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Long-term effects of organic amendments on the total contents and fractionation of potentially toxic metals in soils

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The application of organic wastes as amendments to agricultural soils is an economically attractive waste management strategy. However, these wastes may also be a source of potentially toxic metals, and studies on the long-term effects of their application are needed in order to assess the risks associated to their application in soils. In order to assess the environmental impact of metals contamination, the total metal concentrations in soils are not enough and it is also necessary to evaluate the metals availability, which depends strongly on their specific chemical forms or ways of binding. Several sequential extraction methods have been proposed to investigate the metals partition among different fractions. As the metal fractionation is strongly dependent on the experimental procedure, the modified BCR sequential extraction method (mBCR) has been proposed by the Commission of the European Community, as the result of a standardization effort [1]. According to that method, metal ions are fractionated into four fractions: 1) exchangeable, water and acid soluble (metal in soluble species, carbonates or bound to cation exchange sites - extracted in step 1), 2) reducible (metal bound to reducible iron-manganese oxides - extracted in step 2); 3) oxidizable (bound to oxidizable organic matter and sulfides – extracted in step 3); 4) residual (strongly bound metal – extracted with aqua regia after the previous extraction steps).

The aim of the present work was to evaluate the long term effects of organic amendments on metals total contents and fractionation in soil. For that purpose, we compare the total contents of Cu, Pb, Zn and Fe, and their distribution among the above men-

tioned fractions in soil plots submitted, since 1962, to fertilization with three different types of amendment: sewage sludge, compost from household waste and mineral fertilizer (control). The soil samples have been supplied by professor Scherer, from the Institute of Agricultural Chemistry of the University of Bonn, who started a field experiment (randomized complete block design) in 1962, on a luvisol derived from loess [2]. Samples from three different plots were used as replicates for each type of amendment.

The statistical analysis of the results shows that both organic amendments increase the total content of Cu, Pb and Zn in soil relatively to soil submitted to conventional mineral fertilization (control). Besides, the organic amendments also modified the fractionation of Cu and Zn in soil. In the case of Zn, the percentage of metal in the exchangeable fraction increases significantly, suggesting a higher availability for plants and higher risk for leaching and ground water contamination.

[1] – M. Zemberyová, J. Barteková and I. Hagarová, Talanta 70(2006)973

[2] – H.W. Scherer and S.P. Sharma, Biol. Fertil. Soils 35(2002)414