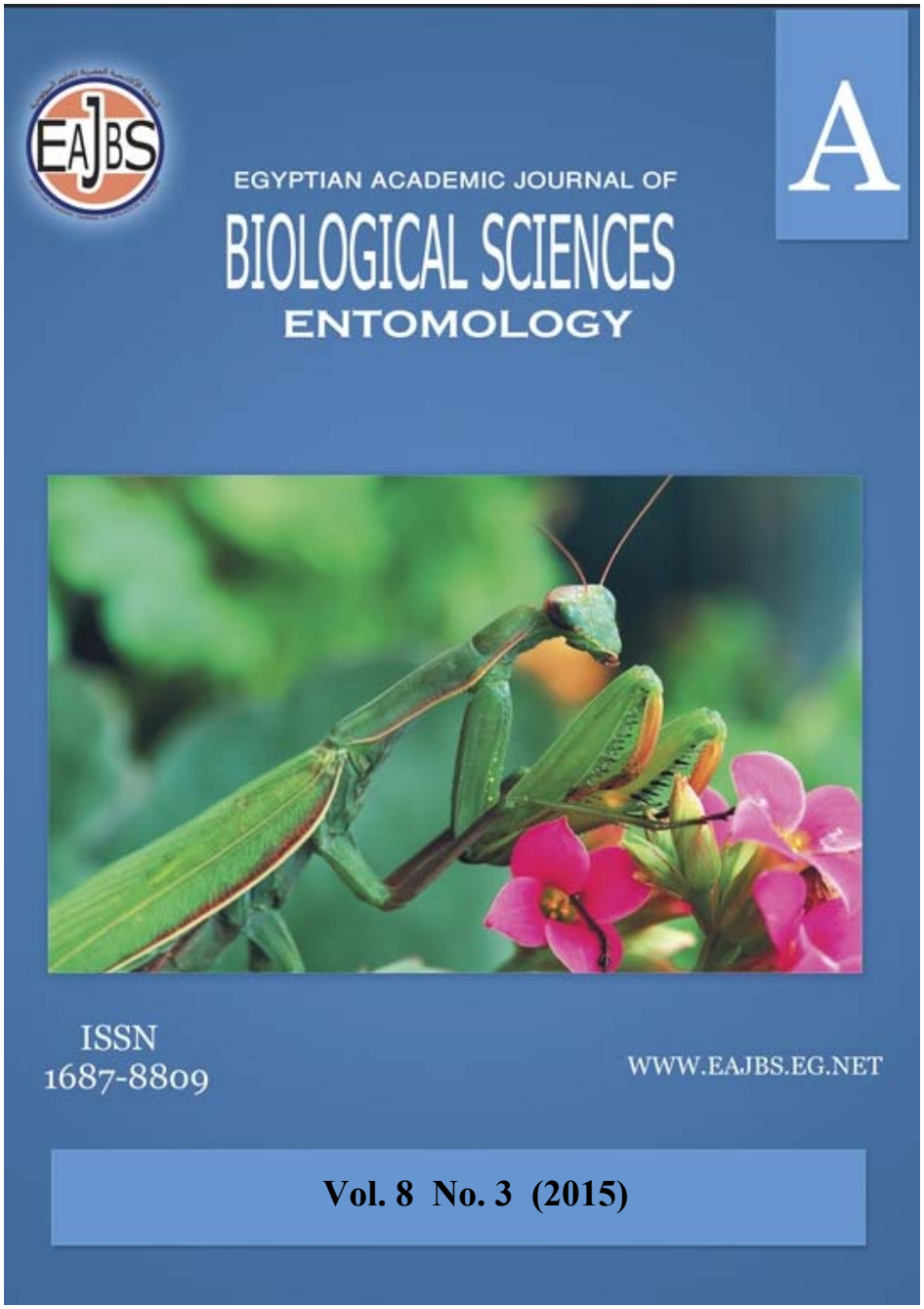

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Study the Biology and Thermal Requirements of *Pectinophora gossypiella* (Saunders), Infestated Cotton Bolls var Giza 90, Under Natural Conditions.

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ABSTRACT

The Egyptian cotton variety Giza 90 was planted in a wire green house (4 sides and rough of wire 0.1mm mesh) and the recommended agronomic practices were followed during 2013 and 2014 cotton seasons. The cotton bolls 20-25 days of age were tagged and artificially infected with newly hatched larvae of Pink Bollworm (PBW), *Pectinophora gossypiella* and followed daily during cotton season as well as during late season. The present results revealed that the PBW ability infestation% (= infestation severity) and infestation % are affected significantly by ambient temperature °C and relative humidity (R.H. %) at the first half hour of infestation at the infestation date. Also, PBW larval instars were photographed inside the cotton bolls samples as well as determination thermal requirements of all PBW stages under the natural conditions In addition, present results recorded the average of head capsule width for the four instars of larvae. It ranged between (0.17±0.002 mm) to (1.30±0.23 mm) for the first and fourth larval instars, respectively. Statistical analysis proved significant negative correlation between temperature and all instars duration (r = - 0.77576, - 0.89575, - 0.99905 and - 0.98433) .In contrary there was significant positive correlation between temperature and rate development of all instars (r = 0.96, 0.94, 0.98 and 0.94) for (the first, second, third and fourth instars, respectively). Also, PBW heat unites requirements for larval instars and total larval stage under natural fluctuated temperature was estimated according to Campbell and Mackaure (1975). The developmental zero (to) for successive instars recorded (15.17&15.12&15.11and 15.5), °C respectively. While it recorded 15.22 °C for the larval stage under field conditions. Furthermore, development rates, durations as well as thermal requirements of larvae, pupae, pre-oviposition, and incubation period under field conditions were evaluated according to (Zalom1983). DD° s values for the respective stages were (149- 153), (238.5-248.7), (44.6-56.7) and (54.6-73). The emergence of adult moths (91%) took place after 22 - 23 days from the egg hatchability, with the sex ratio (1.5♀: 1♂). The pre-oviposition period and the incubation period of eggs on cotton Varity Giza 90 recorded (3 - 4 days) & (4 - 5 days), respectively, during cotton season. General results showed that one generation of PBW recorded 30-31 days with 485-502 DD° s through period from 20th July to 3rd September 2014.

INTRODUCTION

Cotton, *Gossypium hirstum* L. is an economic crop in Egypt and worldwide. The pink bollworm (PBW), *Pectinophora gossypiella* (Saunders) (Gelichiidae: Lepidoptera) has been described as internal feeder and considered as the most

destructive lepidopterous pests, causing great economic losses in both quantity and quality for crop yield (lint and seeds) (Elkashlan and Nassef,1998). Under unprotected condition this pest had been known to cause 2.81 to 61.87 per -cent loss in seed cotton yield, 3.44 to 37.83 per cent loss in germination, 2.12 to 47.13 per cent loss in oil content and 10.66 to 59.15 per cent loss in normal opening of bolls (Patil, 2003).

Temperature is an important climatologically variable that influences on the biology and ecology of insects. It plays a vital role in predicting insects' seasonal occurrence and fluctuations on a physiological time-scale (Harcouurt, 1981). Temperature requirements (t and k) together with knowledge of diapause capabilities of insects useful in forecasting the potential, distribution and abundance of insects species (Flint, 1980); However, Prasad (1990) studied the ecobiology of the pink bollworm, *P. gossypiella* infesting cotton (cv. NHH 44) at fluctuating ambient temperatures and also on artificial diet. The results indicated that, no significant differences were observed in the life cycle. Muhammad and Nadeem (2010) predicted and observed moth population peaks on the basis of accumulation of degree-days (DD) in the Agro-Climate of Faisalabad. They indicated that, DD can help to detect periods of high risk for PBW moth activity and thus can be used for a management of this pest throughout the crop season. Additionally, (Grant et al. (1976) compared temperature-dependent development rates for three laboratory strains of *P. gossypiella* with that of a field strain. They found that, when the laboratory rates were utilized in a computer program (WATBUG) to simulate development under field conditions, they provided a good estimate. Also, Gergis *et al.* (1990) collected larvae of *P. gossypiella* from cotton in Egypt and used it to establish a laboratory culture. They determined the mean degree-day accumulations required for completion of the egg, larval, pupal and pre-oviposition periods. The results were used to demonstrate the accuracy of a logistic equation model for simulating the relationship between temperature and rate of development.

However, the accuracy distinguish of small PBW (1^{st}& 2^{nd}) instars as well as calculation its percentage inside infested cotton bolls and the thermal requirements of PBW are essential for taken of control decision against *P. gosssypiella*, with chemical and / or non chemical methods as well as determine the rate of used insecticides (kreema 2003 ; Yones *et al*. 2011).

To our knowledge, in Egypt, the biology and DD' s of pink bollworm stages and a complete generation on their natural host (cotton bolls) was carried out only under laboratory conditions. So, the present work was carried out under field conditions to determine and photograph the *P. gosssypiella* larval instars development inside infested bolls of cotton Giza 90 based on head capsule measurements. That may be considered as guide for inspectors of cotton boll infestation. In-addition, the thermal requirements of developmental stages and a complete generation of PBW were calculated by two methods. Difficult control with insecticides programs give dramatically results against Pink bollworm (Abd-ELRahman 2006). For this reason the present work may be considered more accurate technique that determine the best time for the application of any type of control program against this pest in the cotton fields, that minimize insecticide applications, cost of control & residual insecticide effect, preserve cotton bolls from PBW infestation and achieved greatest economic of yield production with a great protect of environmental system.

Family Anthicidae, are moderate-sized grouped; about 3000 species under 40 genera (Booth *et al.*, 1990). They are characteristically narrow-bodied beetles with a

distinctive pronotum that is constricted posteriorly and are usually black or dark brown, sometimes with patches of dull red or yellow. . Some species have an obvious horn on the anterior border of pronotum. Members of the Anthicidae are most commonly residents of the coastal fringe, especially on sandy soils, or the sides of rivers. Others species are associated with compost or straw.

This is the last paper for reviewing family Anthicidae from Egypt. The design made to review this family resulted four papers as follows: (El-Torkey *et al.*, 2005), (Abd El-Dayem, 2009), (El-Gharbawy *et al.,* 2010) and (El-Torkey, 2014). This study dealing with Eight species belonging currently to four genera (*Mecynotarsus, Notoxus, Pseudonotoxus* and *Tomoderus*), which known to occur in Egypt.

MATERIALS AND METHODS

Field studies and the experimental design:

The present investigation was carried out to study the biology and thermal requirements of the all pink bollworm (PBW) stages under field at the experimental area of Plant Protection Research Institute, Dokki, Egypt conditions during the two successive cotton seasons 2013 & 2014. Cotton seeds variety Giza 90 was planted inside the wire green house structure measuring 12 m^2 (4 sides &rough of the wire 0.1mm mesh) and contained 5 rows (each of 2m long x 60cm width & hills at 20 cm). Planting date was on 7th March in both seasons. The plot received the recommended agricultural practices. No chemical control application was practiced throughout the growing seasons. Daily maximum & minimum temperature and R.H. % were recorded as well as after 1/2 hour of infestation.

Assessment:

At different dates, groups of immature green cotton bolls (20 to 25 day old) were tagged, dated and then artificially infested with newly hatched pink bollworm larvae (laboratory culture). Ten newly hatched PBW larvae were placed on the wall of each tagged boll by a soft brush. Date of infestations take place on 23 th September and (1^{st,} 7th & 22 th) October during season 2013; and on (20th, 23th & 24$^{th)}$ July and (20th, 24th & 27th) August during season 2014.

One group of–about 30 artificially infested bolls with PBW larvae were collected in daily sequence. This procedure was replicated through 20-25days during cotton season 2013 and 10 -11days during season 2014. These samples of collected bolls were carefully examined externally & internally. It were dissected to record the PBW alive larvae inside infested bolls (infestation ability % = severity of infestation %) as well as, the number of infested bolls (= infestation %).

During season 2014, the larvae of age one day, until 11days old were photographed and kept in 70% ethyl alcohol & glycerin. The widths of larval head capsule were measured by ocular micrometer lines and larval instars were determined according to Watson and Johnson (1974). In addition, other groups of full grown collected larvae were kept individually in clean glass tubes (7 x 2 cm). Vials were plugged with cotton stoppers and kept under room conditions to record the duration of pupal stage, adult emergence %, sex ratio, pre-oviposition period and egg incubation period.

Statistical analysis:

Sine single method:

Sine single method was utilized to calculate the thermal requirements (DD, s) of PBW larval stage, pupal stage, pre- oviposition period and egg incubation period according Zalom (1983)

Microsoft excel program:

The Microsoft excel program can be utilized for calculation of the developmental rate, T_0 (zero development) as well as K value (thermal requirements) for larval stage under the natural conditions of Egyptian cotton field according to Campbell and Mackaure (1975).

RESULTS AND DISSOCIATION

PBW ability and infestation against cotton bolls of Giza 90:

The artificial infestation of PBW newly hatched larvae on cotton bolls verity Giza 90 took place on 23th September and (1st,7th &22th) October during cotton season 2013. While cotton bolls were infested on (20, 23 & 24th) July, (24 & 27th) August and 3rd September during cotton season 2014. As shown in Table (1),through the first half hour of infestation, the range of ambient temperature and relative humidity % varied between (20 & 26) °C and (38 & 89) R.H.%, respectively. Also, PBW neonate larvae gain entrance inside cotton bolls (ability % or infestation severity %) varied between 15.3% and 18.75% at (20◦ C &50 RH%) and (24.5°C & 51 R.H.%), respectively during the period from 23th September to 21th October during late cotton season 2013. Otherwise, These percentages were 20.7% and 53.73% at (26°C &65 R.H%) and (26°C & 74 R.H.%), respectively during the period from 20th July to 3rd September of cotton season 2014 Table (1). However, PBW infested 65.05 to 100% cotton bolls (infestation %) at the day average of ambient temperature and relative humidity % varied between (17&25) °C and (14 & 30) RH%, respectively. Statistical analysis showed significant positive correlation between the ambient temperature (°C) and both of the PBW ability % and infestation % (r =0.63 &0.59), respectively at the first half hour of infestation.

Table 1: PBW Infestation against cotton variety Giza 90 inside the wire green house and its relation to ambient temperature and relative humidity % during 2013 and 2014 cotton seasons.

Date of infestation	Boll Infestation	Infestation Ability	at 1/2 houre of infestation	at 1/2 houre of infestation	Average day	Average day
	%	%	R.H. %	°C	R.H.%	°C
20/7/2014	100	45.68	78	25.5	19	23
23/7/2014	100	41	89	26	22	23
24/7/2014	85.71	20.71	65	26	17	23
24/8/2014	91.2	24.41	75	26	20	25
27/8/2014	98	53.73	74	26	23	25
03/9/2014	100	48.24	74	25.5	14	23
23-9/2.13	65.6	18.75	51	24.5	23	21
01-j10/2013	100	17.2	61	23.5	30	25
07/10/2013	79.3	15.5	38	20	21	17
21/10/2013	70	15.36	50	20	20	17
Correlation value		Infestation%	0.90	0.59	0.02	0.73
		ability%	0.62	0.63	-0.31	0.50

Based on the average of relative humidity (R.H. %), results revealed significant and highly significant positive correlation (r = 0.62 &0.90) for PBW ability % and infestation %, respectively. In addition, there were positive significant and highly significant correlation between the average ^{o}C of day and both of PBW ability % (r =0.5) and infestation % (r = 0.73). On contrary, there was insignificant negative (r = -0.3) and positive (r = 0.02) correlation between PBW ability % and infestation %, respectively. The authors concluded that, the Cotton variety Giza 90 infested with *P. gossypiella* during cotton season as well as during late season. The PBW ability % and infestation % are affected significantly by ambient temperature °C and relative

humidity (RH %) at the first half hour of infestation as well as the average °C at the infestation date. In addition, the PBW ability % decreases in late season where the ranges of natural temperature and relative humidity % were (17- 21) °C and (38% - 61%), respectively. The present results were in line with those of Bilal *et al.,* (2002) who observed high level of pink bollworm infestation was during October, when the infestation level on nectarid cotton was 16.07%, 8.99% &11.43% on flowers, squares and green bolls, respectively ,at temperature ranges (28.31-30.08) ◦ C and relative humidity ranges from (46.91-53.50%). Also, El-Sayed and Abd El-Rhman (1960) found that the mortality % of PBW larval stage decreases from 18°C, with the increase of temperature until at 25°C, where it reaches its minimum being 28.2%.

Biology and thermal requirements of *P. gossypiella*:

Biology of PBW larvae:

Larval instars under field conditions:

Presented data in Table (2) show the measurements of pink bollworm, *P. gossypiella* head capsules width of different larval instars collected from artificially infested cotton bolls. The mean average of head capsule width recorded (0.17, 0.38, 0.77 and 1.75) mm. at the first, second, third and fourth instars, respectively.

Table 2: The measurements of head capsule width, durations, development rates, zero development and thermal requirements of *Pectinophora gossypiella* larval instar and stage at different average of ambient temperature during seasons 2013 and 2014.

1st instar					**2nd instar**			
Average of head capsule width = 0.17 mm ± 0.002					**Average of head capsule width = 0.31 ± 0.006**			
Temperature (°C)		**Duration (days)**	**Rate development**		**Temperature (°C)**		**Duration (days)**	**Rate Development**
Range	**Average**				**Range**	**Average**		
35-25	**21.5**	**5**	**0.2**		**36-24**	**21.5**	**7**	**0.143**
31-.20	**24.66**	**4**	**0.25**		**30-20**	**24.8**	**5**	**0.2**
30-16	**22.25**	**3**	**0.33**		**29-19**	**24.2**	**4**	**0.25**
35-25	**30**	**2**	**0.5**		**36-24**	**29.3**	**3**	**0.33**
r =		**- 0.77**	**0.996**		**r =**		**-0.89**	**+0.94**
To	**15.1864**				**To**	**15.117**		
K	**29.34**				**K**	**42.466**		
DDs	**27.1-- 32.0**				**DDs**	**42.8-- 48.5**		

3rd instar					**4th instar**			
Average of head capsule width = 0.62 ± .01					**Average of head capsule width = 1.3 ± 0.02**			
Temperature (°C)		**Duration (days)**	**rate development**		**Temperature (°C)**		**Duration (days)**	**Rate Development**
Range	**Average**				**Range**	**Average**		
31-17	**22.3**	**6**	**0.17**		**28-16**	**21.5**	**5**	**0.2**
29-17	**23.9**	**5**	**0.2**		**27.21**	**23.37**	**4**	**0.25**
31-16	**29.6**	**3**	**0.33**		**33-23**	**28**	**3**	**0.33**
-	**-**	**-**	**-**		**37-24**	**30**	**2**	**0.5**
r =		**-0.99**	**+0.98**		**r =**		**-0.98**	**+0.94**
T0	**15.11**				**To**	**15.5**		
K	**43.51**				**K**	**31.83**		
DDs	**34.0--44.0**				**DDs**	**27.8-31.5**		

The thermal heat units= (K) Cambell and Mackauer (1975)
(= K) and (= DDs) according Zalom *et al*. (1983)

These measurements and Figs. (1, 2, 3 & 4) demonstrated that, head capsule width clearly doubled at each moult. The accuracy distinguishes of small PBW ($1^{St}_{\&2}{}^{nd}$ instars) inside infested cotton boll is essential for taken of control decision against *P. gosssypiella* (El-Lebody 2003).

Fig. (1): larva First instar

Fig. (2): Second instar larva

Fig. (3): Third instar larv

Fig. (4): Fourth instar larva

Figs. (1-4): Photography of *P. gossypiella* instars show development rate under ambient temperature.

However, the present results was in harmony with the findings of Prasad (1999) who studied the ecobiology and behavioral aspects of the pink bollworm and achieved that the larvae of PBW showed a geometric increase in the width of the head capsule at each moult. Concerning the development of PBW instars, data in Table (2) illustrated in Figs. (5, 6, 7 & 8), obviously show that as temperature increased from 21.5°C to 30°C, the development times for respective instars were shorter and development rates were faster. Regression equations indicated that, the duration periods of all PBW instars recorded inversely significant correlation based on the differences of temperature during exposed time (r = -0.89953, -0.9556, -0.96594 and -0.9752) & (r = -0.89953, -0.9556, -0.96594 and -0.9752) for the first, second, third and fourth instars, respectively. In late season, at 21.7°C, where the respective development times were (4.5, 10.5, 18 & 32) days respectively, but these periods decreased significantly with increasing the temperature during the cotton season recording their lowest values (2.0, 5.0, 8.0 & 10.0) days at 30 °C.

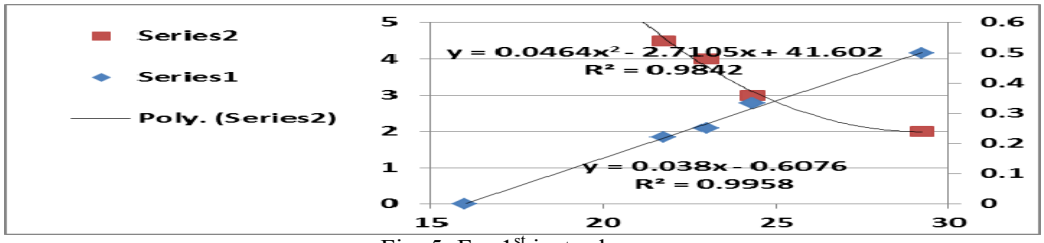

Fig. 5: For 1st instar larvae

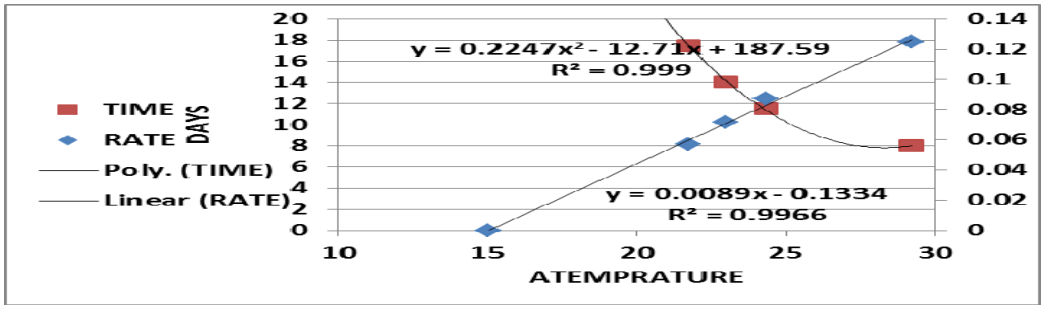

Fig. 6: For 2nd instar larvae

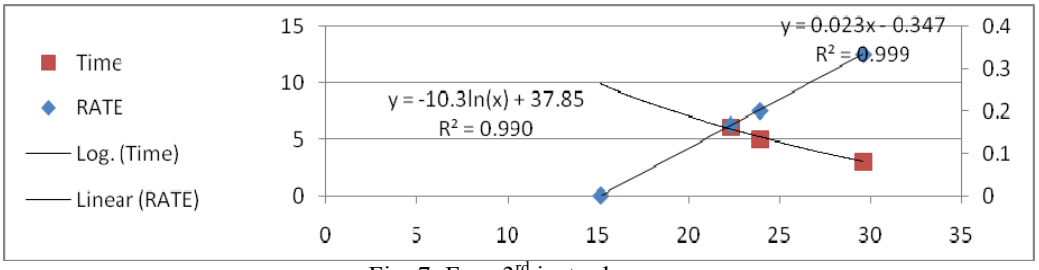

Fig. 7: For 3rd instar larvae

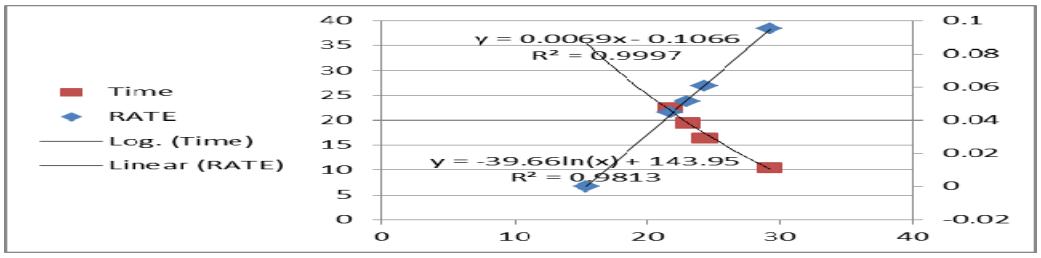

Fig. 8: For 4th instar larvae.

Figs. (5–8): Durations and development rates of different instars of *P. gossypiella* under natural temperature.

On contrary, the rate development of *P. gossypiella* instars increased clearly as temperature increased. Statistical analysis reflex high significant positive correlation between the average of temperature and the rate development of *P. gossypiella* larvae (r = 0.99, 0.94, 0.98 & 0.94); and gave their highest values (0.5%, 0.33%, 0.33% and 0.5%)/day for the (first, second, third and fourth) instars at average of weather temperature (30, 29.3, 26.6 & 30) °C, respectively (Table 2 & Figs. 5, 6, 7 & 8).

As shown in Table (3) & Fig. (9), the total larval stage development took the same trend. Where, the lowest larval duration (10.5 days) and the highest rate development (0.095) were recorded at an average of (29.86°C) ambient temperature where r value were (- 0.097 & +0.99, respectively). El- Sayed (1960) mentioned that, the larval period of pink boll worm was 23.1 days on 25°C.The present result is in agreement with Yones *et al*. (2011). Shah (2013) reported that, the lowest developmental period of pink bollworm larvae was 9 days at 35±1 °C while the highest one scored 13 days at 27±1°C.

Thermal requirements of PBW larval instars and stage:

The thermal heat units for *P. gossypi*ella larvae (instars and / or stage), was estimated by two ways of both Cambell and Mackauer (1975) (= K) and Zalom *et al*. (1983) (= DDs). Based on Cambell and Mackauer (1975), the PBW instars threshold of development (the developmental zero (t0) recorded (15.17&15.12&15.11and 15.5) °C for the (first, second, third and fourth) instars, respectively Table (2). While (t0) for larval stage was 15.22°C (Table 3). In addition, the thermal requirements (K or range of DDs) were (29.34 or 27.1 to 32), (42.46 or 42.8 to 48.5), (43.5 or 34.0 to 44.0) and (31.83 or 27.8 to 31.5) heat units for the (first, second, third and fourth) PBW instars, respectively (Table 2). Regarding to the thermal heat units for *P. gossypiella* larval stage, was (K=157.28 or DDs ranged from 131.5 to 156.0 (Table 3). To limit the critical and best time for beginning the control program the parameter (K / DDs) acts as an important role. The present results revealed no significant differences between the previous parameters according the two tested methods. In this respect, Yones *et al.* (2011) reared PBW larvae (laboratory strain) on different

kinds of artificial diet and evaluated their (t0) and the average of accumulated heat units' requirements (K). They found that t0 = 14.07°C and K= 166.38 °C, respectively. They add that, the food kinds had no significant effect for heat requirements.

Table 3: Durations, development rates, zero development and thermal requirements of *Pectinophora gossypiella* larval stage at different averages of ambient temperature.

Larval stage		
Average Temperature °C	Duration	Development rate
22.6	21	0.0476.
23.39	19	0.0526
25.06	15	0.0667
29.86	10.5	0.0952
r =	- 0.97	+ 0.99
T0	15.227	
K	152.59	
DDs	151.4-156.5	

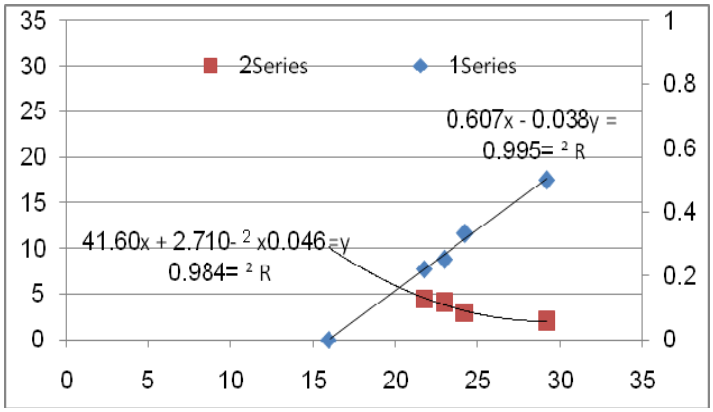

Fig. 9: Duration and rate development of PBW larval stage.

Durations and thermal requirements of *P. gossypiella* stages and a generation during cotton season (s) 2013 and or 2014:

Data in Table (4) show that, the PBW larval duration ranged from 23.0 to 9.11 days at 21.75°C to 30.18 °C. The shortest duration occurred in August 2014, While, the longest value of larval duration was recorded in October 2013. Based on thermal heat unite, this stage recorded different values, from 149.7 to 158.8 DDs according different average of ambient temperature.

Concerning the pupal duration, this parameter (13 days) didn't change dearly based on the tested natural temperature during season 2014. The thermal heat unites that have been required to complete PBW pupae development ranged from 238.5 to 248.7 DD's. Pre-ovipostion periods periods occupies 3- 4 day through the different experimental dates, while the required thermal units to complete the development of this stage ranged between (44.6 - 48.64) DD's. The required time for eggs incubation period was 4: 5 days with range of thermal heat unite (54.6-73.0) DD's. The moth emergence (91%) took place after 22:23 days from the hatchability of eggs. In addition, a generation period of PBW occurred within 30 to 31 days on cotton variety Giza 90 and the heat unites requirements differ from 464.4 to 502.0 DD's during the experimental months (July, August and September). The current investigation results agree with those finding of Yones, et *al*. (2011) and Shah *et al*. (2013).

Table 4: Durations and thermal requirements of *Pectinophora gossypiella* stages and generation on cotton variety Giza 90 during cotton seasons 2103 and 2014.

Stage (s)								
Larvae					Larvae			
season 2014					season 2013			
Month	Average °C	Duration (days)	DDs		Month	Average °C	Duration (days)	DDs
July	29.0	10-11	153.0		September	25.06	16 .0	158.8
August	30.18	9-11	156.5		October 1	23.9	19.0	155.9
September	28.9	10-11	149.7		October	21.76	23.0	150
season 2014								
Pupae					Pre-ovipostion			
Month	Average °C	Duration (days)	DDs		Month	Average °C	Duration (days)	DDs
July	29.35	13.0	248.7		July	29.37	3 - 4	48-64
August	28.96	13.0	246.4		August	28.0	3 - 4	44-60
September	28.46	13.0	238.5		September	27.75	3- 4	45-56.7
season 2014								
Incubation					Generation*			
Month	Average °C	duration (days)	DDs		Month	Average °C	Duration (days)	DDs
July	29.87	4.0	73.0		July	29.31	31.0	486-502
August	28.87	4.0	70.6		August	29.29	30.0	485.0
September	24.75	4 - 5	54.6/ 68.5		September	28.05	31.0	464.4

General conclusion, cotton variety Giza 90 infested with PBW during cotton season as well as late season. Infestation % and ability % were significantly affected by the ambient R.H.% at the 1st half hour of infestation and daily average temperature. On contrary, daily average R.H.% had insignificant effect.

The control decision against this pest depended on the inspection of cotton boll samples as well as trap catches of moth. So, the accuracy distinguish of PBW larvae instars (Figs. 1, 2, 3 & 4) inside the cotton boll samples as well as determination DDs of all PBW stages under the natural conditions are important to determine the PBW generations and the best time for the application of any type of control program against this pest in the cotton fields. In this regard, El-Lebody (2003) found that the, reason of the differentiation of an insecticides efficacy from spray to another during the same season or from season to another is the relation between the used insecticide efficacy and each of the larval ages and percentage of small larvae (1st &2nd instars) to the account number of PBW inside infested cotton bolls (3% level of infestation) at the zero time of spray. Where the highest efficacy of control program obtained when the small larvae percent = 0.0 % and the most or all PBW population consists of full grown larvae and / or holes (i.e. the spray is of protective type). Also, she added that, the type of control methods as well as the rates of used insecticides against *P. gosssypiella* were determined based on the small larvae percent. Concerning the importance of PBW thermal requirements, Yones *et .al*. (2011) carried out a laboratory study and reported that, the heat unites required to complete the development of different stages to complete one generation, as well as helping in the design of development indexes, determining the times required for these stages under fluctuating temperatures in field and forecasting system for establishment and develop the non chemical methods for the pink bollworm IPM program.

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ARABIC SUMMERY

دراسة البيولوجي والاحتياجات الحرارية لدودة اللوز القرنفلية تحت الظروف الطبيعية عند إصابتها لوز القطن جيزة 90.

كريمة عبد الرحمن اللبودى - همت زكريا مصطفى- أمانى محمد رزق

تم زراعة بذور القطن جيزة 90 داخل صوبة سلكية (خمس جهات). أتبعت جميع العمليات الزراعية الموصى بها ما عدا استخدام المبيدات.

أجريت عدة عمليات عدوى صناعية لمجموعات من لوز القطن بالفقس الحديث لدودة اللوز القرنفلية أثناء و أخر الموسم. تم الجمع والفحص اليومى المتتابع للوز المصاب وذلك لمعرفة قدرة الأفة على إحداث الإصابة % ability و نسبة اللوز المصاب % infestation و متابعة نمو اليرقة وتحديد أعمارها داخل اللوز المصاب.وكذلك تم متابعة باقى الأطوار حتى إكتمال الجيل بعد مواعيد الأصابة المختلفة.

أهم النتائج :

1- تراوحت % ability بين 15.5 - 53.7 %-بينما تراوحت %infestation بين 100%- 65.6% وتأثرت هذه النسب معنويا بكل من متوسط الرطوبة النسبية بالجو خلال نصف ساعة بعد الأصابة وكذلك المتوسط اليومى لدرجة حرارة الجو.

2- اليرقة لها أربعة أعمار يرقية. يوجد إرتباط معنوى موجب بين متوسط درجة حرارة الجو ومعدل نمو العمر اليرقى بينما يوجد إرتباط معنوى سالب مع طول فترة العمر اليرقى. ينطبق هذة النتائج على كلا من الطور اليرقى والعذراء و فترة ما قبل وضع البيض و فترة حضانة البيض. تم حساب صفر النمو و الوحدات الحرارية التراكمة اللازمة لنمو لكل ما سبق ذكره .

3- الجيل الكامل لهذه الآفة يستغرق30-31 يوم ويلزمه 485-502 وحدات حرارية متراكمة تحت الظروف الطبيعية.