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Distribution of organic carbon and chemicals in agricultural soils (BET method)

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Modelling the dynamics of soil organic carbon and chemicals in soils requires compartmentalisation in pools or fractions. The determination of organic carbon and chemical concentration in all fractions is often time-consuming or not realisable due to low amount of soil fractions. Therefore, we developed an analytical method to calculate distributions of organic carbon and chemicals in soil without any chemical extraction method. Two sets of experiments were conducted with undisturbed soil columns under field-like conditions. In the first set, maize straw was incorporated into the topsoil and after three months incubation, the ^{14}C-labelled chemicals benazolin or benzo[a]pyrene were applied. The second set was treated equally, but without maize addition. After a total incubation time of six months, the topsoil layers were fractionated with a physical aggregate size fractionation procedure[1]. The content of organic carbon and the distribution of the chemicals were detected in the gained soil fractions. Furthermore, the BET method was used to determine the specific surface area (SSA) of selected soil fractions.

It can be shown that a fraction of organic carbon and chemicals is dependent on the SSA. The slopes of these linear relationships have been used for the estimation of the organic carbon[2] or chemicals associated to the clay fraction. Thus, mass concentrations of organic carbon or chemicals located in the clay and silt+sand fraction can be calculated.

It has been found that the influence of the incorporated maize straw on the amount of organic carbon in the fractions is low due to strong mineralisation processes. In general, the amount of organic carbon in the silt+sand fraction is higher than in the clay fraction. In contrary, the ^{14}C-activity of the chemicals is higher in the clay fraction than in the silt+sand fraction. However, the addition of maize straw increases the amount of ^{14}C-activity in the silt+sand fraction.

The calculated distribution coefficients K_d and K_{OC} indicate a stronger sorption of benzo[a]pyrene than benazolin derivates. Furthermore, a stronger binding of chemicals to the clay fraction than to the silt+sand fraction can be observed. The incorporation of maize straw increases the K_d values of benazolin and its metabolites in all fractions due to stronger metabolism of the herbicide[1]. The K_{OC} of benzo[a]pyrene is more or less constant in the clay fraction after straw incorporation. However, an increase of the K_{OC} value in the silt+sand fraction is observed, which can be related to the binding capacity of the OC straw derivates. In dissolved forms (DOC), they can be involved in co-transport processes of benzo[a]pyrene.

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