PREDICT OF HEAVY METAL BIOAVAILABILITY IN SOIL BY RHIZOSPHERE-BASED METHOD

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Nowadays no method was recognized as a universally applicable approach for evaluation of bioavailability. There were various methods for bioavailability of heavy metals in soils to plants. Those methods are based on different principles: free metal ion activity model, isotope dilution exchange, gradient diffusion from thin film, correlation of metals in soil pools with metal contents in plants. In order to develop a more widely applicable method for prediction of bioavailability a rhizosphere-based method is proposed, which mimics the real-world field conditions of plant growing in soils and integrates the effects of soil-plant interactions as a whole. Wet rhizosphere soil and organic acids as an extractant were used to obtain metal fractions in soil solution pools, which were correlated with metal concentrations in plants.

In order to rationalize the rhizosphere-based method for evaluation of bioavailability of metals in soil to plants a series of study were carried out: The effects of organic acids on the uptake by plants; Wet rhizosphere soil and dry bulk soil were compared for bioavailability; The extracted soil solutions were fractionated into different colloidal fractions and a concept of a labile fraction was recommended for evaluation of bioavailability; A good correlation was obtained between the labile fraction of rare earth elements and their contents in apoplasm and symplasm of maize, etc.

The rhizosphere-based method was compared with the DTPA, EDTA, $CaCl_2$, and $NaNO_3$ extraction methods and with the first step of a three-step sequential extraction method suggested by the European Community Bureau of Reference (BCR). Simple correlation, principal component analysis and stepwise multiple regression analysis were used for the

comparison. Simple linear correlation and principal component analysis indicated that the rhizosphere-based method were preferred for prediction of bioavailability. Stepwise multiple regression analysis revealed that the equation of the rhizosphere-based method was the simplest one, and no soil properties variables needed to be added. The most distinct feature of the rhizosphere-based method was that this method was suitable for acidic, neutral and near alkaline soils. However, the DTPA, EDTA, $CaCl_2$, and $NaNO_3$ extraction methods were only suitable for calcareous soil, or only suitable for acidic soil, or only suitable for exchangeable metals. The reasons why the rhizosphere-based method are logical for evaluation of bioavailability are that this method simulates the real-world field conditions of plant growing in soil and integrates the combined effects of the rhizosphere-plant interactions. Thus, more widespread application of the rhizosphere-based method for bioavailability of heavy metals and rare earth elements in soils to plants is promising.