The contribution of atmospheric pathways to the contamination of surface waters by pesticides has been demonstrated. Among the various pathways involved, the gaseous deposition process needs to be better analyzed. This involves factors like the pesticide physico-chemical properties and environmental conditions, but also on atmospheric pesticide concentrations (hence, emission), distance from the source and the nature of the deposition surface.

A lab system was specifically designed to measure simultaneously volatilization and dry deposition of pesticides under controlled conditions with the aim to better analyze the factors involved in the dry deposition process.

Materials and methods

The experimental system is based on (Figures 1a and 1b):

- an air flow rate sweeping through an Emission cell, where pesticides are volatilized, to a Deposition cell containing a fixed volume of water.
- a derivation of the air flow to quantify the volatilized amount of pesticides by trapping them on a resin.
- Measurements of the pesticide content in each compartment - water, air and residue in the Emission cell - at the end of the experiment

Experiments carried out:

- 7 pesticides with various physico-chemical properties were introduced in the emission cell as a mixture in a solvent: chlorothalonil, metazachlor, s-metolachlor, morpholin, trifluralin, cliomazine and fenpropidin
- 5 experiments, conducted in the similar conditions, were carried out for 3 hours at 28°C.

Chemical analysis procedure:

- extraction of pesticides from water with Stir Bar Sorptive Extraction Twisters® (Deschamps et al., 2011).
- extraction of pesticides from these Twisters® and from the trapping resin by solvent extraction
- analysis by GC/MS

Results

Six compounds over the 7 selected were quantified in each sample, showing thus the feasibility of such an experiment (Figure 2). Fenpropidin showed analytical problems.

A correlation can be found between:

1. the deposited amount (Figure 3) and the volatilized one
2. the deposited amount (Figure 4) and the vapor pressure of the compound (Figure 2)

These results are explained by the correlation between volatilization and vapor pressure of the compounds when they are applied on an inert surface

The comparison of the deposited amount quantified by SBSE or by the mass balance based on the difference of the air concentration between the input (C_{in}) and the output (C_{out}) of the deposition cell (Figure 4), show that accordance may be found for some compounds if extraction efficiency is taken into account

Mass balance was not fully closed for all compounds and standard deviation can be rather large (Figure 2)

These results should be largely improved by extracting Twister® and the trapping resin by thermal desorption as they are designed for.

Conclusions

- Deposition fraction for the six pesticides was linked to the emission and thus with factors driving it, which, under the conditions here considered (pesticides applied on an inert surface), is the vapour pressure of the compound.
- Results are in accordance with modelling results and with other experiments (Fent, 2004).
- For the most volatile compounds, for which emission is not the limiting process, the deposition process itself is expected to become the limiting process.

To explore such situations and to extend these results, further experiments should be carried out under various conditions.

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