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Environmental behaviour of Metazachlor in a small lowland catchment in Northern Germany

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According to the guidelines of the EU-WFD, it is essential to evaluate the relevance of the potential input pathways for pesticides into surface water. With this knowledge, useful mitigation strategies can be developed and implemented successfully. The objective of this study was the assessment of the relevance of field drainage to losses of the herbicide Metazachlor used for rape in a lowland catchment. These areas are characterized by flat topography, shallow groundwater, high proportion of artificial drainages, and a low hydraulic gradient causing low flow velocities. Hence, they are sensitive to alterations that result in changes of the natural water balance and in-stream water quality.
As an example of pesticide behaviour in lowland conditions, Metazachlor was monitored on the field scale (5.4 ha), on the subcatchment (750 ha) and catchment scale (5000 ha) in the catchment of the Kielstau river, from 1/9/2008 – 27/11/2008. Automatic samplers were installed in the drainage inspection shaft on the drained field and at the outlets of the subcatchment and the catchment. In daily samples, herbicide concentrations were analyzed (using HPLC and DAD detection) in drainage and groundwater on a drained field, as well as in the river Kielstau and one of its tributaries, the Moorau. Soil parameters were determined on the drained field to characterize the site conditions. Furthermore, precipitation, groundwater levels and discharges of the tile drainage, of the Kielstau and Moorau were continuously observed. To assess herbicide losses in relation to amounts applied, catchment land use was mapped and local farmers were interviewed for herbicide application data.

Results from drainage, groundwater, and surface water in the rivers show concentrations of > 25 ng/l – 576 ng Metazachlor/l with highest values in the drainage and lowest in the tributary. Metazachlor losses ranged from 0.07 % to 0.3 % on the drained field and 0.02 % on catchment scale of the amount applied. In the Moorau tributary, Metazachlor did not exceed the detection limit of 25 ng/l. The rape fields were located sufficiently far away from the Moorau, so that detectable amounts of Metazachlor were not discharged into the Moorau.
The pattern of the herbicide concentrations reveal that the compounds were transported into the drainage and then into surface water during rainfall-induced discharge peaks. Highest concentrations were observed during first discharge event(s) after application, but highest daily loads occurred 32 – 71 days after application. On the field scale, the relevance of herbicide relocation via drainage was clearly documented. On the catchment and subcatchment scales, however, it was impossible to evaluate all potential pathways. It is assumed that the detected loads mainly originated from drainage systems whereas inputs from other pathways were of lesser relevance.