Journal of Plant Protection and Pathology

Journal homepage: www.jppp.mans.edu.eg
Available online at: www. jppp.journals.ekb.eg

Temperature Effect Study on Fecundity and Development of *Tetranychus urticae,* Koch. (Acari-Tetranychidae) on Different Host Plants

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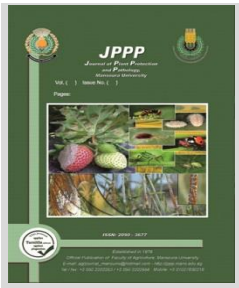

ABSTRACT

Spider mite, *Tetranychus urticae,* Koch., the most one important pests of plant in Egypt. Development and fecundity of this mite were studied on fig and tomato at three constant temperatures (20, 25 and 30°C), 60 ± 5% RH. The developmental time of immature stages ranged from 13.8 ± 1.6 & 10 ± 1.6 days at 20°C to 6.8 ±0.8 &4.6 ± 1.1 days at 30°C. The lower temperature threshold (t_0) and thermal constant (k) of the immature stages were estimated to be 7.9 & 11.16°C and 119.351&85.185 degree days (DD), respectively. The average adult life span of females was determined to be 41.6 ± 3.0 & 34.8 ± 3.1 days at 20°C to 19.8 ± 1.3 & 15.1 ± 3.0 days at 30°C.

Keywords: *Tetranychus urticae; tomato*; fig; temperature, thermal requirements, development.

INTRODUCTION

The mite, *Tetranychus urticae*, Koch; Acari-Tetranychidae, consider a serious pest one of crops varieties, such as vegetable and, fruit tree in Egypt (Jeppson, 1975) (Khanjani & Haddad Irani-Nejad 2009 and Saeidi *et al.*, 2010).recorded that, Each stage feeds on leaves that produce small gray or silver spots. Leaves damages prevents the photosynthesis and the outbreaks can leads to leaves premature fall and lower crops, (Zhang Z.Q. 2003), Spider mites are soft-bodied, medium-sized mites (about 400 mm for an average adult female), and when alive, they are often red, green, orange or yellow in colour. All spider mites are phytophagous and several are major pests of crops and one of the important genus in this family is Tetranychus results of this study can be used to predict the development and population density of *T. urticae* and its can be distinguished based on the shape. Usually, the Temperatures are environment factor and most influence rate on mite growth. Temperatures affect measures on mite growth, life stage of the specie, probably occurred with constant temperature and can used the development results times to growth rate estimates curve (Southwood T.R.E. 1978).

With the growth rates curve, the model can be modeled as a temperature function to predict of time developments. The model is important for decision for pest management making or in use as comprehensive model components, to explore population dynamics. Temperature is the main abiotic factor influencing the temporal and spatial distribution of insects and mites in the field (Perring *et al.*, 1984; Bonato *et al.*, 1990). Population growth rateslargely determine the pest status of spider mites (Janssen & Sabelis 1992) and temperature strongly affects population growth (Sabelis 1986a; Roy *et al*., 2003; Mori *et al*., 2005; Gotoh *et al*., 2010).

There are a some studies were conducted in this area, included the temperature effects on reproduction and development of Acari; Tetranychidae, on some plant hosts; e.g. on cotton attacked by *T. urticae,* (Carey&Bradley, 1982), attack on banana by *T. piercei* McGregor (Yueguan *et. al*., 2002), mulberry attacks by *T. truncates* (Sakunwarin *et al.* 2003), *Eutetranychus banksi* (McGregor), *T. urticae* on beans (Parslika and Huszar, 2004), *T. urticae* on apple (Kasap, 2004), *T. turkestani* Ugarov and Nikolski on eggplant (Nemati *et al*., 2005), *T. turkestani* on bean (Sohrabi and Shishehbor, 2008), *T. urticae* on eggplant (Ju *et al*., 2008), *E. orientalis* on Siris (Imani *et al*, 2009), *Panonychus citri*on sweet orange (Kasap, 2009), *T. turkestani*on cucumber (Karami Jamour, 2011) and *T. horridus* (Canestrini and Fanzago) on hazelnut (Pahlavan *et al*., 2012).

Therefore, the aim of the present study was to investigate the effect of temperature and host plant on development and reproduction of *T. urticae*.

MATERIALS AND METHODS

Tetranychus urticae was collected from fig leaves, *Ficus carica* naturally infested plants growing at Marsa Matrouh. *T. urticae* were bred on new leaves of figs for a generation under laboratory conditions before experiments on mite creation Mites were reared on (2×5cm diameter) diameter leaf disc arenas of each on *Ficus carica* (fig) and *Solanum lycopersicum* (tomato) arising upside down on moisten cotton pad (10 cm diameter and 1 cm thick) in Put on cotton in foam plates (20×15cm) under laboratory conditions of 20, 25, 30 ± 2°C, with only one egg left per arena, in a total of 25 arenas (Zhang *et al*., 1999). All ends of the leaves were covered with wet cotton to avoid escape of mites. During the experiments, leaves were changed every 3 – 4 days to reduce the effects of plants age on mite development and fecundity. The cotton soaked by water two times daily to stay wet and remained fresh.

The developmental stages were carefully checked at least once per day until they grew up toadulthood. After emergence of the adults, duration of pre-oviposition,

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DOI: 10.21608/jppp.2019.67794

oviposition and postoviposition periods as well as longevity, daily fecundity and total fecundity were also recorded.

Statistical analysis:

The statistical analysis (Regression) of the obtained results was performed using SAS program (SAS Institute, 1988). Also the difference between means was conducted using linear regression for the relation between temperature and developmental rates.

RESULTS AND DISCUSSION

Current study were directed to investigate temperature effects of stable systems, 20, 25 and 30°C on *T. urticae* stages developments for purposes determine the critical development (t_0) and daily temperature degrees (calories) necessary to immature stages development, addition to, reproductive capacity of adult (fertility & longevity) of the red spider mite, *T. urticae*. The period of immature stages were tested under various constant temperatures, Table (1).

Table 1. Mean developmental times in days of *T. urticae* females reared on (Fig)and (Tomato) persimmon varieties at constant temperatures and 70± 5% RH.

Variable	Temp. (ºC)	incubation period		Immature stages		Life cycle		Longevity		Life span	
		Fig	Tomato	Fig	Tomato	Fig	Tomato	Fig	Tomato	Fig	Tomato
duration	20	3.2±1.3	3.6±1.1	13.8±1.6	10±1.6	17.0±1.9	13.6±2.3	24.6±3.1	21.2±1.9	41.6±3.0	34.8±3.1
	25	2.2±0.4	2.8±0.8	8.4±2.5	6.2±0.4	10.6±2.6	9±1.0	15.4±2.8	13.4±0.9	26±4.4	22.4±0.6
	30	1.4±0.5	2±0.7	6.8±0.8	4.6±1.1	8.2±1.3	6.6±1.6	11.6±1.3	8.5±1.4	19.8±1.3	15.1±3.0
Rate	20	0.313	0.278	0.072	0.100	0.059	0.074	0.041	0.047	0.024	0.029
	25	0.455	0.357	0.119	0.161	0.094	0.111	0.065	0.075	0.038	0.045
	30	0.714	0.500	0.156	0.217	0.122	0.152	0.086	0.118	0.051	0.066
Regression values	Intercept	-0.511	-0.177	-0.094	-0.134	-0.066	-0.083	-0.050	-0.096	-0.028	-0.047
	Slope	0.040	0.022	0.008	0.012	0.006	0.008	0.005	0.007	0.003	0.004
	t_0 (ºC)	12.710	7.976	11.165	11.408	10.473	10.632	10.967	13.675	10.768	12.587
	K (Degree days)	24.889	45.000	119.351	85.185	158.409	128.229	219.508	141.890	377.835	266.741
	R^2	0.972	0.974	0.996	0.999	0.995	1.000	0.999	0.984	0.997	0.992

Immature development

The incubation period of the pest lasted 3.2 ± 1.3, 2.2 ± 0.4, 1.4 ±0.5, 3.6 ± 1.1, 2.8 ± 0.8 and 2.7 ± 0.7 when feed on tomato and fig at 20, 25 and 30 ºC, respectively. In the present study, the result is in harmony with Kasap, 2004; Parslika and Huszar, 2004. The strains of red mite, *T. urticae*, it may provide an explanation for longer or lower growth time. The threshold of low temperature, (12.1°C/male) were estimated according to "linear regression", and the results agree with Kasap, 2004, this report was conducted on apple plants and Ju *et al*. 2008, recorded 12.5°C, were tested on eggplant, indicated that the, the adaptation of temperature different between various of mite, *T. urticae* populations. While males hatched after shorter periods were calculating, the thermal units and the developmental threshold (t_0) were very necessary for egg stage developments of spider red mite, *T. urticae*. Data resulted in Table1, recorded 12.7ºC., for Developmental threshold temperature (t_0) for egg stage; it's indicated that, thermal unit very necessary to development complete, it's were about 24.89 day/degrees, and results showed that there is a cleared variation in periods incubation joined with increasing of temperature degrees, so the longest of incubation period was (20 °C), and the shortest incubation period was (30 °C.).

The mean development time of immature period decreased from 13.8 ± 1.6, 10 ±1.6 days at 20 °C. 8.4 ± 2.5, 6.2 ± 0.4 days at 25 °C., and 6.8 ± 0.8, 4.6 ±1.1 days at 30°C, when feed on fig and tomato which was significantly different at various temperatures.

Total development time immature of *T. urticae* male was significantly influenced by the food cultivars and ranged between 12.6±1.1 and 9±2.0 at 20°C; 10±1.2 and 5±1 at 25°C; and 5.6±1.5 and 3±0.3 days at 30°C., overall.

The life cycle of female *T. urticae* was the highest in the 20 °C. It took 17±1.9 and 13.6±2.3 days. The shortest duration was 8.2 ± 1.3 and 6.6± 1.3 days in 30 °C. Total development time of *T. urticae* males was significantly influenced by the food and ranged between 15± 1.0 and 12.4 ±2.3 at 20°C; 12.4±1 and 7.4±1.2 at 25°C; and 6.8±1.3 , 5±0.6 days at 30°C. Overall, total duration of total life cycle stages of *T. urticae* males was shorter than females on all plant tested.

In the present study, the result is in harmony with Kasap, 2004; Parslika and Huszar, 2004.

The strains of spider red mite, may give an explication for fewer or longer times of growth in the tested pest. The lower temperature threshold 12.1 °C and 12.5°C/male, were estimated according "linear regression", this results were agreement with those report by Kasap, 2004 and Ju *et al*., 2008, tested on apple and eggplant plants respectively, this data indicated that, the adaptations of different temperature between different populations of mite. The required rate number of degree/days to complete *T. urticae* development recorded, 160.2 DD/females and 174.8 DD/males, this data were in agreement with those estimated higher than, by Ju *et al*. 2008, and lower than by Kasap, 2004, on eggplant and apple plant respectively, recorded (80.5/ females and 74.7 DD/males) and (172.4 DD/female), for *T. urticae* respectively. The existence races of three genetically distinct host of *T. urticae* on peach plant, eggplant, and apple led to these differences.

According to males and females longevity of for *T. urticae*, cleared in Table 1&2, there is an inverse relationship between adult longevity and temperature. The longest duration period was 24.6±3.1 &21.2±1.9 days for females and 20.4±3.5& 15.2+1.3 days for males at 20ºC, was 15.4±2.8 &13.4+0.9 days for females and 12±1.8 & 10.4+1.1 days for males at 25ºC,

The duration of the shortest female period was 11.6±1.3& 8.5±1.4 days while. The same duration period of male was 8.2±0.8 & 7.0±1.5 at 30ºC. Also, data indicated that, the adult longevity/females give longer than adult longevity/males, under the all of temperatures tested. Same results were recorded by Carey and Bradley (1982) and Kasap (2004).

The various factors effects in results for development between the researches due to factors

differentiation; e.g. host plant desperation, humidity differentiations, condition of photoperiods, accuracy of results and the colony sources of red spider mite *T. urticae*.

At the current study, the adult longevity of the tested pest was determined, and the data recorded lower than the others which were conducted at the same conditions. Carey and Bradley, 1982, mentioned that, longevity rate/females give (14.71 and 9.71 days) at (23.8 and 29.4°C) respectively. Kasap, 2004, recorded (29.9, 25.9, 16.8 and 4.7 days) at (20, 25, 30 and 35°C.) respectively for longevity rates/female. The various factors effects in results for development between the researches due to factors differentiation; e.g. host plant desperation, humidity differentiations, condition of photoperiods, accuracy of results and the colony sources of red spider mite *T. urticae*.

Table 2. Mean developmental times in days of *T. urticae* males reared on (Fig) and (Tomato) persimmon varieties at constant temperatures and 70± 5% RH.

Variable	Temp. (ºC)	incubation period		Immature stages		Life cycle		Longevity		Life span	
		Fig	Tomato	Fig	Tomato	Fig	Tomato	Fig	Tomato	Fig	Tomato
duration	20	2.4±0.5	3.4±1.1	12.6±1.1	9±2.0	15±1	12.4±2.3	20.4±3.5	15.2±1.3	35.4±4.2	27.6±3.5
	25	2±0.7	2.4±0.5	10±1.2	5±1.1	12.4±1	7.4±1.2	12±1.8	10.4±1.1	24.4±2.3	17.8±0.8
	30	1.2±0.4	2±0.7	5.6±1.5	3±0.3	6.8±1.3	5±0.6	8.2±0.8	7±1.5	13.8±2.1	12±1.2
Rate	20	0.417	0.294	0.079	0.111	0.067	0.081	0.049	0.066	0.028	0.036
	25	0.500	0.417	0.096	0.200	0.081	0.135	0.083	0.096	0.041	0.056
	30	0.833	0.500	0.179	0.333	0.147	0.200	0.122	0.143	0.072	0.083
Regression values	Intercept	-0.458	-0.111	-0.130	-0.341	-0.103	-0.160	-0.098	-0.091	-0.063	-0.059
	Slope	0.042	0.021	0.010	0.022	0.008	0.012	0.007	0.008	0.004	0.005
	t_0 (ºC)	11.000	5.397	13103	15.333	12.794	13.388	13.377	11.817	14.318	12.563
	K (Degree/days)	24.000	48.571	100.800	45.000	124.390	83.784	137.115	129.756	226.167	212.308
	R^2	0.893	0.988	0.873	0.987	0.876	0.997	0.999	0.985	0.943	0.992

Egg laying capacity (fecundity)

The data revealed a direct relationship between the total number eggs deposited/female throughout the pest life cycle and the temperature 94±15.6 eggs/female tested on 30ºC when feed on fig plant (86.2±12.7 eggs/female) was recorded at 30ºC., when feed on tomato. However, the optimum temperature for eggs laying activity was 30ºC. The rate of eggs total number for red spider mite *T. urticae*, recorded 25°C., this data resulted by (Parslika and Huszar, 2004); (Karimi *et al*., 2006); (Ju *et al*., 2008); (Razmjou *et al*., 2009); (Sedaratian *et al*., 2009) and (Saeidi, 2010).

Extensive research had been done on the biology of different species of spider mites. Most of the works are related to the effect of temperature. Sabelis (1986a) reported that a female *T. urticae* develop from egg to adult in 6.5 days at 30 ºC., and found that a female *T. urticae* lays as many as 60 eggs in five days (Helle, W. & Sabelis, M.W. (Eds.). The larval and nymphal stage lasted 16 days at 20 ºC but only seven days at 31 ºC. The present investigation shows that *T. urticae* develop from egg to adult in 4.22 and 28.33 days at temperature 28.53 and 13.78 ºC respectively.

The values, which obtained from this study, showed the lower value, this may be due to the fact that different hosts demonstrate various characteristics toward brown mite. Several researchers have demonstrated that spider mites produce different populations on various plant cultivars such as *Tetranychus turkestani* Ugarov & Nikolski on Melon; *Amphitetranychus viennensis* (Zacher) Kasap 2003 and *T. urticae* Koch on apple (Skorupska 2004). Such as the mechanisms could be responsible for observed differences, including plant nutritional quality of the host plant and morphological or allelochemical features (Sabelis, 1986a).

The current study, resulted that, the important factor can be effect on reminder and reproduction of mite, *T. urticae*. These results were important included, used of projects mass-rearing and chosen of optimum temperature needed for development breeding. Furthermore, can be used for pest management purposes, in building suitable computer models to calculated population dynamics and the prediction of *T. urticae*. Throughout these results can be used as practical information of biological control and its predators programs against *T. urticae*, to achieve the desired targets, it is very important to obtain specific information in the tested area, specially, on parameters for time development and growth of population of *T. urticae*, These results should be supported by laboratory studies

Generally, the data obtained showed that there are significant differences between the tested host plants. These differences were clear on fecundity, longevity, life cycle and lifespan of *T. urticae*. This difference may be due to the difference of crop rotation, food and chemical component of plant.

Table 3. Fecundity of *T. urticae* on two tested temperatures

Variable	Temp. (ºC)	Mean number eggs/female ± SE	
		Fig	Tomato
Mean number of eggs/female ± SE	20	89.6±9.1	58.4±8.6
	25	83.8±13.8	74.6±8.2
	30	94±15.6	86.2±12.7
Eggs/female/day ± SE	20	6.4±1.2	4.6±0.6
	25	7.4±1.3	7.2±0.9
	30	10.69±0.9	13.692±2.5

REFERENCES

Bonato, O., Cotton, D., Kreiter, S. & Gutierrez, J. (1990) Influence of temperature on the lifehistory parameters of the yellow grape-vine mite *Eotetranychus carpini* (Oudemans) (Acari: Tetranychidae). *International Journal of Acarology*, 16: 241–245.

Carey, J. R. and Bradley, J. W. (1982). Developmetal Rates, Vital Schedules, Sex Ratios, and Life Tables for *Teranychus urticae*, *Tetranychus turkestani* and *Tetranychu pacificus* (Acarina: Tetranychidae) on Cotton. *Acarologia*, 23(4): 333-345.

Gotoh, T., Sugimoto, N., Pallini, A., Knapp, M., Hernandez-Suarez, E., Ferragut, F., Ho, C.C., Migeon, A., Navajas, M. & Nachman, G. (2010) Reproductive performance of seven strains of the tomato red spider mite *Tetranychus evansi* (Acari: Tetranychidae) at five temperatures. *Experimental and Applied Acarology*, 52: 239–259.

Imani, Z., Shishehbor, P. and Sohrabi, F. 2009. Effete of Temperature on Life History and Life Table of *Eutetranychus orientalis* (Klein) (Acari: Tetranychidae). *Sys. Appl. Acarol*., 14: 11-18.

Janssen, A. & Sabelis, M.W. (1992) Phytoseiid life-histories, local predator-prey dynamics, and strategies for control of tetranychid mites. *Experimental and Applied Acarology*, 14: 233– 250.

Jeppson, L. R.; Baker, E. W. and Keifer, H. H. (1975). Mites Injurious to Economic Plants. University of California Press, Berkely, 614 PP.

Ju, K.; Sangkoo, L.; JeongMan, K.; YoungRip, K.; TaeHeung, K. and Jisoo, K. (2008). Effect of Temperature on Development and Life Table Parameters of *Tetranychus urticae* Koch (Acari: Tetranychide) Reared on Eggplants. *Kor. J. Appl. Entomol*., 47(2): 163-168.

Karami-Jamour, T. 2011. Biology of Two Spotted Spider Mite, *Tetranychus turkestani* Ugarov and Nikolski and Its Predator, *Stethorus gilvifrons* Mulsant under Laboratory Conditions. MSc. Thesis, University of Shahid Chamran, Ahvaz, Iran, 138 PP.

Kasap, I. (2004). Effect of Apple Cultivar and of Temperature on the Biology and Life Table Parameters of The Two-spotted Spider Mite *Tetranychus urticae*. *Phytoparasitica*, 32(1): 73-82.

Kasap, I. 2009. The Biology and Fecundity of the Citrus Red Mite *Panonychus citri* (Mc Gregor) (Acari: Tetranychidae) at Different Temperatures under Laboratory Conditions. *Turk. Agric. For*., 33: 593-600.

Khanjani, M. & Haddad Irani-Nejad, K. (2009) *Injurious mites of agricultural crops in Iran*. Bu-Ali Sina University Press, Hamedan, Iran, 560 pp.

Mori, K., Nozawa, M., Arai, K. & Gotoh, T. (2005) Life-history traits of the acarophagous lady beetle, *Stethorus japonicus* at three temperatures. *BioControl*, 50: 35–51.

Nemati, A. R., Soleimannejadian, A., Shishehbor, P. and Kamali, K. 2005. Evaluation of the Effect of Temperature on Biological Parameters of *Tetranychus turkestani* Ugarov and Nikolski (Acari: Tetranychidae). *Sci. J. Agric*., 28: 209- 222.

Pahlavan-Yali, M., Razmjou, J., Khanjani, M., Golizadeh, A. and Hassanpour, M. 2012. Life History Traits of *Tetranycopsis horridus* (Canestrini and Fanzago) (Acari: Tetranychidae) at Three Constant Temperatures. *J. Acarol*., 4: 251-256.

Parslika, J. and Huszar, J. (2004). Influence of Temperature and Host Plants on the Developmental and Fecundity of the Spider Mite (*Tetranychus urticae*). *Plant Prot. Sci*., 40(4): 141-144.

Perring, T.M., Holtzer, T.O., Kalisch, J.A. & Norman, J.M. (1984) Temperature and humidity effects on ovipositional rates, fecundity, and longevity of adult female Banks grass mites (Acari: Tetranychidae). *Annals of the Entomological Society of America*, 77: 581–586. Plants. University of California Press, Berkely, 614 PP.

Roy, M., Brodeur, J. & Cloutier, C. (2003) Temperature and sex allocation in a spider mite.

Sabelis, M.W. (1986a) Capacity for population increase. *In*: Helle, W. & Sabelis, M.W. (Eds.), *Spider mites: Their biology, natural enemies and control.* Elsevier, Amsterdam, World Crop Pests, pp. 35–41.

Saeidi, Z.; Nourbakhsh, S. H.; Nemati, A. R. and Ueckerman, E. A. (2010). First Report of *Schizotetranychus smirnivi* Wain., in Iran. *19th Iran. Plant. Prot.Cong*., Tehran, Iran, 373 PP.

Sakunwarin, S.; Chandrapatya, A. and Backer, G. (2003). Biology and Life Table of The Cassava Mite, *Tetranychus truncates* Ehara (Acari: Tetranychidae). *Sys. Appl. Acarol*., 8: 13-24.

SAS Institute (1988): SAS user's guide: Statistics. SAS Institute, Cary, N.C.

Sohrabi, F. and Shishehbor, P. 2008. Effects of Host Plant and Temperature on Growth and Reproduction of the Strawberry Spider Mite *Tetranychus turkestani* Ugarov and Nikolski (Acari: Tetranychidae). *Sys. Appl. Acarol*., 13: 26-32.

Southwood, T. R. E. (1978). Ecological Methods. Chapman and Hall, London, UK, 232 PP.

Yueguan, F.; Faugping, Z.; Zhengqiang, P.; Kui, L. and Qian, J. (2002). The Effects of Temperature on the Development and Reproduction of *Tetranychus piercei* McGregor (Acari: Tetranychidae) in Banana. *Sys. Appl. Acarol*., 7: 69-76.

Zhang, Y.X.; Zhang, Z.Q.; Liu, Q.Y., and Lin, J.Z. 1999. Biology of *Schizotetranychus nanjingensis* (Acari: Tetranychidae) with reference to effects of temperature on and importance of nests to its survival and development. Sys. Appl. Acarol., 4: 75-82.

Zhang, Z. Q. (2003). Mites of Greenhouses: Identification, Biology and Control. CABI Publishing, Cambridge, UK. 244 PP.

دراسة تأثير درجة الحرارة على تطور وخصوبة العنكبوت الاحمر *Tetranychus urticae* (Koch) على عوائل نباتية مختلفة

محمد عادل نوار*

وحدة الافات الحيوانية – قسم وقاية النبات – مركز بحوث الصحراء

يعتبر العنكبوت الاحمر *Tetranychus urticae* Koch أحد أهم الآفات النباتية في مصر. تمت دراسة تطور وخصوبة العنكبوت الاحمر على كل من التين والطماطم تحت ثلاث درجات حرارة ثابتة (20 و 25 و 30 درجة مئوية) ، ورطوبة نسبية 60± 5 ٪ . تراوحت الفترة التطورية للمراحل غير الناضجة بين 13.8 ± 1.6 و 10 ± 1.6 يوم عند 20 درجة مئوية إلى 6.8 ± 0.8 و 4.6 ± 1.1 يوم عند 30 درجة مئوية . قدرت درجة الحرارة المنخفضة (t_0) والثابت الحراري (k) في المراحل غير الناضجة بـ 7.9 و 11.16 درجة مئوية و 119.351 و 85.185 يومًا (DD) ، على التوالي . تم تحديد متوسط عمر الطور البالغ من الإناث 41.6 ± 3.0 و 34.8 ± 3.1 يوم عند 20 درجة مئوية إلى 19.8 ± 1.3 و 15.1 ± 3.0 أيام عند 30 درجة مئوية .