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EFFECT OF DIFFERENT TEMPERAURES, THERMAL, THRESHLOD UNITS ON DEVELOPMENTOF SILVERY MOTH, *Autographa gamma* Linn.

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ABSTRACT

Developments of the silver Y moth *Autographa gamma* Linn (Lepidpterra : Noctuidae) was studied at constant temperatures 20, 25 and 30^{0}C^0 ±1ȯȯ ^{0}C . Development of immature stages was accelerated as the tested temperatures increased .Total developmental time of larval duration averaged 25.26, 19.14 and 12.08 days at 20, 25 and 30^{0}Crespectively. Generation period ranged between 46.34and 23.81days depending on rearing temperature. Adult female survived slightly longer than male. Fecundity was higher at (30^{0}C) than 20^{0}C. Female of *A. gamma* deposited 106.67eggs at 30 ^{0}C, while this number drastically decreased to 18.55 eggs at 20 ^{0}C. However, egg hatchability was %72.41; 66.04 and 63.64 at 20,25and 30 ^{0}C respectively.

The threshold of development (t_0) degree- day (DDs) was estimated to be 7.5^{0}C, 10.83^{0}C and 3.02^{0}C for eggs, larvae and pupae, respectively. Based on estimated preferred temperature30,25 and 20 C^0 heat units (U.T.) 79.2, 362.5and 247.8 are required to complied the development of egg, larval and pupal stages. Development of one generation may acquire 726.4 Degree-days.

INTRODUCTION

The silver Y moth, *Autographa gamma* (Linn.) is a serious pest which feeds on more than 200 different plant species; one of theses hosts was artichoke (Dochkova, 1972; Harakly, 1975; Hommes, 1992; Izquierdo *et al.* 1996; McHaffie, 1997; Monnet, 1997 and Honek *et al.* 2002). Feeding damage includes skeleton zing, or feeding on the leaf epidermis, as well as on the petiole (leaf stalk), leaving a cut leaf appearance (Harakly 1975, INRA 2003) .

Integrated pest management programs, demonstrates a total system approach to the suppression of pest population, which depend on the importance of the predicting the seasonal abundance of insects, which has led to the formulation of many mathematical, models that, described the developmental rates as a function of temperature.

Therefore, the aim of the current study was to estimate the influence of constant temperature on the biological aspects of *A. gamma* (Linn.) and thermal units (degree-days).

MATERIALS AND METHODS

Eggs and larvae of silver moth Y *Autographa. gamma* (Linn.) were collected from blooming and leaves of the globe artichoke and reared in the laboratory in jars (250 cc) which covered with pieces of thin mesh fixed in place with a rubber band, larvae were fed on leaves of artichoke until pupation. Pupae transferred to a larger container until adults were appeared. Moths were placed in pairs in plastic containers 15- cm high, with moist vermiculite covering the base, and fine gauze, held in place by a rubber band, over the top. They were supplied with a 20% honey solution in small covered plastic containers (pill boxes) with an extruding cotton dental wool wick (Roberts, 1979). The newly laid eggs distributed in four jars, each jar 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 biology of the pest in each temperature had 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 equation:

$$\mathbf{DD = d\ (t - t_0)}$$

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 of *A. gamma* eggs more or less affected by temperature variations. The rate of embryo development. increased with increasing of temperature. The percentage of egg hatchability was 72.41, 66.04, and 63.64 % at 20, 25 and 30°C, respectively. The estimated threshold of egg development (t_0) was (7.5°C) thermal units or thermal summations were 102.6, 78.8 and 56.3 DD's, respectively, at 20, 25 and 30°Crespectively..

Table (1): Rate of development, threshold of development (t_0) and thermal units (DD's) of eggs of *A. gamma* at constant temperatures and fecundity.

Temperatures	Incubation period of eggs (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)	(%) Hatchabil-ity	No. deposited eggs, total average
20◦C	4.5± 0.5	22.22	7.5	102.6	72.41	18.55±1.91
25◦C	3.5± 0.5	28.57		78.8	66.04	57.67± 15.76
30◦C	2.5± 0.5	40		56.3	63.64	106.67± 6.67
Average	-	-		79.2	--	

As shown in Table (2) the larval duration was shortened with the increase in temperature. It lasted 25.26 ,19 .14 and 12.08 days at 20 ,25 and 30°C., the developmental rate of larvae increased as the temperature became higher from 20 to 30 °C. The threshold of larval development (t_0) was estimated as 10.83 °C and the thermal units were 485.8, 366.7 and 237.3 DD's, at 20, 25 and 30°C **,** respectively, with an average of 362.5 DD's

Table (2): Rate of development, threshold of development (t_0) and thermal units (DD's) of larval duration of *A. gamma* at constant temperatures

Temperatures	Mean of larval duration± S.E. (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20◦C	25.26± 0.63	3.96	10.83	485.8
25◦C	19.14± 0.40	5.22		366.7
30◦C	12.08± 0.38	8.28		232.3
Average	-	-		362.5

Data in Table (3) show that the pupal stage decreased when the temperature increased; The pupal stage 11.33; 9.05 and 7.13 days at 20;25 and 30°C respectively. Pupation was highest (46.67%) at 20°C and decreased to reach 38.46% at 25°C. As other

The estimated threshold for *A. gamma* pupal development (t0) was 3.02°C **.**The thermal units were 305.9;245.7and 191.7 DD's at 20, 25 and 30°C respectively; with an average of 247.8 DD's **.**

Table (3): Rate of development, threshold of development (t_0) and thermal units (DD's) of total pupae of *A. gamma* at constant temperatures.

Temperatures	Mean of pupal stage± S.E. (days	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)	(%) Total pupation
20◦C	11.33±4.17	8.83	3.02	305.9	46.67
25◦C	9.05±3.23	11.05		245.7	38.46
30◦C	7.13±2.94	14.03		191.7.	55.56
Average	-	-		247.8	-

The result in Table (4) that life cycle was shortened with the increasing in temperature. Hence, the developmental rate amounted 41.09; 31.69 and 21.71 days at 20, 25 and 30 °C respectively. The threshold of life cycle (t_0) was estimated as 8.80 ◦C and the thermal units were 871.3, 672.04and 460.04DD's, at 20, 25 and 30°C respectively, with an average of 667.8DD's.

Table (4): Rate of development, threshold of development (t_0) and thermal units (DD's) of life cycle of *A. gamma* at constant temperatures.

Temperatures	Mean of pupal stage± S.E. (days	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20◦C	41.09± 5.28	2.43	8.80	871.3
25◦C	31.69± 3.97	3.16		672.04
30◦C	21.71± 2.53	4.61		460.04
Average	-	-		667.8

As showed in Table (5) data illustrated that the generation was shortened with increasing in temperature. The generation amounted 46.34; 35.69and 23.81days at 20, 25 and 30 °C respectively. The threshold of generation (t0) was 9.41 ◦C and the thermal units were 954.1, 734.9 and 490.2 DD's, respectively, at 20, 25 and 30°C respectively **,** with an average of 726.4 DD's.

Table (5): Rate of development, threshold of development (t_0) and thermal units (DD's) of generation of *A. gamma* at constant temperatures

Temperatures	Generation (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20◦C	46.34± 17.92	2.16	9.41	954.1
25◦C	35.69± 13.85	2.80		734.9
30◦C	23.81±9.81	4.20		490.2
Average	-	-		726.4

The longevity of female was illustrated in (Table 6) which showed that increasing in temperature decreased the longevity of female. The longevity amounted 10.45, 7.1 and 5.2 days at 20, 25 30◦C respectively. The threshold of female longevity (t_0) was estimated as 10.28 ◦C and the thermal units were 93.02, 207.26 and 379.22 DD's, at 20, 25 and 30°C, respectively, with an average of 226.5 DD's.

Table (6): Rate of development, threshold of development (t_0) and thermal units (DD's) of ♀ longevity of *A. gamma* at constant temperatures.

Temperatures	♀ longevity (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20◦C	10.45± 0.91	9.57	10.28	93.02
25◦C	7.1± 0.86	14.08		207.26
30◦C	5.2± 0.27	19.23		379.22
Average	-	-		226.5

Table (7) show that the longevity of male decreased with increasing of temperature. The longevity amounted 6.66, 4.75and 3.83days at 20, 25 30◦C respectively. The threshold of male longevity (t_0) was estimated as

10.35 ◦C and the thermal units were 131.3, 93.7and 75.5 DD's, at 20, 25 and 30° respectively**,** with an average of 100.2DD's.

Table (7): Rate of development, threshold of development (t_0) and thermal units (DD's) of ♂ Longevity of *A. gamma* at constant temperatures

Temperatures	♂ Longevity (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20◦C	6.66±0.53	15.01	10.35	131.3
25◦C	4.75± 0.25	21.1		93.7
30◦C	3.83± 0.17	25.11		75.5
Average	-	-		100.2

It was noticed in **(**Table 8) that life span of female was shortened with the increase in temperature. The life span amounted 51.54, 38.79and 26.91days at 20, 25 30◦C respectively. The threshold of life span (t_0) was estimated as 9.12 ◦C and the thermal units were 1076.2, 809.9and 561.9DD's, at 20, 25 and 30°C respectively, with an average of 816.0DD's.

Table (8): Rate of development, threshold of development (t_0) and thermal units (DD's) of ♀ life span of *A. gamma* at constant temperatures

Temperatures	♀ Life span (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20◦C	51.54± 15.32	1.94	9.12	1076.2
25◦C	38.79± 12.30	2.58		809.9
30◦C	26.91± 8.26	3.72		561.9
Average	-	-		816.0

As shown in (Table 9) the life span of male was shortened with increasing of temperature. The life span amounted 47.75, 36.44and 25.54days at 20, 25 30◦C respectively. The threshold of life span (t_0) was estimated as 9.06 ◦C and the thermal units were 999.9, 763.1and 534.8DD's, at 20, 25 and 30°C respectively, with an average of 765.9DD's. These results also indicated that life span of male decreased with high temperature.

In the present study, an explanation for variation in the number of annual generations was given here in for the first time on the basis of available data and calculated degree-days required for insect development .Similarly, the expected number of annual generation could be predicted by determining the date are which 792 DD s have been accumulated at the beginning of spring. Sevacherian (1977), and Johnson *et al*.(1979) developed similar degree-day systems for predicting the need for and timing of insecticide application for different insect species. After Mating occurs 1-2 days after eclosion and lasts 20-50 minutes (Harakly, 1975). Moths begin egg-laying 1-5 days after mating (Rashid *et al.* 1971, Macaulay, 1972). Also the results agreement with Daoud *et al*. (1999) ; Abd El-Wahab**,** *et al* (2009) and Ali *et al* (2011).

Table (9): Rate of development, threshold of development (t_0) and thermal units (DD's) of ♂ life span of *A. gamma* at constant temperatures

Temperatures	♂ Life span (days)	Rate of development (%)	Threshold of development (t_0) ◦C	Thermal units (DD)
20◦C	47.75±17.22	2.09	9.06	999.9
25◦C	36.44± 13.47	2.74		763.1
30◦C	25.54± 8.94	3.92		534.8
Average	--	--		765.9

REFERENCES

Abd El-Wahab,H ; S. A. Ebrahim and R. M.El- Dabi (2009): Influence of constant temperature on the biological aspects of *Phthorimaea opercuella* (Zeller) and thermal units (Degree days). J.Agric. Sci., Mansoura Univ. (3) 1110-0346.

Ali,M.A..; A.Es.Essa ;H. Abd El-Wahab and M. Oda (2011):Thermal constant and degree –day requirements for the development of the egg-plant stem borer,Euzophera osseatella Triet. (Lepidoptera :Pyralidae). Egyptian J. Agr. Res. No.3 ,937-948.

Bratsch, A. (2006): Specialty Crop Profile: Globe artichoke. Extension Specialist, Vegetables and small fruit. 4, 38-45.

CAB. (2003): Crop protection compendium: global module. Commonwealth Agricultural Bureau International, Wallingford, UK.

Campbell, A., Frazer, B.D., Gilbert, N., Gutierrez, A.P. and Mackauer, M. (1974): Temperature requirements of some aphids and their parasites. J. Appl. Ecol., 11: 431-438.

Daoud, M.A.; G. B. El- Saadany; F.M.A. Mairy and M. Y. Ibrahim (1999): The thermal threshold units for *Phithorimaea operculella* (Zeller). Ann. Agric. Sci., Ain- Shams Univ., Cairo, 44(1): 379- 393.

Dochkova, B. (1972): Some biological and ecological studies on *Autographa gamma* L. (Lepidoptera: Noctuidae). Plant Science 9, 141-149.

Johanson,E,F.;R.Trottier and I.E.Laing (1979):Degree-day relationships to the development of (Lepidoptera :Gracillariidae) and its parasite Apanteles ornigis (Hymenoptera :Braconidae).Can. Entomol., 111: 1177-1184

Harakly, F. A. (1975): Biological studies on the loopers *Autographa gamma* (L.) and *Cornutiplusia circumflexa* (L.) (Lep., Noctuidae) infesting truck crops in Egypt.Zeitschrift für Angewandte Entomologie 78: 285-290

Hommes, M. (1992): Simple control thresholds for foliage pests of leek. Bulletin OILB/SROP 15: 115-121.

Honek, A., V. Jarošík, Z. Martinková, and I. Novák.(2002): Food induced variation of thermal constants of development and growth of *Autographa gamma* (Lepidoptera: Noctuidae) larvae. European Journal of Entomology 99: 241-252.

INRA. (2003): *Autographa gamma* (L.). Institut National de la Recherche Agronomique /HYPPZ on line. www.inra.fr/hyppz/RAVAGEUR/6autgam.htm.

Izquierdo, J., E. Arilla, M. Ramírez, and J. Abad (1996): *Plusiinae* (Lepidoptera: Noctuidae) on tomato: species, season evolution and distribution on the plant. Boletin de Sanidad Vegetal, Plagas 22, 803-810.
Macaulay, E. (1972). Flight activity of *Plusia gamma* in the laboratory. Entomologia Experimentalis et Applicata 15: 387-391.
McHaffie, H. (1997). Larva of *Autographa gamma* (Linnaeus) (Lepidoptera: Noctuidae) feeding in the wild on *Athyrium distentifolium*. Entomologist's Gazette 48: 84.
Monnet, Y. (1997): 1996 vegetable and strawberry crops - the main phytosanitary problems. Phytoma: 37-41.
Ramadan, R.A. (2008): Ecological, Physiological and genetical variation in strains of some corn borers under the prevailing environmental conditions in Egypt. Ph.D. Thesis, Ain-shams University, pp 116.
Rashid, F.F.; Hammad, S.M. and Hassan, S.M. (1971): The biology of *Autographa chalcites* L. in Alexandria region (Lepidoptera: Noctuidae). Bull. Soci. Entomo. 55: 419- 426.
Sevacherian,V. (1977): Heat accumulation for timing Lygus control measure in a dependent growth rate simulation.Can.Ent.,106:519-524

تاثير درجات الحرارة الثابتةعلى الخطوات البيولوجية لفراشة *Autographa gamma* (Linn.) والوحدات الحرارية

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تمت دراسة تطور فترات النمو للفراشة *Autographa gamma* (Linn.) (Lepidpterra : Noctuidae) للحرارة الثابتة 20و25و30° م .معدل النمو للاطوار الغير كاملة كانت أطول فى دراجات الحرارة المنخفضة .و.معدل النمو لمجموع الاطواراليرقية كان 25.26، 19.14و 12.08 يوم مع معدلات الحرارةو20 و25 و30° م على التوالى.معدل فترة نمو الجيل بين 46.34 و23.81يوم تعتمد على دراجات الحرارة. مدة بقاء الحشرة الكاملة فى الانثى أطول من الذكر.بينما وضع البيض 106.67 على درجة حرارة 30° م وأقل وضع بيض على درجة حرارة 20° م.18.55 بيضة.الحد الحرج للنمو (صفر النمو) والوحدات الحرارية المجمعة عند درجات حرارة ثابتة وحددت صفر النمو البيولوجى لطور البيض واليرقة والعذراء ، 7.5 ،10.83 و 3.02 م على التوالى. بينما بلغ متوسط الوحدات الحرارية عند درجة الحرارة المفضلة 79.2و362.5و247.8وحدة حرارية اللازمة لتطور البيض واليرقة والعذراء على التوالى . متوسط الوحدات الحرارية اللازمة للجيل 726.4 وحدة حرارية.

قام بتحكيم البحث

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