Degradation and sorption of the herbicide pelargonic acid in agricultural topsoils and in subsoils below railway tracks

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Project Objective

- Determine degradation and adsorption parameters for pelargonic acid in subsoil below railway tracks.
- Estimate leaching potential of pelargonic acid applied as herbicide for vegetation control on railway tracks.

Rapid Degradation in Topsoils and Subsoils from Railway Tracks is Dependent on Starting Concentration

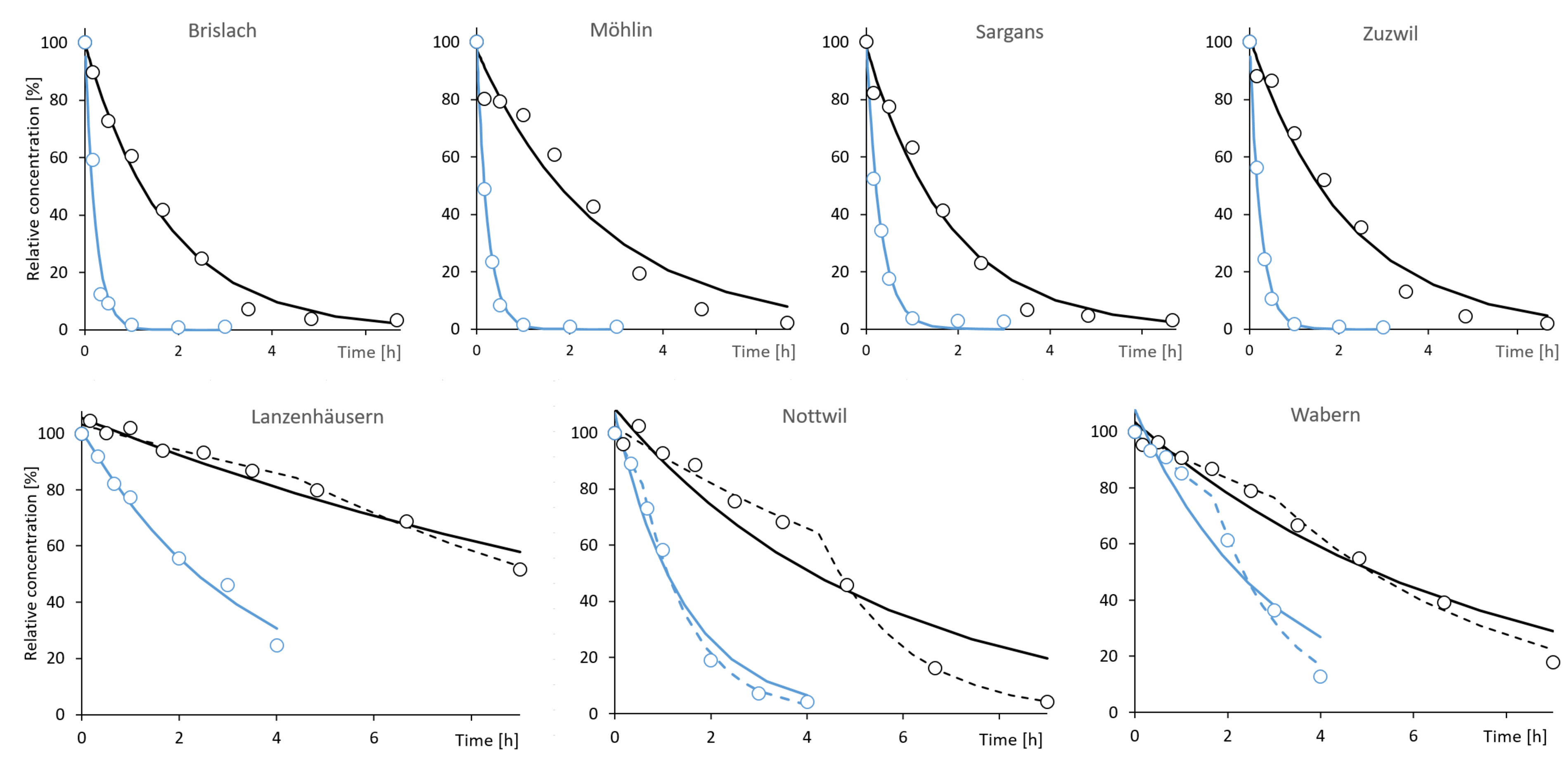

Figure 1: Degradation of pelargonic acid-D_{17} in 4 agricultural topsoils (top row) and 3 subsoils from railway tracks (bottom row) at starting concentrations of 5 mg/kg (blue symbols) and 15 mg/kg, respectively (black symbols). Fitted single first order (SFO) decline curves are plotted as solid lines, bi-phasic decline (hockey stick) as dashed lines.

- Very rapid degradation in agricultural topsoils with DT50s of ≈ 10 min (starting concentration of 5 mg/kg)
- Clearly slower degradation at higher starting concentration (15 mg/kg)
- Degradation in subsoils is slower than in topsoils, but still with DT50-values < 1 d
- Degradation in subsoils is bi-phasic with slower degradation in the initial phase, followed by more rapid degradation later on - can be fitted with hockey-stick model
- Bi-phasic degradation becomes more pronounced at higher starting concentration

pH-Dependent Adsorption to Subsoils from Railway Tracks and Topsoils from Agricultural Fields

- Acceptable adsorption isotherms were obtained in topsoils and subsoils from railway tracks
- Adsorption to soil correlates with organic carbon content
- Pronounced pH-dependence - strongest sorption acidic soils with high OC content
- Organic carbon normalized Freundlich adsorption coefficients (K_{Foc}) can be fitted with sigmoidal function
- Adsorption K_{Foc}-values of subsoils fit well with the data for topsoils

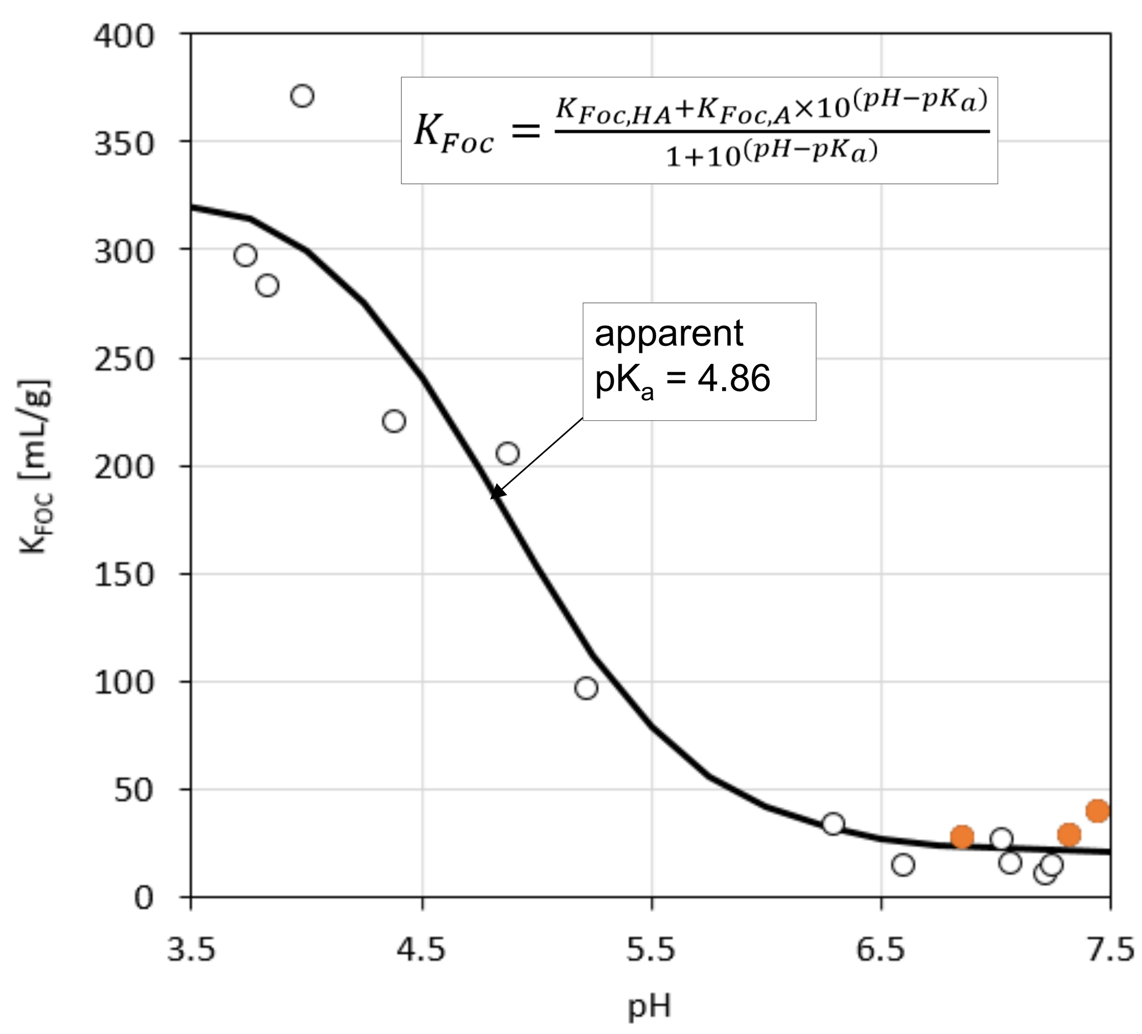

Figure 3: Adsorption K_{Foc}-values of pelargonic acid-D_{17} versus pH of the soil suspensions. The line represents the relationship of K_{Foc} on pH with the equation in the inset, fitted to the data points for topsoils (empty circles) and soils from railway tracks (filled circles).

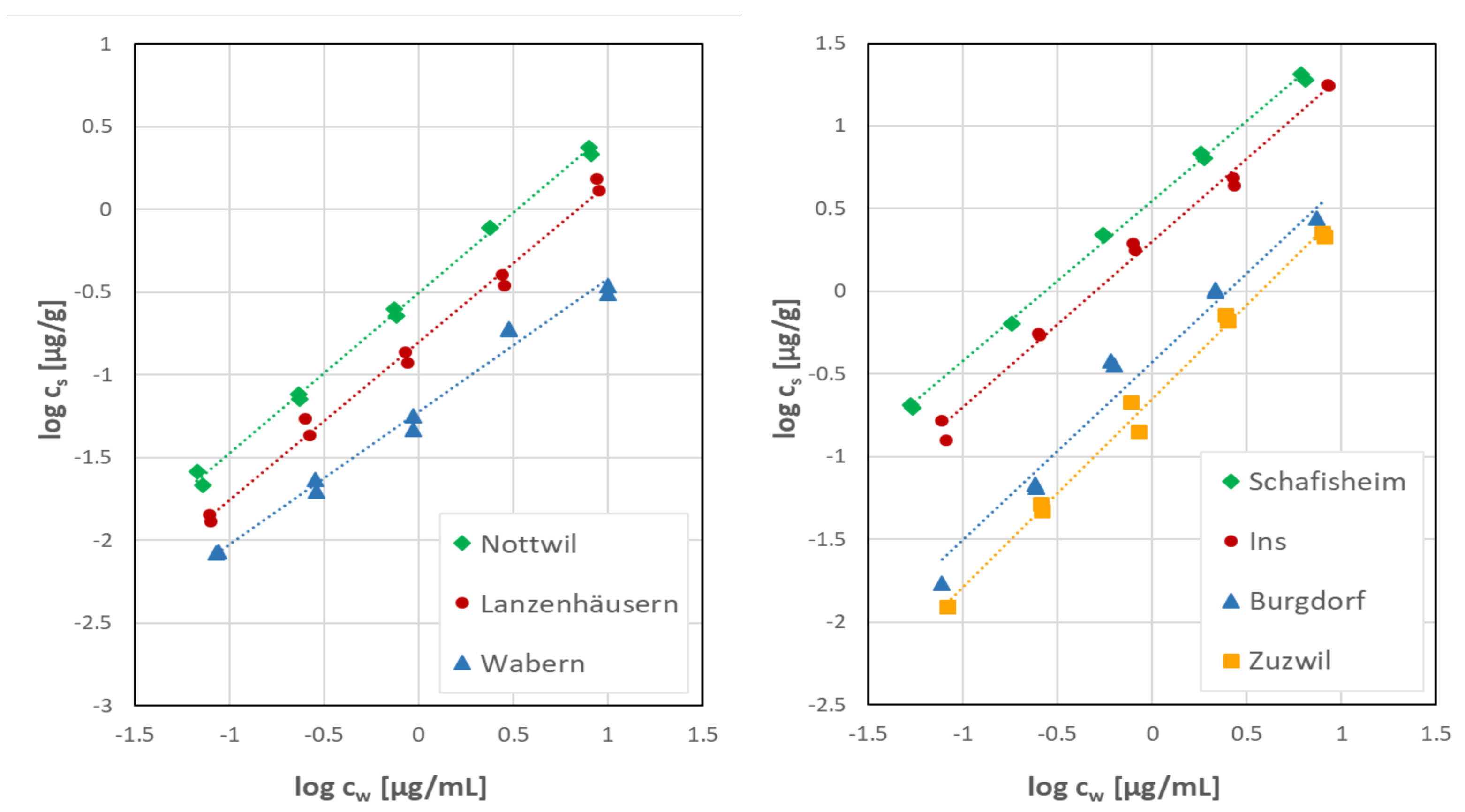

Figure 2: Adsorption isotherms for pelargonic acid-D_{17} in 3 subsoils from railway tracks (left) and 4 alkaline topsoils (right).

Conclusion

- Very rapid degradation with DT50s of << 1 day
- Substantial, yet pH dependent sorption
- Minimal leaching potential, even in alkaline subsoils with low organic carbon content
- No leaching to groundwater above 0.1 µg/L expected when applied as herbicidal active substance for vegetation control on railway tracks

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