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Biological Aspects of the Spider *Theridion melanostictum* (Aranae: Theridiidae) When fed on *Aphis Nerii* and *Aphis Punicae* (Homoptera: Aphididae) under Laboratory Conditions

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Abstract

Biological studies were carried out on the spider *Theridion melanostictum* O.P. Cambridge under laboratory conditions, the study of the effect of prey, both of prey *Aphis punicae* and *Aphis nerii*, on the length of life of the full stage and the breeding rate of predator *T. melanostictum* obtained data showed that females of *Theridion melanostictum* had 5 spiderlings for female and 4 spiderlings for male. The first spiderling was shorter in their duration than other spiderlings of female and male when fed on motile stages of *Tetranychus urticae* Koch, it averaged 9.3 to 9.8 for females and 10 days for males. The life cycle of *T. melanostictum* was longer when the spider fed on *Aphis punicae* averaged 116.3 and 94.8 days than feeding on *Aphis nerii* averaged 82.3 and 63.3 days for female and male, respectively with significant different between two prey. Prey consumption was calculated for different stages. Effect of different prey on longevity and fecundity of the spider were studied. The spider preferred feeding on *A. nerii* than *A. punicae*. As the insects of *Aphis nerii* is one of the preferred prey of this spider for its impact on the different stages of Evolution and the rate of reproduction, which helps in the possibility of being used as one of the elements of biological control in the fight against various pests

Key Words: *Theridion melanostictum*, Biology, aphids, food consumption.

Introduction

Spiders are the most widespread of the predators, often they exist in any place, in particular in the agricultural ecosystem where they are beneficial in the reduction of the population density of the pests (Ghabbour et al., 1999); they devour any small arthropods. Thus they can play an important role in the control of the pests. Spiders consider from the biocontrol agents they fed on most of pests of vegetables, crops, ornamental and orchard trees (Jeppson et al., 1975). Until 2012 there were 8 species belonged to the genus Theridion Walckenaer in Egypt (Thaler-Knoflacch and El-Hennawy, 2012).

The spider Theridion melanostictum O.P. Cambridge, 1876 was described for the first time in 1876 by the Rev.O.P. Cambridge. In this study the Theridiidae spider T. melanostictum reared on two pests (Aphis nerii Boyer& Fonscolombe and Aphis punicae Passerini) under laboratory condition. A. nerii, commonly known as (Oleander aphid) and A. punicae is Pomegranate aphid (Homoptera: Aphididae), are universal, being found in tropical to warm temperate regions throughout the world. This species probably originated in the Mediterranean region, the origin of its host of Apocynaceae, the mean host of milkweed aphid is Nerium oleander as common ornamental shrub in Egypt is an important pest of many ornamental plants. The adults and nymphs of aphid attack the Nerium and Duranta plants and suck cell sap from flowers. Aphid infestation badly affects the flowering capacity of plants, resulting in 20-40% losses (Jayma and Ronald, 1992).

Aphids cause damage and lower agricultural yields in several ways. They can build to high population densities, removing plant nutrients, and may damage plants by removing enough sap to cause withering and death. If not washed off, aphid honeydew excrement can build enough on plants to be a growth other fungal diseases. The most serious problem posed by aphids is the vectoring of plant viruses (John, 2009). The aphids are apterous and reproduce parthenogenetically. Aphid populations may increase very rapidly under natural conditions.

Comprehension of the biological characters for different species of Theridion has been targeted by many scientists around the world. Abo-Taka et al., 2004, Abd El-Azim, 2014, Ahmed et al., 2017 reared T. melanostictum; Rahil, 2004, Ahmad& Heikal, 2016 studied the biological characters of T. spinitarse; Yu et al., 2009 studied the biological characters of T. tepidariorum; Ahmad and Abd El- Maaboud, 2014 studied the biological aspects of the spider T. incanescens; and Sallam et al. 2015 reared T. jordanense.

Consequently, the aim of this study to investigate the potential and biological parameters of spider T. *melanostictum* when fed on *A. nerii* and *A. punicae* under laboratory condition.

Material and Methods

The experiments were conducted in area grown with *Nerium oleander* L. and *Duranta erecta* L. (without chemical treatment) located plants grown in El-Orman Garden, Giza governorate.

Rearing of *Aphis nerii* and *Aphis punicae*

Damaging species of *A. nerii* and *A. punicae* have been collected and reported from most parts of El-Orman Garden, Giza governorate. In order to study

A. nerii and *A. punicae* and their natural enemies the *T. melanostictum*. During year 2017 samples from different parts of previous plants were collecting and transferred to the laboratory. Ten apterous, of *A. nerii* and *A. punicae* respectively were confined in glass Petri dishes (9 cm in diameter) on Oleander and Duranta leaves to produce nymphs. Each Petri dish was provided with a layer of moistened filter paper to provide humidity. All nymphs produced within 24 hours were assumed uniform age. There were 20 replicates for each test with three degrees of temperatures (20, 25 and 28˚C). The experiment conducted under relative humidity (60.0±5.0 R.H.%). *A. nerii* and *A. punicae* colonies were cultured under laboratory conditions (23±2ºC and 60±5% R.H.) on Oleander and Duranta leaves shoots. Terminal shoots (25–30 cm length) of Oleander and Duranta leaves were detached and used throughout this study. Freshly cut shoots were placed in 5% sucrose solution. Shoots were replaced every 3 days. Initially, the aphids were allowed to move between the old and new shoots, but sometimes the aphids were gently stimulated with a needle to withdraw their stylets from the plant and move to new shoots.

Rearing of spider *T. melanostictum*:

The females of *T. melanostictum* were taken from most parts of El-Orman Garden, Giza governorate. They were kept in a small plastic vial of 3 cm diameter x 6 cm height and transferred to the Laboratory. The individuals were checked by the stereomicroscope and the key of (**Jones, 1983**) was used for identification them. Adult females and males were confined together in a test tube (20 cm long and 0.5 cm in diameter) and closed with a cotton pad. The female spider was observed daily until laying the egg sac and immature emergence. Each spiderling was isolated separately in a test tube with a sufficient number of prey individuals. The first spiderling feeding of motile stages of *T. urticae*, while the later stages feeding on Aphids. Thirty predator individuals (spiderlings) were noticed until reaching the adult stage. Numbers of prey individuals (nymph stages of Aphids were counted for each stage of *T. melanostictum* males and females. Individuals (nymph stages of Aphids) were counted for each stage of *T. melanostictum* males and females.

Statistical analysis: One way Anova was calculated by using SAS statistical software (**SAS Institute, 2010**). In addition, LSD (Fisher's Significant Difference Test) was chosen to identify the significant difference within group.

Results and Discussion

Behavior of mating:

The male approached the female then courted her for 6 minutes when the frame stopped the activity while the male began inter his left palpal in her epigynum for 14 minutes.

Behavior of feeding:

Due to the body superiority, the spiders attack the prey from the front easily, thus suck their contents. The behavior of the spider in this work agreed with **Ahmed and Abd El- Maaboud (2014)**, **Abd El-Azim (2014)** and **Ahmed *et al.* (2017)**.

Egg sac.

The egg sac of *T. melanostictum* was spherical in shape, pale white and become dark before hatching; the eggs inside the egg sac were circle, white pale and also become dark before hatching this observation is similar finding by **Ahmed *el al.*, 2017**.

Incubation period

As showed in table (1), the incubation period of males and females lasted 16 days, without no significant different.

Spiderlings duration, longevity and life span for female

As shown in Table (1) obtained data demonstrated that, the females passed through five spiderling stages where as the first spiderling which fed on the spider *T. urtica*e lasted from 9.3±1.03 to 10.0± 1.41 days. While the 2nd spiderling averaged 11.8±0.98 and 22.8±1.16 days when it fed on *A. nerii* and *A. punicae*, aphids respectively. In the same vein the 3rd spiderling lasted 15±0.89 and 24.2 ±0.98 days; also in the same order the 4th spiderling spend about 14.5 ± 0.55 and 20.8 ± 0.75 days; whereas the 5th spiderling lasted about 15.7± 051 and 22.5±1.04 days when spider *T. melanostictum* fed on aphids *A. nerii* and *A. punicae*, respectively. Thus the total immature stages lasted 66.3 ±1.03 when fed on *A nerii* and lasted 100.3 ±1.97 when fed on *A. punicae*. Statistical analysis of data showed that, when the individuals fed on *A. nerii* and *A. punicae* the duration of spiderling and the life cycle were affected by food type where the statistical analysis showed high significant differences depended on prey species, the shortest period occurred when the female spider fed on *A. nerii* while the longest period occurred *A. punicae*. The life cycle duration and the longevity recorded 82,3 ± l.03 and 41.7 ± 2.25 days, respectively when the nutrition was on the prey *A. nerii*; meanwhile life cycle and longevity recorded 116.3± 1.97 and 38.6± 2.88 days, respectively in case spiders fed on *A. punicae.* The spider female life span was averaged 124 ± 3.03 days and 155 ± 2.1 days when fed on *A. nerii* and *A. punicae*, respectively; it had significant different according to the prey type.

Spiderlings duration, longevity and life span for male

The males passed through just four spiderling stages. The first which fed on spider mite, *T. urticae* was 9.8 ±0.98 days and 10.0 ±1.55; while the 2nd spiderling lasted 10.3 ± 1.21 and 23.8 ±1.17 days when fed on aphids, *A. nerii* and *A. punicae*,

respectively. In the same order, the 3rd and the 4th spiderlings lasted 12.5 ±1.05 and 14.7 ± 0.82 days when fed on *A. nerii*; and lasted 23.3±1.63 days and 21.6 ±3.67 days when fed on *A. punicae*, respectively. Therefore the total immature stages lasted 47.3 ± 0,82 days when fed on *A. nerii* and averaged 78.8 ±3.76 days when fed on *A. punicae.* It had significant different between two prey during life cycle. The life cycle and the longevity stages lasted 63.3±0.82 and 25.2±2.56 days, respectively when fed on *A.nerii*, while same stages lasted 94.8 ± 3.67 and 26.3±9.631 days, respectively when fed on *A. punicae*. Whereas the male life span lasted 88.5 ±2.6 days on the first nutrition and recorded shortest period as 121.1±8.4 days on the other nutrition.

Table 1. Duration of stages of the spider *Theridion melanostictum* when the first spiderling fed on *Tetranychus urticae*, while the rest of stages fed on *Aphis nerii* and *Aphis punicae*.

Biological aspects	Duration of female stages (Mean ± SD.) (days)		L.S.D at 0.05	Duration of male stages (Mean ± SD.) (days)		L.S.D at 0.05
	A. nerii	*A.punicae*		*A. nerii*	*A.punicae*	
Incubation period	**16.0±0.0 a**	**16.0±0.0 a**	**0**	**16.0±0.0 a**	**16.0±0.0 a**	**0**
1st spiderling	**9.3±1.03 a**	**10.0±1.41 a**	**1.59**	**9.8±0.98 a**	**10.0±1.55 a**	**1.66**
2nd spiderling	**11.8±0.98 b**	**22.8±1.17 a**	**1.38**	**10.3±1.21 b**	**23.8±1.17 a**	**1.53**
3rd spiderling	**15.0±0.89 b**	**24.2±0.98 a**	**1.20**	**12.5±1.35 b**	**23.3±1.63 a**	**1.76**
4th spiderling	**14.5±0.55 b**	**20.8±0.75 a**	**0.89**	**14.7±0.82 b**	**21.7±3.67 a**	**3.41**
5th spiderling	**15.7±0.52 b**	**22.5±1.05 a**	**1.06**	**-**	**-**	**-**
Total spiderling	**66.3±1.03 b**	**100.3±1.97 a**	**2.02**	**47.3±0.82 b**	**78.8±3.67 a**	**3.5**
Life cycle	**82.3±1.03 b**	**116.3±1.97 a**	**2.02**	**63.3±0.82 b**	**94.8±3.67 a**	**3.5**
Longevity	**41.7±2.25 a**	**38.7±2.88 a**	**3.32**	**25.2±2.56 a**	**26.3±9.63 a**	**9.06**
Life span	**124.0±3.03 b**	**155.0±2.1 a**	**3.35**	**88.5±2.66 b**	**121.2±8.4 a**	**8.01**

The means with the same letters at the same row are not significantly different at 0.05% level.

Similar results were obtained by **Abd El-Azim (2014)** she noticed that the total spiderlings of *T. melanostictum* averaged (105 and 136.6) days for female and male when fed on *T. urticae*. Other studies when the spiders fed *A. nerii*; it sure that food type was the key in this difference, also it was obvious that the duration of the immature stages shortest, when the individuals fed on *A. punicae,* where there were significantly difference in this work between the durations of the stages each case of the nutrition, it agreed with **Wilder (2011)** who mentioned that the type of the food affects on the duration stages of the spiders, and it worth to mentioned that the spider consumed quantity from *A. nerii* bigger than *A. punicae.*

Fecundity of the females

As shown in Table (2), the pre-oviposition period of the female lasted 10.5±1.05 and 12.8±0.75 when fed on *A. nerii* and *A. punicae*, respectively, while oviposition period lasted l5.5±l.22 and 15.7±1.03 with non- significant different between two prey; as same previous order, and the post-oviposition period reached 15.7±1.21 and 10.2±1 .6 also in the same order. Whereas, the average of the number of egg sac per female was 3.5±0.55 when fed on *A. nerii* and 3.8±4.1 when fed on *A. punicae*. In must cases to mention that average of number the individuals into the egg sac was 24.8±1.17 when females fed on *A. nerii* while it was 18.8±3.43 when fed on *A. punicae*. on the other hand, significant differences were recorded in the duration of longevity.

Adult longevity on *T. melanostictum* also differed according to sex and food type; the number of eggs/egg sac was 13-37 when was feeding on *T. urticae* and 17-37 when feeding was on green aphids, *Brevicoryne brassicae* (**Abo-Taka *et al*., 2004**).

Table 2. Longevity and fecundity of female spider *T. melanostictum* when the first spiderling fed on *A. nerii* and *A. punicae*

Biological aspects	Duration of different stages (days) (Mean ± SD.)		L.S.D at 0.05
	A. nerii	*A.punicae*	
Pre-oviposition period	**10.5±1.05 b**	**12.8±0.75 a**	**1.17**
Oviposition period	**15.5±1.22 a**	**15.7±1.03 a**	**1.45**
Post-oviposition period	**15.7±1.21 a**	**10.2±1.60 b**	**1.82**
Longevity	**41.7±2.25 a**	**38.7±2.88 a**	**3.32**
Number of eggs sac/ female	**3.5±0.55 a**	**3.8±0.41 a**	**0.62**
Total number of eggs/sac	**24.8±1.17 a**	**18.8±3.43 b**	**3.29**

The means with the same letters at the same row are not significantly different at 0.05% level.

The food consumption:

The food consumption of the female.

As data showed in Table (3), the first spiderling which fed on *T. urticae* consumed about 118.83±7.7 individuals. The second spiderling consumed about 54.67±2.07 when fed on *A. nerii* while consumed 70.33±2.16 preys when fed on *A. punicae*, on the other hand the third spiderling consumed about 60.2±1.47 and 71.2±2.48 prey when fed on *A. nerii* and *A. punicae*, respectively. On the same context the forth spiderling consumed about 70.2±2.5 and 70.7±8.5 prey *A. nerii* and *A. punicae*, respectively. These values gradually increased depending upon the stage growth. The fifth spiderling consumed about 90.5±1.87 and 77.9±2.3 individuals in the same order, thus the female devoured about 394.34±5.16 and 408.8±15.79 prey during the life cycle when fed on *A. nerii* and *A. punicae*, respectively. The number consumed of prey/spiderling for total spiderling was 32.1 and 24.9 prey/spiderling/ day, when fed on *A. nerii* and *A. punicae*, respectively. The female consumed about 50.2; 59.2 and 89.3 individuals during pre-oviposition period, oviposition period and post oviposition period, respectively, when it fed on *A. nerii*. While it was devoured about 59.3; 77.7 and 55.3 individuals during pre-oviposition, oviposition and post oviposition period, respectively, when it fed on *A. punicae*. It worth to mention that the female consumed about 198.7±5.9 and 192.3±5.3 individuals during the longevity stage; *A. nerii* and *A. punicae*, respectively. Therefore devoured about 593±9.08and 601.2±17.7 prey during the life span *A. nerii* and *A. punicae*, respectively. The number consumed of prey/spiderling for life span were 46.5 and 40.1 preys/spiderling/ day, when fed on *A. nerii* and *A. punicae*, respectively it had significant different between two prey.

Food consumption of the male.

Also as information demonstrated in table (4), the first spiderling which fed on *T. urticae* consumed about 117.4 and 117.2 individuals; while the second spiderling consumed about 61.8±5.26 and 65.2±4.4 preys when fed on *A. nerii* and *A. punicae*, respectively. The third spiderling consumed about 63.4±3.03 and 71.2±2.59 prey also when fed on *A. nerii* and *A. punicae*, respectively, in the same context the forth spiderling fed on 70.8 and 65.2 individuals from *A. nerii* and *A. punicae*, respectively. Thus the male devoured about 313.4±8.56 and 318.8±13.1 prey during life cycle when fed on *A. nerii* and *A. punicae*, respectively. The number consumed of preys/spiderling for total spiderling was 28 and 20.8 prey/spiderling/ day, when fed on *A. nerii* and *A. punicae*, respectively. On the other hand it consumed 91.7±1.4 and 91.2±1.2 in the same order during the longevity stage. Therefore it devoured about 904.8 individuals from *Aphis A. nerii* with number of prey consumed per spider/day was 31.7 and about 410 individuals with number of prey consumed per spider/day from *A. punicae* during the life span with significant different.

The obtained results showed that the female of *T. melanostictum* consumed prey slightly more than the male during all stages; this may be due to that females needed more amounts of protein for fertility and lay eggs comparing with males, or may be due to his smaller size and shorter longevity than female, these results are in agreement with **Abo-Taka *et al.* (2004)**,

Table 3. Food consumption of female spider *T. melanostictum* when the first spiderling fed on *T. urticae*, while the rest of stages fed on *A. nerii* and *A. punicae.*

Biological aspects	No. of prey consumed/ spider		L.S.D	No. of prey consumed/ spider		L.S.D
	A. nerii	***A.punicae***	**at 0.05**	***A. nerii***	***A.punicae***	**at 0.05**
1st spiderling	118.8±7.7 [a]	118.8±7.4 [a]	9.72	12.9±1.6 [a]	12.0±1.39 [a]	1.92
2nd spiderling	54.7±2.07 [b]	70.3±2.16 [a]	2.71	4.6±0.25 [a]	3.1±0.22 [b]	0.3
3rd spiderling	60.2±1.47 [b]	71.2±2.48 [a]	2.62	4.0±0.23 [a]	2.9±0.1 [b]	0.22
4th spiderling	70.2±2.56 [a]	70.7±8.48 [a]	8.0	4.8±0.20 [a]	3.4±0.45 [b]	0.45
5th spiderling	90.5±1.87 [a]	77.8±2.93 [b]	3.15	5.8±0.21 [a]	3.5±0.19 [b]	0.25
Total spiderling	394.3±5.16 [a]	408.8±15.8 [a]	15.1	32.1±1.27 [a]	24.9±1.31 [b]	1.65
Pre-oviposition	50.2±1.47 [b]	59.3±2.94 [a]	2.99	4.8±0.57 [a]	4.6±0.29 [a]	0.58
Oviposition	59.2±4.71 [b]	77.7±2.16 [a]	4.71	3.8±0.33 [b]	5.0±0.3 [a]	0.4
Post-oviposition	89.3±2.58 [a]	55.3±4.08 [b]	4.39	5.7±0.39 [a]	5.5±0.78 [a]	0.79
Longevity	198.7±5.9 [a]	192.3±5.32 [a]	7.23	14.4±0.82 [a]	15.1±1.01 [a]	1.18
Life span	593.0±9.08 [a]	601.2±17.7 [a]	18.12	46.5±1.93 [a]	40.1±0.78 [b]	2.38

The means with the same letters at the same row are not significantly different at 0.05% level.

Table 4. Food consumption of male spider *T. melanostictum* when the first spiderling fed on *T. urticae*, while the rest of stages fed on *A. nerii* and *A. punicae.*

Biological aspects	No. of prey consumed/ spider		L.S.D	No. of prey consumed/ spider		L.S.D
	A. nerii	***A.punicae***	**at 0.05**	***A. nerii***	***A.punicae***	**at 0.05**
1st spiderling	117.4±6.35 [a]	117.2±6.3 [a]	8.11	11.9±1.47 [a]	11.8±1.83 [a]	2.13
2nd spiderling	61.8±5.26 [a]	65.2±4.49 [a]	5.69	6.0±0.38 [a]	2.7±0.18 [b]	0.38
3rd spiderling	63.4±3.05 [b]	71.2±2.59 [a]	3.67	5.2±0.38 [a]	3.1±0.25 [b]	0.4

4th spiderling	70.8±1.92 [a]	65.2±4.6 [b]	5.14	4.9±0.37 [a]	3.1±0.47 [b]	0.54
Total spiderling	313.4±8.56 [a]	318.8±13.1 [a]	12.9	28.0±1.05 [a]	20.8±1.52 [b]	1.68
Longevity	91.4±1.14 [a]	91.2±2.17 [a]	2.0	3.7±0.37 [a]	4.0±1.81 [a]	1.68
Life span	404.8±9.65 [a]	410.0±14.8 [a]	14.6	31.7±0.93 [a]	24.7±1.81 [b]	1.84

The means with the same letters at the same row are not significantly different at 0.05% level.

Abd El-Azim (2014) and **Ahmed *et al.* (2017)** on the same spider. Also these results agreement with finding with **Ahmad & Abd El-Maaboud (2014)** on spider *Theridion incanescens* and **Sallam *et al.* (2015)** on spider *Theridion jordanense*.

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المظاهر البيولوجية للعنكبوت (Aranae: Theridiidae) *Theridion melanostictum* عند تغذيته على من الدفلة ومن الدورانتا (Homoptera: Aphididae) تحت الظروف المعملية

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اجريت دراسات بيولوجية على العنكبوت *Theridion melanostictum* O.P. Cambridge, 1876 تحت الظروف المعملية لدراسة تأثير الفرائس وهى كلا من حشرتى من التفلة و من الدورانتا على طول فترة الحياة للطور الكامل ومعدل التكاثر للمفترس *T. melanostictum* حيث اوضحت النتائج المتحصل عليها ان له خمسة أعمار يرقية وللذكر أربعة أعمار يرقيه. سجلت فترة العمر اليرقى الأول أقصر فترة تطور لكل من الذكر والأنثى عند تغذيتها على الأطوار المتحركة للعنكبوت الأحمر العادي، بمتوسط 9.3– 9.8 يوم للإناث، 10 أيام للذكور. بينما سجلت الاعمار التالية أطول فترة لدورة الحياة للعنكبوت *T. melanostictum* عند تغذيته على حشرات من الدورانتا بمتوسط 116.3، 94.8 يوماً من التغذية على من الدفله بمتوسط 82.3، 63.3 يوما للإناث والذكور على التوالي. مع وجود اختلاف كبير بين الفريستين. تم حساب عدد الفرائس المستهلكة لكل الأطوار. وتم دراسة تأثير الفرائس على طول فترة الحياة للطور الكامل ومعدل التكاثر. يفضل العنكبوت التغذية على من الدفله عن من الدورانتا. حيث ان حشرات من التفلة تعتبر من العوائل المفضلة لهذا النوع لتأثيرها على مراحل التطور المختلفة و معدل التكاثر مما يساعد فى امكانية استخدامة كاحد عناصر المكافحة الحيوية فى مكافحة الآفات المختلفة.