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Morphology and Biology of the Carmine Mite *Tetranychus cinnabarinus* (Boisduval) (Acarina : Tetranychidae)

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ABSTRACT

The life history of the carmine mite *Tetranychus cinnabarinus* (Boisduval) was studied in the laboratory. The incubation period ranged from 3–8 days. The larval period or the deutonymphal period ranged from 1.5–3 days; while that of the protonymph was 1.5–4 days. The total developmental period was completed in 10–23 days. The immature stages and the adults of both sexes are described. The molting process, the copulation process, the sex ratio and the preoviposition period are discussed. An unidentified fungal disease attacked the females in the laboratory was found to affect their rate of oviposition and longevity.

INTRODUCTION

In Tripoli, citrus orchards were found to be infested with the common two-spotted spider mite. Close examination have indicated that it belongs to the *Tetranychus urticae* Koch complex. Boudreaux (1) had recognized at least three species in this complex; and was able to distinguish them from one another by constant morphological characters of the female. He further established the validity of these species by failure to hybridize them with one another in the laboratory.

The uncertainty of our species had urged us to obtain the correct identification of our samples. Dr. G. Dosse, from Universitat Hohenheim, Germany; and Dr. D. MacFarlane, from the Natural History Museum in London, England had kindly examined our samples and identified them as *Tetranychus cinnabarinus* (Boisduval). Tutle and Baker (8) listed *Acarus telarius* Linnaeus and *Acarus cinnabarinus* (Boisduval) as synonyms for this species. According to Boudreaux (1) the distribution of this spider mite is within the warmer temperate zone of the world, subtropics, and occasionally in northern greenhouses. In Libya it has been recorded for the first time by Damiano (2) as a pest on both vegetable crops and some ornamental plants, but not on citrus.

In Tripoli it causes severe damage to the citrus trees infesting the lower surface of the leaves, as well as the fruits. The symptoms appear from the upper surface of leaves as yellow areas where the chlorophyl disappears as a result of its feeding. Later these areas become dark in colour. While the infested areas on fruits appear dark and dry.

Because of the economic importance of this spider mite, its morphology and life history were studied in the laboratory.

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MATERIALS AND METHODS

In order to have a continuous supply of the spider mite, it was mass cultured on orange or lemon fruits in the laboratory under controlled conditions. For the biological studies, the adult females were taken from the culture and transferred on detached citrus leaves. The leaves were placed with the lower surface up, on pieces of wet cotton in Petri dishes as described by McMurtry and Scriven (5). The leaves were changed every 4 days because after this period they loose its satisfactory condition. Studies as well as the cultures were carried at 23 $\pm$ 2°C, and 75–87% relative humidity.

RESULTS AND DISCUSSION

The adult female (Fig. 1) is oval in shape, large in size and measuring 0.385 mm long and 0.347 mm wide on the average. The colour of the body during the first two days is beige-greenish like that of the deutonymph but with lightly coloured one spot on each side. Then it becomes orange or red, with the side spots darker. Few days later two other posterior spots appear, one on each side of the body.

The dorsal shield of the adult female like other tetranychids (4) has on each side: three dorsal propodosomal setae (dps); three dorsocentral hysterosomal setae (dchs); three dorsolateral hysterosomal setae (dlhs); one humeral seta (hs); two sacral setae (ss); and one clunal seta (cs). The hysterosoma carries transverse striae between the dorsocentral hysterosomal setae. The area between the third pair of dorsocentral hysterosomal setae and the inner sacrals has a diamond-shaped striae. The genital aperture and the anal plates are typical for the tetranychids (Fig. 1B).

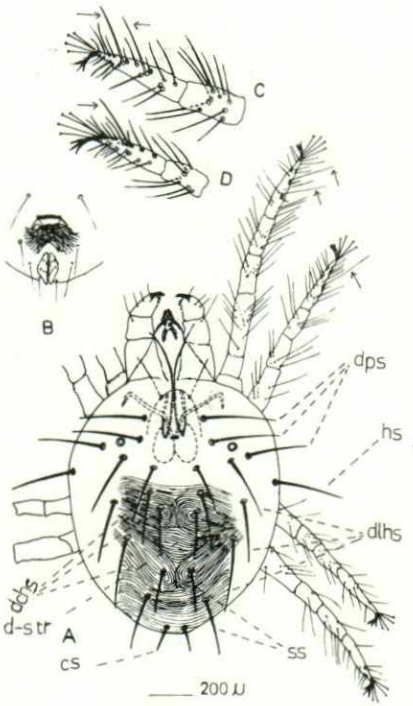

Fig. 1. Adult female. A, dorsal view; dps, dorsal propodosomal setae; dchs, dorsocentral hysterosomal setae; dlhs, dorsolateral hysterosomal setae; hs, humeral seta; ss, sacral seta; cs, clunal seta; d-str, diamond-shaped striation. B, venter of the posterior end. C, tarsus and tibia I. D, tarsus and tibia II. Arrows indicate duplex setae.

The adult male is much smaller and more active than the adult female. Its body is triangular with a tapered posterior end (Fig. 2). Its colour is beige with scattered light orange areas and dark red eye spots. It measures 0.308 mm long and 0.216 mm wide on the average.

The dorsal shield of the adult male has the same chaetotaxy of the adult female, and differs only in the arrangement of the setae. Striation between the last dorsocentral hysterosomal setae and the inner sacral setae is transverse. No diamond-shaped striae is present in that area. The knob of the aedeagus is moderately small, with a convexed dorsal margin; tapering anterior projection and a small acute posterior angulation, (Fig. 2C).

The deutonymph is oval in shape and varies greatly in size. It measures 0.277–0.354 mm long and 0.203–0.277 mm wide (Fig. 3). The colour of the body is beige-greenish as in case of the protonymph, but the two side spots are more pronounced and larger in size.

The chaetotaxy of the dorsal shield of the deutonymph is the same as the adult female. The clunal setae are present. The striation between the last dorsocentral hysterosomal setae and the inner sacral setae are of two kinds, and only one of either kinds is present on each individual. One of the striation is almost the same like that of the adult female, while the other kind is similar to that of the adult male. Usually the large deutonymphs have the first kind of striation, and the small deutonymphs have the other kind, and for this resemblance they are sometimes called female-type and male-type deutonymphs. There are two duplex setae on tarsus one and one duplex seta on tarsus two (Fig. 3, arrows). No genital structures are formed. The anal plates are usually present in the

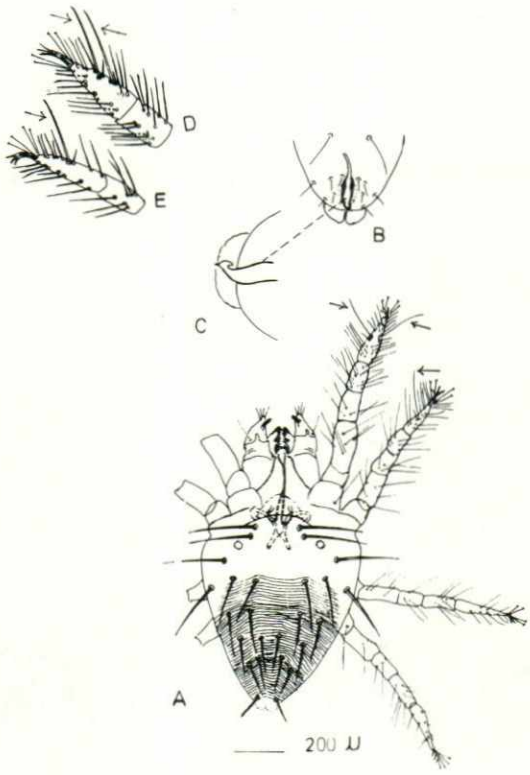

Fig. 2. Adult male. A, dorsal view; B, venter of the posterior end; C, the aedeagus; D, tarsus and tibia I; E, tarsus and tibia II. Arrows indicate duplex setae.

female-type deutonymphs, however, it may be partially formed in some cases. In the male-type deutonymph there are two posterior lobes at the end of the body like those of the adult male, but not completely formed.

The protonymph is four-legged and oval in shape, and averages 0.231 mm long and 0.208 mm wide (Fig. 4). Its colour is beige-greenish with two lightly dark spots one on each side.

The newly hatched six-legged larva is round and averages 0.185 mm in diameter (Fig. 5). It is beige-greenish at first, however, after feeding it becomes light orange in colour.

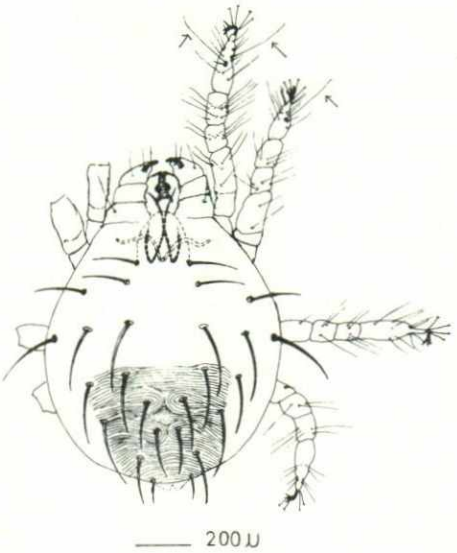

Fig. 3. Deutonymph, dorsal view (female-type). Arrows indicate duplex setae.

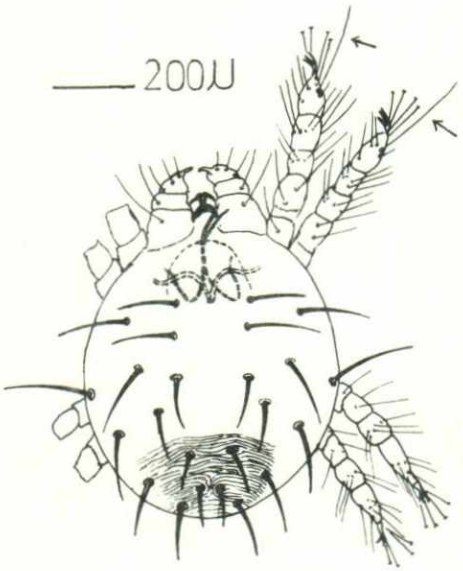

Fig. 4. Protonymph, dorsal view. Arrows indicate duplex setae.

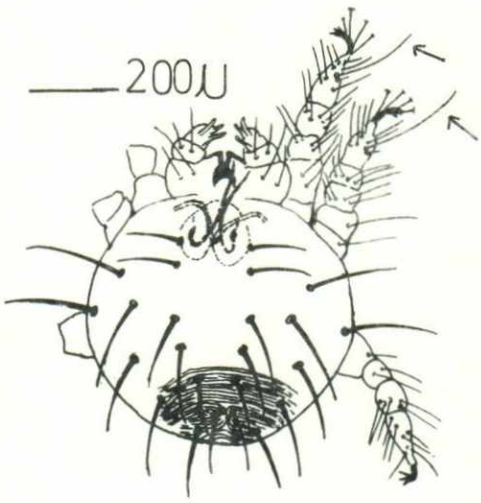

Fig. 5. Larva, dorsal view. Arrows indicate duplex setae.

The chaetotaxy of the dorsal shield for the larva and the protonymph is similar to that of the adult female, except for the absence of the clunal setae. In case of the larva the striation between the last dorsocentral hysterosomal setae and the inner sacral setae tends to be a simple transverse one. In case of the protonymph a diamond-shaped striation starts to form in the above mentioned area. Only one duplex seta is present on tarsus one and tarsus two for both the larva and the protonymph (Figs. 4 and 5, arrows). The genital structures and the anal plates which appear on the ventral surface are absent in these two immature stages.

The eggs of this spider mite are round in shape, and averages 0.175 mm in diameter. The newly deposited egg is clear, however, a dark red spot appears on one side after 2–3 days from oviposition. Before hatching the egg becomes straw-orange in colour with that side of the spot darker.

The incubation period ranges from 3–8 days with an average of 5.5 days. The length of the incubation period at 23 $\pm$ 2°C agrees with the points indicated on a graph and established by Davis (3) who studied the life history of *Tetranychus 'multisetis'* the polychaetous form of *Tetranychus cinnabarinus*. However, the same author found differences in the length of that period on the different host plants he used, such as the bean leaves and the banana squash fruits. Hatching occurs from the darker side where the egg is opened and the posterior end of the larva appears first, then the legs help in pushing the body to the outside. Usually the hatched larva moves slowly or stays close to the egg shell before starting its activity.

The duration of the larval stage ranges from 1.5–3 days, with an average of 2.3 days. The protonymphal stage ranges from 1.5–4 days, with an average of 2.8 days. The deutonymphal stage like the larval stage ranges from 1.5–3 days with an average of 2.3 days.

Before each molt, the immature stages go through a quiescent period that varies in length from 0.5–2 days. When the individual is ready for molting it fixes the mouth-parts into the plant tissue, enter the quiescent period, and then a transverse split occurs through the old skin. The emerged newly molted forms move around slowly but close to the molting skin, for few minutes, before it starts feeding or other activities. The molting process takes about 7–10 minutes.

The total developmental period from egg to adult ranged from 10–23 days, with an average of about 16.7 days. The length of that period had been discussed by Davis (3) who stated that at 23 $\pm$ 2°C it ranged from 10–15 days. The wide range of this period that is noticed during the present study may be due to the high relative humidity that occured sometimes in the rearing chamber.

Copulation occurs between the males and both the newly emerged and older females. Sometimes the males stand close to the female-type deutonymphs till they molt to adult females and mate with them at once. Penman and Cone (6) in their work on *T. urticae* Koch stated that this behavior may be a response of the males to the sex-pheromone secreted by the females at that stage.

The mating process is typical of the tetranychids. The male stands under the female with their heads in one direction, then the male raises the posterior end of its abdomen reaching the female genital opening. The process lasts about 2–5 minutes. It was noticed that one female can copulate more than one time and with two different males within a short period of time.

The preoviposition period lasts 24–48 hours. The unfertilized females produce only males, while the fertilized females produce both sexes. The sex ratio was variable. The male percentage ranges from 9.5–76.5%, while the female percentage ranges from 23.9–90.5%. The average percentage is 43% and 57.2% for males and females respectively.

The normal female starts laying few eggs in the beginning of her life, then its rate of oviposition increases until it reaches a peak of 4 eggs per day, after that it declines till no eggs are laid for few days before the female dies. At several constant temperatures Davis (3) studied the rate of daily egg production. He found at 22.2°C the egg production can reach a maximum of 4 or 5 eggs per female per day which agrees with the findings in this work. At 35.0°C as an optimum temperature, Davis (7) stated also that egg deposition can reach 19 eggs per female per day.

The length of life of the normal female ranges from 8–41 days, with an average of 21.8 days. The longevity of males ranges from 24–41 days with an average 32.8 days. The high rate of dispersion for the males made it difficult to get a complete information about their longevity. The short life of some of the females in this study might be due to the high relative humidity that occurred sometimes in the chamber. Petrov (7) found that in case of both *T. urticae* Koch and *T. cinnabarinus* (Bois.) large numbers of those spider mites died under conditions of high relative humidity.

An unidentified fungal disease appeared on some of the females during the course of this study. The older females seem to be more susceptible to the attack of the fungus. It has been found that the males are resistant since only one male has been infected. No instances of infection occurred in any of the immature stages. It was noticed that this disease has a reducing effect on reproduction and longevity of the females in the laboratory. While 1.5 eggs per healthy female were deposited daily, the diseased female laid only one egg per day. The maximum length of life for the diseased females was only 29 days, while that of the normal undiseased female was 41 days. Further study on this fungus is needed to find out its value as an economic biological control measure against this pest.

LITERATURE CITED

1. Boudreaux, H. B. 1956. Revision of the two-spotted spider mite (Acarina: Tetranychidae) complex, *Tetranychus telarius* (Linnaeus). Ann. Entomol. Soc. Amer. 49 : 43–48.
2. Damiano, A. 1961. Elenco delle specie di insetti dannosi ricordati per la Libia fino al 1960. Tipografia del governo. Nazirato dell'Agricoltura, Tripoli, 81 p.
3. Davis, D. W. 1961. Biology of *Tetranychus 'multisetis'*, the polychaetus form of *Tetranychus cinnabarinus*. Ann. Entomol. Soc. Amer. 54 : 30–34.
4. Krantz, G. W. 1971. A manual of acarology. Oregon State Univ. Book Stores, Inc., Corvallis, Oregon. p. 209–210.
5. McMurtry, J. A. and G. T. Scriven. 1964. Studies on feeding, reproduction, and development of *Amblyseius hibisci* (Acarina: Phytoseiidae) on various food substances. Ann. Entomol. Soc. Amer. 57 : 649–655.
6. Penman, D. R. and W. W. Cone. 1974. Role of web, tactile stimuli, and female sex pheromone in attraction of male two-spotted spider mites to quiscent female deutonymphs. Ann. Entomol. Soc. Amer. 67 : 179–182.
7. Petrov, V. M. 1973. Effect of temperature and relative atmospheric humidity on the development and fecundity of the spider mites *Tetranychus urticae* Koch and *T. cinnabarinus* (Boisduval) (Acariforms: Tetranychidae). Latv Psr Zinat Akad Vestis 3 : 20–26.
8. Tuttle, D. M. and E. W. Baker. 1968. Spider mites of southwestern United States and a revision of the family Tetranychidae. The University of Arizona Press, Tucson, Arizona. p. 129–130.