Insecticides lead to starvation of aquatic organisms

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Topics: Pollutants | Biodiversity

Neonicotinoid insecticides have adverse effects not only on bees but also on freshwater invertebrates. Exposure to low but constant concentrations of these substances – which are highly soluble in water – has lethal effects on these aquatic organisms.

At the end of April, the EU imposed a 2-year ban on the use of neurotoxic agents belonging to the neonicotinoid group. In Switzerland, the Federal Office for Agriculture (FOAG) has followed suit, suspending the authorizations of three insecticides used on oilseed rape and maize fields. These measures have been taken in response to evidence that neonicotinoids are toxic to honeybees and are contributing to the decline of bee colonies.

Problems seen with constant exposure

An Eawag study published today in the journal PLOS ONE (Public Library of Science) now shows that at least one of the insecticides in this class also has toxic effects on freshwater invertebrates. In this study, native freshwater shrimps (gammarids) were exposed to pulsed high and to constant low concentrations of imidacloprid. Peak concentrations typically occur when rain falls on farmland during or shortly after the application of insecticides; these soluble but persistent substances can then enter surface waters via runoff. Interestingly, pulses lasting no more than a day proved less harmful to the organisms than concentrations that were much lower but persisted for several days or weeks. While organisms transferred to clean water after pulsed exposure recovered relatively rapidly, constant exposure led to starvation after 2 to 3 weeks. This was because the organisms' mobility and feeding behaviour was impaired by the neurotoxin.

Überlandstrasse 133
CH-8600 Dübendorf
T +41 58 765 55 11
F +41 58 765 50 28
info@eawag.ch
www.eawag.ch
eawag aquatic research

Failure of conventional toxicity testing

The slow starvation effect observed under constant exposure to low levels of neonicotinoids is not detected by conventional toxicity tests, as they are not carried out over a period of several weeks. In addition, the study indicated that seasonal and environmental factors can be crucial: the results of the experiments are significantly affected by organisms' initial fitness and lipid reserves. To eliminate these effects and to identify processes other than starvation that influence survival rates in aquatic organisms, the research team has also developed a mathematical model which makes it possible to predict harmful concentrations and exposure times.

Originalpaper

Nyman A-M, Hintermeister A, Schirmer K, Ashauer R (2013) The Insecticide Imidacloprid Causes Mortality of the Freshwater Amphipod Gammarus pulex by Interfering with Feeding Behavior. PLoS ONE 8(5): e62472. doi:10.1371/journal.pone.0062472

Gammarus pulex – the test species – eating leaf material
Photo: Eawag

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Contact

Überlandstrasse 133
CH-8600 Dübendorf
T +41 58 765 55 11
F +41 58 765 50 28
info@eawag.ch
www.eawag.ch

Andri Bryner
Media officer
Tel. +41 58 765 5104
andri.bryner@eawag.ch

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