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Diffusion studies with a phenylurea herbicide and a complex rhizoexudate mixture

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In order to better understand soil carbon cycles knowledge about transport processes is essential. Furthermore, transport phenomena are an important link between microbes and their substrate. Convective transport processes in soil already have been studied in detail. But little is known about the transport of dissolved organic matter where diffusion is a predominant transport mechanism, e.g., at low to zero seepage velocities, outside preferential flow-paths or in close proximity to plant roots.

In a study of the degradation of the ^{14}C-herbicide isoproturon by a specialized microbial community, identical mineralization rates were observed when applying microbe covered expanded clay particles to a liquid culture and to a soil via "hot-spots". The initial mass of isoproturon was 230μg and was decomposed at a maximum rate of about 5 μg d^{-1}. A diffusion tube experiment (Schaefer et al., 1995) was used to determine the apparent diffusion coefficient of isoproturon ($2.8{\cdot}10^{-7} \pm 0.2{\cdot}10^{-7}$ cm^{2}s^{-1}) in the soil. The maximum possible isoproturon mass transfer rate into the total quantity of microbial "hot spots" was calculated to be approximately 6 μg d^{-1}. It is concluded that in this case not transport by diffusion, as might be assumed (Bosma et al., 1997), but the intrinsic degradation ability of the microbes is the limiting factor of isoproturon mineralization.

In a second study barley was grown in sterile hydroponics in an atmosphere with ^{14}C-labelled carbon dioxide at ambient concentration. The hydroponic solution was collected to obtain ^{14}C-labelled root exudates. Subsequently diffusion tube experiments were conducted to study the diffusion characteristics of barley rhizoexudates as an example for naturally occurring complex mixtures of organic substances.