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Sorption hardly affects pesticide concentrations leaching to groundwater assuming degradation in liquid phase only

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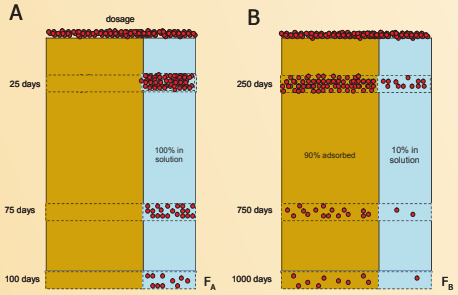
Problem

Pesticide leaching as calculated with FOCUS leaching models is very sensitive to pesticide sorption properties; therefore the variability of these properties across different soils leads to considerable uncertainty in the predictions

Conceptual basis leached fraction not affected by sorption processes when degradation is restricted to liquid phase



Leached fraction $F = \frac{\text{mass leached}}{\text{dose}}$

Only 10% of B in solution:
- 10X slower movement
- 10X slower degradation

So leached fraction $F_B = \frac{10}{10} \times F_A$

CDE assuming linear sorption and steady state water flow, leached fraction F at depth L:

$$F = e^{-\frac{vL}{2D}\left(\sqrt{1+\frac{4kD}{v^2}}-1\right)}$$

D = hydrodynamic dispersion coefficient ($m^2\ d^{-1}$)
v = filtration velocity ($m\ d^{-1}$)
k = transformation rate coefficient in liquid phase (d^{-1})

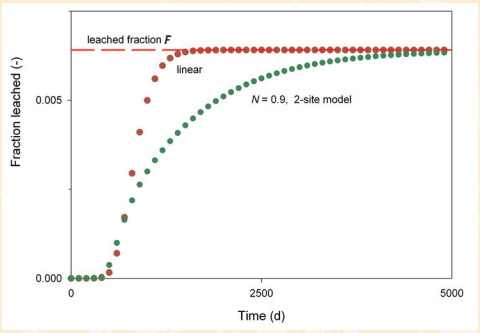
Leached fraction independent from sorption

Hypothesis 1

Leached fraction equation also true assuming Freundlich sorption and a two-site kinetic model

Procedure test 1

- PEARL calculations assuming steady state water flow
- linear sorption isotherm assuming equilibrium
- Freundlich isotherm assuming 50% equilibrium sites and 50% kinetic sites
- K_{eq} = 1 L kg^{-1}, $DT50_{liquid\ phase}$ = 20 d



Cumulative fraction of dose leached to groundwater assuming linear sorption and assuming Freundlich sorption and a two-site sorption model equal to calculated leached fraction F

Conclusion 1

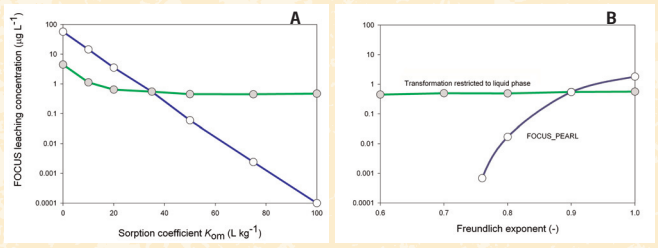
Assuming transformation in liquid phase only and steady state water flow, the leached fraction is not affected by sorption parameters irrespective of the sorption model used

Hypothesis 2

Assuming transformation in liquid phase only, leaching concentrations calculated in FOCUS groundwater scenarios are no strong function of sorption parameters

Procedure test 2

- Calculations with FOCUS_PEARL v2.2.2 and a modified version of PEARL that simulates transformation in the liquid phase only
- Kremsmünster, winter wheat
- FOCUS example compound D, DT50 = 20 d
- $DT50_{liquid\ phase}$ = 4.53 d



Leaching concentrations asssuming degradation in liquid phase only are hardly affected by the sorption coefficient (A) or by the Freundlich exponent (B)

Conclusion 2

The FOCUS leaching concentration is hardly affected by sorption parameters, assuming that transformation is restricted to the liquid phase.

Recommendations

- Perform sorption and degradation studies for pesticide registration with same soils
- Explore usefulness of this approach in pesticide registration procedure

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