BIOLOGICAL SCIENCES

TROPİLAELAPS MİTES İN HONEYBEE COLONİES AND CONTROL MEASURES

Mahmudov S.,
Doctor of Philosophy in Engineering, Associate Professor
Scientific Research Institute of Animal Husbandry
Dunyamaliyev F.,
Director of the "Beekeeping" Center
Mammadov M.,
Laboratory Manager of the "Beekeeping" Center
Najafov R.
Laboratory Manager of the "Beekeeping" Center
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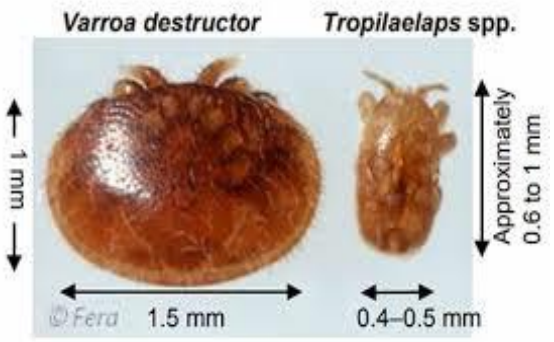
Abstract

Tropilaelaps mites are ectoparasitic organisms that feed on the hemolymph of honeybee pupae, leading to substantial damage to bee colonies. This infestation results in physical deformities in both pupae and adults, viral transmission, and a decline in colony productivity. The reproductive cycle of these mites is rapid and occurs exclusively within capped brood cells, which complicates effective control. Mitigation strategies include the application of formic acid, thymol, and queen bee caging. Research has demonstrated that appropriate intervention can halt mite proliferation and preserve colony productivity. Additionally, mite spread can be facilitated by the transfer of infected brood frames to healthy colonies and through robbing behavior. Consequently, beekeepers must vigilantly monitor these activities. Despite the cessation of egg-laying by queens in winter and low environmental temperatures, Tropilaelaps mites can remain dormant until spring. Although these mites typically perish within a few days in the absence of bees, some individuals can survive. Like Varroa destructor, Tropilaelaps mites are expected to continue spreading in apiaries, necessitating sustained control efforts and preventive measures by beekeepers and colony managers.

Keywords: Tropilaelaps mites, honeybee diseases, parasitic mites, formic acid, thymol, Varroa destructor, control strategies, queen bee caging, productivity, colony health.

Tropilaelaps mites are parasitic mites that feed on the hemolymph (blood) of male and worker bee pupae, and also reproduce on honeybee brood. Infestation with these mites leads to significant colony damage, including malformed pupae and adults (e.g., stunted growth, damaged appendages), parasitic mite syndrome (PMS), and a reduction in the worker bee population. This can result in colony failure or absconding, contributing to the dispersal of mites to new apiaries. Furthermore, Tropilaelaps mites are vectors of viral pathogens that exacerbate colony health deterioration and increase susceptibility to additional diseases**.**

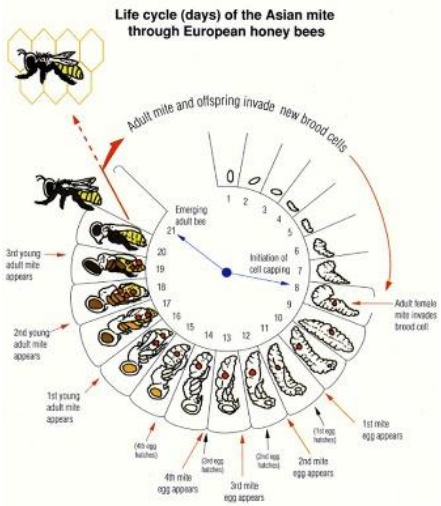
The life cycle of Tropilaelaps mites is very similar to that of Varroa mites, as both species are parasitic feeders on the developmental stages of honeybee brood. However, the life cycle of Tropilaelaps mites is shorter, giving them a higher reproductive rate compared to Varroa mites.



Studies based on foreign literature have shown that in some hives, both Varroa and Tropilaelaps mites can coexist in a honeybee colony. However, unlike Varroa mites, which can live for several months on adult bees, Tropilaelaps mites can only survive on adult worker bees for about 3 days, as the adult Tropilaelaps mite's mouthparts are unable to pierce the adult bee's body membrane and feed on it. For this reason, Tropilaelaps mites spend most of their life in the brood and continue to reproduce and survive within the honeybee colony as long as there are bees present.

Considering that Tropilaelaps mites cannot survive for a long time on adult bees, the vast majority of adult mites (>95%) will typically mate and enter the brood cell within 2 days after the adult bee emerges from the capped brood to lay more eggs.

Tropilaelaps mercedesae has a very limited dispersal phase because it does not require feeding after mating and can invade brood cells to lay eggs within less than two days after emerging. In comparison, V. destructor requires about five days after mating for the sperm to be ready to fertilize the female eggs. During this period, V. destructor primarily feeds on adult honeybees, which increases the likelihood of contact with lethal doses of treatment. This difference not only allows T. mercedesae to reproduce at an accelerated rate but also complicates control through chemical methods. The shortened dispersal phase limits T. mercedesae's ability to interact with long-term chemical treatments, ultimately reducing effectiveness. Amitraz-based medications are generally ineffective against Tropilaelaps in closed brood cells. Formic acid, due to its ability to penetrate cell cappings and kill mites hidden in capped brood cells, remains the only chemical that has been successfully tested for consistent and effective control of T. mercedesae.



Biology and Harm of Tropilaelaps Mites: Tropilaelaps mites, especially Tropilaelaps clareae and Tropilaelaps mercedesae, are parasitic mites that feed on the pupae of male and worker honeybees. By damaging honeybee larvae during their developmental stages, these mites cause the following problems in bee colonies:

• **Deformations**: The mites attack developing pupae, causing damage to the wings, legs, and abdomen

• **Spread of Viruses**: Tropilaelaps mites accelerate the spread of viruses within the bee colony.

• **Parasitic Mite Syndrome (PMS)**: This syndrome leads to the weakening of bee colonies and eventually results in the gradual destruction of the colony.

• **Reduced Productivity**: The weakening of the bee colony leads to decreased honey production and reduced pollination efficiency.

Tropilaelaps mites can cause deformities in both pupae and adults, leading to a reduction in the worker bee population. These mites can also carry viruses that affect the health of the bees. The female Tropilaelaps mite enters capped brood cells of worker and male bees, where it lays 1-4 eggs (usually 3 or 4). The development from egg to adult takes about a week, and the mature mites (usually around 2-3) will leave the brood cell along with the emerging young adult bee. While in the capped cell, the mite's larval stage is white and feeds on the developing bee. Adult Tropilaelaps mites are active, about 1 mm in length and typically 0.5 mm in width, making them roughly one-third the size of a Varroa mite. Since Tropilaelaps mites cannot survive for long on adult bees, the majority of adult mites (>95%) will mate and enter the brood cell within 2 days after the adult bee emerges from the capped cell to lay more eggs.

Simple Detection Methods for Mites in Bee Colonies. There are several methods for detecting Tropilaelaps mites. One of the quick, easy, and effective methods is the "capping" method. To collect mites using this method:

1. Remove a frame of capped brood from the bee colony.
2. Shake the adult bees off the frame.
3. Firmly strike one side of the frame onto a white surface.
4. Flip the frame over and strike it again.
5. Repeat steps 3 and 4, making a total of four strikes (two on each side).
6. Then, measure the quantity of mites.

Tropilaelaps mites will be visible on the white surface. It's important to remember that Tropilaelaps mites are small and move quickly, so using a white surface, such as a tray, is recommended to help collect the mites that fall off.

Control Measures for Tropilaelaps Mites: Widely recommended beekeeping management strategies for controlling Tropilaelaps include the use of healthy queen bees and the removal of brood frames that can be taken out. One successful cultural control method for treating Tropilaelaps infestations involves using queen cages. The population of Tropilaelaps mites in a bee colony can significantly decrease if the queen is caged for a period of nine days and the colony is deprived of brood by removing capped brood cells during this time. This period without brood reduces the mite population as the mites rely on the developing pupae for their reproduction.

To prevent the further spread of Tropilaelaps mites, serious monitoring programs have been established worldwide. The transportation of honeybees from a Tropilaelaps-infected area to a Tropilaelaps-free region should be done using bee packages (only adult

bees, without frames), rather than established colonies. These packages must be kept at least two days away from any honeybee colonies. After this two-day period, any Tropilaelaps mites carried within the package will die, as there is no brood to support mite feeding [1, 2]. According to other literature sources, caging the queen has been proven to increase the effectiveness of treatments for both *T. mercedesae* and *V. destructor*, forcing both mite species into an uncapped developmental stage where they cannot reproduce under the cell cappings [3, 4]. In addition to providing a potential treatment condition for *T. mercedesae*, caging the queen can eliminate brood at the right age for mite feeding in the colony, thus starving the mites. In a colony without capped brood or larvae, a newly laid honeybee egg would take 6.5 days to reach the appropriate stage for *T. mercedesae* to feed, which is much longer than the three days the mites can survive without feeding [5, 6]. Additionally, *T. mercedesae* will not be able to reproduce in a capped brood cell nine days after the initial egg is laid. Chemical controls against *V. destructor* have shown high effectiveness [7].

Research has been conducted in many countries' Honeybee Research Institutes and Research Centers using formic acid and thymol against *Tropilaelaps* mites. The study involved the experimental division of 36 bee colonies into two groups for treatment (formic acid and thymol). Formic acid (70%) and thymol were applied in six treatments, including a control group. (T0=0,0 ml, T1=5ml, T2=10ml, T3=15ml, T4=20ml and T5= 25ml) and (To=0.0g, T1=5g, T2=10g, T3=15g, T4=20g, and T5=25g). The treatments were randomly applied over a period of 5 weeks with 3 repetitions. The maximum number of *Tropilaelaps* mites collected was 782 and 518, respectively, in the collection containers for the treatments using 25 ml of formic acid and 25 g of thymol. The highest efficacy of formic acid and thymol against the mites was 97% and 95.3%, respectively. In the formic acid group (T5, 25 ml), the maximum honey yield was 22.54 kg per bee colony, while in the thymol group (T5, 25 g), the maximum yield was 20.7 kg per colony. All results clearly showed that formic acid and thymol treatments were effective against *T. mercedesae*. Throughout the study, no queen bees were lost, and there were no deaths of adult worker bees in any of the colonies.

This effectiveness is due to these treatments not only killing the mites on the open adult bees but also eliminating the mites in the sealed brood cells.

Conclusion: Tropilaelaps mites pose a serious threat to honey bee colonies. Given the biological characteristics of the mites and their impact on bee colonies, a combination of chemical, biological, and cultural control measures should be implemented. These measures are vital for protecting the health of the bees and increasing honey production.

Tropilaelaps mites are carried by adult honey bees both within and outside the colony. Foretic mites (mites attached to adult bees) can be transferred to other colonies when the adult bees are moved to another colony. This transfer can occur during attacks on other colonies or when frames contaminated by the pests are shared between colonies, as well as through other unintended methods of contact.

Beekeepers must strictly adhere to monitoring and preventive measures to limit the spread of these mites.

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