

# Journal of Plant Protection and Pathology

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Available online at: [www.jppp.journals.ekb.eg](http://www.jppp.journals.ekb.eg)

## Biological Studies on *Steatoda triangulosa* Walckenaer (1802) (Arachnida: Araneida: Theridiidae) Feeding on Different Preys

Rashwan, A. M. A.<sup>2\*</sup>; M. A. Ahmed<sup>2</sup>; M. A. M. Mohafez<sup>1</sup> and H. S. k. Ahmed<sup>2</sup>



Cross Mark

<sup>1</sup>Agricultural Zoology and Nematology Dept., Fac. of Agric., Al-Azhar Uni., Cairo.

<sup>2</sup>Agricultural Zoology and Nematology Dept., Fac. of Agric., Al-Azhar Uni., Assiut.



### ABSTRACT

The life cycle of *Steatoda triangulosa* Walckenaer (1802), belonging to family Theridiidae, was studied in laboratory. It had 6 and 5 spiderling instars before adulthood for female and male respectively. Various instars reared on the cotton aphid, *Aphis gossypii*, vinegar fly, *Dorsophila melanogaster*, two-spotted spider mite, *Tetranychus urticae*, stored grain moth, *Ephestia kuhniella*, and larva of the Cotton leaf worm *Spodoptera littoralis*. Prey consumption was calculated for different stages. Mating behavior was also described.

**Keywords:** Life cycle, *Steatoda triangulosa*, feeding, different preys

### INTRODUCTION

Adult females of most web-building spiders remain sessile on their webs. When threatened, they often drop out of their webs to avoid predation (Uma and Weiss 2012). If their webs are destroyed during attempted predation or through a mechanical disturbance, they may rebuild their web or settle elsewhere on existing webs which are indicative of quality habitats (Fischer 2019), as recently shown for mated females of the false black widow spider, *Steatoda grossa* C. L. Koch 1838 (Theridiidae) (Fischer *et al.*, 2019). However, selecting a web still occupied by a conspecific female may result in conflict or even cannibalism (Wise 2006). Theridiidae are a large group of space-web builders found throughout the world. These spiders build irregular snares, from the threads of which they suspend themselves in an inverted position waiting for their prey. A total of 2503 species in 124 genera have been identified in the family Theridiidae all over the world (Platnick, 2020). In Egypt, family Theridiidae has 29 species in 14 genera. genus *Steatoda* has six species. These species are *S. erigoniformis*, *S. ephippiata*, *S. latifasciata*, *S. paykulliana*, *S. triangulosa* and *S. venator*. described from both genders and recorded as new to the fauna of Egypt, according to (El-Hennawy, 2017).

### MATERIALS AND METHODS

The spider species, *Steatoda triangulosa* was gathered from citrus plantation (7 May to 26 October 2019) at Tahta region, Sohag governorate. And kept in Plastic tubes at that point moved to the lab. The first, second, third and fourth spiderling Individuals were separately positioned inside clear plastic chamber compartments of (5 cm in width and 15 cm in profundities). The individuals of spider were raised independently during the tow stages the first and second spiderlings on *T. urticae*, whereas the third and fourth stages

of spiderlings were raised on the phases of *D. melanogaster*, *E. kuehniella*, *A. gossypii*., however the fifth to the 6th for females and advancement to males to the fifth which took care of the versatile phases of. *E. kuehniella*, *D. melanogaster*, larvae *S. littoralis*, and *A. gossypii*. placing every one out of a container (15 cm length and 10 cm width) and covered with a piece of muslin. males and Females were put each pair inside a container (15 cm length and 10 cm width) to have sex and store the egg sacs. All tests were aimed at 25±2°C and 60-70% R.H, each cylinder was provided with known numbers of the previous preys and investigated twice every day. The amounts of copies were (50) cylinders and containers until the finish of the examination. Perspectives natural viewpoints and number of devoured preys were recorded.

### RESULTS AND DISCUSSION

#### Behavior and habit:

An impermanent supply of the Theridiidae spider, *Steatoda triangulosa* they are found in high or medium numbers on horticultural fruit trees (banana, citrus, grapes and guava) locally in Sohag governorate (Al-minshah and Tahta) This spider did not make any plant strips as nests for living, so the females preferred to deposit its egg sac in hidden places. It has been observed that the individuals of this spider inhabit the lower level of the orchard, lived in a group with a group of insects and mites infesting the orchard trees. In the lab, it was taken care of and raised on *Tetranychus urticae*, *Dorsophila melanogaster*, *Aphis gossypii*, *Ephestia kuhniella*, and *Spodoptera littoralis*.

#### Feeding behavior:

Under research facility Circumstances, spiders were raised on *T. urticae*, *A. gossypii*, *D. melanogaster*, *E. kuehniella* and *S. littoralis*. Used its mouthparts the spider in absorbing prey contents leaving only the wings, after 2-3 minutes of external digestion. the hunter began to absorb out substance from the prey, in accordance

\* Corresponding author.  
E-mail address: [mud194@gmail.com](mailto:mud194@gmail.com)  
DOI: 10.21608/jppp.2021.154419

with feeding the spider stomach become inflamed, and usually rested for minutes. It for the most part chases prey nearby in the midst the head and the thorax. Then the spider catches its chelicerae by helping the front legs, If the predator watched another prey, then this is where it hunts to collect some prey.

**Mating behavior:**

Mating is very important for reproduction of *S. triangulosa*, because unmated female could not lay any eggs. female was ready for copulation, after the last moult, starts the After moulting, the female begins feeding until the male is inserted into the plastic tube that contains the female. Remains without moving for minutes the female, and so does a male. Spiders have therefore developed a special courtship behavior that generally precedes mating, this courtship is species specific and ensures that hybridization is avoided (Foelix 2011). The males gradually moves around the plastic tubes toward the females, and the courtship takes 4 minutes, the female stops moving, and the male moves toward her and moves similar pedipalp to reach the epigynum. The copulation cycle lasted for about (12 minutes). The male drifting away from the female for a few minutes, then approaches again to move his left hand to reach her epigynum., then the male moves away. The period of sexual intercourse ranged between (25-40 minutes). The male entered the left palp organ about (10 minutes). After that, the male fused the left palp organ about 10 minutes. At that point, the male step away from the female for a few minutes, and the male approached again and embedded a member of the Pallal organ in her epigynum for about (10 minutes), at which point where the male left the female and stopped at the other side of the cabin.

**Moulting:**

The shedding interaction as a rule should occur as a base extended through the formative stage improving agreeing the expanding in body size because of the fingernail skin didn't extended. It extends through the abdomen. When the spider is fully grown, stop feeding and rest for 1 to 3 hours. After the rest time frame, the arachnids assembled in a curving movement and the longitudinal sidewalls occurred in the old mantle along the body. It occurred in the ancient integration along the horizontal Two sides of the body, where

spider scraped its old cuticle in twisting movements to isolate the old skin from the new skin. Then it pulls out parts of its old skin its mouth and legs and takes the new crawling spider out from the outside. About 25-30 minutes. After the transition has occurred.

**Incubation period:**

Incubated spiders crawl out of the translucent eggshell, skin degeneration is observed inside the eggshell and incomplete stages are indicated (Foelix, 2011). The incubation period of eggs ranged from (10 to 13 days) averaged (12.8 days at 25 ± 2 ° C and 60-70%) relative humidity Table No. (1). **Development:**

After an incubation period whose conditions start 11.0 days on average under laboratory (25 ± 2 ° C and 65-70% RH), hatching and then eggs occurred inside the egg sac exposed outside. A male and female of *S. triangulosa* go through five and six spider stages, respectively, before reaching adulthood.

As shown in Table (1) Each of these spiders when fully developed and before they transform into another goes through a rest time of approximately 1 to 2 hours during which the individual stopped breastfeeding and then miscarriage occurred were 9.3 and 6.0 days for the normal females and males, respectively. Upon completion of this stage, she stopped feeding before molting in the second stage of the spider, which lasted 10.1 and 8.8 days for females and males, respectively, until they were fully developed when fed into adulthood from *T. urticae*. Thus, Stage II stopped feeding, then withdrew and changed to stage III which lasted 14.2 and 8.5 days for both genders separately at the point when benefited from the Prey of *D. melanogaster*, *E. kuehniella*, *Aphis gossypii*. Thereafter, the third spider blew up and switched to stage four which lasted 11.4 and 9.8 days for both genders separately. A similar event occurred in subsequent developmental stages of fifth to sixth spiders of females and growth functions of males up to fifth which fed on *E. kuehniella*, *D. melanogaster* mixed with larva *S. littoralis*, *A. gossypii* and their durations are 7.4 and 12.2 days for females and 5.4 days for males, respectively.

**Table 1. Duration of growth stages *Steatoda triangulosa* when fed on phases of various preys at (25 ± 2°C and 60-70% R.H).**

stages	Prey species	Females	Males
Incubation period	.	12.8± 0.52	-
1 <sup>st</sup> spiderlinq	<i>T. urticae</i>	9.3 ± 0.44	6.0 ± 0.41
2 <sup>nd</sup> spiderlinq	Koch	10.1 ± 0.42	8.8 ± 0.48
3 <sup>rd</sup> spiderlinq	<i>Ephestia kuehniella</i> Zeller	14.2 ± 0.47	8.5 ± 0.65
4 <sup>th</sup> spiderlinq	<i>Dorsophila melanogaster</i> Meigen	11.4 ± 0.53	9.8 ± 0.25
5 <sup>th</sup> spiderlinq	<i>Aphis gossypii</i> <i>Aphis gossypii</i> Glover	7.4 ± 0.38	5.4 ± 0.41
6 <sup>th</sup> spiderlinq	<i>Ephestia kuehniella</i> Zeller <i>Dorsophila melanogaster</i> Meigen <i>Spodoptera littoralis</i> (Boisdural)	12.2 ± 0.57	-
Life cycle		77.4 ± 1.16	48.5 ± 1.66
Life span		247.9 ± 3.10	219 ± 2.94

**Oviposition:**

Data arranged in Table (2) showed that, Usually the female stops feeding for a day before she starts laying eggs and dedicates her push to a silky web by her tease. The true

spider female *S. triangulosa* need pre-laying period before laying the egg sacs. The mean period was (13.7 days) under laboratory conditions of (26 ± 5 ° C and 65±70% RH). Females preferred to lay the eggs in groups inside an egg sacs.

numbers of egg sacs, deposited for each mated female was 5.3 egg sacs during the spawning period under laboratory conditions ( $26 \pm 5^\circ\text{C}$  and  $65 \pm 70\%$  relative humidity). The females covered each egg sacs with another layer of dense silk fabric that looked almost spherical. The values oviposition-period 28.4 days while the post- oviposition period was 128.4 days at conditions  $26 \pm 5^\circ\text{C}$  and  $65 \pm 70\%$  RH. (Table 2).

The total number of eggs with an average of 84.8 eggs, The egg is spherical in shape, white when freshly deposited, gradually turning yellow before hatching. It has been observed that the female incubates and guards eggs during the incubation period, besides during taking care of times.

**Table 2. Fecundity and longevity of *Steatoda triangulosa* when fed on various prey under laboratory conditions ( $25 \pm 2^\circ\text{C}$  and  $60-70\%$  R.H).**

Biological aspects	In days	Fecundity	Numbers
Pre-oviposition period	$13.7 \pm 0.85$	Egg sac	$5.3 \pm 0.40$
Oviposition period	$28.4 \pm 1.91$	Total average of eggs	$84.8 \pm 4.59$
Post-oviposition period	$128.4 \pm 2.29$		
Longevity	$170.5 \pm 3.09$		

**Longevity:**

Longevity also differed according to sex. Generally, female 170.5 under under research facility conditions ( $26 \pm 5^\circ\text{C}$  and  $65-70\%$ R.H.) (Table 2).

**Life span:**

The life span expectancy normal of *S. triangulosa* lasted 247.9 and 85.3 for female and male, separately.

**Efficiency of *Steatoda triangulosa* on various prey consumption:**

The present results illustrated in table (3) showed that, during the investigations of the genuine true spider *S. triangulosa* stages of each *T. urticae*, *A. gossypii*, *D. melanogaster*, *S. littoralis* and *E. kuhniella T. urticae*. were utilized principle wellspring of food. was offered for taking care of the spiderling stages first and second, while *D. melanogaster*, *E. kuehniella* and *A. gossypii* was used for the

spiderling stages 3rd and the 4th, whereas, *D. melanogaster*, *E. kuehniella*, *A. gossypii* and *S. littoralis*. were utilized for taking care of spiderling stages the fifth to the sixth.

Spider assaults the tetranychid vermin for the front piece of the body and turns the prey more than once prior to retaining the substance of its body. The natural product fly assaulted from the intersection between the head and chest at that point absorb the substance of the prey from this spot till absorbing all the body substance.

In the early stages, females and males wasted an moderate of 55.2 and 42.8 individuals of spider mites, respectively. The second stage of the female and the male wasted an moderate of 140.2 and 118.5 individuals of spider mites, separately (Table 3).

The 3rd and 4th spiderling stages squandered a normal of 44.1 and 31.8 *D. melanogaster*, *E. kuehniella* and *A. gossypii* individuals, separately (Table, 10). Then again, the 3rd and 4th male fed spiderling stages devoured a normal of 63.8 and 54.5 *D. melanogaster*, *E. kuehniella* and *A. gossypii*, separately (Table, 3).

Female 5th and 6th spider, feeding on 75.6 and 114.9 adult stages of *D. melanogaster*, *E. kuehniella*, *A. gossypii* and *S. littoralis* respectively. Then again, the 5th spiderling of male fed on 56.8 adult stages of *D. melanogaster*, *E. kuehniella*, *A. gossypii* and *S. littoralis*, separately (Table 3). This study agrees with that of Rahil, (1988). studied the life history and behavior of the spider, *Steatoda triangulosa* Walckenaer,1802 (family: Theridiidae). They found males reached maturity after 5 spiderling instars (55.28 days), while females after 6 spiderling instars (75.3 days). prey types (larvae and nymphs of *S. littoralis*, larvae of *M. vicin* and larvae of *A. ypsilon*. The study releaved that the spider the life cycle and longevity periods of the spider lasted 90.07, 83. 45 and 75.85, 39.71 days for female and male, respectively. By (El-Hennawy and Mohafez, 2003; Ahmed, 2012 and Rashwan, 2017)

**Table 3. Food consumption of *Steatoda triangulosa* when fed on various preys under laboratory conditions ( $25 \pm 2^\circ\text{C}$  and  $60-70\%$  R.H).**

Stages	Preys	Females	Males
		Mean $\pm$ SE	Mean $\pm$ SE
1 <sup>st</sup> spiderling	<i>T. urticae</i>	$55.2 \pm 2.36$	$42.8 \pm 1.11$
2 <sup>nd</sup> spiderling		$140.2 \pm 3.01$	$118.5 \pm 0.65$
3 <sup>rd</sup> spiderling	<i>Drosophila melanogaster</i> + <i>Ephestia kuehniella</i> +	$44.1 \pm 1.38$	$31.8 \pm 1.03$
4 <sup>th</sup> spiderling	<i>Aphis gossypii</i>	$63.8 \pm 1.51$	$54.5 \pm 1.55$
5 <sup>th</sup> spiderling	<i>Ephestia kuehniella</i> + <i>Drosophila melanogaster</i> +	$75.6 \pm 1.85$	$56.8 \pm 2.69$
6 <sup>th</sup> spiderling	<i>Spodoptera littoralis</i> + <i>Aphis gossypii</i>	$114.9 \pm 1.37$	-

The obtained results are mostly agreed with those obtained by Romeih *et al.* (2014), released The Spider *Steatoda triangulosa* as a Biocontrol Agent against Tetranychus urticae Koch in Green Houses. Two levels of *Steatoda triangulosa* (25 and 50 individuals/ replicate) were released (one time); on 29th September 2005 at rate 50 individuals and on 20th April 2006 at a rate 25 individuals.

**Description**

This species shows some spreading tendencies within Europe. Nevertheless, it shall not be listed as alien or invasive because it is native for Europe, Only in buildings in Central Europe, at dry, sunny places under stones in the south, in caves, dunes, forests, garrigue, fallow land, marshes, rocky seashore, littoral salty areas. Since a few decades, (Nentwig *et al.*, 2020) (Fig.1).

**Male**

Prosoma red brown, wrinkled, 1.6-2 mm long. Sternum red brown, wrinkled. Conductor long and bent. Tibia of male palpal longer than cymbium. Chelicerae brown, shiny. Legs yellowish, to bright red brown, all segments sometimes distally darkened. Opisthosoma dark brown to almost black, pattern yellowish, sometimes broken into single spots (Fig.2).

Body length male: 3.5-5 mm.

**Female**

Colouration as in male. Body length female: 3.5-8.6 mm

Epigyne small and rounded. Prosoma 1.8-2 mm long (Fig.3).

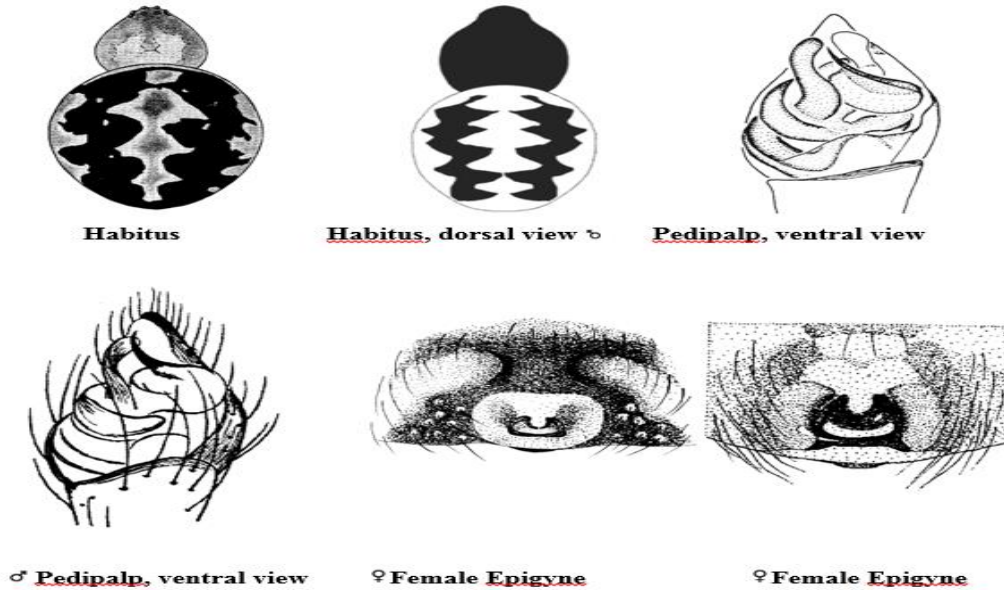


Fig. 1. Different morphological characters of *Steatoda triangulosa*.



Fig. 2. Adult male



Fig. 3. Adult female and egg sac

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## دراسات بيولوجية على ( *Steatoda triangulosa* ) عندما تمت تغذيته على فرائس مختلفة.

عبد الرحيم محمد عبد الرسول رشوان<sup>١</sup>، مسعد عبد الحليم احمد<sup>٢</sup>، محمد عبدالعال محمد محافظ<sup>١</sup> و هشام سيد قرني احمد<sup>٢</sup>  
<sup>١</sup> قسم الحيوان الزراعي والنيماطودا- كلية الزراعة- جامعة الأزهر فرع القاهرة.  
<sup>٢</sup> قسم الحيوان الزراعي والنيماطودا- كلية الزراعة- جامعة الأزهر فرع أسبوط.

تمت دراسة دورة حياة (١٨٠٢) *Steatoda triangulosa* Walckenaer، عائلة Theridiidae، في المعمل وصل لمرحلة البلوغ بعد ٦٥،٥ إنسلاخات للإناث والذكور على التوالي. تم تربية أجناس مختلفة على العنكبوت الاحمر ذي البقعين، *Tetranychus urticae*، المن، *Aphis gossypii*، ذبابة الفاكهة، *Drosophila melanogaster*، فراشة المواد المخزونة، *Ephesia kuhniella*، يرقة دودة ورق القطن *Spodoptera littoralis*. تم حساب استهلاك الفريسة لمرحل مختلفة. كما تم وصف سلوك التزاوج.