties studied and only resulted in a slight decrease in soil respiration.

It can be concluded that basal respiration, microbial biomass C and urease activity are sensitive to contamination by copper, zinc and nickel, and that these properties can therefore be used to indicate contamination by these metals. However, the ED_{50} values of the properties under consideration were very variable, which may be problematical in assessing contamination of soils by heavy metals.