

Pesticide Residues and Bee Mortality

Subjects: Zoology

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Honeybee health can be compromised not only by infectious and infesting diseases, but also by the acute or chronic action of certain pesticides. In recent years, there have been numerous reports of colony mortality by Italian beekeepers, and it was deemed necessary to draw up national guidelines with the aim of standardizing sampling active ties. In this paper, we present the results of a survey carried out in Italy from 2015 to 2019, following these guidelines. Residues of 150 pesticides in 696 samples were analyzed by LC-MS/MS and GC-MS/MS. On average, 50% of the honeybee samples were positive for one or more pesticides, insecticides being the most frequently detected, followed by organophosphates and neonicotinoids.

Keywords: honeybees ; pesticides ; mortality

1. Introduction

Honeybee health can be compromised not only by infectious and infesting diseases, but also by the acute or chronic action of certain pesticides. In recent years, there have been numerous reports of colony mortality by Italian beekeepers, but the investigations of these losses have been inconsistent, both in relation to the heterogeneity of personnel involved (beekeepers, official veterinarians, members of the police force, etc.) and procedures used. It was therefore deemed necessary to draw up national guidelines with the aim of standardizing sampling active ties. In this paper, we present the results of a survey carried out in Italy from 2015 to 2019, following these guidelines. Residues of 150 pesticides in 696 samples were analyzed by LC-MS/MS and GC-MS/MS. On average, 50% of the honeybee samples were positive for one or more pesticides with an average of 2 different pesticides per sample and a maximum of seven active ingredients, some of which had been banned in Europe or were not authorized in Italy. Insecticides were the most frequently detected, mainly belonging to the pyrethroid group (49%, above all tau-fluvalinate), followed by organophosphates (chlorpyrifos, 18%) and neonicotinoids (imidacloprid, 7%). This work provides further evidence of the possible relationship between complex pesticide exposure and honeybee mortality and/or depopulation of hives.

2. Results of Data Analysis

The data collected following the five-year monitoring survey showed that the application of ministerial guidelines allows the gathering of data on honeybee mortality incidents at national level in a consistent and reliable manner. We have shown that honeybee mortality events are still occurring and widespread, and that honeybees and beehive products are widely exposed to a large number of substances used legally and illegally, in agricultural practices and in beekeeping. In the honeybee matrix, 50% of the samples were found to be positive, while a greater proportion of the other matrices were contaminated. The honeybee is certainly the most interesting matrix for this study but also the most delicate from an analytical point of view, considering that laboratory results may be affected by various factors, from meteorological aspects to beekeeper reporting times and consequently the intervention of the official veterinarian responsible for sampling. This could potentially result in an underestimation of the problem. As a consequence, beekeepers and official veterinarians need to be highly aware and well informed of this problem to ensure that reporting and samplings are as punctual and prompt as possible. It is also important for the laboratory assigned to sample analysis to be aware of the problems linked to the possibility of pesticide concentration decreasing rapidly in dead bees and therefore of the best ways to conserve the samples before analysis. The pesticide panel must also be kept up to date, based on the continuous evolution of the pesticides available on the market. Furthermore, the notification of honeybee killing incidents to the competent national and regional authorities could contribute to increase the awareness of farmers about the possible impact on honeybees of PPPs application. Moreover, this awareness could lead to a more reasonable application of the mitigation measures (established at regional level), such as proper maintenance of PPP application machines together

with the use of deflectors to reduce the drifting of active ingredients during treatment, as well as to cut the grass on the orchard or vineyard surface when blossoms are present. The latter measure could strongly reduce the risk of exposure of honeybees to contaminated sources of nectar and pollen, even when the orchard is not blooming.

Author's results, based on the appropriate management of bee killing events, as described above, together with laboratory investigations, could contribute to a better understanding of the influence of pesticide mixtures on honeybee health, even at sublethal concentrations. The application, for example, of otherwise sublethal doses of miticides when tau-fluvalinate and coumaphos are simultaneously present in the hive could lead to honeybee mortality^[1]. Likewise, great synergy is observed in the laboratory between EBI fungicides at field application rates and pyrethroids used as varroacides^[2]. The present type of forensic study cannot demonstrate a direct link between honeybee mortality and pesticide mixtures but does provide us with valid indications of the interactions between active ingredients and therefore the pesticides that warrant further study in the future.

References

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