Bees and ecotoxicology

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The OIE Reference Laboratory at the French Agency for Food, Environmental and Occupational Health and Safety (ANSES) in Sophia Antipolis has spent many years researching and, at the same time, analysing different components of the health of bee colonies to identify links between them.

The results have demonstrated that bee colonies face multiple exposure to low doses of pesticides in pollen [1], wax and honey.

The disease incidence was recorded, together with bee-keeping practices [2]. Diseases and bee-keeping practices were shown to be statistically linked to the excess winter mortality of colonies.

Evidence of multiple exposure to low pesticide doses has now led research to switch its focus to widespread diffuse mortality among bees, as opposed to acute mortality of entire colonies.

Low pesticide doses can also affect the life-history traits of bees (longevity, immunity), and this, in turn, has a deleterious effect on colonies in the medium or long term. However, field study protocols for an in depth study of such disorders are still under development; in particular, the tools needed to measure colony health. In this respect, a major breakthrough study published in 2012 has shown that sub-lethal exposure to an insecticide indirectly increases colony mortality, due to a poor return rate of foraging bees to the hive [3].

The unintended effects of pesticides on bees have been studied widely in honey bees (Apis mellifera). However, research teams have recently turned their attention to pesticide effects on wild bees. The results have shown that species with a different biology and ecology from those of honey bees are just as vulnerable to pesticides. These results are crucial to adjusting pesticide risk assessment models, as stated in a recent report by the European Food Safety Authority (EFSA) [4]. As with A. mellifera, account must be taken of a complex combination of exposure factors, which involve sub-lethal doses and affect the overall colony as well as individual bees, leading to acute and chronic mortality.

Where possible, for honey bees and bumblebees for example, there should be a laboratory phase to study the exposure of bees (adults or larvae) to combinations of pathogenic or toxic stress factors. Indeed, experiments have shown that bees exposed simultaneously to the Nosema ceranae parasite and an insecticide exhibit diminished social immunity, changes in biochemical criteria and increased mortality [5, 6].

Epidemiology is the study of diseases and health factors in a population. What makes epidemiology unique is that it applies to populations rather than individuals. Initially, it was applied to the study of bee pathogens. However, according to the definition of epidemiology, a number of factors must be considered simultaneously in an attempt to understand disease as a whole. Health factors cover all individual and environmental factors likely to influence health positively or negatively. This seems to call for the development of programmes to monitor mortality and impairment among bees generally.

Recent studies published in a number of countries have shown honey-bee colonies to be co-infected with several infectious agents. These protocols study several elements simultaneously: i.e. the observation of clinical signs in colonies; the detection and quantification of pathogens; and the detection and quantification of pesticide residues in different hive
matrices (Fig. 1). Authors face recurring difficulties in conclusively incriminating a single factor or decisive combination of factors, as evidenced by the results of surveillance programmes conducted in Germany [7], the United States and Greece. Depending on the protocols used, other studies blame one specific pathogen, such as *Varroa destructor* in Canada [8] or *Nosema ceranae* in Spain [9]. Extensive epidemiological studies are currently under way in Europe (EPILBEE2) and the United States2. These protocols will help to identify risk factors influencing honey-bee-colony mortality.

Fig. 1

Sampling pollen pellets from a honey-bee colony

References


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1 An introduction to this network is given on page 69
2 See page 71