



Processes of water contamination by pesticides at catchment scale in Mediterranean areas

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Pesticides are widely used in modern agriculture in most countries throughout the world and in a large range of environments. But, environmental monitoring increasingly indicates that trace amounts of pesticides are present in surface and underground water bodies, far from the sites of pesticide application. To find strategies for limiting the contamination of the surrounding environment, the processes affecting the persistence and the transport of pesticides have been largely studied for many years. However, although many studies observed pesticide contamination at the catchment scale, a few only analysed the processes by which contamination takes place and propagates from the place of pesticide application to catchment outlet. The prediction of water contamination by pesticides remains therefore very difficult. It is even more so in semi-arid environments, since most available data concerning the fate of pesticides have been obtained in temperate or humid conditions. However the behaviour of pesticides in semi-arid environments should also interest us. The risk of contaminating waterbodies by pesticides is not less severe there than in other environments, and has potentially large social consequences given the limited water resources. In effect, the intense rainfall events of semi-arid climates combined with often discontinuous soil cover by crops are well known to cause intense overland flow and erosion, and thereby high leaching potential of pesticides. Moreover, the specific characteristics of semi-arid areas require to reevaluate the pesticide behaviours observed in other conditions, and may in turn help to better enlarge our understanding of the processes influencing pesticide transport and.

In this paper we illustrate some aspects of the specific behaviour of pesticides in semi-

arid conditions by analyzing patterns of pesticide persistence and pesticide transport at the field and catchment scales which we have monitored in the vineyard growing area of south-France since 1995. Several points are shown:

- 1) The concentrations of pesticides in topsoil decline irregularly after application according to the succession of rainy and droughty periods.
- 2) The main pathway of pesticide losses to runoff water at the field scale is the intense overland flow that is generated by the heavy rainfalls of semi-arid climates.
- 3) The temporal patterns of pesticide concentration in runoff water are not only related to the decay of pesticide residues at the soil surface but also to temporal changes in pesticide sorption properties and to overland flow intensity.
- 4) Agricultural practices are a main factor of variation of herbicide losses by overland flow, since they modify the infiltration properties of the soil surface.
- 5) A large decrease in the seasonal pesticide losses by runoff water can be observed between the field and catchment scales due to reinfiltration processes in the drainage network of catchments.
- 6) The large between-year variation of rainfall patterns in semi-arid areas causes also large between-year variation of the patterns of water contamination by pesticides.

In the light of these observations, this paper will conclude with an analysis of the main gaps of present catchment modelling approaches for simulating water contamination by pesticides in surface and groundwaters, especially in semi-arid areas.

Related papers :

Lennartz, B., Louchart, X., Voltz, M. & Andrieux, X., 1997. Diuron and Simazine losses to runoff water in Mediterranean vineyards. *Journal of Environmental Quality*, 26, 1493-1503.

LOUCHART, X., VOLTZ, M. & ANDRIEUX, P. 2000. Dynamique de la mobilisation et du transfert du diuron par ruissellement in situ. *Compte-rendus à l'Académie des Science, Earth and Planetary Sciences*, 331, 474-481.

Louchart, X., Voltz, M., Andrieux, X. & Moussa, M., 2000. Herbicide transport to surface waters at field and watershed scales in a Mediterranean vineyard area. *Journal of Environmental Quality*, 30, 982-991.

Moussa, R., Voltz, M & Andrieux, P. 2001. Effects of the spatial organization of agricultural management on the hydrological behaviour of a farmed catchment during flood events. *Hydrological Processes*, 16, 393-412.

Voltz M., Louchart, X., Andrieux, P, Lennartz, B., 2003. Processes of pesticide dissipation and water transport in a Mediterranean farmed catchment. IAHS Publ. no. 278 “ Hydrology of Mediterranean and Semiarid Regions ”, Edited by E. Servat, W. Najem, C. Leduc and A. Shakeel, pp.