Adsorption of acetochlor onto kaolinite-humus complexes

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Adsorption is an important factor affecting the fate and biological activity of herbicides released into soil. Acetochlor belongs to the group of acetanilide herbicides and is used on a large scale in Europe and USA as a weed-control agent. Soil organic matter, and humic acids in particular, play an important role in adsorption of acetochlor (Wang at. al. 1999, Liu at al., 2000). To predict an adsorption affinity of acetochlor to different soils, quantitative relationships are to be established between the structure of soil organic matter and partition coefficients of acetochlor. The objective of this study was to estimate partition coefficients of acetochlor onto model kaolinite-humus complexes and establish their relationship to the structure of humic acids (HA) used.

The kaolinite-humus complexes were prepared by adsorbing humic acids (HA) onto kaolinite saturated with Ca^{2+} and follow up desorption of loosely bound HA with distilled water. Ten samples of HA isolated from seven soils, two peats, and brown coal were used in this study. Content of irreversibly bound organic carbon (OC) in the obtained kaolinite-humus complexes ranged from 0.41 to 1.17% (wt). Adsorption affinity of acetochlor for kaolinite-HA complexes was characterized with partition coefficients K_d and K_{OC}, where the latter is K_d normalized to the content of organic carbon (OC) in the complexes.

The obtained K_d values ranged from 5.2-29.9 L/kg exceeding 2-3 times the corresponding K_d values for soils (2.1-10.3 L/kg) used for isolation of humic acids. The close K_d values of kaolinite-HA complexes to those of the corresponding soils indicate a feasibility to use the kaolinite-HA complexes as a model of soil particles. For K_d values ranged as follows: K-Ca < K-Pw< K-Pg < K-T10 < K-GpS < K-Pp < K-T7 < K-Gw < K-Am < K-CtL<K-AGK. For K_{OC} values ranged as follows: K-Pw < K-Pg < K-GpS < K-T10 < K-Pp < K-T7 < K-AGK < K-Am < K-CtL. The values of partition coefficients of acetochlor increased along with an increase in the partial surface area of kaolinite-humus complexes (r = 0.87). There was no relationship found between K_d and OC (%, wt). Nonetheless, the values of acetochlor K_d for kaolinite-humus complexes were, in general, larger than those for pure Ca^{2+}-kaolinite. The statistically significant relationships were found between K_{oc} and aromaticity (^{13}C-NMR data) of the humic acids adsorbed onto kaolinite (r= 0.69) and between Kd and aromaticity (r = 0.84). This indicates a substantial contribution of interaction of acetochlor with humic acids into adsorption behavior of acetochlor in soil.

The study was supported by the research grants of the Russian Foundation for Basic Research 00-04-48692, 02-04-06662 and 01-03-32664. The grant for interdisciplinary research of the Lomonosov Moscow State University (2002) is deeply appreciated.

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