

# Improved regulation needed as pesticides found to affect genes in bees

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Bumblebee colony. Credit: TJ Colgan

Scientists are urging for improved regulation on pesticides after finding that they affect genes in bumblebees, according to research led by Queen Mary University of London in collaboration with Imperial College London.

For the first time, researchers applied a biomedically inspired approach to examine changes in the 12,000 genes that make up bumblebee workers and queens after [pesticide exposure](#).

The study, published in *Molecular Ecology*, shows that genes which may be involved in a broad range of biological processes are affected.

They also found that queens and workers respond differently to pesticide exposure and that one pesticide they tested had much stronger effects than the other did.

Other recent studies, including previous work by the authors, have revealed that exposure even to low doses of these neurotoxic pesticides is detrimental to colony function and survival as it impairs bee behaviours including the ability to obtain pollen and nectar from flowers and the ability to locate their nests.

This new approach provides high-resolution information about what is happening at a [molecular level](#) inside the bodies of the bumblebees.

Some of these changes in [gene activity](#) may represent the mechanisms that link intoxicification to impaired behaviour.

Lead author of the study Dr. Yannick Wurm, from Queen Mary University of London, said: "Governments had approved what they thought were 'safe' levels but pesticides intoxicate many pollinators, reducing their dexterity and cognition and ultimately survival. This is a major risk because pollinators are declining worldwide yet are essential for maintaining the stability of the ecosystem and for pollinating crops.

"While newer pesticide evaluation aims to consider the impact on behaviour, our work demonstrates a highly sensitive approach that can dramatically improve how we evaluate the effects of pesticides."

The researchers exposed colonies of bumblebees to either clothianidin or imidacloprid at field-realistic concentrations while controlling for factors including colony social environment and worker age.

They found clothianidin had much stronger effects than imidacloprid—both of which are in the category of 'neonicotinoid' pesticides and both of which are still used worldwide although they were banned in 2018 for outdoor use by the European Union.

For worker bumblebees, the activity levels of 55 genes were changed by exposure to clothianidin with 31 genes showing higher activity levels while the rest showed lower activity levels after exposure.

This could indicate that their bodies are reorienting resources to try to detoxify, which the researchers suspect is what some of the genes are doing. For other genes, the changes could represent the intermediate effects of intoxicification that lead to affected behaviour.

The trend differed in queen bumblebees as 17 [genes](#) had changed activity levels, with 16 of the 17 having higher activity levels after exposure to the clothianidin pesticide.

Dr. Joe Colgan, first author of the study and also from Queen Mary University of London, said: "This shows that worker and [queen](#) bumblebees are differently wired and that the pesticides do not affect them in the same way. As workers and queens perform different but complementary activities essential for colony function, improving our understanding of how both types of colony member are affected by pesticides is vital for assessing the risks these chemicals pose."

The researchers believe that the approach they have demonstrated must now be applied more broadly. This will provide detailed information on how pesticides differ in the effects they have on beneficial species, and

why species may differ in their susceptibility.

Dr. Colgan said: "We examined the effects of two pesticides on one species of [bumblebee](#). But hundreds of pesticides are authorised, and their effects are likely to substantially differ across the 200,000 pollinating insect species which also include other bees, wasps, flies, moths, and butterflies."

Dr. Wurm added: "Our work demonstrates that the type of high-resolution molecular approach that has changed the way human diseases are researched and diagnosed, can also be applied to beneficial pollinators. This approach provides an unprecedented view of how bees are being affected by [pesticides](#) and works at large scale. It can fundamentally improve how we evaluate the toxicity of chemicals we put into nature."

**More information:** 'Caste- and pesticide-specific effects of neonicotinoid pesticide exposure on gene expression in bumblebees'. Thomas J. Colgan, Isabel K. Fletcher, Andres N. Arce, Richard J. Gill, Ana Ramos Rodrigues, Eckart Stolle, Lars Chittka and Yannick Wurm. *Molecular Ecology*.

Provided by Queen Mary, University of London

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