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Time integrated Pesticide analysis in the tropical Rio Tapezco in Costa Rica by using passive sampling approaches

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Tropical areas are pesticide “hot spots”. Global data indicate that in these regions the annual average pesticide application rates and surface runoff potentials can be very high. However in tropical regions, information about the pesticide entry routes, their environmental behavior, and the degree of water pollution is often lacking. Catchment-scale monitoring data are required to fill these knowledge gaps and to gain a better systematic understanding of the environmental fate, behavior and impacts of pesticides in tropical aquatic environments.

Accordingly, our study was conducted in the tropical Rio Tapezco catchment in the Zarcero canton, Costa Rica. The area covers 5112 ha, ranges between an altitude of 1580 and 2010 m above sea level and receives a total annual precipitation between 1500 and 3500 mm. The catchment is intensively used for the horticultural production of vegetables and herbs. It is a hot spots of pesticide use with an average application rate of about 22 kg/ha of arable land and cropping cycle. In conjunction with the poor pesticide application practices, the tropical climate, strong precipitations and the continuous pesticide application during the whole year, the risks for water pollution and environmental health are high. Indeed, previous spot sampling showed that in streams of the study area, several pesticides were found in concentrations up to 6.8 μg/L.

While this data indicate the risk for the aquatic environment, the seasonal grab sampling reflects only poorly the highly dynamic concentration time-series. Additionally, the assessment of the actual pollution level was restricted by a limited analytical window. To close these research gaps, we sampled the rivers of the study area continuously between end of July and beginning of October 2015 by using three passive sampling systems (Camcather® with styrene-divinylbenzene reverse phase sulfonated discs, polydimethylsiloxane sheets, and a water level proportional water sampler). Samples were taken in biweekly intervals at five sampling points. Loggers were installed at all sites for recording continuously water temperature and level. The analytical window was substantially enlarged by using GC-MS/MS and LC HR-MS for the quantification of 260 substances.

The sampling campaign 2015 resulted in a continuous set of samples at all sites with a total of 120 samples to be analyzed. The sampling period was characterized by a rather dry phase in the beginning and a more typical, wet period in the end of August 2015. First analytical results confirm the occurrence of a fairly large number of compounds even during dry conditions. We will present results how rainfall and discharge conditions have influenced the pesticide levels. This will also allow for conclusions regarding possible sources of the pesticides in the catchment and transport mechanisms into the streams.