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A DECISION TOOL TO MANAGE FOOD SAFETY AND CROPPING SYSTEMS: STUDY CASE OF POLLUTED FIELDS BY THE POP CHLORDECONE IN THE FRENCH WEST INDIES

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INTRODUCTION

In French West Indies, banana producers have been using chlordecone ($C_{10}Cl_{10}O$, CAS registry: 143-50-5), a persistent organochlorine pesticide, for 1972 to 1993 to fight against the banana weevil. This molecule exhibits a high stability, a low solubility and a very low volatility, with non observed biodegradation in real conditions. Its high hydrophobicity allows a great affinity towards soil organic matters ($logK_{oc}$ = 3.34 to 3.415, Kenaga 1980 in ATSDR, 1995). Morever, it can be trapped by the specific physical properties of allophonic soil (andosol) (Woignier et al 2008). A simple leaching model (WISORCH, Cabidoche et al 2009) accounted for the current soil residue according to the soil type and exhibited different K_{oc} values, between 12 and 24 $m^3\ kg^{-1}$ for andosol and between 2 and 3 $m^3\ kg^{-1}$ for nitisol. Thus, this insecticide led to a heterogeneous and diffuse pollution but the pollution origin is limited to ancient banana fields. Chlordecone molecule is now polluting soils, water and food chains and farmers have to manage the sanitary risk of the molecule transfer to food crops where fields are polluted.

MATERIALS AND METHODS or DESCRIPTION OF MODEL

We first assessed the chlordecone transfer between soil and crops by measuring the chlordecone level in each compartment. We focused our study on the most eaten food crops in the French West Indies: roots vegetables (dasheen, sweet potato and yam), banana, pineapple, Solanaceae (tomato, hot pepper and eggplant). Two soil types were tested (andosol and nitisol) at the 0-30cm depth. All samples were taken at harvest stage in field conditions, repeated 10 to 20 times and stored at -20°C before analyse. All the samples were analysed by the LDA26 at Valence (France), which works under the French norm NF17025 and the "COFRAC" accreditation committee and determined the sample chlordecone rate by GC-MS-MS "triple quadrupole" (Varian, MS1200) after air drying, crushing, homogenising and acetone-hexane ASE.
We calculated the mean and the maximum transfer relationship between soil pollution level and crop contamination, using simple linear models. We considered the maximum transfer rate as anenvelop straight line, which was raised only by root vegetable cortex.
Then, our decision tool integrated these results and the UE sanitary regulation (Maximum Residue Limit, MRL=0.02 mg kg^{-1}FM for chlordecone food residue) in the soil limit calculation.

RESULTS AND DISCUSSION

The food crops sensitivity differed according to soil types, crops and harvested organs. The more sensitive crops are root vegetables and the less sensitive are banana, pineapple and *Solanaceae*. For these crops, chlordecone residues were under the MRL and nearby the detection level for the

harvested and edible part, thus their cultivation is possible on polluted soil, whatever the soil type. For root vegetables, contamination was proportional to the soil pollution (y=0.025x, R^2=0.73). Results dispersion was important because field soil pollution was heterogeneous at the contact surface scale. The root vegetable contamination was lower than soil pollution. This result excluded their use for remediation. We used the maximum transfer line to assess the risk of contamination for root vegetables (y=0.2x) and we translated the MRL value into a chlordecone maximum soil pollution level, under which one the risk of transfer above the MRL was zero (figure 1).
Our tool would help the farmers to anticipate the contamination risk for food products at the planting stage using a soil analysis. In the case of relevant farming system evolution or conversion, it would help them to choose adapted crops according to the field pollution context and the farmers' objectives. Our tool would help too the decision makers to propose pollution management measures and new cropping system practices and orientations. So as a conclusion, simple tools could predict and help to manage the contamination and exposure risks suitably/appropriately. The acceptable soil pollution level could be less binding by a better knowledge of soil-plant contamination relationships for each couple soil type – crop.

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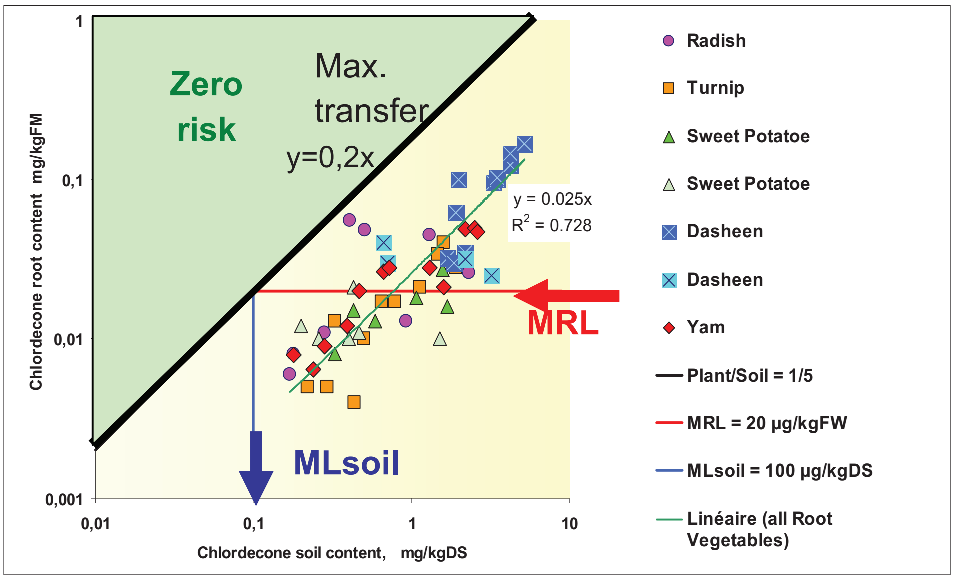

Figure 1: Use of the maximum transfer relationship to manage the contamination risk towards crops at the planting stage, root vegetables case. (MRL: maximum residue limit)

Presented at

Farming Systems Design 2009

an international symposium on

Methodologies for Integrated Analysis of Farm Production Systems

August 23-26 2009 - Monterey, CA

www.iemss.org/farmsys09