

Inverse Modelling of Degradation and Sorption Behaviour of Clothianidin in Long-term Field Accumulation Studies

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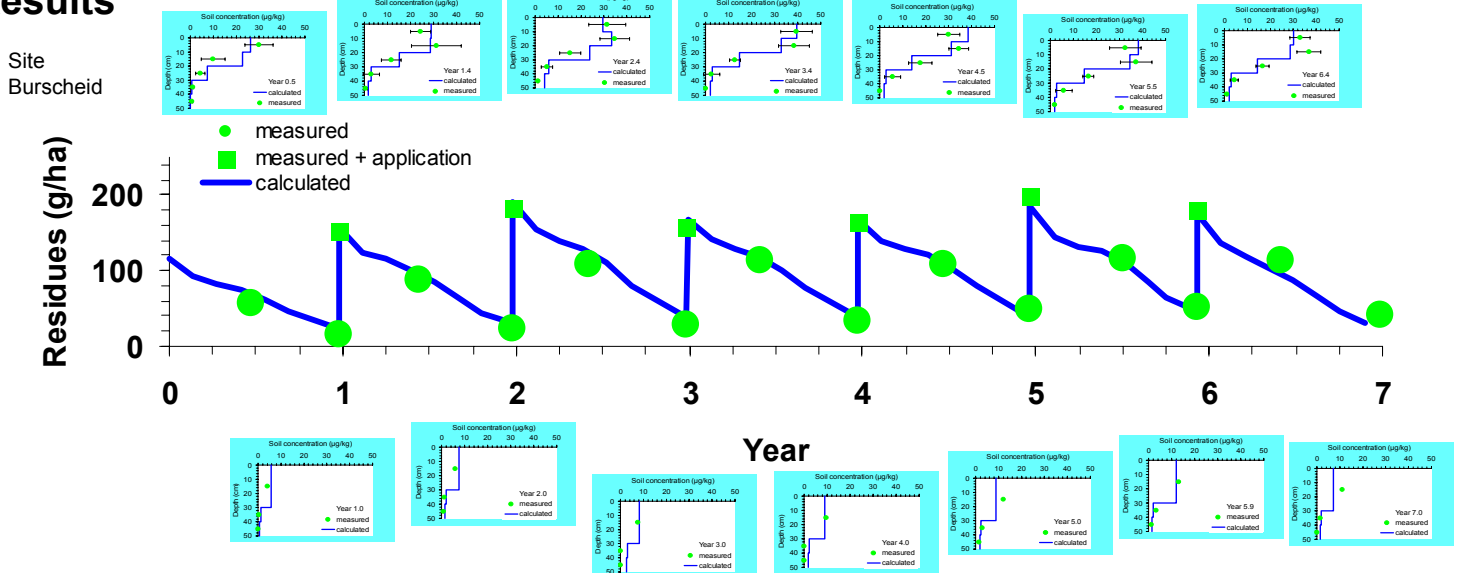
Introduction

- Seven year residue data from three field experiments with annual application of the insecticide clothianidin as seed treatment to winter wheat were analysed with respect to mobility and degradation using inverse modelling

Methods

- Five depths down to 0.5 m at the sites Burscheid (Germany), St. Etienne du Gres (France) and Wellesbourne (UK) were sampled at about every half year using large sampling volumes (6 replicates with 25 cm×25 cm×10 cm = 6.25 L each).
- For inverse modelling the optimisation code PEST in combination with the fate model PEARL were used.

Results



Degradation DT50 and Koc of clothianidin obtained by inverse modelling (95 % confidence interval)

Trial	DT50 (20 °C, 100 % FC, days)	Koc (L/kg)	Model efficiency
Burscheid	52 (82 - 97)	136 (126 - 148)	0.92
St.Etienne du Gres	112 (97 - 129)	201 (158 - 256)	0.79
Wellesbourne	109 (97 - 123)	203 (177 - 233)	0.84

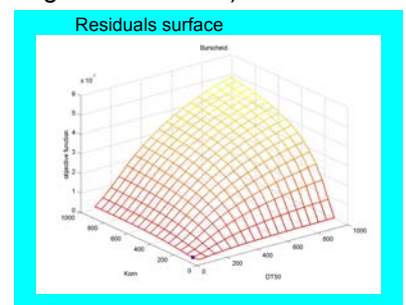
Q10 = 2.58, DT50 and Koc fitted log-transformed

Mean sensitivity (%) of degradation DT50 and Koc of clothianidin on hydraulic parameters (5th/95th percentile values, UNSODA database)

Parameter	DT50 (20 °C, 100 % FC, days)	Koc (L/kg)
α	21	1
n	17	1
θ_r	18	2
θ_s	2	1
K_s	3	1

α , n van Genuchten parameter, residual, θ_r , and saturated water content θ_s , hydraulic conductivity at saturation K_s

- Residue data were well reproduced by PEARL model with high model efficiencies (0.79 to 0.92)
- Hydraulic parameters have modest influence on DT50 via moisture correction (≤ 21 %) and very minor influence on Koc (≤ 2 %).
- DT50 are systematically shorter than those obtained from standard field dissipation studies (spray application, elimination of photolysis conservatively by discarding first samples)
- Effective sorption in field is higher than that derived from standard batch study (approximately by the degree of kinetic sorption determined in the laboratory), i.e. kinetic sorption parameter derived from a laboratory study are consistent with the findings in the accumulation trials.
- Two key parameters (DT50 and Koc) can be determined with high reliability (only one global minimum)



Conclusions

- Inverse modelling provided reliable results for two substance key parameters (DT50 and Koc)
- Soil hydraulic parameters have only minor or modest influence on the parameters optimised
- DT50 obtained from long-term field studies (seed treatment application) suggest that DT50 derived from standard field dissipation studies (spray application) is too conservative
- Koc obtained indicate the occurrence of kinetic sorption