Journal of Entomology

ISSN 1812-5670

Academic Journals Inc.

www.academicjournals.com

Journal of Entomology 11 (4): 210-217, 2014
ISSN 1812-5670 / DOI: 10.3923/je.2014.210.217

Survey and Biological Studies on Mite Species and Scale Insects Inhabiting Mango Trees at Sharkia Governorate, Egypt

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ABSTRACT

Field studies were carried out on mite species and scale insects inhabiting mango trees at El-Khatara and Belbais districts, Sharkia Governorate, Egypt during the period extended from April 2010 to May 2012. Survey proved the occurrence of seventeen mite species belonging to four suborders, eleven families and twelve genera. These mites included five species of Phytoseiidae, three species of Tydeidae, one species belonging to each family of Tetranychidae, Tenuipalpidae, Tarsonemidae, Cunaxidae, Stigmaeidae, Raphignathidae, Eupalopsellidae, Hemisarcoptidae and Haplozetidae. Two species of scale insects, *Aulacaspis tubercularis* (Newstead) and *Kilifia acuminata* (Signoret) were recorded. Phytoseiid, *Amblyseius swirskii* Athias-Henriot, the stigmaeid *Agistemus exsertus* Gonzalez and the tydeid *Tydeus kochi* Oudemans were more abundant and inhabiting a wide range of host plants. Also, the eupalopsellid and hemisarcoptid mites were mainly founded associated with scale insects. The cunaxid mite, *Cunaxa capreolus* Berlese was usually found inhabiting mango trees in moderate numbers. Biological studies were carried out in plant protection research institute to determine the developmental duration of the cunaxid mite, *Cunaxa capreolus* Berlese when fed on different preys *Eutetranychus orientalis*, *Tydeus kochi* and *Aulacaspis tubercularis* at 30±2°C and 70±5% R.H. The predacious mite, *C. capreolus* was successfully developed from egg to adult stage during the experiment when fed on different preys.

Key words: Mite species, scale insect, mango trees

INTRODUCTION

Mango fruits, *Mangifera indica* Linnaeus (Anacardiaceae) are one of the most popular fruits in Egypt. It contains a high percent of sugar, protein, fats, salts, vitamins and it plays an important role in food industrialization such as juices, which wanted with large amounts to export according to good reputation of Egyptian varieties. Now, the Egyptian agricultural strategy is to increase the quality level of exported crops to certain European countries, for this reason many efforts has been done to increase the total cultivated areas of mango in Egypt, as a favorable fruits in many countries (Nabil, 2010).

Mite species and scale insects which infesting mango trees are sufficient to destroy or seriously reduce plant growth or crop production in the absence of chemical or biological control agents. The predacious arthropods, in general and mites in particular, are expected to be found associated with many phytophagous mite infestations. It considered as important natural control agents to a wide range of economically injurious pests infesting different crops, they are well known to be capable

of regulating and balancing the population of different pests as well as help to gain product free from toxic to keep human health and save the environment from pollution (Taha *et al*., 2006).

Biological and ecological investigations by various authors proved that certain species of the families Cunaxidae, Stigmaeidae, Raphignathidae, Eupalopsellidae, Hemisarcoptidae and Phytoseiidae showed a wide range of distribution and might play a considerable role in reducing other pest populations.

Many authors recorded that the mite, *Hemisarcoptes malus* Schimer (Hemisarcoptidae) as a parasitic on scale insects belonging to the family Diaspididae (Gerson and Izraylevich, 1997; Ofek *et al*., 1997) while some of them recorded as a predator of diaspidids scale insect (Houch, 1989; Ji *et al*., 1991, 1993; Katsoyannos and Stathas, 1995; Charles *et al*., 1998; Cooper and Cranshaw, 1999; Stathas *et al*., 2005; Sorribas *et al*., 2008).

The important prey for *Hemisarcoptes* mites recorded in different fruit trees such as *Parlatoria pergandii* and *Parlatoria cinerea* on grape fruit and orange orchards (Izraylevich and Gerson, 1993); *Aonidiella orientalis* on mango (Ofek *et al*., 1997); *Lepedosaphes ulmi* on apple trees (Erol and Yasar, 1999); *Aspidiotus nerii*, *Lepedosaphes ulmi* and *Parlatoria oleae* on olive trees (Stathas *et al*., 2005) and *Aonidiella aurantii* on citrus orchards (Sorribas *et al*., 2008).

The present work aimed to study the following points:

- Occurrence of the mite species and scale insects inhabiting mango trees at El-Khatara and Belbais districts, Sharkia Governorate, Egypt
- Biological studies on the most commonly species, *Cunaxa capreolus* Berlese fed on different preys at the laboratory conditions

MATERIALS AND METHODS

Survey studies: Survey studies were carried out in two mango farms located at El-Khatara and Belbais districts at Sharkia Governorate, Egypt. The studies were continued for two successive years, from April 2010 to May 2012. The farms received normal agricultural practices and no chemical control was applied. The studies were conducted in an area of about one feddan of mango, *Mangifera indica* L. leaves, buds and stem bark were monthly randomly collected from the two districts. The samples were put in polyethylene bags and transferred to the laboratory for carefully inspection. These samples were examined in the same day using a stereomicroscope. Scale insects and mite species were recorded. Mite species were directly mounted in Hoyer's medium and identification together with other necessary information about their habitats and written on labels stuck on the slides.

Biological experiments: To study the effects of different preys on the biology of dominant predaceous mites which seemed to be active in nature at both districts. Pure culture of the cunaxid species, *Cunaxa capreolus* Berlese was established. It was reared on discs of mango leaves infested with the tydeid mite, *Tydeus kochi* Oudemans and the citrus brown mite *Eutetranychus orientalis* Klein as preys for the predator. *Cunaxa capreolus* was placed over cotton wool in the prepared petri dishes. Water was added daily to maintain suitable moisture for mite development.

The cunaxid mite, *C. capreolus* was reared on three different prey species. Those preys were mixture of adults and nymphs for *E. orientalis* and *T. kochi*, while it reared on eggs of the scale insect, *A. tubercularis*. Twenty newly hatched larvae for each treatment were confined singly in glass rings of 1 cm diameter and 7 mm deep. The rings were fixed to glass slides and each was covered with another glass slide held in position with rubber bands. When the young reached maturity the both sex were allowed to mate and females were retained to complete their oviposition. The food preference experiments and feeding capacity were carried out at 30±2°C and 70±5% R.H. (Krantz, 1970).

Statistical analysis: The results were statistically analyzed by using the analysis of variance according to Snedecor and Cochran (1982) using the computer program SPSS (1997).

RESULTS AND DISCUSSION

Survey studies: Data tabulated in Table 1 showed the surveying mite species and scale insects inhabiting mango trees during the two successive years (2010-2011 and 2011-2012). The occurrence of seventeen mite species and two scale insects were abundance and distribution completely correlated with environmental conditions. Numbers of the collected mites were five species of suborder Gamasida, ten species of suborder Actinedida and one specie of both suborders Acaridida and Oribatida. All gamasid mites were belonging to family Phytoseiidae. The phytoseiid species were *Amblyseius swirskii* with high numbers and *Amblyseius cydnodactylon* with moderate numbers, while the others *Amblyseius yousefi*, *Amblyseius enab* and *Amblyseius cucumeris* were in a few numbers. All species were found on mango trees at both districts.

The Actinedida mites included one species of each family, Tetranychidae (*Oligonychus mangiferus*), Tenuipalpidae (*Brevipalpus obovatus*) and Tarsonemidae (*Steneotarsonemus sayedi*) with a low numbers, Cunaxidae (*Cunaxa capreolus*) with moderate numbers, Stigmaeidae (*Agistemus exsertus*), Eupalopsellidae (*Saniosulus nudus*) with high numbers and Raphignathidae (*Raphignathus gracilis*) with rare numbers at El-Khatara distract. Three species of Tydeidae were recorded, *Tydeus kochi* with high numbers, *Tydeus oregonensis* and *Pronematus ubiquitus* with a few numbers at both districts.

The suborder Acaridida represented by only one specie *Hemisarcoptes malus* belonging to the family Hemisarcoptidae with a few numbers at both districts. It was mainly associated with the scale insects *A. tubercularis* and *K. acuminata* and might be responsible of their reduction.

The suborder Oribatida, family Haplozetidae ware represented by *Xylobates souchnaiensis* was observed in low numbers in both districts.

The species of scale insects were collected from mango trees. It represented by two species, *A. tubercularis* (Diaspididae) with a moderate numbers at both districts and *K. acuminata* (Coccidae) with a low numbers at Belbais district only.

The present results agrees with those given by Kandeel *et al.* (1986) who reported that family Hemisarcoptidae is represented by the predator mite, *H. malus* which was found feeding on eggs and crawlers of scale insects that infested citrus groves. And mentioned that phytoseiid mites, *Typhlodromus mangiferus, A. swirskii* and *Aphis gossypii* were most abundant on citrus they added to that these predator mites feed on phytophagous mites and crawlers of scale insects *Chrysomphalus aonidum, Lepidosaphes beckii* and *A. aurantii*.

Table 1: Occurrence of mite species and scale insects on mango trees at El-Khatara and Belbais districts, Sharkia Governorate, Egypt during two successive years (2010-2011 and 2011-2012)

Species	Locality	Host plant	Occurrence	Feeding behavior
Suborder: Gamasida				
Family: Phytoseiidae				
Amblyseius swirskii Athias- Henriot	El-Khatara	Mango trees	+ + + + +	Predator
	Belbais	Mango trees	+ + + + +	
Amblyseius cydnodactylon Shehata and Zaher	El-Khatara	Mango trees	+ + + +	Predator
	Belbais	Mango trees	+ + + +	
Amblyseius yousefi Zaher and El-Brollosy	El-Khatara	Mango trees	+ + +	Predator
	Belbais	Mango trees	+ + +	
Amblyseius enab El-Badry	El-Khatara	Mango trees	+ + +	Predator
	Belbais	Mango trees	+ + +	
Amblyseius cucumeris (Oudemans)	El-Khatara	Mango trees	+ + +	Predator
	Belbais	Mango trees	+ + +	
Suborder: Actinedida				
Family: Tetranychidae				
Oligonychus mangiferus Rahman and Sapra	El-Khatara	Mango trees	+ +	Phytophagous
	Belbais	Mango trees	+ +	
Family: Tenuipalpidae				
Brevipalpus obovatus Donhadieu	El-Khatara	Mango trees	+ +	Phytophagous
	Belbais	Mango trees	+ +	
Family: Tarsonemidae				
Steneotarsonemus sayedi Zaher and Kandeel	El-Khatara	Mango trees	+ +	Uncertain
	Belbais	Mango trees	+ +	
Family: Tydeidae				
Tydeus kochi Oudemans	El-Khatara	Mango trees	+ + + + +	Uncertain
	Belbais	Mango trees	+ + + + +	
Tydeus oregonensis Baker	El-Khatara	Mango trees	+ + +	Uncertain
	Belbais	Mango trees	+ + +	
Pronematus ubiquitus (Mc Gregor)	El-Khatara	Mango trees	+ + +	Uncertain
	Belbais	Mango trees	+ + +	
Family: Cunaxidae				
Cunaxa capreolus Berlese	El-Khatara	Mango trees	+ + + +	Predator
	Belbais	Mango trees	+ + + +	
Family: Stigmaeidae				
Agistemus exsertus Gonzalez	El-Khatara	Mango trees	+ + + + +	Predator
	Belbais	Mango trees	+ + + + +	
Family: Eupalopsellidae				
Saniosulus nudus Smmere	El-Khatara	Mango trees	+ + + + +	Predator
	Belbais	Mango trees	+ + + + +	
Family: Raphignathidae				
Raphignathus gracilis Rack	El-Khatara	Mango trees	+	Predator
	Belbais	Mango trees		
Suborder: Acaridida				
Family: Hemisarcoptidae				
Hemisarcoptes malus Shimer	El-Khatara	Mango trees	+ +	Uncertain
	Belbais	Mango trees	+ +	
Suborder: Oribatida				
Family: Haplozetidae				
Xylobates souchnaiensis Abdel-Hamid	El-Khatara	Mango trees	+ + +	Uncertain
	Belbais	Mango trees	+ + +	

Table 1: Continued

Species	Locality	Host plant	Occurrence	Feedingbehavior
Scale insects				
Family: Diaspididae				
Aulacaspis tubercularis (Newstead)	El-Khatara	Mango trees	+ + + +	Piercingsucking
	Belbais	Mango trees	+ + + +	
Family: Coccidae				
Kilifia acuminata (Signoret)	Belbais	Mango trees	+ + +	Piercingsucking

+ + + + +: High numbers, cosmopolitan, recorded in all collected samples, + + + +: Moderate numbers, recorded in about 60% of the collected samples, + + +: Low numbers, recorded in about 30% of the collected samples, + +: Few numbers, recorded in about 10% of the collected samples, +: Rare numbers, recorded in one sample only by 2-3 individuals

Table 2: Developmental duration of female and male stages of *Cunaxa capreolus* fed on three different prey species at 30±2°C and 70±5%R.H

Variable	*Eutetranychus orientalis*	*Tydeus kochi*	*Aulacaspis tubercularis*	Significant
Female				
Egg stage	8.5±0.13	9.0±0.13	8.0±0.22	* *
Larva stage	4.5±0.12	3.2±0.12	4.0±0.17	* *
Protonymph stage	5.5±0.13	3.5±0.13	5.0±0.13	* *
Deutonymph stage	4.4±0.16	3.0±0.20	4.5±0.53	* *
Tritonymph stage	5.5±0.26	4.0±0.22	3.5±0.30	* * *
Life cycle	28.4±0.16	22.7±0.16	25.0±0.27	* * *
Pre- oviposition period	2.8±0.26	1.5±0.49	2.5±0.13	* *
Oviposition period	25.0±0.51	22.0±0.53	21.0±0.28	* * *
Post oviposition period	2.5±0.11	2.0±0.22	2.5±0.22	* *
Longevity	30.3±0.29	25.5±0.41	26.0±0.31	* * *
Life span	58.7±0.66	48.8±0.67	50.0±0.53	* * *
Male				
Egg stage	8.0±0.13	8.5±0.13	8.5±0.13	* *
Larva stage	4.5±0.16	3.5±0.17	3.5±0.90	*
Protonymph stage	3.8±0.13	4.0±0.13	4.0±0.13	* *
Deutonymph stage	4.7±0.19	3.0±0.22	3.5±0.28	*
Life cycle	21.0±0.15	19.0±0.16	19.5±0.36	*

Means with different super scripts in the same row differ significantly *p<0.05, **p<0.01, ***p<0.001

Table 3: Effects of different preys on fecundity and consumption rate of the females of *C. capreolus* at 30±2°C and 70±5% R.H

Prey	No. of eggs/female	No. Eggs/female/days	Total consumption
Eutetranychus orientalis	52.62±0.79	2.08±0.07	192.2±0.33
Tydeus kochi	87.63±1.17	3.95±0.08	272.5±0.24
Aulacaspis tubercularis	6.53±0.27	0.28±0.05	260.5±0.32
	***	* * *	* * *

Means with different superscripts in the same row differ significantly ***p<0.001

El-Halawany *et al.* (1986) who mentioned that, the predator mite *A. exsertus* which is widely distributed all over the country, this predator mite specie known by its wide food range on phytophagous mite, scale insects, white flies and pollen grains.

Attia *et al.* (2012) studies the predaceous mites associated with the scale insects infesting mango trees at Qalubyia Governorate, Egypt. They found that *H. malus* considered as one of the most biocontrol agent of diaspidid scale insects on mango trees.

Biological studies on *Cunaxa capreolus*

Life history: Female of *C. capreolus* passes through one larval and three nymphal stages before reaching adulthood, while male has one larval and only two nymphal stages.

Effects of different preys on developmental periods of *Cunaxa capreolus*: Data given in Table 2 reported that the predacious mite *C. capreolus* successfully developed from egg to adult stage when fed on any of the three prey species. The females' life cycle of *C. capreolus* was longer than males. Female life cycle durations were 28.4, 22.7 and 25.0 days compared with 21.0, 19.0 and 19.5 days for males when it fed on *E. orientalis, T. kochi* and *A. tubercularis*, consecutively. The shortest life cycle of both sexes were recorded when predator immatures fed on *T. kochi* followed by *A. tubercularis* and *E. orientalis*. Feeding on *T. kochi* accelerated the development significantly shorted the predator female life cycle compared with the other preys and distinctly elongated female incubation period. Feeding on *E. orientalis* elongated adult female longevity of *C. capreolus* to 30.3 days comparing with 25.5 and 26.0 days on *T. kochi* and *A. tubercularis,* respectively. Feeding on *A. tubercularis* significantly shorted the oviposition period compared with the other preys.

The female life cycle was longest when fed on *E. orientalis;* while it was shortest fed on *T. kochi*. This results were agree with those obtained by Zaher *et al.* (1975) and Taha *et al.* (1988).

Similar findings have been reported for other cunaxid by Zaher *et al.* (1975) and Arbabi and Singh (2000) who reported that incubation period was the longest immature stage, lasting 8.5, 9.0 and 8.0 days when fed on the different preys.

De Castro and de Moraes (2010) mentioned that life cycle and behavior of *Cunaxatricha tarsospinosa* Castro and Den Heyer from rubber trees in Brazil were studied, with *Tenuipalpus heveae* Baker offered as prey. The egg stage was the longest immature stage, lasting 17.1±1.3 days. Total juvenile development was completed in 33.2±2.8 days. Lifetime fecundity was 12.0±2.2 eggs.

Effects of different preys on reproduction fecundity: Data given in Table 3 showed that preys influenced the total eggs laid per female and the total number of consumed prey. The reproductive rate of *C. capreolus* obviously reflected the preference of feeding on *T. kochi* comparing with the other preys. In addition, data showed that the fecundity were significantly lower when fed on *A. tubercularis* compared with *T. kochi* and *E. orientalis*. The female deposited a total number and daily rate average where (52.62 and 2.08; 87.63 and 3.95 and 6.53 and 0.28 eggs) when feeding on *E. orientalis, T. kochi* and *A. tubercularis,* successively. On the other hand number of preys consumed were significantly higher when fed on *T. kochi* and *A. tubercularis* compared with *E. orientalis*. Results showed that number of consumed preys obviously differ according to prey type.

During life span the female consumed greater numbers of *T. kochi* and *A. tubercularis* and moderate numbers of *E. orientalis*. They were 272.5 individuals, 260.5 eggs and 192.2 individuals of *T. kochi, A. tubercularis* and *E. orientalis,* respectively.

When *C. capreolus* fed on *A. tubercularis* were not favorable for egg production which resulted in predator population decrease, while tetranychid and tydeid mite induced population increase which might result in suppression of the prey population density. However, those species needs field investigations.

In addition as it should be obliged to search for its prey and this might increase its importance as a biological control agent.

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