A SOIL- BASED MODEL TO PREDICT RADIONUCLIDE TRANSFER IN A SOIL- PLANT SYSTEM

M. Roig, M. Vidal, J. Tent and G. Rauret.
Departament de Química Analítica. Universitat de Barcelona.
Diagonal, 647, 08028 Barcelona, Spain.
M. C. Roca and V. R. Vallejo.
Departament de Biologia Vegetal. Universitat de Barcelona.
Diagonal, 645, 08028 Barcelona, Spain.

Knowledge acquired from the Chernobyl accident has underscored the need to improve the quantification of parameters that affect radionuclide mobility, mainly radiocaesium and radiostrontium transfer through the food chain. The multifactorial character of the transfer makes it difficult to establish simple relationships between soil-plant attributes and transfer. Models based on the available fraction alone fail to predict the radionuclide mobility observed at field level, and predictions based on the calculation of the in situ K_D appear to explain radionuclide behaviour better. However, the use of the available fraction is still needed to correct the value of the distribution coefficient.

The in situ K_D may be predicted from the values the sorption pool of the soils (mainly cation exchange capacity for radiostrontium, and specific sites in frayed edge sites in the illitic material for radiocaesium), and the levels of competitive species of the radionuclides. For radiocaesium, this means potassium and amonium levels in soil solution.

With respect to the available fraction, and if the desorption approach is used to quantify it, it is usually defined by the radionuclide fraction that may be desorbed by using an extractant reagent and that may undergo an exchangeable process in the solid phase, in given experimental conditions, often after a single extraction using a batch technique. However, to date there is no general agreement as to a common methodology for defining this fraction. The only agreement lies in the fact that monovalent cations seem to desorb radiocaesium exchangeable fraction better, whereas radiostrontium appears not to be so dependent of the reagent selected. Therefore, a simple methodology, that may be applied in routine analysis, should be chosen to quantify this fraction.

The aim of this work was to check if the main soil parameters predefined as ruling soil-plant transfer were sufficient to predict a relative scale of radionuclide mobility in mineral soils. Two agricultural soils, two radionuclides (^{85}Sr and ^{134}Cs), and two crops (lettuce and pea) were used in these experiments following radioactive aerosol deposition simulating the conditions of a site some distance far away from the center of a nuclear accident, for which condensed deposition would be the more significant contribution.The available fraction of these radionuclides was estimated in these soils from experiments in which various reagents were tested and several experimental conditions were compared.

As a general conclusion, the soil parameters seemed to be sufficient for prediction purposes, although the model should be improved through the consideration of physiological aspects, especially those depending of the plant selectivity according to the composition of the soil solution.