



# A Vaccine for Deformed Wing Virus?

New vaccine for AFB may have wider benefits

by Tina Sebestyen

There is an interesting correlation between the words ignored and ignorance. For most of my beekeeping life, I have heard about deformed wing virus (DWV), and have mostly ignored it because I have not seen many bees with deformed wings in my colonies. This is because I was ignorant about the facts regarding DWV.

One important fact is that the virus that causes the disease is almost always present in our honey bees, even if their wings look perfectly normal. Also, deformed wings aren't the worst part of the disease, only the obvious, observable part. Bees that are infected with many copies of the virus (or in science-speak have higher titers) while they are pupating can emerge from their cocoons with the classically deformed wings and may also have bloated abdomens and decreased adult size. Bees that don't get high titers of the virus until they are adults have normal-looking wings, which is why this disease can be obliterating the health of a colony without the beekeeper noticing a problem until collapse becomes imminent.

Even subclinical levels of DWV in bees can cause impaired cognitive function and reduced lifespan and foraging efficacy. Obviously, bees without functional wings can never fly, and thus will not be able to forage, or even take cleansing flights. But, the really bad part of being infected with DWV is that the bee's lifespan will be so dramatically reduced<sup>1</sup> that, even with functional wings, they will never be able to forage, nor even be helpful inside the hive for very long.

The eye-opener for me was reading<sup>2</sup> that DWV is the main reason that varroa is harmful to our colonies. This makes sense when I think about the higher concentrations of varroa my colonies could handle when I started beekeeping, versus the 2% model for

treatment that is the threshold now. Our mites back then weren't carrying the virus like they are now, they were just damaging the fat bodies of the bees (and therefore were down-regulating their immune systems, and compromising their ability to produce heat in winter, feed larval bees in winter, detoxify pesticides, store nutrients, and all of the other functions the fat body performs).

Deformed wing virus used to be spread most commonly from the queen to the egg, by trophallaxis, and by nurse bees feeding larvae. When it spreads by those means, the adult or larval bee just gets a small dose, so she doesn't develop the high titers of the virus that cause clinically apparent symptoms unless other stressors are present. Now, DWV is spread by our nemesis, *Varroa destructor*. When the virus is injected into the pupating honey bee by the mite, it gets a much bigger dose of the virus, and thus the high titer count that means disease symptoms are present, whether or not the wings are visibly deformed.

There are three major types of the virus: DWV-A, DWV-B, and DWV-C (rare).<sup>3</sup> DWV-A was originally the most prolific, while currently it has been replaced in many places by DWV-B, which is now understood to be more virulent and transmissible. Part of this may be because DWV-B can proliferate inside the mite. So now, when the foundress mite digs into a pupating honey bee's fat body to feed herself and her babies, she is injecting a heavy dose of DWV-B. The bee may or may not emerge with deformed wings, but she will suffer the shortened lifespan of an actively diseased bee while also feeding copies of the virus to her larval sisters before she dies. The colony may collapse suddenly in late summer or fall, when mite concentrations have risen to their highest proportion of the

year, with hardly a visible symptom. Until now, there has been no treatment, and no way to decrease DWV other than by controlling mites, which may or may not actually decrease the prevalence of disease once established.

Now there is a vaccine that may help. When I talked with company representatives about the vaccine for American foulbrood (AFB) at the North American Honey Bee Expo last winter, I thought that was great for the commercial beekeepers who struggle against that scourge, but it didn't sound like something we backyard beekeepers would need very much. It wasn't personally exciting until the guys from Dalan Animal Health mentioned in almost a whisper that it seemed from early clinical trial data to show protection against European foulbrood (EFB) and DWV. Even then, since I was unaware of just how pervasive and damaging DWV is, I was mostly excited about the prospect of something to help with EFB, which in some years can be quite difficult to deal with.

In additional testing last year (as yet unpublished<sup>1</sup>), vaccinated queens were placed in 200 colonies, and unvaccinated queens were placed in another 200. DWV was measured immediately before and four months after placement of the queens. Both sets of colonies started with the same concentrations of DWV and the same numbers of mites. Mite numbers rose equally in all colonies, but DWV was reduced by an average of 83% in the colonies with vaccinated queens.

Mites were controlled during the study using Amitraz in a normal commercial outfit with no special treatment other than the placement of the vaccinated queens. DWV was reduced in spite of the presence of mites in the colonies. These colonies were also tested for AFB, EFB, DWV-A, DWV-C, and sacbrood, but these pathogens

were not found, so there are no results to report. (A separate trial is being run this year directly against EFB.)

The reason Dalan Animal Health wasn't talking out loud about their vaccine's efficacy against DWV was because the USDA license they initially obtained was for AFB, and they wanted to build more data. Now they have substantial data from a large-scale field trial, and have submitted a new claim to USDA.

The vaccine is made of inactivated *Paenibacillus larvae*, the bacterium that causes American foulbrood. Why it causes a reduction in DWV remains a bit mysterious. "The level of protection was a complete surprise," said Nigel Swift, Dalan's Head of Sustainable Agriculture and One Health, in an interview with the Journal.

Just before press time, Dalan reported results (also unpublished) of a new, 2024 trial at Tauzer Apiaries (<https://tauzerbees.com/>). To assess use and effects of the vaccine in a commercial setting, 100 control and 100 vaccinated queens were introduced into 200 freshly made splits. Samples were taken from each group in April prior to queen placement, and in August (16 weeks post vaccination) after confirming queen status. Samples were submitted to the National Agricultural Genotyping Center (NAGC) in Fargo, South Dakota, to look at various disease levels. Four months after vaccination, DWV-B viral loads were 90% lower in vaccinated colonies than unvaccinated colonies.

"I'm excited about the proactive approach to bee health," Chief Operating Officer Trevor Tauzer said. "Our initial work with Dalan showed that the vaccine benefits both queens and hive health, and this trial now offers a reliable tool to prevent both AFB and DWV, allowing us to shift from managing infections to outright prevention."

It is postulated that the vaccine causes a general up-regulation of the immune system. "What we think is happening," Swift added, "is that somehow this vaccine may trigger expression of different proteins in the immune system." If this is the case, there is still the possibility that other diseases may be mitigated by the vaccine. Researchers have not seen anything that indicates a change in behavior of vaccinated colonies, so this should not decrease the hygienic behavior of VSH or mite-resistant bees. They say it does not change the DNA of the bee.

When the queens are vaccinated, they are caged with nurse bees. The *P.*



Nurse bees caged with queens feed them candy containing the vaccine.

*larvae* bacterin is mixed into bee candy, the nurse bees ingest the candy, and the vaccine is delivered to the queens as they are fed by the nurse bees. A vaccinated queen and her progeny should have a much reduced chance of suffering from AFB or DWV. Their chances of over-wintering success are much better. This benefit is not passed from the queen to a daughter queen.

The vaccine is sold in a vial with enough doses to vaccinate 50 queens. This is great for larger queen producers. For us backyarders, Dalan Animal Health has a listing of queen producers who sell individual, vaccinated queens. Prices range from \$45 and up, and some queens are even listed as also having VSH characteristics. I experimented with some VSH queens this summer, and it truly is wonderful to have bees that solve the varroa issue. Now that we can buy VSH queens that are also resistant to DWV-B, the cost of a queen is more than justified by the savings in mite treatments, work in the apiary, and fewer colony losses.

This vaccine is good news not only for our honey bees, but also for other bees such as bumble bees.<sup>4</sup> Honey bees and bumble bees can give DWV to each other in sharing flowers, so having vaccinated queens and thus lower DWV loads in our colonies means we can worry less about this possible negative impact. The vaccine is conditionally licensed by the USDA for protection against AFB, and Dalan Animal Health is working toward a claim extension for DWV protection. I can't wait to see how much further this might go if the conjecture that the vaccine upregulates the bees' immune system proves accurate.

#### FOOTNOTES

1. Isaac Weinberg, Amy Floyd, Nathan Reid, Nigel Swift, Reduction of Deformed Wing

Virus-B levels in Colonies of the Honey bee *Apis mellifera* after Queen Vaccination with inactivated *Paenibacillus larvae*, bioRxiv 2024.07.01.601551; <https://doi.org/10.1101/2024.07.01.601551>

This article is a preprint and has not been certified by peer review.

2. The Honey Bee Solution to Varroa, A Practical Guide for Beekeepers. Steve Riley, Northern Bee Books, 2024.
3. Robert J. Paxton, Marc O. Schäfer, Francesco Nazzi, Virginia Zanni, Desiderato Annoscia, Fabio Marroni, Diane Bigot, Eoin R. Laws-Quinn, Delphine Panziera, Christina Jenkins, Hassan Shafiey. Epidemiology of a major honey bee pathogen, deformed wing virus: potential worldwide replacement of genotype A by genotype B, International Journal for Parasitology: Parasites and Wildlife, 2022, Volume 18, Pages 157-171, (<https://www.sciencedirect.com/science/article/pii/S2213224422000451>)
4. Phillip Alexander Burnham, Samantha A. Alger, Brendan Case, Humberto Boncristiani, Laurent Hébert-Dufresne, Alison K. Brody. Flowers as dirty doorknobs: Deformed wing virus transmitted between *Apis mellifera* and *Bombus impatiens* through shared flowers. Journal of Applied Ecology, Volume 58, Issue 10 p. 2065-2074, 2021



**Tina** got started in bees in 2007. She learned from "old guy" mentors and from mentoring others as founder of the Four Corners Beekeepers Association. She keeps bees in Langstroth, long Langstroth, and top-bar bee hives, and depending on the year sells queens, nucs, or honey. She is a frequent contributor to American Bee Journal and Bee Culture, and travels and speaks all over the U.S.