PROBLEMS RAISED BY INVASION OF HONEY BEES BY ACARINE MITES IN THE WORLD

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Introduction

Following thorough consultation of the world literature it results that a great number of acarine mites have been found to live as parasites on honey bees : thehoney bee of the western hemisphere, *Apis mellifera* L., and *Apis cerana.* Here is the list including the major parasite mites on whose relationships with the honey bees we shall dwell in this report.

Tropilaelaps clarae, Delfinado, Baker

Mellitiphis alvearis, Berlese

Neocypholaelaps indica, Evans

Neocypholaelaps ampulla, Berlese

Neocypholaelaps novaehollandiae, Evans

Carpoglyphis lactis (L.)

Acarapis dorsalis, Morgenthaler

Acarapis externus, Morgenthaler

Acarapis woodi, Rennie

Euvarroa sinhai, Delfinado, Baker

Varroa jacobsoni, Oudemans

Importance and consequential effects of various parasite mites on honey bees

The first report on such mites was from the Philippines ; a species native of the Philippines — *Tropilaelaps clarae* was described. It mostly feeds on bee larvae and causes losses of up to 50% in heavily infested colonies (ATWAL and GOYAL, 1971). This mite is not yet a problem in Europe, but its possible introduction is a constant threat.

Mellitiphis alvearis was discovered in 1895, and was described in detail in 1930 by VITZTHUM.

EVANS and TILL (1966) reported that the mite was found to exist in Great Britain and western Europe. In a recent study, DELFINADO and BAKER (1974) report that the same species was also identified in

New Zealand, where it was spreading fast. No information is available about the biology of the mite and possible economic consequences on honey bees.

Neocypholaelaps indica was found in Sri Lanka (Ceylon), India, and Nepal ; the parasite is reported to be visibly dependent on adult bees which carry it to the pollen stores on which it feeds (BAKER and DELFINADO, 1976). Other two species of the same family, also dependent on adult bees, were identified : *Neocypholaelaps ampulla* — in Java, and *Neocypholaelaps novaehollandiae* — in New Zealand. To our knowledge, up to now the acarine mites belonging to Neocypholaelaps family caused no economic damage to honey bees.

Carpoglyphis lactis was identified on hive combs in Europe and the United States. This parasite is primarily a predator, preferring dry fruits. CHMIELEWSKI (1970 and 1971) reported that such mites were found in Poland on dry plums and other fruits, but also as being a typical pest of the honey combs in the hive. BAKER and DELFINADO (1978) state that considering the results of the investigations made in USA — in Alabama and Michigan, this mite is not expected to spread.

Two of the three *Acarapis* species belonging to Tarsonemidae family — *Acarapis dorsalis* and *Acarapis externus* were identified only on dead bees, and although parasites they do not cause any damage (DELFINADO, 1963).

The third species of the same family — *Acarapis woodi* causes the Isle of Wight disease. This tiny mite is found in the fore part of the main trachea in the bee's thorax. Some historical records refer to the death of a number of colonies in the 19th century. The parasite spread fast at the beginning of the 20th century, being now found the world over. The problem of the economic damage caused by it is still under discussion (CLAER, 1977).

Recent investigations in South America (FLECHTMANN, 1978) showed that the parasite is spreading to the northern zone concomitantly with the advance of the famous African bee. Considerable progress was achieved by keeping stronger bee colonies and by more rigorous quarantine.

Euvarroa sinhai was first found on *Apis cerana* in south-eastern Asia, and now it is not a dangerous parasite of the honey bee any more.

Varroa jacobsoni causes a bee disease commonly known as *Varroa* disease. Although it was described in 1904 by OUDEMANS who found it

in New Guinea, it was only in the last few years that the parasite caused heavy damage to honey bees. There were several causes :

Initially it was a peaceful parasite on *Apis cerana,* causing no apparent damage to the bees. But when the western honey bee *Apis mellifera* — a more resistant and more productive bee — was introduced into the eastern regions, the parasite found a new "ecological nest" in this new bee species, which provided it with most favourable conditions for development.

The mite was reported to have been found in Japan, Indonesia, China, Pakistan, Soviet Union, Bulgaria, Yugoslavia, Romania, Greece, Federal Germany, and the German Democratic Republic. The parasite is most likely to be also introduced into France and Switzerland. In the New World it was introduced by honey bees imported from Japan.

The *Varroa* mite sucks the haemolymph of bee larvae and nymphs. The bees cannot resist the parasite invasion which causes a high death rate of adult bees and brood, and finally the death of the entire colony population. The adult female is the only one which can live outside the bee brood cells, and move to other colonies to overwinter there. According to a report from Romania, an infested bee population may spread *Varroa* mites within a 3 km radius, in the first year, and within a 6 km radius — in the second year, which means an area of 100 sq km. The *Varroa* males and larvae can only live on sealed brood. The males would die after mating which takes place inside the sealed cell ; that is the reason why at the beginning the mites were erroneously considered to reproduce themselves by parthenogenesis — males were never found on adult bees. After being fertilized, the female fixes itself on adult bees and so it reaches into other brood cells. A number of authors report that females could lay eggs into the already sealed brood cells, by piercing the cappings. The *Varroa mite* is 1.1 mm long and 1.6 mm broad, being the largest species of the acarine mites identified up to now as being parasites on honey bees, and may be even seen with the naked eye.

The mite is likely to have quite a special breathing apparatus which enables it to live both inside the sealed brood cells where the carbon dioxide content is high, and in open air, with normal oxygen concentration — when found on adult bees. It also has several morphological possibilities for adaptation.

By means of its palpi which are higly motile, the mite fixes itself on the adult bees walking to the larvae to feed them.

This acarine mite belonging to Gamasidae has the thinnest palpi of all Gamasidae species, which makes them most efficient in fixing themselves on bees. Another adaptation facility is the absence of the anal pouch ; the excretory duct opens directly into the rectum, because of the narrow space available between the nymph and the wall of the cell. The female feeds on small amounts of haemolymph, but neither its idiosoma (body) nor its mouth parts become larger when feeding themselves, as it is usual with the Gamasidae blood sucking mites (SHABANOV, NEDYALKOV and TOSHKOV, 1978). Preliminary reports on investigations now under way point out that the reproduction of the mite begins with the egglaying which lasts till late in autumn. The parasites would multiply when air temperature rises, and when the amount of bee brood, especially of drone brood, on which they feed, increases. The fertilized female would lay 4—6 eggs, feed itself and rest, after which it would lay eggs again. The number of these egglaying periods and the number of eggs laid are not known. The egg stage lasts for 2 to 28 hours. From the egg, a 6-leg larvae hatches, which in 48 hours turns into an 8-leg protonymph. The arachnides (spiders, acarine mites, and ticks) have 4 pairs of legs, while the other insects onl y3 pairs of legs.

The protonymph, which has the number of legs of an adult mite, continues to feed itself on the haemolymph of bee larvae and nymphs, and in 48 hours it sheds hair turning into an 8-leg deutonymph. The later sheds hair after 3 days when it becomes an adult mite (imago).

So, the cycle of development — from egg to the adult mite — lasts for 8—9 days.

This mite is a parasite on both adult bees and brood, causing unrest, confusion, and weakening of worker bees, especially by sucking the haemolymph of larvae and nymphs. The mite also causes other infections by the micro-organisms introduced following the many wounds it causes to adult bees. The study of symptoms depends to a certain extent on the stage of development.

When the bee is invaded by two or more acarine mites, it is excited, loses its stability, and would fly with great difficulty only. Its life span declines, just as its working efficiency. Quite significant symptoms are identified in the brood — dead larvae and nymphs, and also in adult bees — deformed worker bees and drones. With medium and serious contamination by *Varroa jacobsoni* of a colony, symptoms typical of the disease are seen : deformed worker bees and drones would limp and

crawl around, unable to fly. Such individuals are seen in the morning or in the afternoon, in spring or autumn, after a flowless period. In the first year the death rate accounts for 10—15%, in the second — for 20—30%, and reaches even 100% in the third and fourth years since contamination.

Our investigations at the Institute of Applied Zoology of the Bonn University are certainly limited to morphological studies of conserved samples, to avoid any possible spread of this dangerous invasion by acarine mites.

All samples examined by us were supplied to us by the Bee Research Institute in Oberursel. During our morphological examinations we made new findings thanks to the use of the binocular or flash microscope, and the electronic microscope.

We found that the mite has a convex shape because of which the mouth parts and antennae making up the gnathosoma are almost completely covered by the dorsal side of the mite. This curved shape enables the mite to clutch itself to the bee's body quite easily. Under the cover of the curved dorsal side, the mandibles and palpi can be stretched out by mere contraction of the dorso-ventral musculature. The size of the hairs of the palpi and the fact that they are actually motile show that the palpi also contribute to the feeding, most likely by fixing the mouth parts. The basis of the mouth parts — the hypostoma, comes, during the feeding process, into contact with the tegument of the bees into which the chelicerae are introduced.

Under the upper side of the chelicerae there is a pod which protects the feeding duct, which enables direct intake of the haemolymph into the mouth opening (notworthy is that the pod consists of the superposed chelicerae). As the acarine mites are intermitently sucking insects, staying therefore constantly in contact with their hosts, they need the same energy for obtaining their food just as other predator *Gamasidae* which were described by WENTZ and KRANTZ (1976).

No precise method of prophylaxis has been developed as yet because many investigations of the *Varroa jacobsoni* mite are under way, for finding, to the benefit of beekeepers, their bees and of the environment, the most efficient treatment against this scourge. We hope that the investigations being made by Prof. F. RUTTNER and his assistant RITTER of the Bee Research Institute at Oberursel will result in a final solution for the control of the *Varroa* disease.