Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31374

REACTIVITY AND MOBILITY OF NEW PHYTOSANITARY ALKALOIDS IN AGRICULTURAL AND CARBONATE SOILS OF BEAUCE (FRANCE)

EMMY VOGLEVAIE[1], CLAUDE LE MILBEAU[1], BOUAMAMA ABBAR[1,2], NICOLAS FRESLON[1], FABRICE MULLER[3], HAMDI SANAA[4], AURÉLIE PIVERT[1], MOHAMED BOUJOUDAR[1], CYRIL NICOLAS[4], ISABELLE GILLAIZEAU[4] AND MOHAMED AZAROUAL[1,5]

[1]ISTO, UMR 7327 (Univ. Orléans, CNRS, BRGM), Orléans, France
[2]LOMC, UMR 6294 (Univ. Le Havre-Normandie, CNRS), Le Havre, France
[3]ICMN, UMR 7374 (Univ. Orléans, CNRS), Orléans, France
[4]ICOA, UMR 7311 (Univ. Orléans, CNRS), Orléans, France
[5]BRGM French Geological Survey, 45060 Orléans, France.

The development of new pesticides and the study of their behavior in soils are essential for finding new chemicals non-toxic to humans and the environment. Understanding the mechanisms that control their reactivity (either physical or chemical), and their mobility within the vadose zone is essential for assessing the risk of groundwater contamination. Natural alkaloids containing a 4-hydroxy-2-pyridone (4H2P) core offer a wide variety of structures, granting them diverse biological activities, including insecticide, fungicide, bactericide, cytotoxic properties [1]. These characteristics make them promising candidates for the development of new crop protection products. This study investigates the mobility of two synthetic 4H2P alkaloids in agricultural and limestone soils, as well as their interactions with mineral phases. The soil samples used were collected from the O-ZNS (Observatory of transfers in Vadose zone) site in Villamblain (France).

Dynamic column elution experiments show that 4H2P alkaloids are more strongly retained in agricultural soil than the tracer, probably due to their interactions with mineral reactive phases and soil organic matter. In reconstructed limestone columns, their behavior differs depending on the nature substituents presents on the molecule: the less polar studied 4H2P alkaloid is more retained on the column with a long residence time, whereas the second displays a residence time comparable to the tracer, without being fully recovered. Adsorption isotherms performed on various soils and mineral phases showed that these molecules are mainly adsorbed onto smectite, and to a lesser extent on kaolinite. However, modelling of the experimental data suggests that the mean free energy values are low (< 8KJ/mol), indicating a physisorption mechanism. As a result, the molecule can be retained in soil, and remobilized with minimal energy input, particularly in soils with low organic matter content. The experiment elution data were further used to simulate and model the reactive transport of these molecules, incorporating calculated transfer, sorption, and interaction parameters.

Reference

[1] Ding et al., (2014), Chemistry - An Asian Journal 9, 2548−2554. DOI: 10.1002/asia.201402466.