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A 10-m^2 laboratory lysimeter to assess lateral and vertical pesticide transfers in a plowed horizon

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A good knowledge of the processes of pesticides transfer in agricultural soils is necessary to assess the fate of these chemicals in the environment. A range of experimental devices have been proposed to study pesticide transfers both in the laboratory and in the field. However, due to experimental limitations, the size of the studied samples is generally small and the lateral fluxes like overland flow, erosion or subsurface flow can not be realistically investigated. Experiments at a larger scale can be carried out with field devices, like lysimeter or plot. But the setting of such large scale field experiments is heavy and it limits the possibility of replication. The objective of this work is to present the first results obtained with a laboratory device designed to mesure erosion, overland and vertical fluxes of water and chemicals on a plot-scale volume of cultivated soil.

For the experiments presented in this paper two cultivated soils with contrasted erodibility and hydrodynamic behaviour, a silt loam and a silty clay loam, were tested. The main piece of the experimental device is two stainless steel boxes (1-meter large, 5-meters long and 0.30-meters deep each box) with adjustable slope (0 to 20 %) fixed to 5 %. These boxes were filled with air-dried soil from the plowed layer of the cultivated plots and the surface was prepared as a seedbed. The boxes were submitted to a first rainfall event (30 mm.h^{-1}) until the runoff rate reached 10 %. A second rainfall event of same intensity was then resumed after about 24 hours. One day before the first rainfall event, a solution containing four pesticides (Metribuzin, Metazachlor, Metamitrone and Linuron) with K_{OC} ranging from 1 to 500 L.Kg^{-1} as well as a water tracer (Br) was applied at the upslope part of each plot (2 $\times$ 1 m^2). A solution containing two pesticides (Isoproturon and Diflufenicanil) with K_{OC} ranging from 50

to 5000 L.Kg^{-1} was further applied on the same plot before the second rainfall event. In the soil volume, the dynamic of the water potential was followed thanks to a tensiometer profile. Overland and percolated fluxes were sampled every 10 min with one runoff and three drainage collectors. Sediments and particle-bound pesticides were measured in runoff samples and soluble pesticides and Br were followed in runoff and percolated water samples. At the end of the experiment, Br and pesticides were measured in soil samples collected along a vertical profile in each upslope, middleslope and downslope plots of the boxes.

The data were analysed for water and chemical budgets. The silt loam soil presented a low infiltration capacity due to the rapid formation of a sealed surface at this rainfall intensity. By contrast, the silty clay loam soil exhibithed a high infiltration capacity. These results are in agreement with the hydrodynamic behaviour of each soil. The accuracy of the Br budgets (return rate of 102 $\pm$ 5 % for the silt loam and 79 $\pm$ 3 % for the silty clay loam) suggests that Br transport was well evaluated in this experimental device. Distribution of pesticides lossses between infiltration and runoff were correlated to K_{OC} properties. The ratio of particle-bound to soluble pesticides in runoff waters also increased with increasing K_{OC}.