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Virus Resistance, Results of a Mass Breeding Program

In Belgium, researchers have found that selective breeding can improve honey bees' natural resistance to viruses, offering a promising way to strengthen colony health and reduce the impact of disease.

By Matteo Giusti



A honey bee specimen died with clear symptoms of DWV infection. (Photo by Stefan de Konink - Wikipedia).

Viruses are among the most dangerous pathogens affecting honey bees, causing colony depopulation, weakening colonies, and, in severe cases, colony losses. Viral diseases can be transmitted horizontally through food, trophallaxis, direct contact, and

contaminated materials, or vertically from queens and drones to their offspring. Moreover, the Varroa mite is a highly efficient vector that can increase viral loads within honey bee colonies.

However, can honey bees develop resistance to viral infections? And is it possible to select for this resistance through selective breeding?

A ten-year study conducted in Flanders, Belgium, suggests that selective breeding could help honey bees become more resistant to viral infections. The research, published in 2026 in the scientific journal Insects, investigated whether selecting queens with lower levels of viral infection could gradually improve the health of subsequent generations. The researchers, led by Emma Bossuyt of Ghent University, analysed samples collected between 2015 and 2024 as part of an established honey bee breeding programme.

The scientists focused on a genetic trait known as "suppressed *in ovo* virus infection" (SOV), defined as the absence of viruses in pooled samples of ten drone eggs. Queens were classified as SOV+ (positive) when no viral particles were detected in their drone egg samples, or as SOV− (negative) when genetic material from at least one of the viruses tested was detected. Four viruses were investigated in this study: deformed wing virus (DWV), sacbrood virus (SBV), acute bee paralysis virus (ABPV), and black queen cell virus (BQCV). The experiments involved several honey bee subspecies and breeding lines, including Apis mellifera carnica, Apis mellifera Buckfast, Apis mellifera mellifera, as well as queens of unknown subspecies.

The results were promising, showing an increase in the proportion of SOV+ queens over the ten-year period. The researchers also found that breeding from SOV+ maternal lines increased the likelihood of producing offspring displaying the same characteristic. At the same time, the study recorded a decline in both the prevalence and viral loads of several viruses within the bee population.

These findings suggest that resistance to viral infections can be improved through systematic selection, even within large-scale breeding programmes. Similar results were observed across the different honey bee subspecies and breeding lines included in the study.



A symptomatic queen cell affected by BQCV. (Photo by BeeHistory - Wikipedia)

The study also highlights the potential role of targeted mating in accelerating genetic progress. By selecting queens from virus-resistant maternal lines and implementing more controlled mating strategies, such as using selected drones at isolated mating stations or through instrumental insemination, beekeepers could increase the frequency of the SOV characteristic in future generations.

These findings provide encouraging evidence that genetic selection can contribute to healthier and more resilient honey bee populations. They demonstrate that breeding programmes can play an important role in improving honey bee resistance to viral infections. This approach could eventually become an important component of sustainable beekeeping, helping breeders develop colonies better equipped to cope with viral diseases.

Moreover, the researchers emphasise the need for further investigation, particularly into how SOV based selection and targeted mating can be combined with other resistance traits. For example, combining this approach with selection for resistance to Varroa destructor could offer an even more effective strategy for improving honey bee health.

References

Bossuyt et al. (2026) - **Evaluation of 10-Year Selection for Virus Resistance in a Mass Breeding Program** - Insects, vol. 17, issue 2