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# EFFECT OF TEMPERATURE DEGREES ON THE BIOLOGICAL ASPECTS AND THERMAL REQUIREMENTS OF *THERIDION INCANESCENS* SIMON (ARANEAE: THERIDIIDAE) REARED ON *SPODOPTERA LITTORALIS* LARVAE

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**ABSTRACT:** *Temperature degrees affect the development, growth, survival, and reproduction of spiders especially Theridion incanescens. Thermal effect and requirements of Theridion incanescens Simon, 1890 and the developmental stages was studied under laboratory conditions at 25 & 30°C and 60-70% RH. Spider individuals were fed every two days. First and second spiderlings were fed on the first instar larvae of Spodoptera littoralis (Boisduval). Later spiderlings were fed on 2nd larval instar of S. littoralis. Males and females reached maturity at the fifth spiderling after 36.08 & 26.83 and 34.14 & 25.25 days at 25 and 30°C, respectively. Adult longevity, life span, fecundity of female and food consumption were reported.*

***Key words***: *Life cycle, food consumption, thermal effect, life history, fecundity, spiders, Egypt.*

## INTRODUCTION

*Theridion* Walckenaer, 1805 is the type genus of family Theridiidae Sundeall, 1833, as defined by Levi (1963). Also, it is the largest genus of the theridiids as well amongst all spiders (Levy and Amital, 1982). *Theridion* has more than 587 species worldwide (Platnick, 2014). *T. pictum* (Walckenaer) is the type species of *Theridion.* In Egypt, there are eight species had been recorded for genus *Theridion* (El-Hennawy, 2006). *Theridion incanescens* Simon, 1890 was recorded for the first time in Egypt at 2012 by Thaler-Knoflach and El-Hennawy, 2012.

Temperature affects development, growth, survival, and reproduction of spiders. Temperature degrees play a major role in different aspects of spider's life cycle (Bonnet, 1930; Frick *et al.,* 2007 and Rittschof, 2012). Llife history of *Theridion incanescens* was reported by Ahmad and Abd El- Maaboud (2014) preying on *Tetranychus urticae* Koch and *Ceratitis capitata* at 28 °C.

The present study aims to evaluate the effect of two temperature degrees on the biological aspects of *T. incanescens* when feed on *Spodoptera littoralis* (Boisduval) larvae.

## MATERIALS AND METHODS

### *Spodoptera littoralis* rearing:

A laboratory strain of cotton leaf worm, *S. littoralis* was obtained as egg masses and larvae from the Economic Entomology and Pesticides Department, Faculty of Agriculture, Cairo University. All stages were kept in glass jars (20 cm height and 12.5 cm diameter) covered with muslin and cultured under room temperature. Larvae were reared on leaves of castor oil plant, *Ricinus communis* (L.). The leaves were washed by running water and dried before being placed in rearing jars. Larvae feces were removed and *R. communis* old leaves were replaced by new ones every two days. As larvae reached the 5th larval instar, saw dust was placed in the jars to absorb excess moisture and to serve as pupation site. Pupae were collected and placed in separate jars under

the same conditions. Newly emerged male and female moths were allowed to mate. The rearing jars were lined with waxy paper to provide egg laying sites and were daily provided with cotton pads moistened with 10% honeybee solution for the nutrition of the adults. Egg masses, laid on the paper, were daily removed and transferred to clean jars (Ahmad 2009). First and second larval stages produced were used as a prey for the spider.

## Spider rearing:

Adult females of *T. incanescens* were collected from mango, citrus and grape trees at Fayoum, El-Sharkia and Ismalia Governorates. Biological study of the spider was performed under two constant temperatures (i.e. 25 and 30°C) and 60 - 70% RH. Newly hatched spiderlings were placed separately in plastic vials (3 cm diameter x 5 cm height). First and second spiderlings were fed, every two days, on 1$^{st}$ *S. littoralis* larval stage. Later spiderlings were fed on the 2$^{nd}$ *S. littoralis* instar larvae. Linear regression for the relation between temperature and developmental rates (=1/developmental time) was conducted to determine thermal requirements and developmental threshold.

## RESULTS AND DISCUSSION

Obtained results on the developmental durations, rates and thermal requirements are presented in Tables (1 & 2).

## Incubation period:

Eggs were obtained as egg sacs of *Theridion incanescens.* Eggs became dark yellow before hatching. The incubation period was 15 and 6 days at 25 and 30°C, respectively (Tables, 1 & 2).

## Spiderlings development:

Maturity was started at the 5$^{th}$ spiderling stage for females and males (Tables, 1 & 2 and Figs. 1 & 2). The obtained data agree with those of Hussein *et al.,* 2003; Sallam *et al*., 2010 and Ahmad and Abd El- Maaboud, 2014. These results disagree with those of Abo-Taka *et al.* (2004); Abd El-Azim, (2014) and Sallam *et al.,* (2015). They reported that the number of female molts were more than male ones. This different can be attributed to the molts number depends on the required body size. Small males achieve maturity with 1-2 fewer molts than the females (i.e. larger ones) (Foelix F. R. 1996). Average duration of different stages gradually increased as spiderling stage increased. In the mean time these durations decreased with increasing of temperature. The average duration of total spiderlings for females was 34.14 & 25.25 days and. 36.08 & 26.83 days for males on 25 and 30°C, respectively (Tables 1 & 2).

## Temperature effect and thermal requirements of spider development:

Developmental times over tested temperatures revealed negative relation with temperature, while developmental rates were positive. Female total developmental time was 36.08 and 26.83days at 25 and 30$^{o}$C, respectively. Spiderlings' corresponding rates were 0.03 and 0.04 per day. Total developmental thermal requirement was 523.26 degree days over thermal threshold ($t_0$) of 10.50$^{o}$C.

## Adult longevity, life span and developmental duration of female:

Adult longevity was recorded as 80.25 & 60.33 days at 25 & 30°C for females, respectively. Pre-ovipositional, ovipositional and post-ovipositional periods were 8.08 & 7.00, 47.42 & 35.42 and 24.75 & 17.92 days (Tables 1&3). Ahmed and Abd El- Maaboud (2014) reported biological aspects of *T. incanescens* on *T. urticae* and *C. capitata* under laboratory conditions of 28°C. Female longevity was 124.25 days. Pre-oviposition, oviposition and post-oviposition periods were 20.50, 53.50 and 50.25 days, respectively. The increase of female adult longevity was due to longer pre-ovipositional period (Table 3). This may be due to the female requirement (qualitative or

quantitative) of protein to certain level to begin egg-laying. Male longevity was recorded as 39.86 & 29.75 days at 25 & 30°C, respectively. These durations compared with 33.83 days under laboratory conditions, 28°C on *T. urticae* and *C. capitata* (Ahmed and Abd El- Maaboud, 2014). The life span lasted to 131.33 &93.17 and 88.14 & 61.00 days under 25 & 30°C for females and males, respectively.

**Table (1): Thermal effect of *Theridion incanescens* Simon, 1890 females when fed on *Spodoptera littoralis* larvae.**

| Variable | Duration | | Rate | | Regression values | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 25°C | 30°C | 25°C | 30°C | Intercept | Slope | $t_0$ (°C) | (Degree days) | R2 |
| incubation period (day) | 15 | 6 | 0.07 | 0.17 | -0.43 | 0.02 | 21.67 | 50 | 1 |
| 1st spiderling | 4.25 | 3 | 0.24 | 0.33 | -0.25 | 0.02 | 13 | 51 | 1 |
| 2nd spiderling | 5 | 3.17 | 0.2 | 0.32 | -0.38 | 0.02 | 16.34 | 43.31 | 1 |
| 3rd spiderling | 6.08 | 4.17 | 0.16 | 0.24 | -0.21 | 0.02 | 14.1 | 66.29 | 1 |
| 4th spiderling | 7.83 | 6.17 | 0.13 | 0.16 | -0.04 | 0.01 | 6.42 | 145.52 | 1 |
| 5th spiderling | 12.91 | 10.33 | 0.08 | 0.1 | -0.02 | 0.004 | 4.98 | 258.45 | 1 |
| Total spiderlings | 36.08 | 26.83 | 0.03 | 0.04 | -0.02 | 0.002 | 10.5 | 523.26 | 1 |
| Life cycle | 51.08 | 32.83 | 0.02 | 0.03 | -0.03 | 0.002 | 16.01 | 459.44 | 1 |
| Adult longevity | 80.25 | 60.33 | 0.01 | 0.02 | -0.01 | 0.002 | 9.86 | 1215.23 | 1 |
| Life span | 131.33 | 93.17 | 0.01 | 0.01 | -0.01 | 0.0002 | 12.79 | 1603.25 | 1 |

**Table (2): Thermal effect of *Theridion incanescens* Simon, 1890 males when fed on *Spodoptera littoralis* larvae.**

| Variable | Duration | | Rate | | Regression values | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 25°C | 30°C | 25°C | 30°C | Intercept | Slope | $t_0$(°C) | (Degree days) | R2 |
| incubation period (day) | 15 | 6 | 0.07 | 0.17 | -0.43 | 0.02 | 21.67 | 50 | 1 |
| 1st spiderling | 4.14 | 3 | 0.24 | 0.33 | -0.22 | 0.02 | 11.88 | 54.38 | 1 |
| 2nd spiderling | 5 | 3 | 0.2 | 0.33 | -0.47 | 0.03 | 17.5 | 37.5 | 1 |
| 3rd spiderling | 5.29 | 4 | 0.19 | 0.25 | -0.11 | 0.01 | 9.44 | 82.22 | 1 |
| 4th spiderling | 7.29 | 5.25 | 0.14 | 0.19 | -0.13 | 0.01 | 12.11 | 93.95 | 1 |
| 5th spiderling | 12.43 | 10 | 0.08 | 0.1 | -0.02 | 0.004 | 4.42 | 255.76 | 1 |
| Total spiderlings | 34.14 | 25.25 | 0.03 | 0.04 | -0.02 | 0.002 | 10.8 | 484.83 | 1 |
| Life cycle | 48.29 | 31.25 | 0.02 | 0.03 | -0.04 | 0.002 | 15.83 | 442.87 | 1 |
| Adult longevity | 39.86 | 29.75 | 0.03 | 0.03 | -0.02 | 0.0001 | 10.28 | 586.59 | 1 |
| Life span | 88.14 | 61 | 0.01 | 0.02 | -0.01 | 0.0006 | 13.76 | 990.45 | 1 |

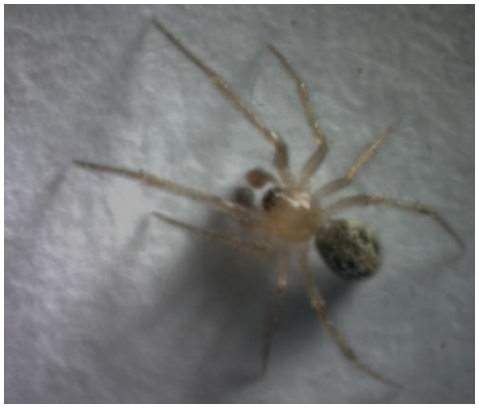

**Fig. (1): *Theridion incanescens* Simon, 1890 adult male.**

**Fig. (2): *Theridion incanescens* Simon, 1890 adult female.**

**Table (3): Female specific data of *Theridion incanescens* Simon, 1890.**

| Specific data | 25°C | | 30°C | |
|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. |
| Pre-oviposition period (days) | 8.08 | 3 | 7 | 1.04 |
| Oviposition period (days) | 47.42 | 5.05 | 35.42 | 4.98 |
| Post-oviposition period (days) | 24.75 | 4.35 | 17.92 | 5.82 |
| Number of eggs/egg sac | 37.25 | 1.91 | 39.67 | 1.83 |
| Number of egg sacs / female | 4.17 | 0.72 | 4 | 0.74 |

## Food consumption:

During the study, results in Table 4 showed that, *T. incanescens* 1st and 2nd spiderlings were fed on the 1st instar of *S. littoralis,* while later instars were fed on the 2nd instar larvae. The number of consumed

larvae increased gradually with increasing individual's instar in male and female, but the number of consumed larvae by female more than those consumed by male in all instars. The effect of temperature on the number of larvae consumed appeared clearly in the female where the number of larvae consumed increases with temperature.

The averages of consumed prey during total spiderlings duration were 122.14± 7.15 &121.00±10.68 and 139.17± 9.06 &171.42±10.82 larvae at 25 & 30°C by male and female, respectively.

The average numbers of consumed prey by adults were 238.57± 69.86 &222.50±80.57 and 499.67± 48.18 &504.17±47.76 larvae under 25 & 30°C by male and female, respectively. Obtained results showed that the female of *T. incanescens* consumed slightly more preys than the male during all stages; this may be due to that females need more amounts of protein for fertility and egg laying comparing with males. Results are agreement with these conducted by ( Hussein *et al.*, 2003; Abo-Taka *et al.*, 2004; Abd El-Azim ,2014; Ahmad and Abd El- Maaboud , 2014 and Sallam *et al.*, 2015).

**Table (4): *Theridion incanescens* food consumption on *Spodoptera littoralis* larvae**.

| Stage | Temp (°C) | Male | | | Female | | |
|---|---|---|---|---|---|---|---|
| | | Mean | S.D. | Daily rate | Mean | S.D. | Daily rate |
| 1 st spiderling | 25 | 8.29 | 1.7 | 2 | 9 | 1.65 | 2.14 |
| | 30 | 7.75 | 0.96 | 2.58 | 10.42 | 1.68 | 3.47 |
| 2 nd spiderling | 25 | 14.86 | 2.41 | 2.97 | 20.42 | 2.5 | 4.08 |
| | 30 | 13 | 3.46 | 4.33 | 22.67 | 3.63 | 7.33 |
| 3 rd spiderling | 25 | 19.57 | 2.57 | 3.71 | 24.92 | 3.85 | 4.21 |
| | 30 | 19 | 1.15 | 4.92 | 28.5 | 6.65 | 7.06 |
| 4 th spiderling | 25 | 27.86 | 2.67 | 4.12 | 31.92 | 4.6 | 4.27 |
| | 30 | 28.75 | 2.5 | 5.54 | 40.25 | 4.25 | 7.23 |
| 5th spiderling | 25 | 51.57 | 6.83 | 4.18 | 52.92 | 7.82 | 4.47 |
| | 30 | 52.5 | 8.66 | 5.53 | 69.58 | 6.56 | 7.22 |
| Total spiderlings | 25 | 122.14 | 7.15 | 3.6 | 139.17 | 9.06 | 3.89 |
| | 30 | 121 | 10.68 | 4.83 | 171.42 | 10.82 | 6.51 |
| Adult longevity | 25 | 238.57 | 69.86 | 6 | 499.67 | 48.18 | 6.23 |
| | 30 | 222.5 | 80.57 | 7.43 | 504.17 | 47.76 | 8.5 |

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## REFERENCES

Abd El-Azim, N. A.I. (2014). Rearing *Theridion melanostictum* O. P. Cambridge (Araneae: Theridiidae) on *Tetranychus urticae* Koch and larvae of *Spodoptera littoralis* Boisduval, Acarines , Vol.8(2): 79-82.

Abo-Taka, S. M., A. M. Hussein, A. A. Osman, G.I. Zohdi and E.G.I. Hamada (2004). Studies on some biological aspects of *Theridion melanostictum* O.P. Cambridge, 1876 (Arachnida: Araneida). Serket, 9(1): 5-9.

Ahmad, N. F. R. (2009). Biological, toxicological and mass rearing possibility of the spider *Kochiura aulica* (C. L. Koch, 1838). Ph.D. Thesis, Fac. Agric., Benha Univ. Egypt. 226pp.

Ahmad, N. F. R. and A. S. Abd El-Maaboud (2014). Biological aspects of the spider, *Theridion incanescens* (Araneae: Theridiidae) feeding on *Tetranychus urticae* and *Ceratitis capitata* with notes on its mating behavior. Egypt. Acad. J. Biolog. Sci., 7(2): 9 – 14.

Bonnet, P. (1930). La mue, 1'autotomie et la regeneration chez les Araignees, avec une etude des *Dolomedes* d'Europe. Bull . Soc . Nat . Hist . Toulouse 59 :237-700.

El-Hennawy, H.K. (2006). A list of Egyptian spiders (revised in 2006). Serket, 10(2): 65-76.

Foelix, R.F. (1996). Biology of spiders. Second Edition. Oxford University. 330 pp.

Frick, H., C. Kropf and W. Nemtwig (2007). Laboratory Temperature Preferences of the Wolf spider *Pradosa riparia* (Araneae: Lycosidae). Bull. Br. Arachnol. Soc.14(1),45-48.

Hussein, A.M., M.F. Hassan and N.F.R. Ahmad (2003). Biological aspects of *Anelosimus aulicus* (C.L. Koch, 1838) (Arachnida: Araneida: Theridiidae) in Egypt, Serket, 8(4): 129-134.

Levi, H. W. (1963). American spiders of the genus *Theridion* (Araneae, Theridiidae). Bull. Museum of Comparative Zoology, 129(10): 481– 589.

Levy, G. and P. Amitai (1982). The comb-footed spider genera *Theridion, Achaearanea* and *Anelosimus* of Israel (Araneae: Theridiidae). J. Z., London 196: 81-131.

Platnick, N. I. (2014). The world spider catalog, version 15. American Museum of Natural History, online at: http://research.amnh.org/iz/spiders/catalog_15.0 /index.html

Rittschof, C.C. (2012). The effects of temperature on egg development and web site selection in *Nephila clavipes* (Linneaus 1767). J Arachnol. 40:141–145.

Sallam, G.M. E., N. A.I.Abd El-Azim and H. M.G. El-Kawas (2010). Biodiversity of spiders associated with cotton and maize in Sharkia Governorate with a special reference to the spider *Kochiura aulica* (Koch). Acarines, 4: 67-71.

Sallam, G.M.E., N.A.I. Abd El-Azim and M. A. Mohafez (2015). A study of some biological aspects of the spider *Theridion jordanense* Levy & Amitai, 1982 (Araneae: Theridiidae) in Egypt. Egypt. Acad. J. Biological Sci., 8(1): 73 – 77.

Thaler-Knoflach, B. and H. K. El-Hennawy (2012). *Theridion incanescens* Simon, 1890 and *Theridion jordanense* Levy & Amitai, 1982 new to the fauna of Egypt. (Araneae: Theridiidae). Serket, 13(1/2): 91-98.

# تأثير الحرارة علي بيولوجي *Theridion incanescens* Simon, 1890 (Araneae: Theridiidae) والاحتياجات الحرارية لأطواره المختلفة عند التربية علي يرقات دودة ورق القطن

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**الملخص العربى**

تؤثر الحرارة على العناكب من حيث تطور الاطوار المختلفة ، النمو ، التكاثر والقدرة الحياتية ، لذلك تم دراسة تاثير الحرارة علي بيولوجي *Theridion incanescens* Simon, 1890 والإحتياجات الحرارية لأطواره المختلفة تحت الظروف المعملية ( درجتي حرارة 25 م° ، 30 م° ورطوبة نسبية 60- 70 ٪) .

تم تغذية أطوار العنكبوت المختلفة بانتظام كل يومين حيث تغذي الطور الأول والثاني علي العمر اليرقي الأول من دودة ورق القطن (Boisduval) *Spodoptera littoralis* ، وتم تغذية باقي الأطوار العنكبوتية علي العمر اليرقي الثاني لدودة ورق القطن ، وقد وصل كل من الذكور والأناث الي الطور البالغ بعد خمسة انسلاخات استغرقت 36.08 ، 26.83 ، 34.14 ، 25.25 يوم علي درجة حرارة 25 م° ، 30 م° علي التوالي . كما تم د راسة عمر الافراد البالغة ،و حساب خصوبة الإناث و حساب عدد الفرا ئس المستهلكة .