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Pesticide interactions with soils affected by olive oil mill wastewater

Yonatan Keren, Nadezhda Bukhanovsky, and Mikhail Borisover
The Institute of Soil, Water and Environmental Sciences, The Volcani Center, ARO, Bet Dagan, Israel

Soil pesticide sorption is well known to affect the fate of pesticides, their bioavailability and the potential to contaminate air and water. Soil – pesticide interactions may be strongly influenced by soil organic matter (SOM) and organic matter (OM)-rich soil amendments. One special OM source in soils is related to olive oil production residues that may include both solid and liquid wastes. In the Mediterranean area, the olive oil production is considered as an important field in the agricultural sector. Due to the significant rise in olive oil production, the amount of wastes is growing respectively. Olive oil mill waste water (OMWW) is the liquid byproduct in the so-called "three phase" technological process. Features of OMWW include the high content of fatty aliphatic components and polyphenols and their often-considered toxicity. One way of OMWW disposal is the land spreading, e.g., in olive orchards. The land application of OMWW (either controlled or not) is supposed to affect the multiple soil properties, including hydrophobicity and the potential of soils to interact with pesticides. Therefore, there is both basic and applied interest in elucidating the interactions between organic compounds and soils affected by OMWW. However, little is known about the impact of OMWW – soil interactions on sorption of organic compounds, and specifically, on sorption of agrochemicals. This paper reports an experimental study of sorption interactions of a series of organic compounds including widely used herbicides such as diuron and simazine, in a range of soils that were affected by OMWW (i) historically or (ii) in the controlled land disposal experiments. It is demonstrated that there is a distinct increase in apparent sorption of organic chemicals in soils affected by OMWW. In selected systems, this increase may be explained by increase in SOM content. However, the SOM quality places a role: the rise in organic compound – soil interactions may both exceed the SOM content increase and be less than that. Sorption interactions of herbicides with soils demonstrate a strong hysteresis (which is not expected to be related to a biodegradation). The data suggests that the OMWW – soil interaction seems to change the shape of the apparent sorption isotherms of organic sorbates, and, possibly, their sorption mechanisms: from a Langmuir-like sorption isotherm (describing the adsorptive interactions with a saturation of sorption sites) in the native soils to the sigmoidal or linear isotherms (expected for a partitioning into the bulk OM phases and their swelling) in the OMWW-amended soils. These results may have a significant impact on multiple agricultural and hydrological aspects, e.g., such as the application rate of herbicides in the field, and their possible release and the long term effect on groundwater. The authors acknowledge the support from the OLIVEOIL project (SCHA849/13) funded by DFG.