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The Chlordecone crisis in the French West Indies : Its fate in soils and water

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In the French West Indies, chlordecone (CLD), an organochlorine pesticide, which is highly persistent in the environment, was applied in banana plantations from 1972 to 1993 against the banana weevil Cosmopolites sordidus. Pollution surveys conducted in 2001 by the French Department of Health revealed the presence of chlordecone in soils, rivers, springs over large areas in Guadeloupe and Martinique islands. Contamination of drinking water, food crops, aquatic species by CLD has been observed as well as its presence in blood of men, pregnant women and newborns. There is therefore a large social concern about the extent and evolution of CLD pollution in the French West Indies and its impact on human health and ecosystems. From 2008 to 2012 a multidisciplinary project CHLORDEXCO took place to study the CLD fate in water, soils and the contamination characteristics of aquatic species and food crops. Here, we summarize results obtained on the processes controlling the spatial and temporal patterns of soil and water contamination at the scale of the banana cropping area in Guadeloupe and of the Perou catchment. The main soils in the contaminated areas are andosols and nitisols and formed from the weathering of volcanic ashes. They have a high organic carbon content and high content of secondary minerals, allophane for andosols and halloysite for nitisols. An analysis of the spatial distribution of CLD in soil over 1045 field plots showed that the soil type had a strong impact. Andosols, with a high sorption capacity (Koc 20 000 L/kg), had the highest CLD concentrations and stocks, unlike Nitisols, which had 10-fold lower sorption capacities. A significant « farm effect », due to between-farm variations of application times and amounts, was also noticed. The observed stocks of CLD clearly correspond to the accumulation in soil of successive treatments and thereby confirm the high persistence of CLD in soil also observed in incubation studies in soil microcosms. Soil column studies of the transport of aged CLD however showed that CLD concentration in percolation water varied little (5 to 10 μg/L) and were of same magnitude for both soils although their sorption properties and hydrodynamic behaviours differed with larger macropore flow in the andosols. At catchment scale, contamination of surface waters was permanent with CLD concentrations one order of magnitude less than in percolation water. Temporal variations of contamination were due to dilution effects caused by water from uncontaminated uphill areas. CLD concentrations were highest in base flow indicating that the main pathway of applied CLD to surface waters is by percolation and groundwater flow. In conclusion, contamination of soil and water in the banana cropped areas of the French West Indies is general and permanent. If no soil remediation strategies can be elaborated this severe environmental contamination will last over centuries as estimated by Cabidoche et al. (2009, Environ. Poll., 57, 1697–1705). Since CLD propagates mainly by subsurface flow, buffer strips, usually recommended in many regions to limit the pollution of water by pesticides, will not be useful.