

MITES ASSOCIATED WITH HONEYBEE, *APIS MELLIFERA* IN EGYPT

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Abstract

In the present study, an intensive survey of hive debris, honeybee brood combs, bee-collected pollen, live and dead adult bees was carried out during two successive years 2005-2006, throughout Egyptian Governorates. For determining the incidence, diversity, host associations and ecological distribution of mites associated with honeybees. Data proved the occurrence of 42 mite species belonging to 4 suborders: Mesostigmata, Prostigmata, Astigmata and Cryptostigmata and 19 families associated with honeybees in Egypt, including house guests, phoretic, and parasitic. *Varroa destructor* and *Acarapis woodi* are the most important parasitic species. A list of all recorded species is given with their geographic distribution and information on economic importance and type of association is provided. The majority of these species were rarely collected from hives, hives products and honey combs, as well as plant and soil mites and incidental visitors.

INTRODUCTION

Honeybees are considered the most important beneficial insects which have direct and indirect roles in agricultural production. Honey is the main product of this insect besides additional products such as: royal jelly, pollen, wax, propolis and poison. The roles of honeybees in the pollinator of flowering plants lead to an increase in agricultural products and improvements in the product quality (Allam, 1994).

The honeybee, *Apis mellifera* is accompanied by numerous arthropods, a great number of which belong to mites. Relationships between mites and bees are of diverse characters. These mites may be parasitic, phoretic or house guests. Many species of parasitic mites are the cause of economic important diseases to bees. The parasitic mite, *Varroa destructor* previously named *Varroa jacobsoni* Oud. is considered the most widespread ectoparasite of the honeybee, *Apis mellifera* and it causes serious problems in the world of beekeeping due to its parasitic relationship with bees (Ritter, 1981; Donze and Guerin, 1994; Anderson and Trueman, 2000). The literature on these species is very rich but the knowledge on other mite species associated with bees, their nests and stored hive products is rather poor (Chmielewski, 1989). So, the objective of the present work is to investigate the prevalence, host associations and diversity of mites associated with honeybees in Egypt.

MATERIALS AND METHODS

A survey of mites associated with the honeybee, *Apis mellifera* was carried out during two successive (2005-2006) throughout most Egyptian Governorates. Several methods have been used during the period of the study: A sheet of strong white paper or plastic with a screen can be placed under the brood combs to continuously monitor colonies in the areas of suspected infestations. The screen prevents the bees from removing the dead mites falling on the paper (Mautz, 1979; De Jong, 1980; De Jong *et al.*, 1982). Brood combs of infested bees were banged on a table covered with a piece of dark paper. Dislodged mites may be seen running over the paper and picked up with a fine brush wetted with alcohol (Morse, 1978). Adult bees can be sampled directly by brushing them from the brood combs into jars filled with alcohol and shaken for one to thirty minutes. The bees were strained out and the filtrate passed through a white cloth where mites can be examined. For collecting *Acarapis woodi*, bee's prothoracic collar was removed to expose the two largest tracheae in the body, and then examined by a stereo microscope. Adult mites or their developmental stages were collected by a fine camel hair brush no. "00" (De Jong *et al.*, 1982). Mites from random samples of hive debris, pollen, dead bees and brood combs can be extracted also, using the modified Tullgren funnels for 24 hours. The mites were received in Petri-dishes filled with water.

Adult mites and their developmental stages were picked up, cleared in Nesbitt's solution or lactic acid, then mounted in Hoyer's medium on glass slides and examined by stereo microscope for identification. Directories of Acarologists of the World (Hughes, 1961; Chant, 1965; Lindquist & Evans, 1965; Summers & Price, 1970; Hughes, 1976; Krantz, 1978; Zaher, 1984; Zaher, 1986; Smiley, 1992; Lindqvist, 1998) were used.

RESULTS AND DISCUSSION

The honeybee, *Apis mellifera* is considered one of the most important and beneficial insects, whose damage has serious negative economic implications for both beekeeping industry and agriculture (Melathopoulos *et al.*, 2000). The study of prevalence, diversity, host associations and distribution of mites associated with honeybee is necessary to monitor the economically important species, and manage their effects on beehives.

In the present study it is clear that the Acarofauna associated with honeybee, *Apis mellifera* L. in Egypt is numerous and comparatively rich in its species. A survey of hive debris, honeybee brood combs, bee-collected pollen, live and dead adult bees, during the period of the study shows that 42 species of mites are commonly

associated with honeybees in Egypt. Most of these mites have been rarely collected, and are of no ecological concern. Mites that are found in beehives may be house guests, phoretic or parasitic. *Varroa destructor* and *Acarapis woodi* are the most important parasitic species. Phoretic mites are flower or leaf feeding mites that use honeybees just for transport from one plant to another and arrive to beehives accidentally. Among the many house guests are those mite species that feed on old provisions and others that are predators on other mites. It was noticed that mites are rarely fed on stored pollen; however, large numbers of pollen-feeding mites are found in stored combs (De Jong *et al.*, 1982; Sammataro *et al.*, 2000; Refaei, 2001).

The collected mite species in this work were belonged to four suborders: Mesostigmata (Gamasida), Prostigmata (Actinedida), Astigmata (Acaridida), and Cryptostigmata (Oribatida) (tables 1-3).

A- Suborder: Mesostigmata

16 mesostigmatid mite species from 6 families were collected from beehives (table 1).

1- Family Varroidae:

This family was represented by only one species *V. destructor* (Anderson and Trueman, 2000) which is considered as the most serious known ectoparasitic mite of the honeybee, *Apis mellifera*. It was first described in 1904 from *A. cerana* in Indonesia and Later on, it was found distributed worldwide in several countries (Grobov, 1976; De Jong *et al.*, 1982; Chmielewski, 1989; Bailey and Ball, 1991; Hussein, 1991).

Varroa mite is believed to arrive to South America on queens of *A. mellifera* that were taken to Paraguay by Japanese beekeepers (De Jong *et al.*, 1984). Female mites of *V. destructor* deposit their eggs in cells containing late instars honeybee larvae. In their nymphal stages, mites attach to bees and feed on the haemolymph. Not all infested broods are killed but adult infested bees have deformed wings as a result of heavy parasitism in colonies. Mites are most commonly attached to the thorax and can be easily seen with unaided eye as they are larger than most other mites Akwatanakul and Burgett (1975).

In the present study, *Varroa* mites were normally distributed throughout most of Egyptian apiaries visited and the average number of mites in infested colonies was quite high.

2- Family Ascidae:

The ascid mites are mostly predators and occur in soil, humus, moss, stored products, bee nests and plants. They prey on acarid mites, eggs of insects and also can feed on fungi, saprophytic arthropods and pollen. Some species of this family are

parasitic (Egan and Moss, 1969).

Several ascid mites were recorded in association with honeybees in Egypt. *Blattisocius keegani*, *B. tarsalis* and *Lasioseius* sp were found associated with dead bees and hive debris. The genera *Lasioseius* and *Blattisocius* were recorded from beehives all over the world (Brgetova, 1977; Haragsim *et al.*, 1978; De Jong *et al.*, 1982; Crozier, 1989; Chinniah and Mohanasundaram, 1995). On the other hand, *Proctogamasellus mintus*, *Proctolaelaps orientalis* and *Proctolaelaps* sp were found associated with dead bees and brood combs. Similarly, several *Proctolaelaps* species were recorded in bee nests feeding on small arthropods, fungi, pollen or phoretic on adult bees without causing any harmful effects (El-Banhawy and Nasr, 1984; Davydova, 1988; Klimov, 1998; OConnor and Klimov, 2004).

3- Family Laelapidae:

This family contains a diverse assemblage of free living and insect associated mites (Eickwort, 1990). Species belonging to this family are partially cleptoparasitic through predation on astigmatid mites. These mites feed on provisions in beehives without harming the brood they also feed on injured bees and on pollen (Eickwort, 1979). However, the genus *Tropilaelaps* includes mites that are obligatory parasites on different species of *Apis* inflicting significant damage to apiculture (Eickwort, 1993).

The present results showed that five laelapid species were found associated with beehives in Egypt. Likewise, numerous genera of laelapid mites were found associated with bees all over the world (De Jong *et al.*, 1982; Eickwort, 1994; OConnor and Klimov, 2004).

4- Family Parasitidae:

The parasitid mites occur in a wide range of habitats including soil, humus and various organic debris where they feed on eggs, immature microarthropods and nematodes (Zaher, 1986). In addition, parasitid deutonymphs are often phoretic on insects and they also utilize them for transport from one feeding local to another (Krantz, 1978). The members of the genus *Parasitus* are phoretic on adult bees feed on other arthropods and wax (Richards and Richards, 1976). *Parasitus* species occur in 96% of bumblebee nests in Canada and 25-28% in overwintering queens in Denmark (Schousboe, 1987).

In the present work, *Parasitus consanguineus* was rarely collected from samples of hive debris.

Similarly, many authors recorded this genus from bees in different countries including Europe, North America (Hyatt, 1980; De Jong *et al.*, 1982; Davis and McRoy, 1987; OConnor and Klimov, 2004) and Egypt (Refaei, 2001). The nature of associations between these mites and bees is uncertain, although predatory behaviour

towards acarid mites and microarthropods was suggested by Richards and Richards (1976) and this may be beneficial to the colonies.

5- Family Phytoseiidae:

The members of this family are widely distributed predators inhabiting a variety of plants and prey on phytophagous mites, insects and pollen grains (Zaher, 1986). Two phytoseiid species were recorded from Egyptian beehives with a low abundance. These were *Euseius scutalis* and *Typhlodromus athiasae*. Likewise, El-Banhawy and Nasr (1984) collected the phytoseiid mite, *Amblyseius okanagensis* from beehives in the state of New York. All previous studies and the present study revealed that this family is not bee associated; however, it may be transported to beehives by bees visiting plants and flowers causing no harm to bees (Chmielewski, 1991).

6- Family Uropodidae:

The members of this family are free-living mites inhabiting soil, debris, moss, organic manures, nests of insects, and they feed on fungi, housefly larvae and free living nematodes. Of special interest is the discovery of uropodid mites in Egyptian beehives.

Trichouropoda sp. was rarely collected from hive debris and adult bee samples without causing any damage to beehives (table, 1). The phoretic association between uropodid mites and bees is presumed to be transitory because both happen to be migrants and both are exploiting the same temporary habitat (Rubink *et al.*, 1991). Similarly, Chmielewski (1989) recorded uropodid mite, *Urobovella marginata* from Polish beehives and El-Erksousy (1996) collected *Trichouropoda* sp. from Egyptian beehives.

B- Suborder: Prostigmata

The prostigmatid mites vary greatly in their biology, structures and habitats. This diverse suborder has evolved an important relationship with bees.

Table (2) shows 13 prostigmatid mite species belonging to seven families were found associated with honeybees in Egypt.

1- Families Cheyletidae and Cunaxidae:

These families are considered as predaceous Prostigmata and may be facultatively occurring in beehives where they feed predominantly on Astigmata (Eickwort, 1994). Several cheyletid genera were recorded as phoretic on bees (O'Connor and Klimov, 2004); *Cheyletophyes* species were restricted with large carpenter bees (Putatunda and Kapil, 1988; Walter *et al.*, 2002). While species of the genera *Hemicheyletia*, *Cheyletus* and *Cunaxa* (Cunaxidae) were recorded associated with honeybees worldwide (De Jong *et al.*, 1982; El-Naggar, 1982; Davis and McRoy, 1987; El-Erksousy, 1996), but the levels of associations were unknown.

The work presented herein recorded six prostigmatid mite species belonging to the families Cheyletidae and Cunaxidae from beehives in Egypt. These species included. *Cheletogenes ornatus* and *C. lepidopterorum* were found associated with adult bees and hive debris. *C. eruditus* and *C. malaccensis* and *Hemicheyletia bakeri* were recorded from hive debris. Finally, *Cunaxa* sp was found attached to the thorax of honeybee workers. These mites can prey on other mites and small arthropods without conspicuous damage or harm to bees or broods; so they may be useful to the colonies.

2- Family Tarsonemidae:

This family was represented in the present study by three species, *Acarapis woodi*, *Tarsonemus granaries* and *T. apis*. The most serious one is the parasitic mite, *A. woodi* which completes its life cycle within the prothoracic tracheae of the honeybee. *A. woodi* has been detected in several countries all over the world (Delfinado-Baker *et al.*, 1989; Lozano *et al.*, 1989; Gerson *et al.* 1994). It feeds on the haemolymph of their host by piercing the tracheal walls with their mouthparts (Örösi-Pal, 1934). This mite is posing a serious threat to honeybee health and also affects foraging and survivorship of honeybees (Gary and Page, 1989).

In the present study, few numbers of *A. woodi* were detected in the tracheae of the worker honeybee. Species of *Tarsonemus* sp was rarely collected from hive debris. Similarly, several species of the genus *Tarsonemus* were recorded previously from honeybees [De Jong *et al.* (1982, Europe); Senna (1997, Egypt)]. The structure of their mouth parts suggested that these mites are not parasites but possibly feeding commensally on pollen and they are of little or no adverse effects on bees (Lindquist, 1968).

3- Family Scutacaridae:

Several members of this large family are associated with insects or their nests including bees and wasps (Delfinado *et al.*, 1976). All scutacarid mites have been observed feeding on fungi (O'Connor and Klimov, 2004). Both *Imparipes* and *Scutacarus* genera include fungivores species that are closely associated with bees and may introduce fungi to beehives (Delfinado and Baker, 1976; De Jong *et al.*, 1982). Only *S.* sp. was recorded from beehives in Egypt where it was collected from hive debris in very few numbers (table, 2).

4- Families Raphignathidae, Eupodidae and Bdellidae:

These three prostigmatid families are not bee associated; however, their species frequently invade beehives (El-Naggar, 1982). Most of these mites are predators as they may feed on other mites and small insects in beehives without harming bees or broods.

The family Raphignathidae was represented by two species, *R. bakeri* and *R.* sp. collected from dead workers. Also, family Eupodidae represented by *Eupodes* sp. which was found associated with brood combs and adult bees.

Members of the family Bdellidae are common predators in the soil. One species *Spinibdella bifurcata* was rarely collected from hive debris herein (Table, 2). Most of the above mentioned mite genera of the families Raphignathidae, Eupodidae and Bdellidae were collected previously from Egyptian beehives where El-Naggar (1977 & 1982) collected *Raphignathus* sp. and *S. bifurcata* from honeybee colonies at Sohag and Gharbia Governorates, respectively.

C- Suborder: Astigmata

Astigmata is represented in the present study by 10 species of the families Acaridae, Chaetodactylidae, Glycyphagidae and Hemisarcoptidae (Table 3). Astigmata are typically the most abundant obligate bee-associate mites in nests of bees (Eickwort, 1990; OConnor and Klimov, 2004).

1- Families Acaridae and Glycyphagidae:

The Acaridae and Glycyphagidae include numerous mites that occur as scavengers and cleptoparasites in hives of bees feeding on fungi, honey, pollen and other detritus (Veitch, 1936; Grobov, 1979; Baker *et al.*, 1983; Chmielewski, 1989). Many of these are stored-product pests but can become the most numerous mites in the beehives (Eickwort, 1993). In the present study, the genera *Acarus*, *Caloglyphus*, *Glycyphagus*, *Rhizoglyphus* and *Tyrophagus* were the most common mites collected from hives of honeybees in different localities in Egypt.

2- Family Chaetodactylidae and Hemisarcoptidae:

Members of this family are restricting to associate with bees (Eickwort, 1994), their species are primary obligate cleptoparasites (OConnor and Klimov, 2004). The chaetodactylid mite, *Sennertia* was found in the cell of *Xylocopa* apparently feeding on pollen (Skaife, 1952). Hypopus of this genus was collected from the abdominal pouch of the carpenter bee, *Xylocopa aestuans* (El-Badry, 1971) and from the honeybee, *A. mellifera* samples (Baker *et al.*, 1983). At the same time, Lombert *et al.* (1987) hypothesized that this mite may kill the brood, while others mentioned that it may develop without killing the brood (Skaife, 1952; OConnor, 1988). In the present study, the hypopus of *Sennertia egyptiaca* and *Hemisarcoptes* sp were rarely collected from abdomen of dead bees.

Generally, several investigators recorded astigmatid mites associated with bees (El-Duweini, 1978; OConnor, 1982; Baker *et al.*, 1983; Chmielewski, 1989 & 1991; Abrol *et al.*, 1994; Abrol and Kakroo, 1997; Senna, 1997; OConnor and Klimov, 2004).

Table 2. prevalence of prostigmatid mites associated with the honeybee *Apis mellifera*

Family	Mite species	Locality	Abundance
Bdellidae	<i>Spinibdella bifurcata</i> Atyeo	Sharkia	+
Cheyletidae	<i>Cheletogenes ornatus</i> (Can. & Fanz.)	Giza	+
	<i>Cheletomorpha lepidopterorum</i> (Shaw)	Dakahlia	++
	<i>Cheyletus eruditus</i> (Schränk)	Kafr El-Sheikh	++
	<i>Cheyletus malaccensis</i> Oudemans	Giza	++
	<i>Hemicheyletia bakeri</i> (Ehara)	Menofia	+
Cunaxidae	<i>Cunaxa</i> sp	Giza	+
Eupodidae	<i>Eupodes</i> sp	Dakahlia	+
Raphignathidae	<i>Raphignathus bakeri</i> Zaher & Gomaa	Giza	+
	<i>Raphignathus</i> sp.	Menofia	+
Scutacaridae	<i>Scutacarus</i> sp.	Ismailia	+
Tarsonemidae	<i>Acarapis woodi</i>	Gharbia	+
	<i>Tarsonemus granaries</i>	Giza	+
	<i>Tarsonemus apis</i>	Giza	+

+: rare (1-3 mites)

++: moderate (3-9 mites)

+++: high (more than 9 mites)

Table 3. prevalence of astigmatid and cryptostigmatid mites associated with the honeybee *Apis mellifera*

Family	Mite species	Locality	Abundance
Suborder: Astigmata			
Acaridae	<i>Acarus siro</i> L.	Fayoum	+
	<i>Caloglyphus mycophagus</i> (Méglin)	Fayoum	+++
	<i>Caloglyphus</i> sp.	Beni-Suef	+
	<i>Rhizoglyphus robini</i> Claparede	Menofia	+++
	<i>Tyrophagus. putrescentia</i> (Schrank)	Giza	+
Chaetodactylidae	<i>Sennertia egyptiaca</i> El-Badry	Dakahlia	+
Glycyphagidae	<i>Glycyphagus domesticus</i> (DeGeer)	Menofia	++
	<i>Glycyphagus ornatus</i> Kramer	Giza, Fayoum	++
	<i>Glycyphagus</i> sp.	Giza	+
Hemisarcoptidae	<i>Hemisarcoptes</i> sp	Giza	+
Suborder: Cryptostigmata			
Opidae	<i>Oppia sticta</i> Popp	Giza	+
Oribatulidae	<i>Scheloribates laevigatus</i> Koch	Giza	+
	<i>Scheloribates</i> sp	Menofia	+

+: rare (1-3 mites)

++: moderate (3-9 mites)

+++ : high (more than 9 mites)

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حصص الأكاروسات المرتبطة بنحل العسل في مصر

غادة رفاعي ، محمود النجار

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تعتبر حشرة نحل العسل من أقدم الحشرات وأوسعها انتشاراً فهي تعيش معيشة اجتماعية في بيئة غنية بالمادة الغذائية ويصاحب هذا تعرضها للعديد من الآفات والأمراض والأكاروسات .. وغيرها. ونظراً لأهمية هذه الحشرة في عملية تلقيح أزهار المحاصيل الزراعية الحقلية كانت أو بستانية مؤثرة بذلك على كمية وحجم الإنتاج وبالتالي الدخل القومي، بالإضافة إلى أهمية منتجاتها من عسل، وشمع، وغذاء ملكي، وحبوب لقاح، وسموم.

أجرى هذا البحث لدراسة الاتسي :

(١) حصص الأكاروسات المرتبطة بنحل العسل في مصر :

أسفرت عملية الحصر في معظم محافظات مصر على مدار سنتين متتاليتين ٢٠٠٥، ٢٠٠٦ عن وجود ٤٢ نوع من الأكاروسات مرتبطة بنحل العسل في مصر منها ما هو متطفل (داخلياً أو خارجياً)، مفترس، مترمم أو مستخدماً الحشرة كوسيلة انتقال من مكان لآخر. هذا وقد أظهرت عملية الفحص والتصنيف أن هذه الأكاروسات تنتمي لتحت رتبة الحلم ذات الثغر المتوسط، الحلم ذات الثغر الأمامي، الحلم عديم الثغر، والحلم الخنفسى. وكان أهمهما على الإطلاق وأكثرها انتشاراً كلا من طفيل *Acarapis woodi* و *Varroa destructor*.