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A spectroscopic study of possible mechanism of flubendiamide sorption onto humic acids

I. Cavoski (1), V. D'Orazio (2), P. Caboni (3), and T. Miano (2)

(1) Istituto Agronomico Mediterraneo, CIHEAM-IAMB, Italy (cavoski@iamb.it, +39 0804606365), (2) Dipartimento di Biologia e Chimica Agroforestale ed Ambientale, Università di Bari, Italy, (3) Dipartimento di Tossicologia, Università di Cagliari, Italy

Flubendiamide,N′-[1,1-dimethyl-2-(methylsulfonyl)ethyl]-3-iodo-N-{4-[2,2,2 tetrafluoro-1-(trifluoromethyl)ethyl]-0-tolyl} phthalimide is a potent insecticide widely used against lepidopteran pests on a large variety of annual and perennial crops, and belonging to a new chemical class, the phthalic acid diamides. Residues of flubendiamide and its metabolite, the desiodo flubendiamide, were determined in a number of crops. It is stable both under aerobic-anaerobic soil conditions and aerobic-aquatic laboratory conditions whereas it degrades in field condition very slowly. Flubendiamide is almost insoluble in water. Because soils exhibit a marked affinity for hydrophobic organic compounds, they exert an essential role in controlling the environmental fate of these chemicals. There are numerous physical, physico-chemical and chemical binding mechanisms between organic pollutants and soil organic matter. However, the nature and the extent of these binding mechanisms for highly hydrophobic contaminants are not yet fully understood. Humic substances play a major role in the sorption of hydrophobic organic compounds in soils. Adsorption of hydrophobic, non-polar organic compounds can be considered as a non-specific, partitioning process between soil water and soil organic phase, such as the mechanism for retention of nonionic, non-polar organic pollutant that weakly interact with water.
The sensitive and nondestructive nature of fluorescence spectroscopy renders this technique well suitable in analysing the physico-chemical properties of organic matter of various origin, as well as a powerful approach both to carry out studies on the structural and functional properties of HA and to investigate their interaction with metals and/or organic contaminants. Fourier-transform infrared (FT-IR) and fluorescence spectroscopies were used to obtain specific information about the mechanisms involved in flubendiamide sorption onto HAs. The HA-flubendiamide interaction products were obtained after the fine tuning of both solid and liquid interaction model between three soils and a river sediment, in order to evaluate the relationship between structure and binding affinity of humic substances for flubendiamide as a function of their physico-chemical properties.

Keywords: Soil, flubendiamide, humic acids, FT-IR, fluorescence, interaction mechanisms