Geophysical Research Abstracts
Vol. 12, EGU2010-11114, 2010
EGU General Assembly 2010

The influence of different soil management practices on auxin herbicide interactions with organic carbon in soil aggregate fractions

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The influence of changing organic carbon contents in soils on the sorption and/or sequestration mechanisms of xenobiotics and their bioavailability are still not understood precisely. The present work discusses the turnover of a crop residue interacting with processes like mobilisation, binding and metabolism of an auxin herbicide in soil.
The soil type was a haplic chernozem, available in three crop production regimes (low, normal and high) due to three types of fertilisation (none, mineral and mineral & organic) [1]. Two sets of experiments were conducted with undisturbed soil columns under field-like conditions. In the first set 14C-labelled maize straw was incorporated into the top soil and after three months incubation the herbicide benazolin was applied. In the second set the unlabelled maize straw was incorporated first, then 14C-labelled benazolin was added.
Soil layers of 0-5 cm and 5-10 cm were fractionated in according to a soil aggregate fractionation procedure [2]. The content of organic carbon and the distribution of benazolin and its metabolites were detected in the gained soil fractions.
In general, the specific organic carbon content and the specific 14C-activity of benazolin and its metabolites increased in the order from sand-sized though silt-sized to clay fraction due to increasing specific surface areas and sorption sites of the mineral particles. The highest sorption capacity of benazolin and its metabolites was detected in the soil layers of 0-5 cm with mineral fertilisation. In the 5-10 cm soil layers the binding capacity increased with increasing crop production. It was shown that more than half of the residual 14C-activity was not extractable. LC-MS/MS analysis of the extracts showed that the major components were benazolin and the relatively non-mobile thiazolin. The amount of benazolin in the extracts increased with increasing crop production, but decreased with increasing soil depth.
These results indicate that maize straw amendment had levelling effects in the 0-5 cm soil layers, masking the influence of the older organic carbon.

[1] Berns, A.E., Schnitzler, F., Drewes, N., Vereecken, H., Burauel, P., 2007. Dynamics of benazolin under the influence of degrading maize straw in undisturbed soil columns. Environmental Toxicology and Chemistry 26, 2151-2157.

[2] Schnitzler, F.; Lavorenti, A.; Berns, A.E.; Drewes, N.; Vereecken, H.; Burauel, P., 2007. The influence of maize residues on the mobility and binding of benazolin: Investigating physically extracted soil fractions. Environmental Pollution 147, 4-13.