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BOOK OF ABSTRACTS

26-27 GIUGNO 2024
UNIVERSITÀ DI FIRENZE,
CAMPUS DI NOVOLI, EDIFICIO D6

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Kinetic modelling of acetamiprid, metalaxyl, S-metolachlor and terbuthylazine dissipation in a full-scale free water surface constructed wetland in Emilia Romagna region

Enrico Buscaroli^{1*}, Stevo Lavrnić¹, Attilio Toscano¹, Ilaria Braschi¹

¹Department of Agricultural and Food Sciences, Alma Mater Studiorum Università di Bologna. Viale Giuseppe Fanin 44, 40127 Bologna (BO)

*E-mail: enrico.buscaroli2@unibo.it

Abstract

Our research examined the effectiveness of a 3700 m² vegetated free water surface (FWS) constructed wetland (CW) in managing agricultural runoff water contaminated with pesticides. The study simulated a 0.1% pesticide runoff event due to an 88 mm rain on an adjacent 12.5 hectares farm in a rural area of the Bologna province, Italy. Acetamiprid, metalaxyl, S-metolachlor, and terbuthylazine were dispersed in 1 cubic meter of water and were admitted into the CW. Over a period of four months, sediment and water samples were collected at various intervals from the CW to assess pesticide concentration. Multiresidue analyses were carried out by liquid chromatography-mass spectrometry. No detectable pesticide traces were found in wetland sediments throughout the period considered, suggesting that active principles remain suspended in the water column either absorbed by organisms or bound to dissolved organic matter. The dissipation of pesticides within the water column was modelled using Single First Order (SFO), First Order Multi-Compartment (FOMC), and Double First Order in Parallel (DFOP) kinetic models, following European Food Safety Authority (EFSA) best data practices. DFOP model showed the best fit to the observed data. The modelled distribution of each pesticide between the biomass and water in the CW showed a strong correlation with environmental indicators such as K_{ow} and bioconcentration factor. Computed DT₉₀ values according to DFOP model were 7.206, 26.64, 5.153, and 6.799 days for acetamiprid, metalaxyl, S-metolachlor, and terbuthylazine, respectively. The wetland was proven effective in treating pesticides-contaminated agricultural runoff water within a reasonable timeframe. Thus, it is confirmed the relevance of said infrastructure within the scope hydraulic and water quality buffer, as well as their role as ecological niches.

Keywords

Agricultural water quality; Pesticides dissipation; Constructed Wetland