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Biology of spider mite, *Oligonychus tylos* (Baker & Pritchard) (Acari: Tetranychidae) on date palm

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Abstract

Biology of *O. tylos* was carried out on date palm leaves. The egg is completely round and crystalline in color, changing to waxy yellow as it matures. The average larval period was 2.91 ± 0.64 days, Protonymphal period was 3.02 ± 0.59 days and deutonymphal period was 2.58 ± 0.54 days. The average total developmental period was 15.43 ± 1.35 days. The pre-oviposition period (1.26 ± 0.27 days), oviposition period (7.18 ± 0.83 days), post-oviposition period (1.19 ± 0.27 days) and adult period for male and female (4.23 ± 0.89 and 9.63 ± 0.99 days, respectively). The total life period of *O. tylos* was (19.67 ± 1.49 and 25.07 ± 1.37 days) for male and female, respectively, indicating that the male was short lived as compared to female. The fecundity of *O. tylos* was 23.87 ± 4.49 egg/ female. Egg hatching percentage was observed to be 87.12 ± 5.62 and sex ratio was 1: 3.97 on date palm.

Keywords: *Oligonychus tylos*, date palm, biology, life span and life cycle

Introduction

The date palm, being evergreen with its peculiar morphology, offers shelter and food for a wide variety of arthropod pests and their natural enemies. Diseases and pests pose a yield loss of 30 per cent are the key biotic constraints that hinder the cultivation and production of date palm (El-Juhany and Loutfy, 2010) [5]. However, the nature and extent of the problems differ according to cultivar, place, environment and cultural practices (Zaid *et al.*, 2002) [18]. A total of 132 insects' species and mite pests are reported to cause damage to date palm all over the world. These species are distributed among eight orders of insects and 30 families, in addition to one order of mites composed of nine families. The majority of the species (52) were recorded on the leaf (frond) while the roots and trunk were infested with 26 species. Green fruits host 27 species each with their stalks and stored dates. Coleoptera made up 41 per cent of the pest species described, followed by Hemiptera (20%), Acari (16%) and Lepidoptera (12%). Although the number of date palm pest species appears to be large, a few species of mites are considered major economically important pests (El-Shafie *et al.*, 2017) [6]. Factors such as date palm monoculture, global warming, unregulated insecticide application and global movement of date palm planting materials have affected the mites and their natural enemies (Wakil *et al.*, 2015) [17]. Mite infestation and damage to date palms were first recorded in Israel in the southern valley during late 1970s (Gerson *et al.*, 1983) [8] and fifteen species of phytophagous mites have been reported from various date palm growing areas of the world (El-Shafie, 2012) [7].

In the coastal belt of Kachchh, red palm weevil (*Rhynchophorus ferrugineus* Oliver, Order: Coleoptera, Family: Curculionidae), rhinoceros beetle (*Oryctes rhinoceros* L., Order: Coleoptera, Family: Scarabaeidae) and date palm white scale (*Parlatoria blanchardii* Targgioni Tozzetti, Order: Hemiptera, Family: Diaspididae) are the major pest cause economic damage to date palm (Muralidharan, 1993; Muralidharan *et al.*, 2000) [14, 12]. Recently, the incidence of mite, *Oligonychus tylos* (Baker & Pritchard) has been reported in date palm groves of Kachchh in Gujarat, India (Muralidharan *et al.*, 2020) [12]. This mite was only known from Mauritius, where it was collected from *Panicum maximum* (Gramineae) (Baker and Pritchard, 1960) [1]. In 1979 subeconomic infestations of *O. tylos* were found at Elat (Israel) (Gerson *et al.*, 1983) [8]. *O. tylos* infestation and considerable loss in date palm nuts by shriveling and drying was observed in Kachchh. These plant feeders cause various types of direct damage such as loss of chlorophyll, appearance of stippling or bronzing of all kinds of leaves and fruits, stunting of growth and reduction of yield / marketable products and indirect damage by acting as vectors of plant diseases, particularly Tetranychidae and Eriophyidae members, causing further loss to farmers.

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The biology of *O. tylus* under Indian conditions is still unknown. Therefore, a biology study of this species is very much needed to determine the current status, life cycle and distribution of *O. tylus* in date palm-growing areas in India.

Materials and Methods

The study was carried out in the Research laboratory of Date palm Research Station, S. D. Agricultural University, Mundra during 2020-21, at 28 ± 2 °C, 70 ± 5 per cent relative humidity and photoperiod 16: 8 h (L: D). The initial cultures of *Oligonychus tylus* in the form of adults were collected from the fruits of date palm located at Date palm research Station, Mundra brought to laboratory for their rearing. Approximately 50 adults (male and female) from initial culture were transferred on the date palm leaf disc/ piece (5-6 cm) placed on a filter paper in plastic Petri plate having small holes on the cover for proper aeration. All leaves were placed ventral- side up. Leaf discs were replaced when needed to maintain the level of nutrition and vitality. After mating on the leaves in the laboratory, females were allowed to lay eggs for 12- h periods. Proper hygienic conditions were maintained by cleaning the Petri plates and replacing the filter papers. The same procedure was followed for rearing the successive generations. The eggs so obtained were used for biological studies from time to time. All such rearing was carried out under controlled conditions at 28 ± 2 °C temperature and 70 ± 5 per cent relative humidity under 16:8 (L:D) photoperiod.

For biology study of *O. tylus*, the eggs of mites obtained from mass culture were used for the biological studies on date palm. One egg was transferred for each leaf disc/ piece (5-6 cm) using a brush and up to 30 replicates were made for each host. Plastic plates were examined twice daily to record the different stages using stereoscopic binocular microscope. Measurement of body length and breadth of different life stages of the mite were recorded with the help of a standardized ocular micrometer fitted to a stereoscopic binocular microscope and following observations were recorded.

Incubation period: The period between date of egg laying and egg hatching or emergence of larvae.

Larval period: The period between newly emerged larva and nymphochrysalis.

Nymphochrysalis: The nymphochrysalis period is a quiescent period in larval stage.

Protonymph: Protonymphal period between nymphochrysalis to deutochrysalis.

Deutochrysalis: Quiescent period in protonymphal stage is called deutochrysalis.

Deutonymph: The protonymph moulted to the next stage is known as deutonymph.

Teleochrysalis: Quiescent period in deutonymphal stage is called teleochrysalis.

Developmental period: The period taken for development from larva to emergence of adult was considered as total developmental period.

Pre-oviposition period: The female laid eggs after a lapse of certain time was mentioned as pre-oviposition period.

Oviposition period: The period of egg laying *i.e.*, after the pre-oviposition till the termination of egg laying was considered as oviposition period.

Post-oviposition period: The period between last egg laid and death of the female adult was considered as post-oviposition period.

Longevity of male and female: The period from the date of adult emergence to death of the adult.

Total life period: The duration of entire life span was considered as the period between dates of egg laying to death of adults.

Fecundity

To evaluate mite fecundity, one newly emerged female and male was placed on each leaf piece in Petri dish. If needed, one additional male was placed on each leaf disc ensure mating. Eggs laid by female were recorded daily, until its death. As the leaf disc/ piece aged, mites were transferred to new leaf disc. In this way, fecundity of 30 female per host were evaluated (Gotoh and Gomi, 2003) ^[9].

Sex ratio

In order to determine the sex ratio, counted numbers of eggs were kept in Petri plate. Number of males and females emerged from these eggs were recorded separately. Sex ratio was calculated from number of males and females out of total number observed.

Results and Discussion

The egg is completely round and crystalline in color when first laid, changing to waxy yellow as it matures. The large sized eggs were measured on date palm with average diameter of 0.121 ± 0.009 mm. In past, Hussain (1969) ^[10] and Negm *et al.* (2015) ^[15] also reported that the eggs of *O. afrasiaticus* are round and crystalline in colour translucent and covered by web on lower leaf surface of host plants. The larva emerged out from the eggs by making a slit, the larva widened this opening by pushing apart with its legs and came out from eggshell. The incubation period was observed on date palm 5.05 ± 0.64 days. The freshly emerged larva was almost spherical and hexapodous in outline and whitish straw like in colour. Later, it became elongated, pale-yellow colour and developing greenish tinge on body after feeding. Finally, it became yellowish green. The variation in colour of the body might be attributed to the food consumption by the larva. They had three pair of legs and two bright prominent eye spots which were evident on each side near the margin of dorsal propodosomal region over the second coxae. The average larval length on date palm was 0.191 ± 0.009 mm and width was 0.138 ± 0.014 mm. Manjunatha (1988) ^[11] reported the larval body measurement of *O. indicus* and recorded 0.14 ± 0.21 mm in length and 0.10 ± 0.17 mm in width. The larval period was recorded 2.91 ± 0.64 days. Present finding are in agreements with the findings of El-Halawany *et al.* (2013) ^[4], who reported a larval period of 3.07 to 4.00 days on different stages of dates fruit at two different relative humidity at 25 °C.

Table 1: Biological study of *O. tylus* on date palm leaves

| Sr. No. | Biological attributes | Date palm |
|---------|---------------------------------|---------------|
| | | (Av. ± S. D.) |
| 1 | Incubation period | 5.05±0.64 |
| 2 | Larval Period | 2.91±0.64 |
| 3 | Nymphochrysalis period | 0.60±0.16 |
| 4 | Protonymphal period | 3.02±0.59 |
| 5 | Deutochrysalis period | 0.68±0.24 |
| 6 | Deutonymphal period | 2.58±0.54 |
| 7 | Teleochrysalis period | 0.59±0.14 |
| 8 | Total developmental period | 15.43±1.35 |
| 9 | Pre- oviposition period | 1.26±0.51 |
| 10 | Oviposition period | 7.18±0.83 |
| 11 | Post- oviposition period | 1.19±0.27 |
| 12 | Adult longevity (Male) | 4.23±0.89 |
| 13 | Adult longevity (Female) | 9.63±0.99 |
| 14 | Total life span (Male) | 19.67±1.49 |
| 15 | Total life span (Female) | 25.07±1.37 |
| 16 | Hatching % | 87.12±5.62 |
| 17 | Fecundity (No. of eggs/ female) | 23.87±4.49 |
| 18 | Sex ratio (M: F) | 20.12: 79.88 |

M: Male; F: Female

Before moulting into protonymph stage, the larva suspended all its activities of feeding and became motionless and remained in quiescent period anchoring its body to the leaf surface by assuming a characteristic position in which legs were stretched out. Just prior to moult, the mite freed its posterior body first and anterior body afterwards. The exivium was remained stick to the leaf surface. In past, El-Halawany *et al.* (2013) [4] also reported that larvae then transformed to eight legged protonymphs, before transforming to protonymph it passed through a short inactive period which called nymphochrysalis.

The average nymphochrysalis period was observed on date palm (0.60±0.16 days). The protonymph possessed four pair of legs, amber in colour when freshly formed and changed to

greenish after feeding. Two red spots were also observed on either side of cephalothorax. The sex could be distinguished in this stage. The male protonymph had a roughly triangular body with pointed opisthosoma while the female had an ovoid body with broad or rounded opisthosoma. This stage was very active and quick feeder. The length of protonymph was 0.280±0.020 mm and width was 0.171±0.015 mm on date palm (Table 2). Manjunatha (1988) recorded a length of 0.21 to 0.24 mm and a width of 0.17 to 0.18 mm for *O. indicus*, which is closely in accordance with the present observations. Protonymphal period was observed to be 3.02±0.59 days on date palm (Table 1). El-Halawany *et al.* (2013) [4] earlier reported a protonymph period of 2.95 to 4.15 days on date palm fruit. When protonymph matured, it enters into quiescent stage by suspending all its activities of feeding and shrunken its body and legs and reduce in size. Thus, it was the second inactive stage in the development of mite. The average deutochrysalis period was observed to be 0.68±0.24 days. Deutonymph stage resembled the protonymph stage except in size. The deutonymph had four pairs of legs, brownish grey broad body larger than protonymph. Two red spots on either side of cephalothorax were also visible in this stage. The length of deutonymph was 0.319±0.027 mm and width was 0.221±0.019 mm (Table 2). The deutonymphal period was observed to be 2.58±0.54 days (Table 1). The deutonymph stage was followed by the quiescent stage before it moulted into the adult stage. It remained inactive by anchoring itself to leaf surface. The moulting of quiescent deutonymph resulted in the emergence of adult mite. During moulting the outer skin split horizontally first on the dorsal side between the second and third pair of legs and as the slit widened the emerging individual came out of the exivium. While studying the biology of *O. afrasiaticus*, Chaaban *et al.* (2011a) [3] reported similar behaviour of teleochrysalis, which supports the present observation. The average teleochrysalis period was observed to be 0.59±0.14 days (Table 1).

Table 2: Morphometrics of various life stages of *O. tylus* on date pam leaves

| Life stages | Egg* | Larva | Protonymph | Deutonymph | Adult (Male) | Adult (Female) |
|-------------|-------------|-------------|-------------|-------------|--------------|----------------|
| Length (mm) | 0.121±0.009 | 0.191±0.009 | 0.280±0.020 | 0.319±0.027 | 0.351±0.024 | 0.448±0.029 |
| Width (mm) | - | 0.138±0.014 | 0.171±0.015 | 0.221±0.019 | 0.237±0.030 | 0.324±0.024 |

* Measured in diameter

The period of development of *O. tylus* from larva to adult inclusive of quiescent period was considered as total developmental period under present investigation. The average total developmental period was observed to be 15.43±1.35 days on date palm. The male was greenish cream with tinge of red, fast moving and smaller than the female. The body was a narrow triangular and tapering abdomen than female. Female had a broad body and blunt posterior end, having four pair of legs on their propodosomal region of the body. The adult females were milky cream in colour when freshly emerged and changed to greenish-cream in colour. The length and width of male and female adult was 0.351±0.024 mm and 0.448±0.029 mm, respectively on date palm while width of male and female adult was 0.237±0.030 mm and 0.324±0.024 mm, respectively (Table 2).

There are three remarkable periods of the adult female *viz.*, the pre-oviposition, oviposition and post-oviposition periods. The female lay eggs after a lapse of definite time interval. This period is considered as pre-oviposition period. The pre-oviposition period of mite was 1.19±0.27 days, oviposition period was 7.18±0.83 days and post-oviposition period was

1.19±0.27 days (Table 1)

In the present study, the adult mite period for male and female was observed to be 4.23±0.89 and 9.63±0.99 days. The present findings are in close similarities with the observation made by Chaaban *et al.* (2010) [2], who reported that the female longevity of *O. afrasiaticus* was affected by date palm cultivar and females lived longest on Deglet Noor (10.4±2.9 days) and duration was shortest on Kentichi (8.4±2.4 days). The total life period occupied by male and female of *O. tylus* was 19.67±1.49 and 25.07±1.37 days, respectively (Table 1). Which indicated that the male was short lived as compared to female.

It was observed that the male was emerged little bit earlier than the female and approached towards the moulting female deutonymph and aided in shedding of skin. During copulation, the male remained underneath the female from posterior end and grasped its abdomen on either side by keeping its forelegs at the base of hind legs of female firmly. Mating period was very short being 1.00 to 2.00 minutes.

The number of eggs were laid by *O. tylus* on date palm (23.87±4.49 egg/ female). Egg hatching percentage of *O. tylus*

was observed when mite fed on date palm (87.12±5.62%). The data obtained from the biological studies revealed the sex ratio of male to female was 1: 3.97 with 20.12 per cent males and 79.88 per cent females on date palm.

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