LINKING VARROA TREATMENT WITH THE MITE'S LIFE CYCLE

Targeting all Varroa Mites in the Colony

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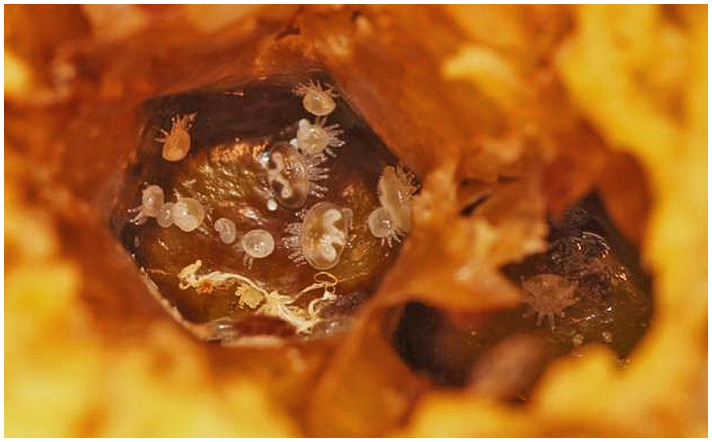
Beekeepers in the UK have successfully treated varroa (*Varroa destructor*) infestations in their colonies with MAQS® beehive strips since 2013. Despite convincing results and good experiences with the product, from time to time beekeepers approach NOD Apiary Products Ltd with questions about the strips.

In this article, we would like to address a couple of the more frequently expressed queries: how exactly does MAQS® cause mortality to varroa mites in the capped brood and why is it so important to target male mites? To understand the answers to these questions satisfactorily, it is essential to have an understanding of the varroa life cycle.

When beekeepers think of varroa mites, they usually picture small, flat, reddish brown bugs, attached to worker bees. These clearly visible adult varroa females are in the phoretic phase of their life cycle when they are carried about by the bees. During this stage, female mites feed on the haemolymph of worker bees, drones and – in rare cases – queens. Additionally, they use members of the honey bee colony as taxis to travel within the hive. When female mites enter their reproductive phase, they move into the open brood cells shortly before the worker bees cap the cells.



David Vanderdussen

Varroa mites reproduce under the cappings of worker or drone brood. Whenever brood is present in the colony, mites reproduce

The Life Cycle

About 60–72 hours after a brood cell has been capped, the soon-to-be varroa mother lays an unfertilised egg, which develops into a male. Next, the mother mite deposits female eggs in the same brood cell at 30-hour intervals[3]. All female eggs have been fertilised earlier, during the mating of the mother mite with her own brother. This happened right after both of them reached sexual maturity in the brood cell in which they hatched.

Both male and female varroa take five to six days to reach sexual maturity. As soon as the first daughter mite is sexually mature, she mates with her brother in the brood cell. The subsequent female mites do the same. Varroa matings take time and have to be repeated to ensure sufficient sperm is transmitted[4]. The main goal of the mite is efficient fertilisation, which explains why females prefer the longer developing drone brood over worker brood for reproduction. The mean number of fertilised female offspring produced in worker brood is 1.2 compared with 2.2 in drone brood[2, 6].

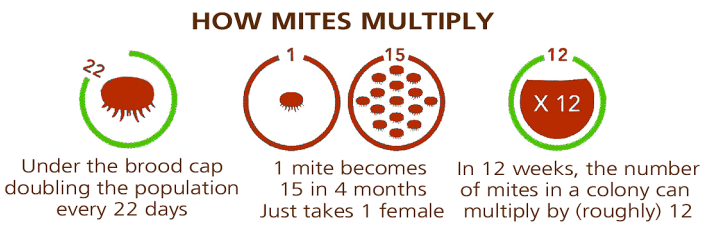
Once the male fulfils his purpose of mating with his sisters, he dies in the brood cell and his sisters emerge with the fully developed bee. The newly fertilised female mites enter the phoretic phase of their life cycle, together with their mother who can survive up to eight reproductive cycles.

This cycle is repeated as long as brood is present in the honey bee colony. Over just a couple of months, mites reproduce exponentially if the colony is left untreated or varroosis is not treated as a brood disease (Figure 1).

Critical Treatment Time

We can learn from looking at the varroa life cycle. By targeting the male mite, beekeepers have between 10 and 11 days to strike a major blow against varroa reproduction in their hives. When we add 60–72 hours (2½–3 days; the time before the first male egg is laid), plus 30 hours (2¼ days; the time before the next, female, egg is laid), plus 120–144 hours (5–6 days; the time for male and female mites to reach

Figure 1. The exponential increase in mites if left untreated



sexual maturity), we arrive at that critical time before the first mating occurs between the male and the first sexually mature sister.

But, why is it so important to target the mites in the brood cell, specifically the males?

First of all, when you see bees with the symptoms of deformed wing virus, it is because the bees were infected as developing brood. Most of the harm is done to the honey bee colony under the brood cappings.

Secondly, beekeepers should keep in mind that whenever there is bee brood in their colonies, about 70–80% of the varroa mites are located under the brood cappings, reproducing. This also means all varroa treatments that do not target the mites under the cappings are missing out on 70–80% of the varroa population for the first two weeks of treatment.

If this sounds like a missed opportunity to you, we agree.

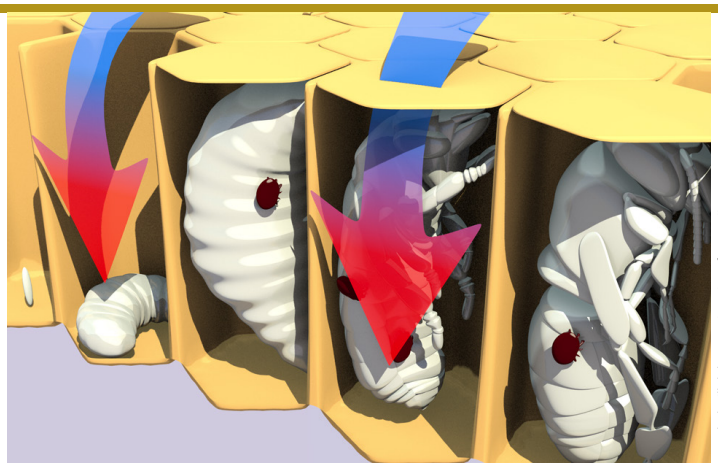
Varroa as a Brood Disease

Varroa infestations should be treated for what they are: a brood disease. This is exactly what the Canadian company NOD Apiary Products Ltd had in mind when developing the MAQS® Beehive Strips.

The decision to use formic acid as the active ingredient in the strips was a logical consequence of its aim to treat varroosis in the brood. Formic acid molecules are tiny enough to penetrate the brood capping[1] (Figure 2). In contrast to other substances, formic acid targets the entire varroa population in a honey bee colony.

Targeting the Males

As for purposefully targeting the males, consider these two aspects of the varroa life cycle.



Dr Ethel Villalobos, University of Hawaii

Figure 2. Formic acid vapour penetrates the brood cap through the wax layer on top

Firstly, male mites need to fertilise female eggs in order for the population to survive. If the treatment used can arrest the male mites before they mate with their sisters, those sisters will remain unfertilised. When they return to the brood area of the hive to reproduce, they will only be able to lay male eggs.

The second interesting fact about the male mite's life cycle is that he lives and dies in the brood cell in which he was born. Males develop under the brood capping and, during their last moult, their mouth parts change so that they lose the ability to eat and die of starvation after the baby bee emerges. This makes them a fixed target that is easy to locate[3].

MAQS® Beehive Strips are applied on the top bars in the centre of the brood nest, right where the males are hiding. The strips target both male and female mites where they reproduce, under the brood capping. Additionally, the polysaccharide gel formulation and the ecoFlex® and cellulose wick of MAQS® guarantee a controlled release of formic acid. The worker bees fan their wings and distribute the formic acid vapour throughout the hive. In doing so, they increase the movement of the vapour that penetrates the brood capping.

Successful control of the whole varroa population with MAQS® in the honey bee colony has been demonstrated repeatedly in field studies. In 2009, researchers at the University of Hawaii compared the percentage of deceased male varroa mites in hives that had been treated with MAQS® with untreated control hives. While they found 33% of males had died in the control hives, an average of 71% of males had died in the MAQS®-treated colonies. When comparing the mortality of young mites (sexually immature juveniles) in the hives, the result was even more striking: 90% of young mites succumbed to treatment with MAQS®, whereas only 18% of juveniles were found dead in the control hives[5].

These and other scientific studies clearly demonstrate the ability of MAQS® technology to target varroa mites where they reproduce, thereby arresting the exponential growth of mite populations.

Treating mite infestations as a brood disease and understanding the varroa life cycle are critical factors in keeping honey bees healthy.

If you have any questions about MAQS®, the varroa mite or varroosis, call, e-mail, Facebook or tweet us! At NOD Apiary Products Europe, our Bee Health Team's mission is to serve and support beekeepers to maintain healthy, vibrant honey bee colonies.

Wishing you all the best in your beekeeping. ♠

Sources

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6 Vanderdussen, D (2006). Varroa doubling info: understanding the boom and assessing your varroa treatment 'time purchase'. *American Bee Journal*, **146**(6), 525–527.

Copies of items 3, 5 and 6 can be downloaded from www.nodglobal.com/research.html

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