Ann. Entomol., 31(1) : 21-29 (2013) ISSN 0970-3721

CUTWORMS OF EGYPT
3-THE BIOLOGY OF *AGROTIS SPINIFERA* (HUBNER) (NOCTUIDAE : LEPIDOPTERA)

by

El-Sherif , S.I. and S.A. Abd El–Rahman*
Dept. of Economic Entomology and Pesticides, Faculty of Agriculture,
Cairo University, ORMAN, GIZA, EGYPT.
samsherif1939@yahoo.com

Abstract

In Egypt, cutworms from family Noctuidae and order Lepidoptera are serious polyphagous pests. *Agrotis ipsilon* (Hufn.) is the most abundant cutworm species followed by *Agrotis spinifera* (Hubner). Locally, plenty of research has been done on *A.ipsilon* while very little is known about *A.spinifera.* This article aimed at adding new contributions to the knowledge on the biology of *A.spinifera.* Egyptian clover (*Trifolium alexandrenum* L.) was the most favorable host plant for rearing the larvae of the pest, and a technique to maintain a laboratory stock culture of it is described. Under laboratory conditions, *A. spinifera* had 3 complete and a 4th. partial overlapping annual generations. The 1st. (winter) generation took place from early-November until early-March, and lasted for 102 -113 days. The 2nd. (early spring) generation occurred between mid-February and late-April, and lasted for 45 – 59 days. The 3rd. (late spring) generation elapsed the period from mid-April until mid–June, and lasted for 56 – 62 days. The partial 4th. (summer) generation occurred between early-June and late-September, with a mean duration of about 88 days. The durations of the egg , larval (with 6 instars) , female pupal. male pupal, female adult and male adult stages were 4 – 15, 27 - 82, 8 – 17, 10 -19, 2 – 12 and 2 – 13 days, respectively. Pre-oviposition, oviposition and post-oviposition periods of mated female moths ranged 1 – 7, 1 – 10 and 0 – 2 days, respectively. Egg-laying capacity ranged 0 – 1421 eggs / mated female. The total life-cycle was completed in 53 – 113 days in female individuals and 53 – 111 days in male individuals.

Keywords : *Agrotis spinifera* (Hubner) *,* Biology, Annual generations, Egypt.

Introduction

Cutworms from family Noctuidae and order Lepidoptera are a group of economically important polyphagous insect pests threatening the seedlings of a wide variety of agricultural crops and many weeds in Egypt. The early larval instars of cutworms feed on plant foliage while older instars bite into young plants from underneath at soil level or slightly above it causing serious damage. Literature refers to a noticeable discrepancy in the number of cutworm species in Egypt. However, the works of Nasr and Nazmi (1975) and El-Sherif and Abd El–Rahman (2012 a) ascertained that there are - at least- seven cutworm species belonging to two genera from the tribe Agrotini. According to El-Sherif and Abd El–Rahman (2012 b) the most abundant cutworm species in Egypt are the black (or greasy) cutworm *Agrotis ipsilon* (Hufn.) (= *A.ypsilon* Rott.) followed by *Agrotis spinifera* (Hubner) (= *A. biconica* Hbm) while the other species are of occasional to rare or very rare occurrence.

The majority of investigations on cutworms in Egypt concentrated on *A.ipsilon* being the most serious and destructive among this group

Received on : *29/08/2012* ***Accepted on :*** *09/03/2013*

*Cutworms Research Division, Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

of pests. Meanwhile, very little has been published on the local other cutworm species, especially in respect of their biology . To contribute to such a gap in the available information on cutworms in Egypt, the current study was aimed with the objective of adding new knowledge on the various aspects of the biology and annual generations of *A.spinifera* which ranks - in economic importance – next to *A.ipsilon*. El-Sherif and Abd El–Rahman (2012 b) mentioned that, in Egypt, *A. ipsilon* formed over 86% of the whole cutworms' moth population in light trap catches while *A. spinifera* formed less than 10% of it. As a matter of fact, few authors reported on the biology and annual generations of *A.spinifera* (Rivnay and Yathom ,1964 in Palestine, Singh, 1986 and Gautam and Trishla Gupta,1994 in India, Hammad and El- Minshawy ,1966, Ghanim *et al.,* 1979 and Abu-Hashish *et al.,*1988 in Egypt). Also, scattered hints on the biology of *A. spinifera* in Egypt were given by Willcocks and Bahgat (1937), Abd El–Rahman (1984), El-Mergawy *et al.* (2003) and Fediere *et al.* (2003).

Material and Methods

1- Host plant

In a pilot laboratory test, the leaves of 12 host plants (lettuce, cabbage, potatoes, alfalfa, cotton, maize, wheat, Egyptian clover, castor oil, bindweed, fenugreek and chick pea) were tested for their suitability to feeding the larvae of *A.spinifera.* Larvae of different instars were hardly collected from numerous cutworm-infested fields under different crops at several scattered areas of the country. Collected larvae were individually kept in plastic containers of suitable size to avoid cannibalism and provided with leaves of the tested host plants. Observations indicated that the larvae were most healthy and achieved maximum growth when they were reared on the fresh leaves and stems of Egyptian clover (*Trifolium alexandrinum* L.). Accordingly, a stock culture of *A.spinifera* was maintained on Egyptian clover leaves and stem-cuttings.

2- Stock culture

To establish the stock culture, a Robinson type light trap (fitted with a 125 Watt U.V. bulb) was operated in an open field from dusk to dawn for about two month before this investigation begins. The killing receptacle (jar) of the trap was replaced by an empty one to receive attracted insects and, in the meantime, keeps them alive. The receptacle jar was also provided with soft cloth strips to keep the scales of the captured insects intact and, hence, facilitate their proper identification visually. Every morning, the whole trap catch of alive insects was anaesthetized (by introducing a small piece of cotton wool lightly soaked in ether or chloroform into the jar until the insects in it calmed down and became almost motionless). At this point, the jar was carefully emptied quickly on a white sheet of paper, and the anaesthetized insects fetched – with the aid of a fine camel-hair brush- for the presence of adult moths of *A.spinifera,* which were immediately individually introduced into 1x3 inches glass vials covered with muslin fitted in place with rubber band. Separated moths were left in the vials until they recovered from anesthesia and regained normal movement then were sexed according to the description given by El-Sherif and Abd El–Rahman (2012 a).

Healthy active moths were selected and introduced into oviposition cages at a rate of 1 pair (1female & 1 male) /cage .The cage consisted of a 1 lb chimney glass with its lower opening resting on the bottom of a Petri-dish lined with black paper and its upper opening covered with a piece of thick black cloth. The internal walls of the chimney glass were also painted in black to secure the darkness necessary to enhance oviposition (Abd El–Rahman, 1984). Every cage was provided with a small piece of cotton wool saturated with 20% sucrose solution for feeding the moths and 2-3 cuttings of clover stems with leaves on them to serve as oviposition sites. Oviposition cages were examined daily to collect deposited eggs, renew clover cuttings and replace the feeding cotton wool.

The stock culture was started with groups of eggs collected from the oviposition cages and kept in Petri-dishes until hatching. Thereafter, groups of 10 – 15 newly hatched larvae were

introduced into clean 1 liter rearing glass jars covered with thick toilet paper to prevent escapes. Every jar was provided with a suitable quantity of clover stems and leaves as larval food. Jars were examined twice daily to replace them with new sterilized clean ones, exclude the bodies of dead larvae and add new food supply. Such procedure continued until the larvae reached 4th. Instar when some of them began to show the cannibalistic behavior. At this stage, it became necessary to keep every larva individually isolated in a separate space. Therefore, larvae were transferred to plastic ice-cube trays at a rate of one larva / each of the cells of the tray. Ice-cube cells were continuously provided with fresh clover leaves until the larvae were about to pupate. As a frequent observation , the grown larvae (5th. & 6th. Instars) usually remained in their isolated cells as long as they had sufficient food and it was unnecessary to cover the ice-cube trays. Occasionally, however, some larvae tended to leave their cells and, in such a case, the trays were covered with thin plastic sheets that stick firmly to the outer rims of the tray. Tray covers were provided with small holes over every cell for aeration and these holes were covered with narrow-meshed wire-gauze to prevent larval escapes . As a routine, the ice-cube trays were changed twice daily and the larvae returned back into the cells.

Shortly prior to pupation, the fully mature larvae were individually introduced into 1x3 inches sterilized glass vials covered with muslin. Before introducing larvae into these vials, a thin layer of sand- clay (about ½ cm. in thickness) was placed at the bottom of every vial to enhance cocoon formation and successful pupation. . Formed pupae were left untouched in the vials for 1-2 days after pupation until their bodies hardened enough to be safely handled. Pupae were kept in the vials until the emergence of adult moths which were reintroduced into oviposition cages to produce the egg progeny of a next generation.. The stock culture was maintained under nearly constant laboratory conditions of 27± 1º C. , 70 ± 5 % R.H. and 14 – 16 h illumination period.

3- Biology and annual generations

The study of the biology and annual generations of *A.spinifera* was carried out under the prevailing laboratory conditions throughout nearly a complete year extending from the month of November until the month of next September. The laboratory temperature and relative humidity were recorded with a thermohygrograph and illumination period was controlled by an electric time-switch. The daily means of temperature and relative humidity for the period extending from the beginning till the end of every generation and each developmental stage in every generation were worked out.

The 1st. generation started with newly-laid eggs obtained from the stock culture at intermittent intervals throughout the month of November. Eggs were kept in sterilized Petri-dishes until hatching and the incubation period recorded. One hundred newly-hatched larvae were individually introduced into 1x3 inches glass vials each provided with few fresh clover leaves and tightly covered with plastic covers. To ensure sufficient aeration in the vials, several minute holes were made in every plastic cover with the aid of a heated thin dissection needle. Vials were examined twice daily to replace them with new clean ones, look after moulting skins and renew clover leaves. Such procedure facilitated the follow up of larval instars and determining the duration of every instar. Vials examination continued until the larvae were about to pupate when each of them was provided with a thin layer of sand clay at the bottom of its vial to encourage successful pupation and , hence, determine the duration of the whole larval stage. Pupae and emerged adult moths were treated as mentioned earlier in the stock culture paragraph and the pupal duration was determined. Emerged moths were sexed and every pair of them (1female &1 male emerging on the same day) was introduced into an oviposition cage and allowed to lay the eggs of the next generation. Moths were allowed to copulate and lay eggs until they died, and both adult longevity and egg-laying capacity were determined.

By repeating the above-described technique,

three complete and a partial fourth successive overlapping generations of *A. spinifera* could be reared successfully throughout nearly one year. It is noteworthy to mention here that at least 20 oviposition cages were used for every generation except for the partial 4th. one where larval and pupal mortalities were considerably high due to a severe viral infection and , subsequently, the number of individuals that could reach the adult stage was insufficient to lead to reliable results. Fediere *et al.* (2003) and El-Mergawy *et al.*(2003) recorded that , in Egypt, densoviral diseases occur among the larval populations of noctuid larvae including those of *A.spinifera*.

Results

1- Annual generations

Under laboratory conditions, *A. spinifera* had three complete and a partial fourth successive overlapping annual generations. The 1st. (winter) generation took place from early-November until early-March, and lasted for 102 -110 days (ca.14-16 w), with an average duration of 105.1±0.6 days under mean conditions of 18.7ºC. and 63% R.H. The 2nd. (early spring) generation occurred between mid-February and late-April, and lasted for 45 – 59 days (ca. 7 – 9 w), with an average duration of 50.6± 0.8 days under mean conditions of 23.0º C .and 54% R.H. The 3rd. (late spring) generation elapsed the period from mid-April until mid –June, and lasted for 56 – 62 days (ca. 8 – 9 w), with an average duration of 57.4±0.8 days under mean conditions of 25.2ºC. and 43% R.H. The partial 4th. (summer) generation occurred between early-June and late-September, with a mean duration of about 88 days (ca.12 – 13 w) under mean conditions of 32.8º C. and 60% R.H. Most of the larvae and pupae of this particular partial generation failed to complete normal development to adults due to a severe infection by a virus disease. It seems that , in nature, the insect cannot withstand the adverse summer conditions (high temperature accompanied with relatively high humidity) and –probably- migrates to remote favourable environments. In support to such probability, Abd El–Rahman (1984) reported that the population of *A.spinifera* in light traps in several regions of Egypt was too low throughout the months from June until October.

2- Biology

The life-cycle of *A. spinifera* is shown in Fig. (1). The various aspects of the biology of the same pest under the prevailing laboratory conditions are presented in the following pages.

2.1- The egg Stage (Fig.1 E)

In nature, the eggs of *A. spinifera* are usually laid singly on both surfaces of the leaves of the host plant as well as the other plant parts. Small groups (clusters) of eggs of different shapes and sizes arranged in one or more layers are of occasional occurrence. Eggs are stuck to the substratum with a sticky material secreted by the ovipositing female. The egg is dome-shaped with a flat base and convex top. Its chorion is ornamented with alternating long and short irregular ribs sculptured with transverse lines running in circles .The egg measures about 0.7 mm. in length and 0.5 mm. in height . Recently-laid fertilized eggs are pearl-white in colour but they change to yellowish-creamy within one day then to pale-yellow with brownish spots at the top and sides by the end of the next day. With the progress of embryonic development, the egg colour darkens gradually to grayish-brown then pinkish-brown shortly before hatching. At this stage, the head-capsule of the developing larva can be easily seen through the egg-chorion. Unfertilized eggs do not undergo these colour changes, crumple and dry up. When the larva is ready to hatch, it chews an elongate hole in the egg-shell, practices several waves of violent body contractions supported with strong pressing action with the head-capsule until the latter protrudes outside the hole. The thorax and abdomen are then liberated slowly .In the laboratory, the percentage of egg hatchability ranged 53 – 80%. Incubation period ranged 4 – 15 days, with averages of 14.0±1.0, 4.5±0.1, 6.1± 0.2 and 4.2±o2 days for the 1st., 2nd. 3rd. and partial 4th. annual generations at respective mean conditions of 18.7º C. & 63% R.H., 23.0º C. & 54% R.H., 25.2º C. & 43% R.H. and 32.8º C. & 60% R.H. Hammad and El-Minshawy (1966) mentioned that under mean conditions of 29.6º C. and 67.4% R.H. the incubation period of the egg stage of *A. spinifera* reared on maize

seedlings was 4 days.

2.2- The larval stage (Fig. 1L)

The larval stage is completed in six instars**.** The measurements of body-length and width of head-capsule for each of these instars are shown in Table(1).

The 1st. instar larva is creamy in colour with a pale -yellow median dorsal line. The head-capsule and prothoracic shield are black while the anal shield is grayish. The body of the 2nd. instar larva is more or less similar in colour to that of the 1st. instar but the head-capsule, thoracic and anal shields render paler. In the 3rd. instar, the body colour changes to light-brown and the mid-dorsal line becomes rather evident while another two pairs of lateral whitish-green fine lines extend along the body; one above the spiracles and the other below them . The head-capsule attains a brown colour while the thoracic and anal shields are similar in colour to the rest of the body. Setae scattered allover the larval body become thicker, darker and more

Table 1: measurements of the body of the different larval instars of *A.spinifera.*

Measurement in mm.	INSTAR					
	1st	2nd	3rd	4th	5th	6th
Width of head-capsule	0.38 - 0.44	0.60 - 0.67	0.97 - 1.21	1.33 - 1.86	2.00 - 2.26	2.40 - 2.89
Body length	1.9 – 2.8	3.1 – 5.0	6.0 – 8.0	11.0 - 15.0	20.0 - 28.0	31.0 - 39.0

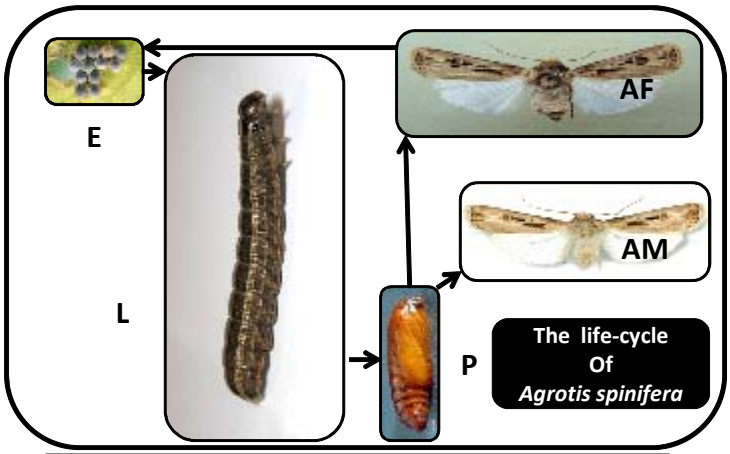

Fig.1:The life-cycle of *Agrotis spinifera*.
E. Egg , L. Larva, P : Pupa, AF: Adult female, AM: Adult male
***Eggs enlarged (nearly 2 -3 X).**
***Larva, pupa and adults almost normal size.**

conspicuous. The 4th. instar larva is quite similar in general characteristics to that of the 3rd. one but the thoracic shield tends to be slightly darker in colour than the rest of the body. The 5th. and 6th. larval instars are nearly similar in colour which varies from light-brown to light-pinkish-brown with a light-brown head-capsule , a dark thoracic shield and the anal shield attaining the body colour. Under the prevailing laboratory conditions, the durations of the 1st. to 6th. larval instars were 5-9, 3- 6, 3 - 6. 3 - 7, 5 - 9 and 7- 11 days , respectively. According to Hammad and El-Minshawy (1966), the larvae of *A.spinifera* reared on maize seedlings at mean laboratory conditions of 29.6º C. and 67.4 % R.H. had 6 instars of 4 – 5, 3 – 4, 2 – 3, 3- 5, 4 – 8 and 2-8 days, By the end of the larval stage, the larva spends a pre-pupal period during which it stops feeding, becomes sluggish and considerably contracted. The larva spins a delicate silken cocoon where it moults and changes into pupa. The moulting skin remains attached to the chremasteric processes of the pupa while some sand and clay particles as well as plant debris stick to the cocoon that acquires a dirty yellowish-brown appearance .

The range and average durations of the active larval, prepupal and total larval periods in the four successive annual generations, together with the means of laboratory conditions, are presented in Table (2). As seen in this table, the total duration of the larval stage ranged 27 - 82 days (according to laboratory conditions) with averages of 76.6 ± 0.7 days at 20.2º C. & 62% R.H, 31.2 ± o.4 days at 22.0º C. & 57 % R.H , 34.3 ± 0.5 days at 27.7 º C.& 47% R.H. and 69.0 ± 1.0 days at 31.8 º C. & 59% R. H. for the 1st., 2nd., 3rd, and partial 4th. annual generations, respectively. Such durations suggest that the temperature range of 22.0 – 27.7 º C. seems to be more favorable for larval development under laboratory conditions. Increase or decrease of temperature beyond this range resulted in subsequent prolongation of larval duration.

2.3- The pupal stage (Fig.1 P)

The pupa is obtect. Female pupae are relatively larger in size than male ones. Females measure 15 – 18 mm. in length and 5 - 6 mm. in width (at the widest part of the body) while males measure 13 – 16 mm. and 4 – 5 mm. in length and width, respectively. The newly formed pupa is light-green. One day after pupation, it attains a yellow-brownish colour. Body colour darkens gradually thereafter until it turns to light-brown with dark-brown narrow transverse bands at the anterior and posterior margins of each abdominal segment. Under laboratory conditions, the pupal stage lasted for 8 – 17 days in females and 10 – 19 days in males. Hammad and El-Minshawy (1966) reported 11 – 14 days as a pupal period of *A.spinifera* in Egypt. The averages of pupal duration for the 1st., 2nd. and 3rd. annual generations were 14.2 ± 0.3 (at 18.7 º C. & 63% R.H.), 13.3 ± 0.3 (at 23.0º C.& 54% R.H.) and 10.2 ± 0.2 days (at 25.2º C. & 43% R.H.), respectively, for females and 15.4 ± 0.5, 13.1 ± 0.3 and 11.8 ± 0.3 days, respectively, (at the same temperatures and humidities) for males. During the partial 4th generation, the mean duration of the pupal stage was 13 and 12 days for females and males, respectively, at 32.8º C. & 60% R.H. The survival rate of pupae ranged 49 – 82% for the 1st. – 3rd. annual generations and drastically dropped to only 2 % for the 4th. generation due to the previously mentioned severe viral infection.

2.4- The adult stage (Fig.1 AF &AM)

Shortly prior to moth emergence, a longitudinal fracture occurs along the dorsum of the pupa from the vertex to the 4th. or 5th. abdominal segment. The prothorax of the emerging moth protrudes from that fracture followed by its abdominal segments then the head-capsule and its appendages. The legs are the last part to be liberated from the pupal skin. Upon emergence, the wings are crumpled while the abdomen is inflatened and contracted, but within a few minutes the body of the moth stretches and takes normal shape. Female moths are relatively larger in size than males measuring 33 – 38 mm. in wing-expanse and 13 – 16 mm. in body-length while males measure 32 – 37 mm. and 12 – 15 mm. in wing-expanse and body-length, respectively. The head and thorax are covered dorsally with brown-clay scales. Antennae are filiform in females and

bipectinate in males. Fore-wings are light-brown and slightly darker in females than in males. The middle area of the fore-wing is pale-brown, marked with two dark-brown triangular areas, a light-brown bar and a dark-brown kidney-shaped spot. Hind–wings are whitish with conspicuous veins and the abdomen is covered with dense creamy to grey scales.

The pre-oviposition, oviposition and post-oviposition periods as well as the egg-laying capacity of the mated female moths of *A.spinifera* in the 1st., 2nd. and 3rd. annual generations, together with the means of laboratory conditions, are presented in Table (3). This table indicates that the pre-oviposition period ranged 1 - 7 days, the oviposition period ranged 1-10 days, the post-oviposition period ranged 0 – 2 days and the egg-laying capacity ranged zero to 1421 eggs / female. Egg-laying capacity seemed to be negatively related with temperature. At mean temperatures of 25.0, 28.4 and 29.7 ºC. the mean numbers of eggs / female were 402.2, 334.6 and 35.0, respectively. Gautam and Trishla Gupta (1994) pointed out that the egg-laying capacity of *A. spinifera* female moths depends on the diet offered to them. The maximum egg-laying capacity (a mean of 535.4 eggs / female) was recorded for the moths fed on glucose (10%) or sucrose (20%) + protinex (5%).

As for adult longevity, female moths lived

Table 2 : Durations of the active larval period, pre-pupal period and total larval period of *A.spinifera* in four successive annual generations.

Generation	Duration in days			Mean laboratory conditions	
	Active larva	Pre-pupa	Total 1arval period	Temperature ºC	R.H.%
1st.	74.4 ± o.7 (64-80)	2.3 ± 0.1 (1 – 4)	76.6 ± 0.7 (67 – 82)	20.0	62
2nd.	28.5 ± 0.4 (25 – 35)	2.5 ± 0.1 (1 – 4)	31.2 ± o.4 (27 – 37)	22.0	57
3rd.	32.1 ± 0.5 (26 – 39)	2.2 ± 0.1 (1 – 5)	34.3 ± 0.5 (27 – 44)	27.7	47
4th.	68.0 ± 1.0 (67 – 69)	1 ± 0.0 (1)	69.0 ± 1.0 (68 – 70)	31.8	59

Table 3 : Pre – oviposition, oviposition and post-oviposition periods as well as the egg-laying capacity of the mated females of *A.spinifera* in the 1st., 2nd. and 3rd. annual generations.

Generation	Period in days			Egg-Laying Capaity	Mean laboratory conditions	
	Active larva	Pre-pupa	Total	(Eggs/female)	Tempe-rature ºC	R.H.%
1st.	1.7 ± 02 (1 – 2)	2.9± 0.6 (1 – 7)	0.9 ± 0.3 (0 – 2)	402.2±65.8 (160 – 654)	26.0	46
2nd	1.3± 0.2 (1 – 3)	2.8 ± 1.0 (1 – 10)	0.5 ±0.2 (0 – 2)	334.6±158.9 (255 –1421)	28.4	46
3rd.	2.5 ±1.0 (1 – 7)	1.3 ±0.2 (1 – 2)	0.3 ± 0.3 (0 – 2)	35.0 ± 13.1 (0 - 115)	29.7	50

for 2-12 days, with averages of 5.5 ± 0.5 days (at 18.7º C. and 63% R.H.), 4.9 ± 1.1 days (at 21.0º C. and 54% R.H.) and 3.7 ± 0.7 days (at 25.2º C. and 43 % R.H.) for the 1st. 2nd. and 3rd. annual generations, respectively. Male moths lived for 2-13 days, with averages of 6.3 ± 0.8 days for the 1st. generation, 4.0 ± 1.0 days for the 2nd. generation and 6.1 ± 1.3 days for the 3rd. generation (under the same temperatures and relative humidities mentioned for female moths) . During the partial 4th. generation, female moths lived for a maximum of 4 days and males lived for up to 2 days only. The above-mentioned female longevity means emphasize that female moth longevity was negatively related to temperature but such relationship was not observed in the case of male moths. Hammad and El-Minshawy (1966) reported that at mean conditions of 29.6º C. and 67.4 % R.H. the longevity of the adults of *A. spinifera* ranged 2 – 8 days.

Under the prevailing laboratory conditions, the total life-cycle of *A. spinifera* was completed in 53 –113 days for female individuals and 53 – 111 days for male individuals, according to generation. In females, the average durations of the 1st., 2nd. and 3rd. generations were 107.8 ± 0.7, 57.4 ± 1.5 and 57.5± 1.2 days, respectively, at respective mean conditions of 19.4 ºC & 62% R.H., 23.0º C. & 53% R.H. and 25.3º C. & 44 % R.H. The corresponding average durations under the same conditions for male individuals were 108.6 ± 0.7, 56.5 ± 1.5 and 59.5 ± 1.3 days. The mean duration of the total life-cycle during the partial 4th. generation (at 32.7º C. & 60% R.H.) was 91 and 89 days for female and male individuals, respectively.

Discution

Cutworms are serious economically important insect pests in many countries. Although at least seven species of cutworms had been recorded from Egypt (Nasr and Nazmi ,1975), the most destructive among these species are *Agrotis ipsilon* (= *A.ypsilon*) followed by *Agrotis spinifera* (= *A. biconica*) and to a relatively less extent *Agrotis segetum* (El-Sherif and Abd El–Rahman ,2012 b). In fact, the revision of the world literature on cutworms revealed that the knowledge on both *A. ipsilon* and *A.segetum* is quite immense while that on *A.spinifera* is scattered and very scanty . This encouraged the authors to conduct the current investigation on the biology and annual generations of *A. spinifera* under laboratory conditions as a preliminary step towards establishing reliable information for combating such a harmful pest.

This study emphasized that, under laboratory conditions, *A. spinifera* underwent four successive overlapping annual generations that were mostly associated with certain geographical seasons as winter (early November – early March), early spring (mid-February – late April), late spring (mid-April – mid-June) and summer (early June - late September) generations. The 4th. (summer) generation seemed to be a partial one. Generation duration ranged 14-16, 7-9, 8-9 and 12-13 weeks for the 1st. to 4th. generations, respectively. In agreement with the current findings Ghanim (1979) and Abu Hashish *et al.* (1988) stated that, depending on light trap catches at Mansoura (middle -Delta) and Ismailia (East-Delta) districts of Egypt,, respectively, *A.spinifera* had 4 annual generations. Also, in Palestine, Rivnay and yathom (1966) found that the number of annual generations of the same pest ranged 4-5. In nature, it seems that the adult moths of the 4th. generation probably migrate throughout autumn season to other unknown more favorable environments (possibly northwards across the Mediterranean see or internally to desert oasis) then returns back by the oncoming of the cold winter weather. Apparently, the insect practices such migratory movement to avoid the destructive viral infections that prevail by the end of summer season and kill the majority of the existing larvae and pupae (Fediere *et al*., 2003 and El-Mergawy *et al.,* 2003). In support to such probability, Abd El–Rahman (1984) reported that the population of *A.spinifera* in light traps in several regions of Egypt was too low throughout the months from June until October.

Comparing the four successive annual generations on basis of total life-cycle duration means refers that *A. spinifera* prefers the

relatively mild spring weather rather than either cold (winter) or hot (summer) weather . The shortest total life-cycle duration means took place during the 2nd. and 3rd. early and late spring generations (56.5 - 57.4 and 57.5 – 59.5 days, respectively, at respective temperature and R.H. means of 23.0º C. & 53%. and 25.3º C. & 44 %) while during the 1st. (winter) generation the mean of total life-cycle duration increased to 107.8 – 108.6 days at means of 19.4º C. and 62% R.H. Similarly, the mean of total life-cycle duration during the 4th. partial (summer) generation was prolonged to 89 -91 days at mean conditions of 32.7º C. and 60% R.H. Based on the above data, it might be generally anticipated that the optimum conditions for the development of the different stages of *A.spinifera* lie between 23 and 25º C. combined with ca. 45-55% R.H. Practically speaking, this point requires further investigation to achieve a more precise conclusion. It is worthy to mention , however, that the authors are currently conducting a detailed laboratory study on the effect of different combinations of constant temperatures and relative humidities on the various aspects of the biology of *A.spinifera*. Preliminary results seem to ascertain the above anticipation.

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