Surface runoff and subsurface tile drain losses of neonicotinoids and companion herbicides at edge-of-field*

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With their application as seed coatings, the use of neonicotinoid insecticides increased dramatically during the last decade. They are now frequently detected in aquatic ecosystems at concentrations susceptible to harm aquatic invertebrates at individual and population levels. This study intent was to document surface runoff and subsurface tile drain losses of two common neonicotinoids (thiamethoxam and clothianidin) compared to those of companion herbicides (atrazine, glyphosate, S-metolachlor and mesotrione) at the edge of a 22.5-ha field under a corn-soybean rotation. A total of 14 surface runoff and tile drain discharge events were sampled over two years. Events and annual unit mass losses were computed using flow-weighted concentrations and total surface runoff and tile drain flow volumes. Detection frequencies close to 100% in edge-of-field surface runoff and tile drain water samples were observed for thiamethoxam and clothianidin even though only thiamethoxam had been applied in the first year. In 2014, thiamethoxam median concentrations in surface runoff and tile drain samples were respectively 0.46 and 0.16 mg/L, while respective maximum concentrations of 2.20 and 0.44 mg/L were measured in surface runoff and tile drain samples during the first post-seeding storm event. For clothianidin, median concentrations in surface runoff and tile drain samples were 0.02 and 0.01, mg/L, and respective maximum concentrations were 0.07 mg/L and 0.05 mg/L. Surface runoff and tile drain discharge were key transport mechanisms with similar contributions of 53 and 47% of measured mass losses, respectively. Even if thiamethoxam was applied at a relatively low rate and had a low mass exportation value (0.3%), the relative toxicity was one to two orders of magnitude higher than those of the other chemicals applied in 2014 and 2015. Companion herbicides, except glyphosate in tile drains, exceeded their water quality guideline during one sampling campaign after application but rapidly resumed below these limits.

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