



## Identification of potential pesticide accumulation processes in soil

Romualda Bejger<sup>1</sup>, Aleksandra Ukalska-Jaruga<sup>3</sup>, Irmina Ćwieląg-Piasecka<sup>2</sup>, Jerzy Weber<sup>2</sup>, Lilla Mielnik<sup>1</sup>, Elżbieta Jamroz<sup>2</sup>, Maria Jerzykiewicz<sup>4</sup>, Magdalena Dębicka<sup>2</sup>, Jakub Bekier<sup>2</sup>, and Andrzej Kocowicz<sup>2</sup>

<sup>1</sup>West Pomeranian University of Technology in Szczecin, Department of Bioengineering, Physics and Agrophysics Lab, Szczecin, Poland

<sup>2</sup>Wrocław University of Environmental and Life Sciences, Institute of Soil Science and Environmental Protection, Wrocław, Poland

<sup>3</sup>Institute of Soil Science and Plant Cultivation – State Research Institute, Puławy, Poland

<sup>4</sup>University of Wrocław, Faculty of Chemistry, Wrocław, Poland

**The aim of the research** was to identify potential processes influencing the accumulation and persistence of pesticides in soils.

The pesticides have been the most effective and modern method of counteracting threats to the yield from biotic factors, despite numerous controversies related to their negative impact on the environment. A natural storage of all types of contaminations in ecosystems, including pesticides, is soil. Pesticides behavior in soils is determined by various processes including volatilization, uptake by plants, leaching and runoff, sorption and binding by soil components, chemical degradation by hydrolysis, oxidation – reduction and photolysis processes as well as degradation by soil microorganisms [2]. Many of these mechanisms depend on molecular properties of individual pesticides and accompanying substances occurring in plant protection products. A strong influence on behavior of pesticide in the environment is related to their formulation/composition. The accompanying substances such as synergists, buffers, activators, organic solvents, adsorbents, fillers, or adjuvants may significantly modify the physical and chemical properties of the active substance. According to numerous studies, these compounds have an effect on availability, durability, mobility, and, in consequence, biologic characteristics of the pesticides in soils [4, 5].

According to the literature data, accumulation of pesticides in soils is strictly dependent on the sorption - desorption mechanisms with soil organic and mineral particles. The extent of these processes depends on the properties of soil and the compounds such as molecular size, shape, configuration, structure, functional groups, solubility, polarity, polarizability, charge distribution of interacting species and acid-base nature [3]. Moreover, the pesticides adsorption involves two phases including (1) macroscopic process (macro sorption) which includes surface sorption where the equilibrium constant is reached relatively fast as well as (2) microscopic process (micro sorption) which requires longer contact between soil and pesticide, related to diffusion of pesticides into inner active layers. Both processes lead to pesticide enclosing in 3D - structure of

the organic matter or in interpocket space of clay minerals [1-5].

The number of processes that determine the behavior of pesticides may occur simultaneously or individually, nevertheless, it is important to identify them in detail in terms of counteracting soil degradation or undertaking appropriate soil remediation processes.

#### Literature:

1. Bejger, R.; Włodarczyk, M.; Waszak, M.; Mielnik, L.; Nicia, P. The adsorption of pendimethalin by peats and lakes bottom sediments. *Ecol. Chem. Eng. A*. **2014**, 21(1), 79-87.
2. Pignatello, J. Dynamic interactions of natural organic matter and organic compounds. *J. Soil. Sediment*. **2012**, 12, 1241-1256.
3. Mamy, L.; Barriuso, E. Desorption and time-dependent sorption of herbicides in soils. *Eur. J. Soil. Sci*. **2007**, 58, 174-187.
4. Ukalska-Jaruga, A.; Smreczak, B.; Siebielec, G. Assessment of Pesticide Residue Content in Polish Agricultural Soils. *Molecules*. **2020**, 25, 587doi:10.3390/molecules25030587.
5. Włodarczyk M. Influence of formulation on mobility of metazachlor in soil. *Environ Monit Assess*. **2014**, 186, 3503-3509.

#### Acknowledgements:

This work was supported by the National Science Center (NCN) Poland (project No 2018/31/B/ST10/00677 "Chemical and spectroscopic properties of soil humin fraction in relation to their mutual interaction with pesticides").