

FATE AND BEHAVIOUR OF PESTICIDES IN FARM DITCHES: SORPTION KINETIC INFLUENCE



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Introduction

The intensification of agriculture leads to nonpoint source contamination of surface and groundwaters by pesticides. Not only pesticide and application characteristics are involved in their ability to move to water bodies, but also natural surroundings and environmental factors. Especially, intermediate lands between application areas and water courses can play a major part in pesticide mitigation.

Among them, artificial farm ditches constitute a current hydraulic connection linking drained plots to rivers, especially in Western Europe. They play a major role in water collect and transfer. Thus, the amount of pesticides passing through ditches can be modified by a number of physical, chemical or biological processes which can contribute to reduce the loads reaching the river. Among them, pesticide sorption on ditch substrates is a positive process whose efficiency is, however, poorly quantified and, probably, highly dependent on the hydrodynamic characteristics as previous field experiments emphasized (Margoum, 2003).

The objectives of this study is to assess the influence of various contact conditions on pesticide sorption kinetics on different ditch substrates : laboratory batches with a distinct shaking speed, an experimental ditch receiving a pesticide solution in recirculation for a fixed duration.

Experimental protocols

Pesticides and ditch substrates

3 herbicides with different physico-chemical properties were selected

Name	Diflufenican	Diuron	Isoproturon
Chemical formula			
Solubility	< 0,05 mg/L	36 mg/L	65 mg/L
Koc	1990 L/kg	480 L/kg	120 L/kg
Log P	4,9	2,9	2,5



2 kinds of typical substratum from ditch bottom were considered : sediments collected in South France and leaves in decay



Characteristics

Samples	Organic C (%)	C/N
Sédiment	0,98	10
Leaves	48,2	52

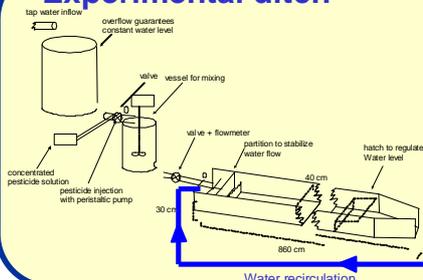
Laboratory experiments

Batch experiments were carried out with the 3 herbicides at low concentration levels (0,2 to 100 µg/L) to estimate pesticide sorption on bed sediments and leaves in decay:

- ✓ under quick agitation (OCDE 106, 2000) to compare with literature
- ✓ under gentle shaking (orbital shaker at about 50 shakes/min) in order to approach natural contact conditions in ditches



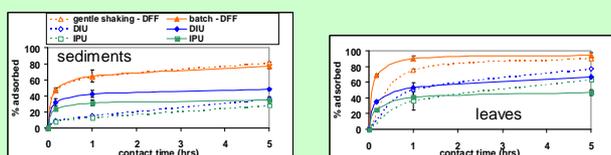
Experimental ditch



Water is re injected upstream to create recirculation, in order to artificially enhance contact time.

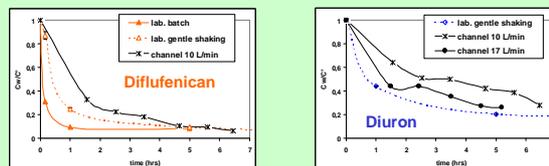
Results

Laboratory sorption kinetics



on both substrates, sorption kinetics are influenced by compound nature and shaking mode

Laboratory vs channel experiments



sorption kinetics assessed by means of laboratory experiments and water recirculation in the channel

Conclusion

In the experimental ditch, pesticide sorption is critically influenced by the hydrodynamic conditions such as water flow. Equilibrium is not reached even after a five hour contact time for diuron and isoproturon. Laboratory experiments under gentle shaking allowed to approach sorption kinetics as observed into the experimental ditch with water recirculation.

This work highlighted the potential inadequacy of equilibrium sorption models when predicting pesticide transfer toward ditch systems. In the presented results for diflufenican and diuron sorption on leaves in the experimental ditch, the equilibrium model is not relevant anymore. Therefore, a greater attention should be paid to the choice of the sorption model according to pesticide properties (sorption kinetics) and water flow characteristics.

Acknowledgments : This work as been partly supported by the MEDD France, Bayer Crop Science, Arvalis and DEFRA (UK).