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Pesticides responsible for bee poisoning: new screening technique proposed

A technique that can detect the array of pesticides bees might be exposed to has been developed in Poland. The simplicity, speed and small sample sizes required for screening makes this technique an improvement over other methods, say the researchers behind its development.

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Pesticides are used to protect agricultural crops, however, some may affect bee health, with their toxicity depending on the active substance used and the formulation of different pesticide products. The risk of influencing bee health also increases when, amongst other potential factors, legal requirements or good practice for pesticide application have not been followed. Bees can be exposed to pesticides when spray drifts onto non-target fields of crops in bloom, or nearby wildflowers or beehives, contaminating pollen and nectar. In cases where exposure is suspected, it is necessary to analyse dead bee samples and identify the cause of death and the pesticides possibly involved.

This study presents a promising technique to screen dead honeybees for a range of pesticides that may have led to their death. In all, 153 active substances, found in commonly used plant protection products, including acaricides (active against mites), fungicides, herbicides and insecticides, can be extracted and detected.

The method first extracts pesticide residues from bee samples using a technique called matrix solid-phase dispersion (MSPD) and then separates and identifies the different pesticides using gas chromatography, a form of chemical analysis.

Preparing the bees for screening is a crucial step, as beeswax, proteins and other substances can interfere with pesticide analysis. During the MSPD procedure, the pesticide extraction and clean-up of the samples is accomplished in the same step, requiring only small solvent volumes (25 ml) and small sample sizes (2 g or 23-29 bees) making the process quick, easy and efficient for routine analysis, without requiring specialised equipment.

To demonstrate the method, 33 samples of bees from different regions of Poland were analysed for pesticide residues. In all, 14 insecticides and three fungicides were detected. Of these, two groups of insecticides were most commonly found: pyrethroids (e.g. cypermethrin and bifenthrin) and organophosphates (e.g. chlorpyrifos and dimethoate). Cypermethrin was found in 51% of the samples. Zeta-cypermethrin was the most toxic form of cypermethrin identified and was found in 33% of the bee samples in concentrations varying between 0.002 to 0.528 micrograms per bee. This represents 89 to 26385%, respectively, of the acute contact toxicity value, LD_{50} (the amount of pesticide that kills 50% of the exposed population).

A combination of two pesticides were identified in 13 of the bee samples, three pesticides were found in two samples and one sample contained five pesticides, underlining the extent to which honeybees may be exposed to multiple pesticides.

Although the use of organochlorines, such as DDT and lindane, has been banned in Poland for over 10 years, traces were detected in bee samples from the southeast of Poland. These substances were not considered responsible for the bee deaths, as the concentrations were too low, but their detection reveals that the environment is still contaminated by these toxins.