

Press release – 26th January 2021

Hygienic honey bees are more resistant to destructive parasite

The parasitic mite *Varroa destructor* is a serious threat to honey bees, capable of decimating entire colonies. Identified as one of the causes behind the disappearance of bees around the world, this parasite is the focus of specific control measures integrated into France's 2020 Pollinator Plan. By analysing the honey bees' behavioural defences against this parasite, researchers from INRAE, the CNRS, the University of Rennes 1 and the University of Otago in New Zealand have discovered that varroa-infested brood emit a combination of molecules that trigger hygienic behaviour in some honey bees—piercing and cleaning contaminated brood cells—which allows them to preserve the colony. Their results, published on January 25th in *Nature Chemical Biology*, open up new possibilities in the fight against *Varroa destructor*, with the development of tests that should allow beekeepers to select the most resistant colonies.

Varroa destructor is a parasitic mite that affects honeybees. It originated in Asia, but has spread to almost every region of the world. Domestic honey bees, *Apis mellifera*, are particularly vulnerable to this parasite, which can cause the loss of a colony in just a few months, as well as significant economic losses for beekeepers. Although chemical treatments have existed since the 1980s, they have several drawbacks, including the appearance of parasite resistance, undesirable effects on bees and the presence of residues of substances in honey or royal jelly. Some honey bee colonies have been able to survive the mite without any treatment, thus showing resistance ability to *Varroa destructor*. The parasite reproduces by lodging in the brood cells of the hive, where bee larvae and pupae grow. By analysing their behaviour, researchers discovered that some bees are capable of detecting the parasite in the cells where it is present. These bees—called hygienic—open the contaminated cells to clean them, sacrificing the developing pupae but controlling the spread of the parasite and preserving the colony. But, how can they detect the parasite hidden in the cells?

To answer this question, researchers analysed and compared both infested and non-infested cells. They were able to identify six specific molecules in the infested cells that had never been identified in honey bees. They synthesised¹ these molecules and carried out several behavioural tests in order to know if the mixture of these molecules could trigger hygienic behaviour in the bees.

The team began by comparing the behaviour of bees faced with parasitized cells to those faced with cells that had been injected with a compound. In both cases, they observed a positive response from the bees—cleaning the cells. Researchers also studied the behaviour of different colonies with different levels of hygienic behaviour prompted by varroa. In colonies with high levels of hygiene, the bees identify and clean brood cells containing sick or dead larvae, which is not systematically done in colonies with a moderate level of hygiene, or at least, not to the same extent. The results show that the most hygienic colonies have a strong reaction towards brood cells containing the compounds. Within a colony, bees have different tasks and functions and only some of them exhibit the hygienic behaviour. In a last test, the researchers compared the response of hygienic and non-hygienic bees to the mixture of molecules. The

¹ Analysing and reproducing the identified molecules in the laboratory

results? All bees are capable of detecting the molecules in their antennae; however, only hygienic bees are able to integrate the information into the central level of the brain and, consequently, adopt a hygienic behaviour—cleaning the contaminated cells.

The discovery of the compound of molecules specific to *Varroa destructor*-infested brood cells opens up new perspectives for beekeepers in the fight against this pest. This would enable them to identify and select the colonies that might be more resistant to the parasite by studying their reaction to the compound of molecules. INRAE and the University of Otago have filed a patent on these molecules and their applications. Research is currently underway to develop reliable tests that can be used by beekeepers in order to select *Varroa destructor*-resistant colonies.

Reference:

Fanny Mondet, Solene Blanchard, Nicolas Barthes, Dominique Beslay, Celia Bordier, Guy Costagliola, Maxime R Hervé, Benoit Lapeyre, Seo Hyun Kim, Benjamin Basso, Alison R Mercer and Yves Le Conte, *Chemical detection triggers honeybee defence against a destructive parasitic threat*, Nature Chemical Biology (2021). DOI : <https://doi.org/10.1038/s41589-020-00720-3>

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