



Assessment of bioavailability of pesticides in soils and identification of pesticide degradation drivers using the in-situ Mass Distribution Quotient (iMDQ)

Christian Folberth

EAWAG, Swiss Federal Institute of Aquatic Science and Technology, Systems Analysis, Integrated Assessment and Modelling, Ueberlandstr. 133, 8600 Dübendorf, Switzerland

The in-situ Mass Distribution Quotient (iMDQ) has recently been shown to reliably describe the bioavailability and mineralization of the widely applied pesticide isoproturon in agricultural soils. It is determined by pore water extraction from previously incubated soil samples and subsequent assessment of the mass distribution between solid and liquid phase. The method was verified by comparing the bioavailability with co-metabolic mineralization in soils under optimum microbial soil conditions (water tension -15 kPa and bulk density 1.3 g cm⁻³). A comparison of the results with the chemical partitioning assessed by the K_d method has shown a higher accuracy of the new method. By combining the iMDQ/pore water extraction method with mineralization of the pesticide under optimum microbial conditions in the soils, further information about mineralization and degradation processes could be obtained or confirmed:

- a) Metabolically outstanding soils could be identified due to inconsistency between bioavailability and mineralization when compared to the co-metabolic soils. In a metabolically hampered soil, the mineralization was very low compared to the bioavailability and in a soil with metabolically IPU degrading microorganisms the mineralization was extremely high despite low bioavailability.
- b) Analysis of metabolite patterns in soil water fractions of a degradation experiment allowed for an additional identification of the metabolic status of the soil. In co-metabolic soils, the diversity of metabolites increased proportionally with the degree of mineralization of the parent compound, whereas in a metabolically hampered soil the metabolite pattern was very diverse despite low mineralization.
- c) A quite stable fractioning between total mineralization of the parent compound to CO₂ and build-up of non-extractable bound residues was found. This is a hint that also during co-metabolic degradation that can up to now not be attributed to a certain group of microorganisms, very similar processes take place in different soils.
- d) It could be shown that soil parameters governing the bioavailability of the compound differ between soils. Although TOC and pH could again be identified as the most important factors for the sorption strength of soils towards isoproturon, the bioavailability itself was driven by a combination of water content and sorption strength that was unique for each soil sample.
- f) The partitioning of parent compound and primary metabolites remained quite stable during the degradation and mineralization.

Further investigations focusing on the microbial side of co-metabolic degradation are in progress. In the future, the method could be used to investigate more compounds, the effectiveness of methods to increase bioavailability in-situ without the need for degradation experiments, and the identification and analysis of degradation pathways in-situ. Other processes that are important for risk assessment, like leaching, have already been investigated with similar methods.