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Pesticide Fate in the Tropical Environment of Brazil: Implications for Sustainable Agriculture and Resource Conservation in the Cerrado Area

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Abstract

Within the last 30 years a pesticide-intensive agriculture has been established in the highland regions of Mato Grosso state (Brazil). In a pilot project we investigated the on-site fate of pesticides under tropical field conditions in the Cerrado highlands, the dispersion of pesticides in the northeastern Pantanal catchment, and the persistence of pesticides in the aquatic environment of the Pantanal outskirts.

Field experiments with two representative tropical soils showed that the dissipation of 10 selected insecticides and herbicides in topsoil was rapid (DT50: 0.6 to 20 d). Nevertheless, polar pesticides progressively leached in sandy soils, whereas in clayey soils leaching below the plow layer was mainly caused by preferential flow. The experimental evidence suggests that for alachlor, atrazine, metolachlor, simazine, and trifluralin a non-point pollution of ground water resources in tropical Brazil cannot be ruled out. During a monitoring study, the off-site distribution of 29 pesticides and 3 metabolites was assessed in the north-eastern Pantanal basin. At least one pesticide was detected in 68 % of analysed surface water samples, 62 % of sediment samples, and 87 % of rainwater samples. Surface and rain water samples were most frequently contaminated by alachlor, endosulfan compounds, metolachlor, monocrotofos, profenofos, and trifluralin. While in surface water samples only low concentrations of <0.1 μg L^{-1} were detected, rainwater was polluted with substantial amounts of pesticides in the highlands (maximum concentrations of 0.3 to 2.3 μg L^{-1}) and with 5 to 10 fold lower mean concentrations of pesticides at remote lowland sites. Pesticide fate in the aquatic environment was assessed using semi-field microcosms. Atrazine, endosulfan b, simazine, metolachlor, and alachlor were identified as quite persistent pesticides in water and water/sediment microcosms (DT50 ^{3}44 d). The presence of sediment in microcosms led to increased persistence of non-polar pesticides, while for polar pesticides a decreased persistence was observed.

We deduct that the fast field-dissipation of pesticides in tropical soils of Brazil is in part attributable to increased volatilisation losses of pesticides. The resulting high dispersion tendency of pesticides in the atmosphere may then negatively influence off-site aquatic ecosystems, where pesticides are more persistent than expected under tropical climate.

Keywords: Dissipation, microcosm, monitoring, pesticide, sediment, soil, water

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