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# کنه‌های پارازیت زنبور عسل- گذشته، حال و آینده

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مقاله حاضر به بررسی تعدادی از مهمترین کنه‌های پارازیت زنبور عسل می‌پردازد. گونه Anderson & Trueman *Varroa destructor*، یک کنه پارازیت زنبور با دامنه پراکنش وسیع و خسارت فراوان می‌باشد که سبب تلفات زیادی به زنبور عسل می‌گردد. در حال حاضر، در آسیا، کنه‌های پارازیت گرمسیری شامل *Tropilaelaps clareae* Delfinado and Baker و *T. koenigerum* Delfinado-Baker and Baker، در حال گسترش بوده و تهدید جدی برای زنبورداران بسیاری از مناطق جهان محسوب می‌گردند. این دو گونه پارازیت اخیرا توصیف شده است. کنه *Acarapis woodi* (Rennie)، که معروف به کنه تراشه‌ای زنبور عسل می‌باشد، مقاومت زنبورها به پارازیت‌ها و بیماری‌های دیگر را کاهش داده و طول عمر آن‌ها را کاهش می‌دهد. همچنین در صورت آلودگی شدید کنه، تراشه‌های تنفسی زنبور نیز مسدود می‌گردد.

**واژه‌های کلیدی**: زنبور عسل، کنه‌ها، پارازیت‌ها، *Varroa*، *Tropilaelaps*، *Acarapis*

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**Some recent work in Iran**

Workers in Iran have been researching potential control methods for *Varroa* using chemicals, natural substances and the behavioural features of bees. These include studies on different acaricides and their effect in controlling the parasite, including formic acid (Bahreini *et al*., 2004a, b) and Apistan and comparisons between their efficacy. They have also examined grooming behaviour as a natural means of controlling the *Varroa* mite (Currie & Tahmasbi, 2008). A number of essential plant oils have been evaluated also, as a potential control method for *Varroa destructor* (Ariana *et al*., 2002). The results of these researches can be summarized.

The grooming behaviour of bees could be a possible lead to *Varroa* control. Currie and Tahmasbi (2008) examined honeybees with high and low grooming behaviour under different treatment combinations involving different temperatures (10, 25, 34 °C) and humidities (low, medium, high). Mite mortality rates were then quantified. Bee grooming behaviour was affected by such environmental conditions and the most promising results were obtained at low humidities with mite mortality greater in the higher grooming groups at the higher temperatures.

Formic acid (used normally as a 60 or 80% solution but not authorized in EU Member States as a method of control) under different temperature and humidity regimes, was tested with Apistan (tau-fluvalinate, a synthetic pyrethroid) and with formic acid (65%) alone, during a three year period (Bahreini *et al*., 2004 a,b). Overall, mite mortality was higher for Apistan treated bees, compared with formic acid, except in year three when higher ambient temperatures (9.5 – 23.5 °C) meant that formic acid was as effective as Apistan. There was a significant correlation between formic acid mortality and temperature but not between mortality and relative humidity**.**

The use of several plant oils against *Varroa* mites has also been investigated (Ariana *et al*., 2002). It was shown that essences of thyme (*Thymus*), savory (*Satureja*) and spearmint (*Mentha*) have acaricidal properties.

Surveys of bee colonies in Iran for *A. woodi* (Mossadegh & Bahreini, 1994) demonstrated that the mite was found in 19 of the 139 apiaries sampled. The two external species, *A. externus* and *A. dorsalis* were found in eight provinces of Iran.

Mossadegh (1990) has studied the development and life-cycle of *E. sinhai* Delfinado and Baker, on *A. mellifera* worker brood on which the mites fed and reproduced as an alternative host to *A. florae*. Development from egg to adult took five days for males and six to seven days for females, with female mites normally producing from one to eight eggs.

**Future prospects for control – looking ahead**

Further genera and species of mite infesting honeybees will be discovered and described. These, together with the presently known species, will continue to be a threat to bees and a problem to beekeepers especially with the threat of global warming and globalization. Treatment with miticides ( = acaricides) will involve new chemicals and new methods of application which will, initially at least, have a controlling affect on the mites. However, resistance, such as pyrethroid resistance which is already well documented, will develop to make the mites less susceptible to new chemical treatment.

Biological control, using micro-organisms which would kill *Varroa*, could prove to be part of the future although integrated pest management, involving several methods, will continue to be the way forward. Bee strains more tolerant to *Varroa* may be selected and developed and the behaviour of bees exploited for the control of mites eg. high grooming strains. Other types of bee may be used for honey production.

In *'Managing Varroa'* (Morton *et al*., 2005) six ways for the future are suggested - new varroacides, new treatment systems, pheromones, biological control, biotechnical techniques and tolerant bees.

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pear shaped in both sexes whereas in *T. clareae* it is longer than wide, truncated anteriorally and posteriorally reticulate (Delfinado & Baker, 1961). The larval stage of *T. clareae* has been described by Krantz and Kitprasert (1990) and the nymphs of *Tropilaelaps* by Delfinado-Baker *et al* (1985).

In Asia, five species of honeybee are known to act as hosts for *T. clareae - A. cerana, A. dorsata, A. florea, A. laboriosa* and *A. mellifera. T. koenigerum* has been reported on *A. laboriosa, A. cerana* and *A mellifera* in Kashmir. Delfinado-Baker et al (1989) have tables of the mites of honeybees in the Asia-Pacific region.

Information about the biogeography of this genus (Baker *et al*., 2005) is still incomplete and the distribution of the various species needs further investigation. In some areas insufficient collecting has been carried out and the reliability of reports depends on the accuracy of the observer (Matheson, 1997). The distribution of *T. clareae* is probably determined by the range of its natural host *A. dorsata*. *Tropilaelaps* has not yet been reported from Iran.

**Honeybee Tracheal Mite**

I addition to *A. woodi*, at least two other species of *Acarapis* (Acarus = mite and Apis = bee) are found on the external surface of bees. These are referred to as *A. dorsalis* Morgenthaler and *A. externus* Morgenthaler but are thought to be harmless. The tracheal mite lives, as the name implies, in the thoracic tracheae of adult bees - drones, workers and queens being infected. Smaller numbers occur in the abdominal air sacs. Heavy infestations block the tracheae and thus prevent air reaching the body tissues of the bee. In older bees the mite population declines.

Mating takes place in the tracheae. Females produce several large eggs in batches of 5 or more. Eggs hatch (in 3 to 4 days) into larval mites which feed and development to the adult stage takes place, via a non feeding nymphal stage (referred to as a resting stage), in about 10-15 days depending on the ambient temperature. Young females climb out of the tracheae attaching to the hairs of bees and via this route transfer to other hosts. For full details of the life cycle and control methods see Webster and Delaplane (2001) and Gant (2005).

Although widespread, infestation levels are often low (probably less than 5%) and it is not thought to be a serious problem to bee keepers. However they are blood feeders and have the potential to transmit micro-organisms, but as far as we know at present do not appear to do so. The presence of this mite in large numbers, combined with other diseases and unfavourable conditions, could contribute to a reduction in activity, a shorter life cycle and the early death of a bee colony.

The discovery and identification of the H.B.T.M. in Europe prompted the United States Congress in 1922 to ban the importation of all bees and intensive sampling occurred. Despite these precautions it was first detected in Texas in the United States in 1984, having probably migrated from South America. First recorded in the UK in 1992, it has spread rapidly and is now widely distributed. However an interesting report from Turkey (Cakmak *et al*., 2003) looking at the incidence of *Varroa* and *Acarapis,* concluded that tracheal mites were very rare in Turkey, none were found in 10200 bees examined and that *Varroa* is endemic.

In North America the tracheal mite has been regarded with somewhat greater importance and the picture appears rather different to that in Europe, although it is not so serious a pest as was previously thought. The literature states that the mite shortens the life of adult bees (but only by a few days) and heavy infestations can affect their flight. A reduction in bee activity has also been suggested which could lead to reduced honey production. It is possible that American bees are somewhat less resistant to the mite and/or that there are different strains of bees involved.

The mite can it be found by careful dissection of the thoracic tracheae using a binocular dissecting microscope. Tracheae are colourless or pale in uninfected bees. In low infestations patchy discolouration of the tracheae occurs and in heavy infestations brown blotches or even a black appearance of the tracheae may be found. Obstruction of the tracheae by mites and eggs occurs in heavy infestations.

**Charting the distribution of bee mites**

Several papers have been published on the world distribution of honeybee parasites and diseases. The first world maps appeared in 1981 followed by updates (Nixon, 1982; 1983), which included *Tropilaelaps* and then by Bradbear (1988). Matheson (1993, 1997) has also charted and updated earlier records. In 1997 the same author produced country records for honeybee diseases, parasites and pests. Records for honeybee mites, especially for species such as *T. clareae,* need continual updating for accuracy, changes in the distribution of the mites as well as for new species and country records.

worker Bruce White. The two men were investigating the cause of Isle of Wight disease. The mite was then thought to be the cause of this disease but that is now believed to be caused by a bee virus and not by the mite. The full scientific name is *Acarapis woodi* Rennie, being first reported (Rennie, 1921) as *Tarsonemus woodi* n.sp. (Rennie, 1921) and re-named by Hirst (1921).

**The present situation – some aspects.**

***Varroa* biology.**

Name changes have taken place in the last decade. *V. jacobsoni* s.s. now refers to the species on *A. cerana* in the Malaysian-Indonesian region and *V. destructor* is the common pest. The latter is the most familiar, widely documented and most serious of the mite parasites of honeybees. It has a world wide distribution and is linked with viral pathogens thought to be transmitted by the mite.

Originally known from *Apis cerana,* the mite has spread across the world, as well as across species and is now a common parasite of the Western honeybee, *A. mellifera.* It is known from all continents except Australia. The life cycle occurs within the hive although there is a transport stage on adult bees. Egg carrying females enter bee brood cells before the cell is capped. After capping, the female mite lays eggs which hatch to larvae followed by two nymphal stages (protonymph and deutonymph) all of which feed on the haemolymph of the bee larvae. In Europe, the mite has 3 or 4 breeding cycles and then dies. Mature female mites leave the cells when mature bees emerge.

The Varroa mite is spread locally by being carried on the bodies of adult bees. Illegal importations and the movement of hives have helped to increase its spread from country to country.

Complete control is unrealistic but beekeepers practice control methods in order to keep the mite at a low level in colonies. Integrated pest management is recommended, using a variety of methods and good husbandry is the key. Acaricidal resistance, especially pyrethroid resistance in some countries, is a serious problem and there is an associated problem of chemical residues in bee products. Breeding more tolerant bee strains and effective methods of biological control could be the way forward.

A related genus, *Euvarroa,* has been described which includes *Euvarroa sinhai* Delfinado and Baker and *Euvarroa wongsirii* Lekprayoon and Tangkanasing.

The effects of the Varroa mite on bees varies, but all stages feed on the haemolymph of the bee. Bees may show signs of damage such as deformed wings, weight loss and a shorter lifespan, as well physiological effects. It presence also reduces resistance to other infections.

***Tropilaelaps* species.**

The genus belongs to the family Laelaptidae (Mesostigmata). *Tropilaelaps* species feed on bee larvae and pupae and like *Varroa*, causes brood malformation and the death of bees in heavy infestations. Although the natural host is the Asian honeybee, *A. dorsata*, the genus has spread to other bee species and *Tropilaelaps* can easily be distributed by the European honeybee, *A. mellifera* (Sammataro, 2004).Two new species have recently been described namely *T. mercedesae* n. sp. parasitizing *Apis dorsata, A. laboriosa* and introduced *A. mellifera* and *T. thaii* n. sp. (Anderson & Morgan, 2007).. Although not yet recorded from Britain it is notifiable disease and Wilkins and Brown (2005) have reported on the potential risks in the UK.

The female mite deposits eggs on mature bee larvae within sealed brood cells and the life-cycle takes about a week to complete, although this will vary under different conditions. The mite, which is phoretic on adult bees, leaves the hive on bees, as is the case with the *Varroa* mite. *Tropilaelaps* has a higher reproductive rate than *Varroa* because of the shorter life cycle and the non feeding phoretic stage is short. This means that heavy populations can build up rapidly

*T. clareae* is known to have a wide distribution in Asia. *T. koenigerum* on the other hand, as far as is known at present, has a more restricted distribution being recorded from Kashmir, Nepal and Sri Lanka.

*T. clareae* is larger than *T. koenigerum*. The dorsal plate of *T. clareae* measures 880µm long by 512 µm wide in the male and 976 µm long and 528 µm wide in the female. Corresponding figures for the dorsal plate of *T. koenigerum* are 570µm long by 364µm wide in the male and 684 µm to 713µm long and 432 µm to 456µm wide in the female. The shape and size of the moveable joint of the chelicera in the male, which acts as a spermodactyl organ, is different in the two *Tropilaelaps* species. In the male *T. clareae* this appears as a long 'corkscrew like' coiled structure whereas in *T. koenigerum* the spermodactyl is shorter, not coiled and has a "pig-tail like" loop at the apex (Delfinado -Baker & Baker, 1982). The anal plate of *T. koenigerum* is

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# The parasitic mites of honeybees–past, present and future

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## Abstract

The paper deals with the some of the more important parasitic mites associated with honeybees. *Varroa destructor* Anderson and Trueman is worldwide and the most familiar and destructive of the bee mites, causing death and damage to large numbers of honeybees. Known from Asia, the tropical bee mites *Tropilaelaps clareae* Delfinado and Baker and *T. koenigerum* Delfinado Baker and Baker, are spreading and are a potential threat to bee keepers in many parts of the world. Two new species of *Tropilaelaps* have recently been described. *Acarapis woodi* Rennie, known as the honeybee tracheal mite (H.B.T.M.) reduces the resistance of bees to other parasites and diseases, shortens the life cycle and in heavy infestations can block the tracheae of bees.

**Keywords:** Honeybees, Mites, Parasites, *Varroa*, *Tropilaelaps*, *Acarapis*

## Introduction

Many mites are known to be associated with honeybees and their hives. Some are free-living predators (Mesostigmata) feeding on other invertebrates living in the hives. Other mites feed on bacteria and fungi (Astigmata). Some species are pollen feeders. The parasitic mites which infest honeybees have been dealt with from an historical point of view by Baker (2000). Sammataro *et al*., (2000) have reviewed the subject and list 19 mesostigmatid mites parasitizing bees including species of *Euvarroa, Tropilaelaps* and *Varroa* arranged according to host bee species. The mites found on Bumblebees (*Bombus* spp.) are quite different to those found on honeybees (*Apis* spp.) and have been described by Chmielewski and Baker (2008). It is unlikely that *Varroa* are spread by bumblebees as some authors have suggested.

Because of the world wide attention to and concerns about *Varroa,* the importance of the *Tropilaelaps* mites (and to a lesser extent *A. woodi* Rennie) may not have been sufficiently recognised. Some of the *Tropilaelaps* mites are relatively newly described and all could become a threat to beekeeping worldwide. Their life cycle is similar to *Varroa* but with some small but important differences and they can easily be separated from *Varroa* by their size and shape.

An infestation with *Varroa* or *Tropilaelaps* can often be detected by observing adult bees and brood or by examining hive debris collected from the floor of hives. Deformed bees with distorted abdomens, missing legs and damaged wings and crawling rather than flying, are features of an infested colony and the death of bee larvae may also reveal the presence of mites. Dissection of the tracheae of bees can reveal the tracheal mite.

### The beginnings

*Varroa jacobsoni* was first described by Oudemans (1904) from mites collected from the Eastern honeybee *A. cerana* in Java (now Indonesia) but this mite has since been found to be a complex. A new species, *V. destructor,* has been described (Anderson & Trueman, 2000).

*T. clareae* was first discovered in the Philippines and described by Delfinado and Baker (1961). A second species, *T. koenigerum,* was described, for the first time, in 1982 by Delfinado-Baker and Baker and found by Gudrun and Nicolaus Koeniger in a collection of honeybee mites from Sri Lanka.

Known to western beekeepers as Acarine or Acarine disease, but better described as the Honeybee Tracheal mite or simply the tracheal mite, it was first discovered by John Rennie (1865-1928) and his co-

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