

Currently Use Pesticides: Fate, Availability, and Effects in Soils

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Abstract : The currently used pesticides represent a broad group of chemicals with various physicochemical and environmental properties which input has reached 2×10^6 tons/year and is expected to even increase. From that amount, only 1% directly interacts with the target organism while the rest represents a potential risk to the environment and human health. Despite being authorized and approved for field applications, the effects of pesticides in the environment can differ from the model scenarios due to the various pesticide-soil interactions and resulting modified fate and behavior. As such, a direct monitoring of pesticide residues and evaluation of their impact on soil biota, aquatic environment, food contamination, and human health should be performed to prevent environmental and economic damages. The present project focuses on fluvisols as they are intensively used in the agriculture but face to several environmental stressors. Fluvisols develop in the vicinity of rivers by the periodic settling of alluvial sediments and periodic interruptions to pedogenesis by flooding. As a result, fluvisols exhibit very high yields per area unit, are intensively used and loaded by pesticides. Regarding the floods, their regular contacts with surface water arise from serious concerns about the surface water contamination. In order to monitor pesticide residues and assess their environmental and biological impact within this project, 70 fluvisols were sampled over the Czech Republic and analyzed for the total and bioaccessible amounts of 40 various pesticides. For that purpose, methodologies for the pesticide extraction and analysis with liquid chromatography-mass spectrometry technique were developed and optimized. To assess the biological risks, both the earthworm bioaccumulation tests and various types of passive sampling techniques (XAD resin, Chemcatcher, and silicon rubber) were optimized and applied. These data on chemical analysis and bioavailability were combined with the results of soil analysis, including the measurement of basic physicochemical soil properties as well detailed characterization of soil organic matter with the advanced method of diffuse reflectance infrared spectrometry. The results provide unique data on the residual levels of pesticides in the Czech Republic and on the factors responsible for increased pesticide residue levels that should be included in the modeling of pesticide fate and effects.

Keywords : currently used pesticides, fluvisols, bioavailability, Quechers, liquid-chromatography-mass spectrometry, soil properties, DRIFT analysis, pesticides

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