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EFFECT OF DIFFERENT CONSTANT TEMPERATURE DEGREES ON DEVELOPMENT OF TOMATO LOOPER, *Chrysodeixis chalcites* (ESPER)

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ABSTRACT

The present study was carried out to study the effect of three constant temperatures (20, 25 and 30^{o}C each ±1^{o}C and 65±5 % R.H.) on *Chrysodeixis chalcites* (Esper). The duration period of immature stages, preoviposition, postoviposition periods and life cycle of *C. chalcites* were significantly affected by different temperatures. The thresholds of development (t_0) were 4.8, 2.7 and 4.6 ^{o}C for eggs, larvae and pupae, respectively. The thresholds of development (t_0) of life cycle and generation were 3.7 and 4.3 ^{o}C, respectively. Also, the thresholds of development (t_0) were 9.8, 10, 5.4 and 4.7 ^{o}C for female longevity, male longevity, female life span and male life span, respectively .

Keywords*:* *Chrysodeixis chalcites* Esper, thermal units.

INTRODUCTION

The larva of the moth is a general feeder on many herbaceous weeds and crops including vegetable, fruit and ornamental hosts. Its crop hosts include cauliflower, chrysanthemum, corn, crucifers, geraniums, greenhouse crops, legumes, soybeans, potato, strawberries and tomatos, so it posses threats on vegetables especially tomato. It has 8 generations in laboratory (Rashid *et al.* 1971) and 9 generations a year in nature (Harakly and Farag, 1975).

Heat unit systems quantify the thermal environment of organisms (Paul, 2013).

The study aims to evaluate the effect of different constant temperatures on the development of *C. chalcites* and thermal units (degree-days).

MATERIALS AND METHODS

Eggs and larvae of tomato looper, *C. chalcites* were collected from leaves of tomato and reared in the laboratory in jars which covered with pieces of thin mesh fixed in place with a rubber band, larvae were fed on leaves of tomato until pupation. Pupae transferred to a larger container until adults were appeared. Moths were placed in pairs in plastic containers (15 cm long) contain a small piece of absorbent cotton wool held in place by a rubber band, over the top and supplied with a 20% honey solution (Roberts, 1979). The newly laid eggs were divided into three groups, each group put in incubator. Every incubator had different temperature on the others; the temperatures were 20, 25 and 30˚C. They reared by the method mentioned above. The biological aspects of the pest in each temperature were studied.

Linear regression method was applied to calculate the theoretical development threshold as follows:

Where the reciprocal for duration time of each stage (Y) in days, 1/y is multiplied by 100 plotted against temperature (T) in degree centigrade, so the value of the ordinate (100/y) represents the average percentage development made by the stage per day at a given temperature (Campbell *et al.*, 1974).Theoretically the point where the velocity line crosses the temperature axis is the threshold development in degree centigrade (t_0). Thermal units (degree-days) required to complete development of each stage was determined according to (Campbell *et al.* 1974) and (Ramadan, 2008). The degree-days (DD's) were calculated from the following:

$DD = d\ (t - t_0)$

Where:

DD: thermal units (day-degree)

d: the developmental duration of a given developmental stage at constant temperature (t)

t_0 : threshold temp in degree centigrade.

RESULTS AND DISCUSSION

The data in Table (1) showed that the incubation period, total immature stages, pupa and total life cycle decreased with increasing temperature from 20 to 30 ˚C. The incubation period was 7.3, 6.5 and 4.4 days at 20, 25 and 30 ˚C, respectively. The total larval stages at 20, 25 and 30 ˚C were 30, 23.6 and 19 days, respectively. Also, the total life cycle for 20, 25 and 30 ˚C was 60.4, 49.9 and 37.4 days, respectively.

Table (1): Effect of different temperatures on the life cycle of *C. chalcites* at 65± 5%R.H.

Temp. °C	Incubation period	Average period of different developmental larval instars (in days)						Total larval stage	Pre-pupa	pupa	Life cycle
		1st	2nd	3rd	4th	5th	6th				
20	7.3± 0.5	7.9± 0.4	6.9± 0.6	4.0± 0.3	4.2± 0.4	4.7± 0.2	2.3± 0.2	30± 0.8	8.5± 0.6	14.6± 1.2	60.4± 5.2
25	6.5± 0.3	7.4± 0.2	6.3± 0.5	2.8± 0.4	2.8± 0.4	3± 0.6	1.3± 0.2	23.6± 0.97	6± 0.9	13.8± 1.1	49.9± 4.1
30	4.4± 0.2	5.9± 0.4	5.2± 0.5	2.3± 0.3	2.3± 0.3	2.2± 0.2	1.1± 0.2	19± 0.8	4± 0.5	10± 0.3	37.4± 3.5
L. S.D at 0.05	1.12							2.61		2.98	13.87

Also, the data in Table (2) demonstrated that female generation, female and male longevity and female and male life span decreased with increasing temperature. The female life span was 78.2, 64.6 and 46.4 days for 20, 25 and 30 ˚C, respectively, while the male life span was 68.4, 55.9 and 41.4 days for 20, 25 and 30 ˚C, respectively.

Data in Table (3) indicated that the total average of deposited eggs increased with increasing temperature. The total average of deposited eggs was 25.67, 27 and 44.33 for 20, 25 and 30 ˚C, respectively.

Table (2): Effect of different temperatures on longevity and life span of both males and females of *C. chalcites* at 65± 5% R.H.

Temp. °C	Duration of different adult stages (in days)						
	Female					Male	
	Pre-oviposition	Generation	Post-oviposition	Longevity	Life span	Longevity	Life span
20	6.5 ± 0.6	66.9± 26.95	4.3± 0.5	17.8± 0.8	78.2± 21.30	8± 0.2	68.4± 26.2
25	4.5 ± 0.3	54.4± 22.7	3.5± 0.3	14.7± 0.9	64.6± 17.6	6± 0.6	55.9± 21.95
30	3.5± 0.3	40.9± 16.95	1.5± 0.3	9± 0.8	46.4± 14.2	4± 0.3	41.4± 16.7
L. S.D at 0.05		7.28		2.92		1.37	

Table (3): Effect of different temperatures on the oviposition period and fecundity of female of *C. chalcites* at 65 ± 5% R.H.

Temperature °C	oviposition period (in days)	Number of deposited eggs	
		Total average	Daily mean
20	7± 0.6a	25.67± 15.56	3.67
25	6.7± 0.3a	27± 13.20	4.03
30	4± 0.6b	44.33± 5.7	11.08
L. S.D at 0.05	2.30		

The results in Table (4) demonstrated the percentage of egg hatching which was 71.43, 91.67 and 57.14% at 20, 25 and 30 ˚C, respectively. The estimated threshold of egg development (t_0) was (4.8˚C). The thermal units were 110.96, 131.30 and 110.88 DD's, respectively at 20, 25 and 30 ˚C.

As showed in Table (5), the larval duration was shortened with increasing temperature. The threshold of development t_0 was 2.7 ˚C. The table observed also that the thermal units were 519, 526.3 and 518.7 DD's at 20, 25 and 30 ˚C.

The obtained results in Table (6) showed that the pupal stage decreased when the temperature increased. The proportion of pupation was 77.78, 88.89 and 87.5% at 20, 25 and 30 ˚C, respectively. The development al threshold was 4.6 ˚C. The thermal units were 355.74, 403,92 and 355.6 DD's at 20, 25 and 30 ˚C, respectively.

Table (4): Rate of development, threshold of development (t_0) and thermal units (DD's) of eggs of *C. chalcites* at constant temperatures.

Temp. °C	Incubation period of eggs (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)	(%) Hatchability
20	7.3± 0.5	13.70	4.8	110.96	71.43
25	6.5± 0.3	15.38		131.30	91.67
30	4.4± 0.2	22.73		110.88	57.14
Average	_	_		117.71	_

Table (5): Rate of development, threshold of development (t_0) and thermal units (DD's) of total larval stage of *C. chalcites* at constant temperatures.

Temp. °C	Mean of larval duration± S.E. (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20	30± 0.8	3.41	2.7	519
25	23.6± 0.97	4.24		526.3
30	19± 0.8	5.08		518.7
Average	_			512.3

Table (6): Rate of development, threshold of development (t_0) and thermal units (DD's) of total pupae of *C. chalcites* at constant temperatures.

Temperatures ◦C	Mean of pupal stage± S.E. (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)	(%) Total pupation
20	23.1± 3.05	4.33	4.6	355.74	77.78
25	19.8± 3.9	5.05		403.92	88.89
30	14± 3.0	7.14		355.60	87.50
Average	_	_		371.75	_

Data in Table (7) indicated that, the total life cycle was affected by the temperature which decreased however the temperature increased. The threshold of development was 3.7 ˚C. The table also showed the thermal units which were 984.5, 1062.9 and 983.6 DD's at 20, 25 and 30 ˚C, respectively.

Table (7): Rate of development, threshold of development (t_0) and thermal units (DD's) of life cycle of *C. chalcites* at constant temperatures.

Temperatures ◦C	Life cycle (days)	Rate of development (%)	Threshold of life cycle (t_0) ◦C	Thermal units (DD)
20	60.4± 5.2	1.66	3.7	984.5
25	49.9± 4.1	2		1062.9
30	37.4± 3.5	2.67		983.6
Average	_	_		1010.3

The obtained data in Table (8) represented that the generation period increased with decreased temperature. Threshold temperature (t_0) was 4.3 ˚C. The thermal units were 1050.3, 1126.1 and 1051.1 DD's at 20, 25 and 30 ˚C, respectively.

Table (8): Rate of development, threshold of development (t_0) and thermal units (DD's) of generation of *C. chalcites* at constant temperatures.

Temp. ◦C	Generation (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20	66.9± 26.95	1.49	4.3	1050.3
25	54.4± 22.7	1.84		1126.1
30	40.9± 16.95	2.4		1051.1
Average	_	_		1075.8

The results in Table (9) represented the longevity of both female and male of *C. chalcites* which decreased with increasing temperature. The threshold temperature (t_0) of female was 9.8 ˚C while was 10 ˚C for male. Also, the thermal units were 181.6, 223.4 and 181.8 DD's for female, while, the thermal units were 80, 90 and 80 DD's for male at 20, 25 and 30 ˚C, respectively.

As shown in Table (10), female and male life span decreased with increasing temperature. The threshold temperature (t_0) was 5.4 ˚C for female and 4.2 ˚C for male.

Table (9): Rate of development, threshold of development (t_0) and thermal units (DD's) of female and male longevity of *C. chalcites* at constant temperatures.

Temp. ◦C	Female				Male			
	longevity (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)	Longevity (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20	17.8± 0.8	5.6	9.8	181.6	8± 0.4	12.5	10	80
25	14.7± 0.9	6.8		223.4	6± 0.6	16.7		90
30	9± 0.8	11.1		181.8	4± 0.6	25		80
Average	–	–		195.6	–	–		83.3

The results also showed that the thermal units were 1141.7, 1266.2 and 1141.4 DD's for female, while, the thermal units for male life span were 1046.5, 1134.8 and 1047.4 DD's at 20, 25 and 30 ˚C, respectively.

Table (10): Rate of development, threshold of development (t_0) and thermal units (DD's) of female and male life span of *C. chalcites* at constant temperatures.

Temp. ◦C	Female				Male			
	Life span (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)	Life span (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20	78.2± 21.3	1.28	5.4	1141.7	68.4± 26.2	1.46	4.7	1046.5
25	64.6± 17.6	1.55		1266.2	55.9± 21.95	1.79		1134.8
30	46.4± 14.2	2.16		1141.4	41.4± 16.7	2.42		1047.4
Average	–	–		1183.1	–	–		1076.2

The obtained results were agreed with Taha *et al.* (2012) on *Autographa gamma* Linn. and with Yones *et al.* (2011) on *Pectinophora gossypiella* (Saund). Also, the results were in agreement with Ebeid (2012) on *Tropinota squalida* Scop., Abd El- Wahab *et al.* (2009) and Ali *et al.* (2011).

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تـأثير درجـات الحـرارة المختلفـة علـى نمـو دودة الطمـاطم النصـف قياسـة *Chrysodeixis chalcites* (Esper).

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لقد تم دراسة تأثير درجات الحرارة المختلفة (٢٠، ٢٥، ٣٠ ±١ °م ورطوبة ٦٥±٥٪) على دودة الطماطم النصف قياسة وأوضحت النتائج أن المراحل العمرية الغير كاملة تأثرت تأثيرا معنويا بدرجات الحرارة المختلفة وكذلك فترات ما قبل التبويض وبعدها وأيضا دورة حياة الحشرة تأثرت معنويا بدرجات الحرارة المختلفة.

وقد تم حساب الحد الحرج للنمو (صفر النمو) للحشرة وكانت النتائج ٤,٨، ٢,٧، ٤,٦ °م لكل من البيض واليرقات والعذارى على التوالى ، كما كان صفر النمو لكل من دورة الحياة وفترة الجيل ٣,٧، ٤,٣°م ، على التوالى. وكذلك كان صفر النمو لكل من معدل نمو طول حياة الأنثى، معدل نمو طول حياة الذكر، معدل نمو للحياة الكاملة للأنثى ومعدل نمو للحياة الكاملة للذكر هى ٩,٨، ١٠، ٥,٤ و ٤,٧°م على التوالى.

قام بتحكيم البحث

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