Screening of plant protection products (PPP) in agricultural soils

First results of the Swiss Soil Monitoring Network NABO

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Method & Sampling

In collaboration with the EAWAG (Switzerland) an analytical method was developed to detect "modern" pesticides in soil. Using QuEChERS and LC-HRMS 90 pesticides can be detected. We analysed soil samples from agricultural sites of the Swiss Soil Monitoring Network (NABO), for which also detailed PPP application data have been recorded (Chiaia-Hernandez 2017). The sites represent current pest management in Swiss agriculture. The land use of the 14 selected monitoring sites were:

- Cropland (Cl)   7 sites
- Orchards (Or)   3 sites
- Vegetable growing (Ve)   1 site
- Viticulture (Vi)   3 sites

Pesticides detected

In 73% of all cases the applied pesticide can be detected in the soil sample. According to the land management data, in 84% of the cases the last application occurred more than one year prior to the sampling date.
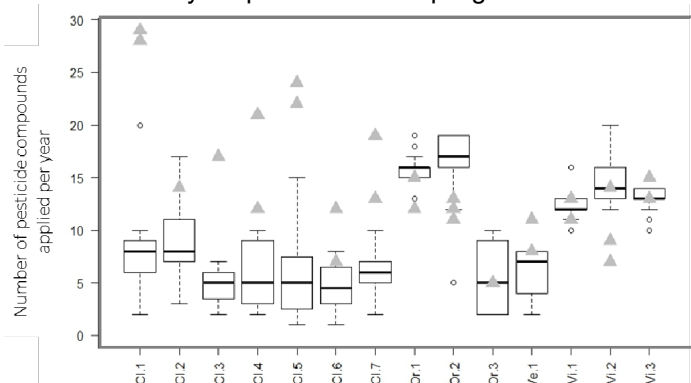
Applied and measured pesticides for the 14 investigated NABO soil sites (cropland sites (Cl); orchards (Or), vegetable growing (Ve), and viticulture (Vi)) between 1995 and 2008: number of pesticides applied per year between 1995 and 2008 (boxplot) and pesticides found in the soil samples (triangles)

Predicted environmental concentration (PEC)

PECs were calculated using the FOCUS model (1997, Simple PECs calculations assuming first order dissipation). However, the measured values in soil did not fit the calculated PECs.

Is the PEC higher than the analytical limit of detection?

Potential Risk

Using ecotox data from the PPDB, a potential risk coefficient (pRQ) for each pesticide can be calculated:

$$pRQ = \frac{environmental\ concentration}{NOEC * 0.2}$$

Summing up all pRQs form parent pesticides in one sample, a pRQ mix can be identified. In 14% of the cases the pRQmix was higher than 2 indicating that for such cases the the concentration in soil was two times higher than the lowest NOEC*0.2 value.

all   86% 14%
71% 29%
83% 17%
yes
no
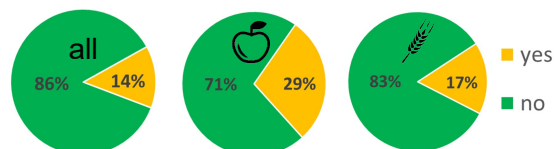
With regard to the land use types, the highest risk was found in orchards. In particular, high risks were caused by the chemical substances Imidacloprid, Chlorpyrifos and Linurone.

Summary

- Screening of soils from14 monitoring sites using QuEChERS and LC-HRMS to analyse 90 pesticides as targets (Ai)
- In 74 % of the cases, applied Ai can be detected in soil samples
- In 84 % of the cases the last application at the site was more than a year ago before soil sampling
- Measured and predicted values do not fit (yet)
- Orchards revealed the highest pRQ

Literature: Chiaia-Hernandez, A, C. et al, 2017, Long-term Persistence of Pesticides and TPs in Archived Agricultural Soil Samples and Comparison with Pesticide Application, ES&T, sub.

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