

Environmental risks of mosquito control with *Bacillus thuringiensis israelensis* (Bti)

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The midge species *Chironomus riparius* in the standardised laboratory study.
Credit: Carsten Brühl

Researchers of the University Koblenz-Landau studied the sensitivity of midges, central food resources of wetlands in a standardised laboratory design against the biocide Bti used in mosquito control. The young larval stages were up to 100 times more sensitive than the older stages and are more than 200 times below the environmental concentrations used in the Upper Rhine Valley, Germany. The data indicate the crossing of a risk threshold factor used in biocide regulation by three orders of magnitude. A potential risk for other animal groups via food web effects in treated conservation areas cannot be excluded.

Mosquito control is established at a global scale and along the Upper Rhine Valley in Germany a treatment scheme is in place for decades. Mosquito control based on the use of *Bacillus thuringiensis israelensis* (Bti) is regarded as an environmental friendly method, because it efficiently kills mosquitos but has no lethal effects on other organisms. However, the closely related non-biting midges, present in high abundances and species numbers in wetlands, are also Bti sensitive. Midges represent central food sources in wetland food webs because of their high biomass and protein content. Their larvae are eaten by other aquatic insects and fish, the emerging adults represent food for birds, bats or dragonflies.

The environmental scientists of the University Koblenz-Landau studied the sensitivity of the midge *Chironomus riparius* against Bti concentrations following the entire life cycle including four larval stages. Until now only data for older larval stages were available, and generally a higher sensitivity of younger, smaller larvae is assumed. The researchers around Carsten Brühl used an OECD approved test design for their

study, established for the risk assessment of pesticides.

The results show that the youngest larvae are up to 100 times more sensitive than the oldest 4th instar larvae. Their sensitivity was more than 200 times below the lowest field application concentration used in mosquito control in the Upper Rhine Valley. Using the new data of the most sensitive larval stage together with the lowest resulting Bti field concentration indicates a 2000 time exceedance of a risk threshold factor.

The conducted laboratory study represents a simplification of environmental conditions. "In reality the efficiency of Bti can be reduced by the presence of sediments, water turbidity and other factors" explains Carsten Brühl, however "the high values indicate probable effects on midges in Bti treated wetlands."

In currently available field studies in different ecosystems around the world some showed effects on midges, others did not. "The results are dependent on the environmental conditions of the studied wetlands; salt marshes have different species compositions than floodplains of large rivers" clarifies the researcher. Recent studies in France showed effects on wetland food webs in Bti treated areas. "A solid evaluation of possible Bti [food](#) web effects in the Upper Rhine Valley are difficult since, contrary to Sweden, the USA or France, no long-term monitoring with control areas was established in Germany" regrets Carsten Brühl. As an environmental friendly alternative compared to other insecticides Bti is used multiple times per year in the Upper Rhine Valley in nature conservation areas of European value. The sensitivity of midges against Bti and their possible large scale reduction in treated areas might violate nature protection goals.

More information: Anna Kästel et al. Decreasing *Bacillus thuringiensis israelensis* sensitivity of *Chironomus riparius* larvae with

age indicates potential environmental risk for mosquito control, *Scientific Reports* (2017). [DOI: 10.1038/s41598-017-14019-2](https://doi.org/10.1038/s41598-017-14019-2)

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