

Acarapis woodi

Introduction

Acarapis woodi (Rennie), known as the Honeybee Tracheal Mite, is a parasitic, microscopic mite of honeybees. It causes a disease of honeybees known as Acariosis or Acarine disease. The disease has caused serious economic damage to the beekeeping industry throughout the world especially in the early years of infestation. Rennie first described the mite in 1921 from bees in the Isle of Wight, England where a bee disease called the Isle of Wight disease existed since 1904. Today the tracheal mite has been reported in nearly every country of the world including some countries in the Caribbean.

Identity

Authority	: Oudemans
Classification	
Kingdom	: Animalia
Phylum	: Arthropoda
Class	: Arachnida
Order	: Acari (Acarina)
Family	: Tarsonemidae
Genus	: <i>Acarapis</i>
Species	: <i>woodi</i>
Common name	: Honeybee Tracheal mite
Role	: Pest

Signs & Symptoms

While there are several symptoms that can be observed in honeybee colonies in the field that are indicative of acarine disease, none of them is conclusive because there are other diseases (paralysis and nosema) of honeybees that show similar symptoms.

The only positive diagnosis of acarine disease in a honeybee colony is to identify the adult *A. woodi* mite under a microscope after removing it from the tracheal system of a host bee.

Field Symptoms

a) Crawling bees

Bees can be seen crawling, unable to fly, on various parts of the hive, on top of brood frames, on bottom boards, on landing boards and in front of the hive – on the ground or clinging to vegetation.

This crawling symptom is the result of several effects. The mites clog up the breathing tubes (tracheae) of bees and this reduces oxygen flow, which affects the ability and efficiency of the bees to fly. Also the mites suck the haemolymph of honeybees by piercing the walls of the tracheal system and the underlining tissue.

This will result in a loss of nutrients to bees, which will also reduce their longevity as well as their ability to fly.

b) **Disjointed wings**

The crawling bees have an abnormal “dislocated” position of their wings. The hind wing is held at an angle that gives a K design.

c) **Distended abdomens and dysentery**

It has been reported that bees with Acarine disease could have distended abdomens. Dysentery has also been reported.

d) **Reduction in bee population**

The bee population slowly dwindles with a resultant reduction in honey and pollen production and brood rearing. With severe infestation of tracheal mites, entire colonies could be found dead or the hive abandoned by the bees.

However, these field symptoms are not specific to Acarine disease and positive diagnosis of *A.woodi* can only be done by microscopic examination.

Morphology

There are three *Acarapis* species of mites that are to found on honeybees. However, only one, *Acarapis woodi*, is of serious economic importance and it is the only mite to be found in the tracheal system of the honeybee. This is the one and only positive diagnostic evidence for *A.woodi*.

A.woodi has been described in detail in several publications. However, the following description is quoted from the “Diagnosis of Honey Bee Disease, U.S.D.A. Agriculture Handbook 690, April 1991: “ The female *Acarapis woodi*, or honeybee tracheal mite is 143 - 174 um long and the male 125 – 136 um. The body is oval; widest between the second and third pair of legs; and whitish or pearly white with shining, smooth cuticle. A few long hairs are present on the body and legs (Fig. 1). This mite has an elongated, beak-like gnathosoma with long, blade-like styles (mouthparts) for feeding on the host.”

Another reference entitled AUSVETPLAN 1996, gives the following measurements of the different life stages of *A. woodi*.



Fig. 1: Adult mite (*Acarapis woodi*)

Life Stage	Length (um)	Breadth (um)
Egg	128	72
Mature larvae	168	64
Adult female	140	80
Adult male	100	52

Biological & Ecology

When a honeybee colony is infested with tracheal mites, mature, gravid female *A. woodi* mites enter the tracheal system of young adult honeybees (usually under 9 days old and preferably 1-2 days old) through the first pair of thoracic spiracles. The female mite begins to feed on the haemolymph of the honeybee by piercing the tracheal walls. This puncturing causes scar tissue on the tracheal walls. This and the clogging up of the trachea contribute to the reduction in respiration and interferes with the gas exchange needs of the flight muscles. Also, mites which feed on haemolymph, deprive the bees of some of their nutrients.

It is also believed that tracheal mites causes morbidity indirectly due to virus transmission and indirectly by compromising the immune response of bees to infections caused by bacterial, protozoan and viral agents.

After feeding, within 3 - 4 days, the mite lays 5 - 7 eggs, one at a time, in the large thoracic spiracles. All stages of the mite live and multiply in these large spiracles but they have also been found in the air sacs of the tracheal system in the head, thorax and abdomen.

An egg hatches in 3 - 6 days into a six-legged larva, which molts into a non-feeding adult stage (quiescent nymph) before maturing into an adult. A female mite takes about 14 - 15 days to mature from an egg into an adult in the trachea, while a male mite matures in 11 - 12 days. Male and female mites mate in the tracheae where all stages and both sexes of the mites can be found: eggs, larvae, nymphs and adults.(Fig2).

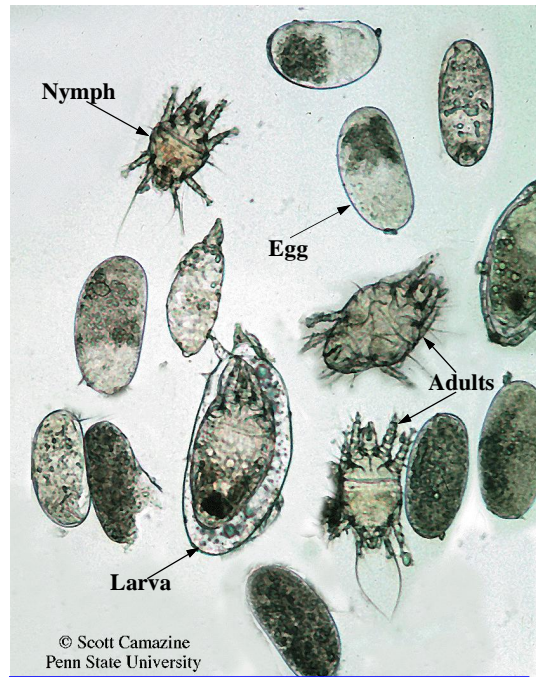


Fig.2: Life Stages of *Acarapis woodi*

Dispersal/vectors

Mature, gravid female mites leave their honeybee hosts by exiting through the same pro-thoracic tracheae that earlier mites had used to enter. After exiting, mites climb on the thoracic hairs of the honeybees and then transfer to preferably any young bees that brush past them. The female mites then enter their new hosts through their pro-thoracic tracheae and the entire cycle is repeated continuously until the death of the honeybee colony occurs or the beekeeper takes action to destroy the mites.

Tracheal mites also spread from colony to colony in an apiary or in the wild by drifting worker bees and drones and by the robbing of colonies by robber bees from other colonies. The beekeeper can transfer mites by moving bees from hive to hive and by the sale or purchase of infested bee colonies or honeybee queens.

Castes of Bees Infested

It must be noted that all castes and races of honeybees can be infested by tracheal mites i.e. workers, drones and queens. This information is important for Caribbean countries, which still continue the practice of importing honeybee queens.

Population Dynamics

The population of mites will vary seasonally. The higher the population of bees, the lower will be the percentage of bees infested with mites. It is therefore easier to find tracheal mites in the non-honeyflow period when the bee population is at its lowest.

Management

An Integrated Pest Management (IPM) approach is recommended for the control/management of all pests and diseases of honeybees. This approach, in the case of Acarine disease, is in essence, carrying out all the normal management practices that will keep a colony strong (eg. feeding, re-queening annually with selected queens that show resistance to diseases, reduction of swarming, etc.). In addition to the above, recommended acaricides and other substances are used to kill tracheal mites.

Many acaricides and substances have been used throughout the world. Many of them, if used incorrectly, can kill bees along with mites. Also, they can contaminate the products of the hive – honey, pollen and beeswax. Extreme care must therefore be taken to follow the manufacturer's recommendations or those of the responsible Government agencies in each country.

Two relatively safe methods and formulations are recommended hereunder:

a) Use of vegetable shortening/powdered sugar treatment;

Mix one part vegetable shortening with two parts white granulated sugar (1: 2 ratio) until it becomes a thick paste. Make half-pound size flattened patties (size of a hamburger). Place one patty per colony between the upper and lower brood chamber, or if there is only one brood box, then on the brood nest top bars. This patty should be replaced as often as it is finished which could take about 4 - 6 weeks or less. The vegetable shortening appears to disrupt the life cycle of the tracheal mite, thus suppressing the mite population. It is believed that vegetable shortening gets all over the bees in their attempt to remove the patty from the hive and this makes the bees body hairs oily. The mites that are attempting to transfer from bee to bee in a colony cannot do so because they slide off the oily body hairs and cannot get into the pro-thoracic spiracles to continue their reproductive cycle. Mites die if they cannot get into a tracheal system within a couple of days. All colonies in an apiary should be treated at the same time.

b) Use of Menthol Crystals

Menthol crystals (food grade with a purity of 98% +) when placed in a mite infested colony will evaporate and the vapor will kill mites (*tracheal* and *Varroa* mites). Place one 7" x 7" window screen packet containing 1.8 ounce (50 grams) of crystalline menthol in each hive on the bottom board.

Treat before honey production begins in the dry season or after the last surplus honey is removed. There should be no honey supers on the hive during treatment. Treatment must end one month before the first nectar flow to avoid contaminating

marketable honey. Colonies could be treated for 14 - 28 days. The packets of menthol crystals can be replaced when finished if necessary. All colonies in an apiary should be treated at the same time. Menthol crystals give good control of *A.woodi* mites but must be used properly.

Host Notes

Acarapis woodi is probably specific to the honeybees. It is parasitic on all races of European, African, Africanized and Asian honeybees.

Distribution

A. woodi has been reported in England (1921), Brazil (1974), and Mexico (1980). By 1981 it was found in most of South America, parts of Africa and Asia and throughout most of Mexico and Europe. It was identified in the United State in 1984, in Canada in 1987 and by 1999 it was found in all 50 states of America except Hawaii. It is present in every continent except Australia. It has been reported in the Caribbean in t Cuba (1996), Grenada and St. Vincent and the Grenadines, but few details are available on its impact in the sub- region.

Pest Significance

Acarine disease is a serious problem of honeybees if left unmanaged. High levels of tracheal mites (over 30% of the bees in the colony are infested) can cause significant economic damage, decreased honey and brood production, decreased pollen collection, increased death or reduced life span of adult honeybees and a slower increase in honeybee population before the honeyflow.

The adverse effects of acariosis are increased when the disease is combined with other diseases, for example, varroasis and European Foulbrood. Also, the mortality becomes worse when there are adverse environmental conditions, for example, inadequate pollen and nectar food stores.

In the United States, where it was previously said by several beekeeping experts that acarine disease would not have caused major problems, it did have a serious negative impact on beekeeping and it did spread faster and at higher levels of infestation than expected.

Beekeepers in the Caribbean, especially those in countries where the tracheal mites have been reported, should not underestimate the economic damages that this problem can cause.

INSPECTION PROCEDURE

Only a close examination of the thoracic tracheae can determine the presence of tracheal mites. Only *A. woodi* is present in the tracheae – this is an important diagnostic fact.(Fig 3).

Honeybees that are not infested with tracheal mites have thoracic tracheae that are creamy white and smooth in appearance. Infested tracheae are discoloured with brown blotches or darkened or black when it is full of mites of all stages and their excreta.

Several methods have been described to find and identify *A. woodi*. Nine (9) methods have been described in the USDA Agriculture Handbook No. 690 “Diagnosis of Honey Bee Disease” (1991).

A simple method formulated from the handbook is as follows:

Grasp the bee between the thumb and forefinger of one hand and remove the head and the first pair of legs of the bee with the next hand. Then with a scalpel, razor blade, or a pair of fine scissors, cut a thin transverse section from the anterior face of the thorax in such a way as to obtain a disc. If there is a large sample of fresh suspected bees to work with, then prepare 50 discs from the thoraces of 50 honeybees. Place the 50 discs in a glass container with enough potassium hydroxide (7% KOH) to soak the discs. Leave the discs in the solution for 24 hours. The KOH dissolves the muscle and fat tissue, leaving the tracheae exposed.

Then examine the tracheal discs suspension under a dissecting microscope at x 30 magnification. Remove suspicious discolored tracheae from the discs with forceps and examine the tracheae with a compound microscope at x 40 – 250 magnification for darkened, blotchy, and discolored tracheae and all life stages of *A. woodi*.

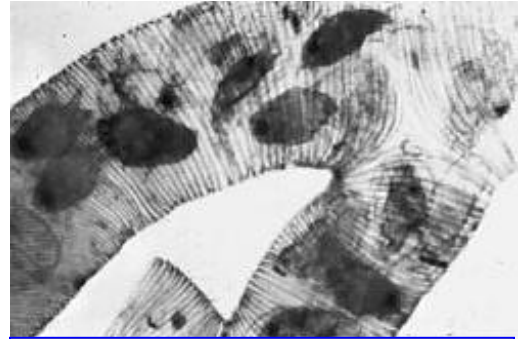


Fig. 3: *Acarapis woodi* mites in honeybee trachea

(Photo credit: USDA (BARC))

ACKNOWLEDGEMENT

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