Geophysical Research Abstracts, Vol. 8, 06545, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06545

Enhanced mineralization of organic chemicals in soils enriched by active microbial soil communities

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Agricultural soils are continuously loaded with organic chemicals that are applied directly to soils by man or indirectly via atmospheric deposition. To prevent further accumulation of chemical residues in soils and subsequently to reduce the risk of groundwater contamination, applicable methods are needed to enhance selectively the in situ degradation of chemicals in soils. The possibility of an enhanced mineralization of organic chemicals in soils was investigated with the herbicide isoproturon, the chlorinated compound trichlorobenzene and the PAH benzo(a)pyrene.

In lysimeter-experiments under outdoor conditions and in laboratory-experiments under constant conditions the mineralization of ^{14}C-isoproturon was measured continuously and the amounts of extractable and non-extractable residues were analysed at the end of the experiments. Under fluctuating as well as under constant conditions the mineralization of the herbicide and the formation of non-extractable residues differed significantly in the four investigated soils. The different herbicide degradation could not be explained by abiotic soil characteristics which account for the bioavailability of the chemical in soils but by diverse capabilities of the microbial soil communities to mineralize isoproturon. Differences in the isoproturon-degrading microbial communities of these soils were affirmed by diverse isoproturon mineralization dynamics, differences in the pattern of herbicide metabolites and different mineralization behaviour in liquid-culture-experiments.

In additional experiments a specific microbial community with a high capability to mineralise isoproturon was isolated. By transferring this microbial community to different isoproturon loaded agricultural soils the herbicide mineralization was increased

significantly under laboratory and environmental conditions; even in heavy metal contaminated soils this effect could be observed. These results affirmed that the capability of microbial communities for mineralising isoproturon was the main factor determining the mineralization of the herbicide in soils.

First results affirm that the transfer of specific microbial communities to enhance the mineralization of organic chemicals in soils is also transferable to other substances. By using this technique the mineralization of the organic chemicals trichlorobenzene and benzo(a)pyrene were enhanced successfully in laboratory experiments.