Egypt. J. Agric. Res., 81 (4), 2003.

MORPHOLOGICAL AND BIOLOGICAL STUDIES ON *CONOMORIUM* SP. (HYMENOPTERA: PTEROMALIDAE), A NEWLY RECORDED PARASITOID ON PUPAE OF *SESAMIA CRETICA* LED. (NOCTUIDAE: LEPIDOPTERA) IN EGYPT

SHALABY, F. F.[1], E.A. KARES[2], A. A. HAFEZ[1] AND G.H. EBAID[2]

1 plant Protection Department, Faculty of Agriculture, Moshtohor, Zagazig University, Egypt.

2 Plant Protection Research Institute Agricultural Research Centre, Dokki, Giza, Egypt.

(Manuscript received December 2002)

Abstract

The pteromalid *Conomorium* sp. is one of the gregarious endoparasitoids attacking the pink stalk borer, *Sesamia cretica* pupa in Egypt. The biological and morphological studies were not adequately investigated before. Accordingly, this work was conducted to study this aspect for the sake of easy differentiation between this species and other species belong to genius *Conomorium*. The different immature stages of *Conomorium* sp. (egg, four larval instars, prepupa and pupa) were briefly described. The mean incubation period is 1.75 ± 0.25 days, the mean total durations of the larval stage (4 instars) are 2.25 ± 0.25, 3.5 ± 0.09, 3.75 ± 0.20 and 4 ± 0.18 days, respectively. Whereas the prepupal and pupal stages lasted 1.13 ± 0.12 and 8.5 ± 0.23 days, respectively at 25 ºC and 65 ± 5 R.H. The two sexes of the parasitoid were differentiated and described. Mating and oviposition processes are described. Pupae of 8 lepidopterous species were tested as hosts for *Conomorium* sp. Two species, *S. cretica* and *Agrotis ipsilon* were attacked by the parasitoid female. Effects of different types of supplementary food on the longevity of adults were tested. The suitable temperature for rearing the parasitoid is 25 ºC, where the female lived for a mean period of 27 days and produced an average of 189.3 ± 32.46 adult parasitoids during its life span with sex ratio of 1 male : 10.47 female. It was found that mating did not affect the ovipositional activities, life-span. Oviposition parthenogenesis occurs and unfertilized eggs give rise to males only. The number of generations of parasitoid per year in laboratory were 13 generations. Adults (females and males) of the pteromalid *Conomorium* sp. were stored at 10 ºC for different periods of storage. Mortality rates were lower among females than males. Also, cold storage of males for longer periods more than 25 days caused detrimental effect on the fertility of males. The cold storage for 35 days led to a sex-ratio of 1 male: 0.2 female when storage males copulated with freshly emerged females. It was found that 90 days period of storage may be considered the maximum favorable period of storage for virgin or mated females without any detrimental effects on their own or their progeny, fecundity or longevity. Storage studies are important to obtain the greatest numbers of parasitic adults at any required time much early before occurrence of economic damage of the target insect pest *S. cretica*.

INTRODUCTION

The pteromalid gregarious endoparasitoid, *Conomorium* sp. was secured from *S. cretica* pupae collected periodically from the Experimental Farm of Faculty of Agriculture, Moshtohor, Qalubia Governorate. Dr. Hannes Baur, staff member of the Natural History Museum (Bern, Switzerland), identified this parasitoid. Dr. Hannes assured that this parasitoid is not *Conomorium amplum* (*eremita*) (Walker) and it's a new undescribed parasitoid species on *S. cretica* pupae in Egypt. The present studies deal with the biology of this beneficial species.

MATERIAL AND METHODS

1. Rearing of the parasitoid hosts: *Sesamia cretica* egg masses were collected from maize plants cultivated in the Experimental Farm of the Faculty of Agriculture, Moshtohor, Qalubia Governorate. After hatching, larvae were reared at an average of 25 ± 2 ºC and 65 ± 5 R.H. using the technique described by Yacoub (1999). Large numbers of *A. ipsilon* larvae were collected from the field and reared at an average of 25 ± 2 ºC and 65 ± 5 R.H. using the technique described by Gesraha (1993).

2. Rearing of the parasitoid: Rearing began with the adults, which emerged in the laboratory from parasitized pupae of *S. cretica* collected from Experimental Farm of the Faculty of Agriculture. Each group of parasitoids emerged from a single pupa of *S. cretica* were confined in a glass jar 13 x 7cm., covered with muslin set in position by a rubber band. On the outer surface of the muslin cover, droplets of honey were put to feed the adult parasitoids. Parasitoid adults were left for 24 - 48 hours for feeding and mating. Females were separated and each one was confined in a glass tube 8 x 2 cm. A freshly formed single pupa of *S. cretica* was exposed to adult female within the glass tube for 24 hours and then removed to be replaced by another pupa for 24 hours and so on until the death of female. The parasitized pupae were kept individually in glass tubes 8 x 2 cm. until emergence of the parasitoid adults. Rearing of the parasitoid was conducted at 25 ± 2 ºC and 65 ± 5 % R.H.

3. Description and duration of immature stages of *Conomorium* sp.: 30 newly formed pupae of *S. cretica* were exposed daily to mated females of *Conomorium* sp. Two times every day a group of 15 host pupae were dissected under a binocu-

lar microscope. The egg at different stages of embryonic development, the four larval instars, the prepupa and pupa were studied; mounted and drawn under a binocular microscope by the aid of a camera Lucida.

4. Emergence of adult parasitoids from host pupa, sex differentiation, mating process and oviposition were observed and described.

5. Host range in the laboratory: A group of fifty pupae of 8 lepidopterous species namely; *Sesamia cretica* Led.; *Ostrinia nubilalis* Hb.; *Chilo agamemnon* Bles.; *Earias insulana* Boisd., *Pectinophora gossypiella* Saunders; *Agrotis ipsilon* Rott.; *Anagasta kuehniella* Zell., and *Spodoptera littorals* Boisd. were individually confined in a glass test tube. A freshly emerged adult female of *Conomorium* sp. was introduced in each test tube and left for 48 hours for oviposition. Pupae were then removed and kept individually in glass test tubes until emergence of the parasitoid adults or moths of the hosts.

6. Effect of different temperatures on total developmental period and progeny produced throughout the longevity of adult female: Three groups, each of 10 newly emerged and mated females were kept individually in glass test tubes. Every group was kept at a thermal condition of 15, 25 and 35 ºC and 65 ± 5 % R.H. A single freshly formed *S. cretica* pupa was introduced to adult female within glass test tube for 24 hours and then removed to be replaced by another pupa for 24 hours and so on until the death of female. The parasitized pupae of each group were kept individually in glass test tube at the same temperature until emergence of parasitoids. The aforementioned points of study were estimated.

7. Effect of mating on sex-ratio of *Conomorium* sp.: Two groups, each of 10 newly emerged females, one mated and the other unmated, were used in this study. Each female was confined in a glass test tube. The unmated females were separated immediately just after emergence and before any copulation took place. Females of the two groups were fed on droplets of honey and then left to the end of the preoviposition period. A single pupa of *S. cretica* was introduced to each adult female within glass test tube for 24 hours and then was removed. Ten parasitized pupae resulted from each of the two treatments, those were kept individually in glass test tubes until the emergence of adult parasitoids and then the sex-ratio was calculated.

8. Effect of rearing of *Conomorium* sp. on two different host species on the number of emerged adults, sex-ratio and life-cycle: Two groups, each of 10 newly mated females were kept individually in glass tubes. Each group was kept at 25 ± 2 ℃ and 70 ± 5 % R.H. Adult females of the first group were left with pupae of *S. cretica*, while those of the second one were left with pupae of *Agrotis ipsilon*. The parasitized pupae were removed after 24 hours to be replaced by another pupa and so on until death of female. The parasitized pupae of each group were kept individually in glass test tubes which were kept under the above mentioned condition until emergence of adult parasitoids. The number of the emerged adults, sex-ratio and the total developmental period were estimated.

9. Effect of different types of supplementary food on the longevity of *Conomorium* sp. adults: Six groups of freshly emerged *Conomorium* adults were used in this experiment. Each group consisted of 20 couples; adults were confined individually, in 2 x 6 cm. glass tubes. Groups of adults were fed on droplets of water, 50 % sucrose solution, pure bee honey and bee honey mixed with 20% dried yeast. Adults of the fifth group were kept starved. Females of the sixth group were fed for 2 days on 50 % sucrose solution and then left for oviposition and feeding on host fluid. The tested foods were supplied as fine droplets scattered regularly on the inner surface of the glass vials. All vials were daily examined and mortality was recorded until the whole life-span of the experimental adults has finished. This experiment was carried out under laboratory conditions of 30 ± 2 ℃ 70 ± 5 % R.H.

10. Number of generations of *Conomorium* sp. / year under laboratory conditions of 25 ± 2 °C and 65 ± 5 % R.H.: The laboratory culture of *Conomorium* sp. began with adults that emerged in the laboratory from pupae of *S. cretica* collected from maize fields. The yearly number of generations was estimated

11. Storage of *Conomorium* adults: The newly emerged adults were collected in glass jars supplied with 50% sucrose solution and stored at 10 ℃. Adult's parasitoid were checked every 3 days for their survival. They were transferred to the room temperature and fed for about two hours, then returned to refrigerator for other 3 days and so on until mortality.

a. Effect of storage on mortality rates among *Conomorium* adults: The effect of different periods of cold storage of *Conomorium* adults at 10 °C. on the rates of mortality was estimated for 20, 30, 40, 50, 60, 70, 80, 90, and 100 days. After each period of storage, a number of 100 adults (50 couples) were confined in a glass jar 5 x 10 cm. covered with muslin set in position by a rubber band. The jars were kept in the refrigerator and were checked periodically every 3 days for feeding the adults. Mortality of adults was counted at the end of each period.

b. Effect of storage at 10 °C on mated females of *Conomorium* sp. stored for different periods: The effect of cold storage was studied for 30, 60, 90 and 120 days at 10 °C on female adults emerged from *Agrotis ipsilon*. Ten mated females were removed after different periods of storage mentioned above, separated and each one was confined in a glass test tube 8 x 2 cm. A newly single pupa of *Agrotis ipsilon* was exposed to adult female within the glass tube for 24 hours and then removed to be replaced by another pupa for 24 hours and so on until female's mortality. The parasitized pupae were kept individually in glass tubes until the emergence of the parasitoid adults. The total number of resulted adults and the number of females and males were counted. Consequently, the sex-ratio was determined.

c. Effect of storage at 10 °C on virgin females of *Conomorium* sp.: The same technique and conditions used in the aforementioned experiment was also used in this experiment. Unmated females were stored in the refrigerator for different periods and then removed out to mate with freshly emerged males before introduction to parasitized pupae of *Agrotis ipsilon*

d. Effect of different periods of storage at 10 °C on the fertility of *Conomorium* males: Large numbers of freshly emerged males were collected to be stored at 10 °C for 25, 35, and 45 days. The same technique used before was also followed in this experiment. Each male was confined with one female for 24 hours to insure mating.

RESULTS AND DISCUSSION

1. Description of immature stages

A. Egg stage: The newly deposited egg, Fig. 1A is translucent white to yellow in colour, elongate in shape and its measures 0.70 mm. long and 0.28mm. at its widest part. It is slightly convex at one side, while concave at the other side. The wide cephalic end is clearly rounded and gradually tapers towards the posterior end. The chorion is smooth, glittering and devoid of reticulation, sculpturing, or external processes of any kind. As development proceeds, there are marked changes in size. Thirty-six hours after deposition, the egg dimensions highly increase to 1.31 mm. length and 0.437 mm. width. Just before hatching; the larva could be easily discerned through the translucent chorion Fig., 1B.

B. Larval stage: The larva of *Conomorium* sp. molts three times during its growth; i.e., the larva has four larval instars. All moultings occur inside the host pupae. Throughout its development, the larva of *Conomorium* sp. could be detected and described as follows:

***First instar larva:** The first instar larva, Fig.2A measures 1.40-mm. long and 0.525 mm. wide. It is translucent white in colour and after feeding, it attains the colour of the consumed host i.e., creamy pink. The body has 13 segments. The digestive tract is clearly visible, especially after feeding. The head capsule is well developed and sclerotized, most chitinized dorsally and laterally. It measures 0.210 mm. long and 0.210-mm. wide. The mouthparts protrude from the ventral side of the head. The falcate mandibles are well developed and each measures 0.140-mm. length and 0.070-mm. width, Fig., 5A.

***Second instar larva:** The body, Fig., 2B is creamy in colour and measures 2.625 mm. in length and 0.7 mm. in width. Its body tends to taper towards both ends and is characteristic by presence of one tracheal branch extending along of each lateral side of body. The head is more or less rounded in shape and fleshy and measures 0.245 mm. long and 0.42-mm. wide. The mandibles are about 0.175-mm. long and 0.105 mm. wide. The alimentary canal is clearly seen occupying most of the body cavity, Fig., 5B.

***Third instar larva:** The third instar larva measures 4.2-mm. long and 0.875-mm. wide. The undigested portion of the ingested food accumulates (throughout the larval stages) in the alimentary tract which attains a homogenous pale yellow appearance and occupies almost all the body cavity Fig., 2C. For this reason, the larva appears darker in color than in the previous instars and body becomes curved and notably swollen. The head capsule measures 0.21 mm. long and 0.315 mm. wide. The mandibles are larger in size and more pigmented than in the preceding stage. Each mandible has a broad rounded base and tapers to sharp end Fig., 5C. It is about 0.21-mm. in length and 0.14 mm. in width at its base .

***Fourth larval instar:** The fourth larval instar measures 3.325 mm. long and 0.857 mm. wide and is quite similar in the shape and structure as to the third instar, except the size of head capsule which measures 0.179 in length and 0.208 mm. in width. The mandible is 0.28-mm. long and 0.193 mm. wide Figs 2D & 5D.

C. Pre-pupal stage: The prepupal stage Fig., 4 measures 2.90 mm. in length and 1.0 mm. in width. The head capsule becomes not clear. The posterior part of this stage is characterized by absence of segmentation. The mid-gut opens to the hind-gut and so the meconium is discharged out of the body. This stage is also formed inside the host pupa.

D. Pupal stage: Inside the host pupa, the prepupa is subsequently transferred to pupa. The latter Figs. 4 is typically of the free type. It measures about 3mm. in length and 2.24 mm. in width. At the beginning of this stage, the pupa is creamy in colour, the compound eyes and ocelli appear red. As development proceeds, the body darkens gradually starting with the head and thorax, which becomes black. Legs appear brown with yellow in some parts.

2. Duration of *Conomorium* sp. immature stages at 25 °C and 65 ± 5 % R.H.

The duration of various immature stages of *Conomorium* sp. reared on *S. cretica* pupae are presented in Table 2, Data showed that the incubation period of the egg stage occupied 1.5 – 2 days with an average of 1.75 ± 0.25 days. The first instar larva lasted 2 - 2.5 days with an average of 2.25 ± 0.25 days. The second larval instar, sub-

sequently, averaged 3.5 ± 0.09 days with a minimum of 3 and maximum of 4 days. The third instar larva lasted (3.5 - 4) with an average of 3.75 ± 0.20 days. The fourth instar larva ranged between 3.75 and 4.25 with an average of 4 ± 0.18 days.

The total larval period, lasted 13.5 ± 0.72 (12.25 - 14.75) days. Subsequently, the pre-pupal and pupal stages lasted 1.13 ± 0.12 (1 - 1.25) and 8.5 ± 0.23 (8 - 9) days, respectively. The total developmental period of the parasite (from egg deposition to adult emergence), averaged 24.88 ± 1.32 days with a minimum of 22.75 and a maximum of 27days at 25 ℃ and 65 ± 5 % R.H.

Table 1. Durations of *Conomorium* sp. immature stages reared on *S. cretica* pupae, at 25 ℃ and 65 ± 5 R.H.).

Stage	Duration (in days)		
	Minimum	Maximum	Average ± S.E.
Egg	1.5	2.00	1.75 ± 0.25
Larva:			
1st instar	2	2.5	2.25 ± 0.25
2nd instar	3	4	3.5 ± 0.09
3rd instar	3.5	4	3.75 ± 0.20
4th instar	3.75	4.25	4 ± 0.18
Total larval period	12.25	14.75	13.5 ± 0.72
Pre-pupa	1	1.25	1.13 ± 0.12
pupa	8	9	8.5 ± 0.23
Total developmental period	22.75	27.00	24.88 ± 1.32

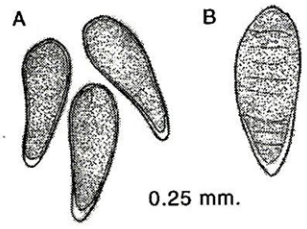


Fig. 1. Egg stage of *Conomorium* sp.
A. deposited egg B. Egg before hatching

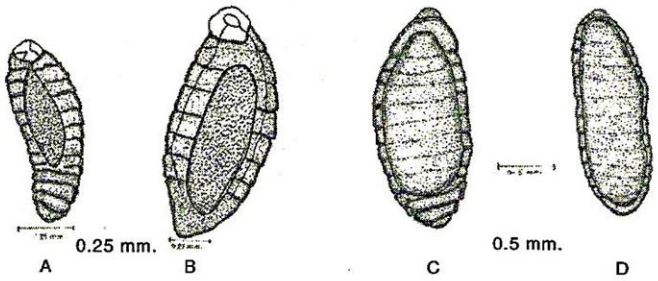


Fig. 2. A. First instar larva. B. Second instar larva.
C. Third instar larva. D. Fourth instar larva of *Conomorium* sp.

Fig. 3. Prepupal stage of *Conomorium* sp.

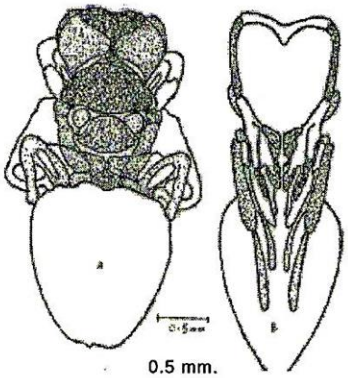


Fig. 4. Pupa of *Conomorium* sp.
A. dorsal view. B. Ventral view.

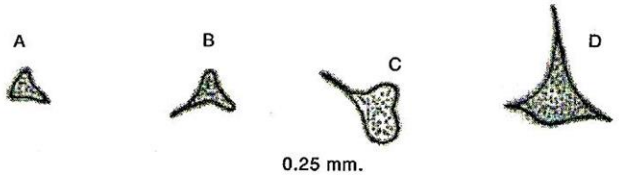


Fig. 5. Mandible of *Conomorium* sp. larvae.
A. First instar. B. Second instar. C. Third instar. D. Fourth instar.

3. Emergence of adult parasitoids from host pupa

Emergence takes place at any time during the day or night. When it fully developed, the parasitoid adults gnaw through any part of the emptied host pupae, making a circular hole of sufficient diameter, about (1-1.5 mm.) that enables it get out through. It was found that the wasps may make second hole for emergence. Out of 200 parasitized *S. cretica* pupae 163 had one emergence hole and 37 had two holes. In all cases, the parasitoid adults emerged from a single host pupa within few hours. Through the hole of emergence, the head of the parasitoid protrudes, followed by fore-legs, then the rest of its body. The adults in their gradual emergence attain an upright position. As the whole body of the adult becomes free, it moves randomly inside the vial for about 2 hours before it comes in rest on any place inside the vial. It was also observed that some of the emerged adults may re-enter the host pupa through the hole of emergence.

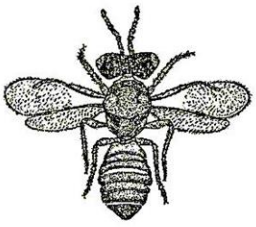
4. Sex differentiation

The two sexes of *Conomorium* sp. could be differentiated by examination of the ventral surface of abdomen, which is characterized by the presence of a pale yellow ring in the case of male, but absent in case of female. It also noted that the motion of male is more quickly than female. The end of female abdomen is wide and slightly curved, but elongate and narrow in male. The close examination of antenna and genitalia (Figs. 6, 7, 8, 9) perform other differences between the two sexes. The antenna is of geniculate type and consists of a long scape, a shorter pedical and a 7-segmented flagellum in both of the two sexes. The flagellum is longer in male (1.22 mm.) than female (1.05 mm.). The male genitalia consists of numerous lobes composed of an aedeagus extending in between the caulis, which is formed by the paramere and basiparamere. All these lobes are provided distally by pairs of dark spines.

5. Mating process

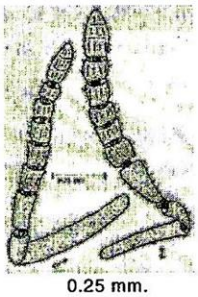
Mating occurs immediately just after emergence. The two sexes usually appear excited, moving quickly. The male can recognize the female only at a short distance of about 1 cm. then male run behind female vibrating his wings. The male suddenly climbs the female's back holding her neck with his fore-legs, then bend down his head vibrat-

ing quickly up and down his antenna touching the antennae of female. This process continues for 2-3 seconds where female becomes motionless. Then, the male goes back until his middle part of abdomen reaches the end of female's abdomen then bends down his abdomen towards the female's abdomen trying for copulation. At the same time, the female stays quietly with her antenna stretched forward or vibrating up and down. Sometimes, the female moves forward before copulation, but the male quickly moves again forward to touch female's antennae and trying again and again until successful mating occurs. Males were able to mate at any time during their whole life and the process might be repeated several times within one day. Copulation was repeated also during the female's life.



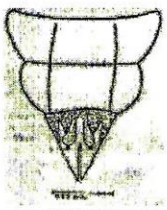
0.5 mm.

Fig. 6. Adult male of *Conomorium* sp. (dorsal view)



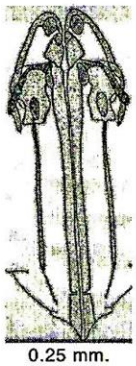
0.25 mm.

Fig. 7. Antenna of *Conomorium* sp



0.25 mm.

Fig. 8. Male genitalia of *Conomorium* sp.



0.25 mm.

Fig. 9. Female genitalia of *Conomorium* sp.

6. Oviposition

The female could recognize its host, only, at a short distance (about 1- 1.5 cm.) during its random movement. The female suddenly climbs the pupae making flagella of her antennae held vertically and moving rapidly up and down, tapping most of the surface of the pupae with the tips of antennal flagellae. It was found that this process elapsed (1.5 – 3.5 min.) . In this process the female aim to determine the suitable position for insertion. The adult parasite shows, suddenly, the next stage of behavior pattern as female stops tapping flexes her body and begins drumming with tip of her abdomen on a restricted area of the surface of the pupae. After drumming, the female places the tip of her ovipositor in the correct position for drilling. In this stages the full length of the ovipositor could be observed extended vertically between the mid and the hind legs. Also, the female either kept her antennae motionless or vibrating them slowly up and down.

Once the tip of the ovipositor is in position, the female body becomes in a shape of semicircle by partly straightened the fore legs and bending the mid and hind legs. The female starts, then, to drill through the wall of the pupa. After piercing the wall of pupa and the hole is large enough for insertion of the female ovipositor, it inserts the entire length of her ovipositor. The female partly withdraws the ovipositor, but not completely out the hole, to be in that position for 0.5 –1.5 min. Female again inserts the ovipositor through the hole and the aforementioned steps repeated several times to make a feeding tube.

If the host is suitable, the female lays her eggs and on getting out the ovipositor a feeding tube is formed. After removing the ovipositor, the female returns by her back goes seeks for the end of the feeding tube with her antennae and sucks up the host haemolymph for nutrition. The time required for making the feeding tube and oviposition lasted about 6 (4.1- to 10.5) minutes.

7. Host rang in the laboratory

In a laboratory experiment, pupae of 8 lepidopterous species namely *Sesamia cretica* Led., *Ostrinia nubilalis* Hb., *Chilo agamemnon* Bles., *Earias insulana* Bois., *Pectinophora gossypiella* Sounders, *Agrotis ipsilon* Rott, *Anagasta kuehniella* Zell. and *Spodop-*

tera littoralis Boisd. were tested as a host of *Conomorium* sp., Table, 2. Three species were found to be attacked by the parasitoid female. Higher percentages of parasitism were obtained on *S. cretica* and *A. ipsilon*. In case of *S. littoralis*, the females of parasitoid attacked the pupae; however parasitism was not successful in all cases. Out of 50 *S. littoralis* pupae exposed to adult female's parasitoid, only one showed successful parasitism by *Conomorium* sp.

8. Effect of different temperatures on total developmental period and progeny produced throughout the whole longevity of adult females

Adult female of *Conomorium* sp. were left to parasitize on *S. cretica* pupa for 24 hours and then the host pupa removed to be replaced by another for 24 hours and so on until the death of female. Associating with the three temperatures 15, 25 and 35 ℃, the experimented mated females lived for an average periods 47.8, 27 and 15 days, respectively.

The total developmental periods from egg to adult were 40.8, 24.2 and 16.5 by rearing on 15, 25 and 35 ℃, respectively showing significant different between them.

The mean total progeny number of *Conomorium* adults resulted by an adult female during its life-span varied, in turn, with the associated temperature. These numbers were 142.3, 189.3 and 83 adults/ female by rearing at 15, 25 and 35 ℃, respectively. Generally, as shown in Table 3, the total numbers of resulting females dominated those of males (10.2, 16.5 and 7.9 males opposed to 132.1, 172.8 and 75.1 females at the three temperatures, respectively indicating the sex-ratios 1: 12.95, 1: 10.47 and 1: 9.5 (male: females).

From all the aforementioned data it is clear that 25 ℃ is the most favourable temperature for the activity of *Conomorium* sp. At this temperature, the mated females produced the highest number of total progeny (189.3 adults) among which 172.9 females (highest number) were also produced.

At the highest temperature (35 ℃), many of both of the host pupae and the internal parasitoid immature stages died and subsequently the total progeny/female was found to be reduced to 83 parasitoid adults/female. This observation of mortality due

to high temperature was also observed during rearing through the period of mid-July and August when many parasitoids failed to emerge through the host pupae.

Table 2. Host range of the parasitoid, *Conomorium* sp. Under laboratory conditions (Exposure period, 24 hours at 25 ± 2 ℃ and 65 ± 5 R. H.)

Host species	No. of exposed pupae	No. of parasitized pupae	% of parasitism
Sesamia cretica	50	22	44
Ostrinia nubilalis	50	0.00	0.00
Chilo agamemnon	50	0.00	0.00
Earis insulana	50	0.00	0.00
Pectinophora gossypiella	50	0.00	0.00
Agrotis ipsilon	50	18	36
Anagasta kuehniella	50	0.00	0.00
Spodoptera littoralis	50	1	2

9. Effect of different temperatures on pre, post and oviposition periods

The oviposition period of the experimental females varied with changing the rearing temperature; showing the similar trend of the female longevity. The shortest period (averaged 11days) was reported at 35 ℃. At the moderate temperature (25 ℃), the oviposition period was 19.4 days being significantly different from the shortest periods. At the lowest temperature (15 ℃), the oviposition period (36 days) was significantly, the highest, compared to the other two records, Table 3. The average preoviposition periods of the experimental females under the different temperatures ranged from 1.0 to 5.3 days, Table 4. Such periods were in respective, 5.3, 1.7 and 1 days by rearing on 15, 25 and 35 ℃, respectively showing significant difference between the moderate temperature and the lowest one, but this difference was insignificant between the moderate temperature and the highest one, Table 4. The postoviposition period varied insignificantly between 6.5 days at 15 ℃ and 6 days at 25 ℃. Such period, which recorded at 35 ℃ (2.2 days), was varied significantly compared to

the other two records.

Table 3. Effect of different rearing temperatures on the oviposition period, females longevity and total developmental period of *Conomorium* sp. reared on *S. cretica*.

Temp.	Longevity of adult female	Total developmental period from egg to adult	Progeny produced / female			Sex- ratio ♂ : ♀
			Total	Males	Females	
15	47.8 ± 1.58 (40 – 58)	40.8 ± 2.25 (40 – 42)	142.3 ± 22.24 (55 – 256)	10.2 ± 5.71 (4 – 22)	132.1 ± 22.02 (43 – 244)	1:12.95
25	27 ± 1.35 (22 -34)	24.2 ± 0.2 (23 – 26)	189.3 ± 32.64 (72 – 375)	16.5 ± 3.71 (5 – 24)	172.8 ± 28.78 (59 – 338)	1:10.47
35	15 ± 0.62 (12 – 17)	16.5 ± 0.25 (15.8 – 18)	83.0 ± 7.72 (62 – 130)	7.9 ± 1.16 (4 – 15)	75.1 ± 6.77 (57 – 115)	1:9.50
L.S.D.	2.99	0.69	52.45	5.64	48.15	

Table 4. Effect of different temperatures on the pre, post and oviposition period .

Properties	Average periods in days			L.S.D.
	15 °C	25 °C	35 °C	
Pre-oviposition	5.3 ± 0.40 (4 – 7)	1.7 ± 0.33 (1 – 4)	1 ± 0.00 (1)	0.72
Oviposition	36 ± 1.61 (29 – 43)	19.4 ± 1.28 (14 – 23)	11 ± 0.56 (9 – 13)	7.45
Post-oviposition	6.5 ± 0.88 (2 – 12)	6 ± 1.15 (2 – 10)	2.2 ± 0.13 (2 – 3)	3.5

10. Effect of mating on sex ratio in *Conomorium* sp.

As previously mentioned, by rearing at 25°C (the optimum temperature), most of progeny produced by mated females were females, and the sex-ratio was almost 10 females: 1 male. While, by allowing the virgin females to oviposit in *S. cretica* pupae, the deposited eggs hatched normally and the developing larvae transferred to pupae which developed to normal adults, but all were males. Thus, confirming that the species under study is a parthengenetic arrhenotokeous parasitoid.

11. Effect of the host species on the number of progeny, sex-ratio and life-cycle

Data obtained and recorded in Table 5 indicate shorter total developmental period by rearing on *S. cretica* pupae (16.81 days) than that recorded in case of rearing on *A. ipsilon* (17.44 days). The difference between the two periods was statistically significant. A parasitized *S. cretica* pupa produced an average of 19.06 (5 – 45) *Conomorium* adults, of which 16.93 adults were females and2.12 adults were males indicating a sex-ratio of 1male: 7.9 females. While, in case of rearing on *A. ipsilon*, the parasitized pupa produced an average of 22.31 (15 – 30) *Conomorium* sp. Adults, being more than that produced from a *S. cretica* pupa. But, from the adults emerged from *A. ipsilon* pupa, 18.37 were females and 3.93 males; i.e., a sex-ratio 1male: 4.67 females, Table, 5. Thus, confirming more percentage of females by rearing on *S. cretica* pupae. Although of higher percentage of females by rearing on *S. cretica* pupae, it is worth mentioning to indicate that during the present study, the parasitoid was reared on *A. ipsilon* pupae because of the much easier laboratory rearing on this host which led to obtaining more adults of the parasitoid.

12. Number of generations of *Conomorium* sp. per year in the laboratory

13 generations of *Conomorium* sp. could be obtained throughout one year by rearing it in the laboratory, for two years. The period of life-cycle was, mostly, a temperature dependent; i.e., generally shortened as the temperature increased. The longest life-cycle (46 days) occurred during December – February at mean temperature 15 ℃. & 55 % R.H., while the shortest life-cycle (16 days) was obtained during May-June at 27.5 ℃ & 60 % R.H.

Number of generations of the parasitoid in comparison to generations of the host in laboratory

According to El-Naggar (1967), Ismail (1968) and Kira *et al.*, (1974), *S. cretica* has five overlapping generations under laboratory conditions. However, *Conomorium* sp. has 13 annual generations at almost the same conditions. By comparing the life-cycle of the parasitoids with that of the host, the result seems to be in favor to the parasitoids since its life-cycle takes only (28 – 30) days compared to about 73 days for a

generation of the host at the same period. This host parasitoid relationship ratio seems to indicate that, there are 2 to 3 generations of the parasitoids for each generation of the host. Usually, such situation leads to a more considerable impact of the parasitoids in regulating the population of its host.

13. Effect of different types of supplementary food on the longevity of Conomorium sp. adults

Adult males and females were kept and supplied with either of bee-honey; bee-honey with 20% dried yeast, 50% sucrose solution or water droplets, or kept starved without nutrition at 30 ± 2 ℃ and 70 ± 5% R.H. As shown in Table 6, the longevity of both sexes was considerably short under the state of starvation and when water only was supplied.

Statistical analysis (F. test), in case of male, showed insignificant difference between male longevities when kept starved, or supplied with water or 50 % sucrose solution. Considering the L.S.D. values, the differences between longevities of adults fed on bee honey with 20 % dried yeast and those given honey only were significant and in the favor to the former.

In case of females, the statistical analysis showed insignificant difference between longevity of adult's fed on water (5.2 ±0.79) and those left without food (4.4 ± 0.18 days). The L.S.D. value showed that the longer life-spans (12.7 ± 0.77; 12.85 ± 0.94 and 9.2 ± 0.73 days) were recorded by feeding the adult females on 50 % sucrose solution, bee honey with 20 % dried yeast and bee honey. On the other hand, adult females which were left to deposit their eggs and fed on the heamolymph of their host manifested the longest life-span (17 ± 0.9 days) at the same temperature (30 ± 2 ℃& 70 ± 5 % R.H).

14. Cold storage of *Conomorium* sp. adults

Storage of the adult parasitoids is important to obtain the greatest numbers of parasitic adults at any required time much early before occurrence of the economic damage of the target insect pest.

Four laboratory experiments were carried out at 10 ℃ to study the effect of low temperature on adults of *Conomorium* sp. The parasitoid was reared on its factitious host pupae, *Agrotis ipsilon.* In all experiments and after each period of storage the parasitoid was mass-reared at 15 ℃. also, this study was conducted to determine the maximum period for which adults of the pteromalid could be stored.

Table 5. Effect of rearing the parasitoid on two different host species on the number of progeny, sex ratio and total developmental period (30 ℃± 2 & 70 ± 5% R.H.)

properties	Number of adults / pupa		t. value
	S. cretica	*Agrotis ipsilon*	
No. of emerged adults	19.06 ± 2.85 (5 – 45)	22.31 ± 1.29 (15- 30)	
No. of females	16..93 ± 2.71 (3 – 45)	18.37 ± 0.99 (12 – 24)	1.38
No. of males	2.12 ± 0.33 (0.0- 6)	3.93 ± 0.44 (1 -8)	0.7
Sex ratio (male: female)	1:7.9	1:4.67	
Total developmental period in days	16.81 ± 0.14 (16 -18)	17.44 ± 0.22 (16 -19)	2.41°

Table 6. Effect of different types of supplementary food on the longevity of *Conomorium* sp. adults (30 ± 2 and 70 ± 5% R.H.)

Treatment	Longevity of adults in days	
	Male	Female
Without nutrition	3.05± 0.14 (2 – 4)	4.4 ± 0.18 (3 – 5)
Water	3 ± 0.14 (2 – 4)	5.2 ± 0.79 (2 – 8)
50 % sucrose solution	3.6 ± 0.1 (2 – 4)	12.7 ± 0.77 (6 -17)
bee honey	4.25 ± 0.35	9.2 ± 0.73 (5 – 15)
bee honey with 20 % dried yeast	6.55 ± 0.68 (3 – 9)	12.85 ± 0.94 (2 – 16)
50 % sucrose for 2 days and then host fluid (female only)	———	17.45 ± 1.06 (7 – 24)
L.S.D.	0.64	4.14

a. Effect of cold storage on mortality rates among *Conomorium* sp. adults: Adults of the pteromalid *Conomorium* sp. were stored at 10 ℃ for 9 different periods (from 20 to 100 days). At each period of storage, a number of 50 males and females were used. Data in Table 7 indicated that among the stored adults, the mortali-

ty percentage increased with the lengthening of the period of storage. The lowest mortality rates (10 and 8 % for females and males, respectively) occurred when adults were stored for 20 days. These percentages increased, successively, by lengthening the storage period until reached the highest mortality rates by storage for 100 days (82 and 92 %, respectively, Table 7.

From data in Table 7, it could be, generally, observed that the mortality rates, at all periods of storage (except for 20 days), were lower among females than males, indicating that females could resist cold storage more than males. Also, storage of adults for one month may be considered safe as in this case about 27 % of the stored adults died, while the remaining adults did not. By lengthening the storage period to 40 days, about 49 % of adults died. While, storage of adults for longer periods led to mortality of most of the stored parasitoids.

b. Effect of different periods of storage at 10 °C on the fertility of *Conomorium* sp. males: *Conomorium* sp. males were stored for 25, 35 and 45 days and then allowed to mate with freshly emerged females and the resulted progenies were counted and sexed.

Data presented in Table 8, indicated that, on the contrary of females, which were able, to resist storage at 10 °C for a period extended to 3 months, male's fertility was, greatly, affected due to cold storage. Conservation of males at 10 °C for 25 days may be considered the longest safe period as the progeny / female mated by a stored male consisted of average of 14.5 males and 106.4 females indicating a sex-ratio of 1: 7.3 opposed to 1: 12.7 in case of progeny from a control female. While, cold storage of males for longer periods caused detrimental effect on the fertility of males, as the cold storage for 35 days led to a sex-ratio of 1 male: 0.2 female and by male's storage for 35 days then mating with fresh females, no females were produced and all the progeny consisted of males.

c. Effect of cold storage at 10 °C for different periods on mated females of *Conomorium* sp.: In this experiment the effect of cold storage was measured for 30, 60, 90 and 120 days at 10 °C on adult females emerged from *A. ipsilon*. Data obtained in Table 9 indicated that the experimented mated females lived for the respective periods 36, 38, 36.1 and 25.2 days at 10 °C. Longevity recorded for

the 30, 60 and 90 days of storage, varied insignificantly between them and induced 19.64, 14.29 and 19.41 % reduction in the longevity of adults than control.

Table 7. Rate of mortality among *Conomorium* sp. adults stored for different periods at 10 °C (Data from 50 adults of each sex at each period)

Period of storage	Females		Males	
	Mortality		Mortality	
	No	%	No	%
20	5	10	4	8
30	13	26	14	28
40	23	46	26	52
50	30	60	34	68
60	31	62	36	72
70	34	68	39	78
80	37	74	43	86
90	39	78	45	90
100	41	82	46	92

Table 8. Effect of storage of *Conomorium* sp. males at 10 °C, then mating with fresh females on number of resultant progeny and sex-ratio.

Period of storage (days)	Number of		% reduction in females	Sex-ratio ♂ : ♀
	Males	Females		
Control	10.2 ± 5.71(4- 22)	129.1± 22.02(58- 244)	.....	1:12.65
25	14.5 ± 4.68(12- 21)	106.4± 11.02(60-140)	17.58	1:7.3
35	150.2 ± 41(20- 319)	29.3± 10.54(44- 103)	77.88	1:0.2
45	206.4 ±17.87(146-266)	0.00	100	1:0.00
L.S.D.	51.39	31.18		

While, those of 120 days found to be varied significantly from the other three recorded and control. The means in number of adults resulted per a mated female after different periods of storage and until mortality were 101.3, 83, 75.1 and 72.2 adults / female stored for 30, 60, 90 and 120 days, respectively opposed to 142.5 adults / a control female, Table 9. Thus, indicating 28.91, 41.75, 47.3 and 49.33 % re-

ductions in the number of progeny than control, respectively. Among the adults produced from different storage periods, 91.6, 74.5, 67.1 and 63.7 adult females, respectively showing the sex-ratios 1: 9.4, 1: 8.8, 1: 8.4 and 1: 7.5 (male: females), respectively, Table 9.

While, those of 120 days found to be varied significantly from the other three recorded and control. The means in number of adults resulted per a mated female after different periods of storage and until mortality were 101.3, 83, 75.1 and 72.2 adults / female stored for 30, 60, 90 and 120 days, respectively opposed to 142.5 adults / a control female, Table 9. Thus, indicating 28.91, 41.75, 47.3 and 49.33 % reductions in the number of progeny than control, respectively. Among the adults produced from different storage periods, 91.6, 74.5, 67.1 and 63.7 adult females, respectively showing the sex-ratios 1: 9.4, 1: 8.8, 1: 8.4 and 1: 7.5 (male: females), respectively, Table 9. While, inspection of the progeny produced by a control female showed 129.1 females indicating a sex-ratio of 1: 9.6. These data indicated that long term cold storage led to significant reduction in the total number of resultant progeny / female, on one hand and increasing the percentage of males in the progeny, on the other hand.

d. Effect of cold storage for different periods on *Conomorium* sp. virgin females : virgin *Conomorium* sp. females were stored at 10 ℃ for the same periods as that occurred with mated ones. After the storage period, females were allowed to copulate with newly hatched male. Data obtained in Table 11 shows that different length of stored had effect on the longevity of adult's females. It could be note varied significant for the longevity of adult females stored for 30 days from those stored for 60, 90 and 120 days. Also, insignificant found between the longevity of adult females stored for 30 and 90 days. On the other hand, the lowest longevity averaged (27 ± 0.89) days which recorded for 120 days being significantly within the first three treatment checked. The different length of periods storage induced percentages reduction in the longevity by 16.81, 7,42, 18.55 and 41.05 % respectively. Results showed that after storage for 30, 60, 90 and 120 days, an adult female produced an averages 102.5, 86, 80.1 and 69.7 parasitoid adults, respectively opposed to 145.5 adults resulted / a control female, Table 10, thus showing 28.3, 40.8, 45.6 and 53 % reductions in the total progeny / female due to cold storage, respectively. These re-

duction percentages increased by the increase in the storage period. While, the sex-ratio among adults resulted from stored females were almost not affected by the storage period as those ranged from 1: 9 to 1:10 opposed to 1: 12 (male: females) in case of progeny from control females, Table 10. In all cases, the dominance of females in the progeny was confirmed.

Conclusion: from all the aforementioned data, it could be concluded that 90 days period of storage may be considered the maximum favorable period of storage for the virgin females. At this period, the female lived for 37.3 days during which it produced 80.1 adults from which 73 ± 8.28 adults were females. It could be generally concluded that mating of females before or after storage did not affect, greatly, the reproductivity of the stored females, Tables 9 & 10. Gautam (1986) studied the influence of cold storage on the adult parasitoid *Telenomus remus*. The author found that males of the parasitoid did not survive beyond 3 and 4 days of storage at 5 and 10 ℃, respectively. The females survived up to 7 days at both temperatures and parasitized 27.3 % of the host eggs at 5 ℃ and 24.2 % at 10 ℃ on the 7^{th} day. Both sexes could be stored up to 3 days at both temperatures without any detrimental effects on their own or their progeny, fecundity or longevity. Jalali *et al.*, (1990) studied the effect of low temperatures on the survival of *Cotesia morginventris* (braconidae). One day old mated adults were stored at 10 ℃ for 30 and 40 days. The mortalities of adult females were 2, 13, 59.3 and 100 % when stored for 10, 20, 30 and 40 days, respectively. Males were more susceptible to low temperatures than females. El-saied (1992), indicated that the adults of *Bracon brevicornis* could be stored for up to 18 weeks at 4 ℃ and l: d 8: 16 photoperiod and feeding them on 20 % honey without adverse effects on their survival or fecundity.

Table 9. Longevity, number of adults and sex-ratio of progeny resulted for mated females of *Conomorium* sp. stored for different periods at 10 ℃.

Period of storage (days)	Longevity		Progeny resulted / female				Sex-ratio
	Days	% reduction than control	Adults	% reduction than control	Females	Males	
Control	44.8 ± 2.37(26-50)	.....	142.5 ±22.15 (55-256)	.....	129.1 ± 22.02 (58-244)	13.4 ± 3.07 (4-36)	1:9.6
30	36 ± 3.46 (22-44)	19.64	101.3 ± 9.03(68-140)	28.91	91.6 ± 7.36 (66-133)	9.7 ± 2.63 (2-22)	1:9.4
60	38 ± 2.32 (26-51)	14.29	83 ± 7.72 (61-130)	41.75	74.5 ± 6.34 (55-110)	8.5 ± 1.67 (5-20)	1:8.8
90	36.1 ± 1.66 (27-44)	19.41	75.1 ± 5.65 (56-96)	47.3	67.1 ± 4.82(38-84)	8 ± 0.92 (4-12)	1:8.4
120	25.2 ± 0.99 (21-29)	43.75	72.2 ± 9.31 (23-101)	49.33	63.7 ± 8.61 (20- 105)	8.5 ± 1.35 (3-18)	1:7.5
L.S.D.	5.38		26.35		15.68	4.9	

Table 10. Longevity, number of adults per female and sex-ratio of progeny form virgin females of *Conomorium* sp. stored for different periods at 10 ℃. then mated by newly hatched males.

Period of storage (days)	Longevity		Progeny resulted / female				Sex-ratio
	Days	% reduction than control	Adults	% reduction than control	Females	Males	
Control	45.8 ±2.19 (30-48)	.....	145.5 ±22 (62-262)	.....	134.3 ± 20.6 (56-248)	11.2 ± 1.82 (4-22)	1:11.99
30	38.1 ±3.13 (25-57)	16.81	102.5 ± 20.67(10-201)	28.31	94.2 ± 19.39 (8-187)	8.3 ±1.37 (2-14)	1:11.34
60	42.4 ± 2.32 (26-46)	7.42	86 ± 13.99 (40-171)	40.82	78.4 ±12.96 (44-131)	7.9 ± 1.17 (3-14)	1:9.92
90	37.3 ± 1.8 (30-44)	18.55	80.1 ± 8.81 (43-116)	45.57	73 ± 8.38 (35-101)	7.1 ± 0.56 (5-10)	1:10.28
120	27 ± 0.89 (25-32)	41.05	69.7 ± 8.96 (41-121)	52.09	63.5 ± 8.32 (40-110)	6.2 ± 1.03 (2-11)	1:10.24
L.S.D.	5.1		36.76		34.43	2.93	

REFERENCES

1. El-Naggar, S. E. H. 1967. Studies on corn borers and their biological control. M. Sc. Thesis Fac. of Agric., Assiut Uniiv.

2. El-Saied, M. A. 1992. Biological and ecological studies on certain parasitoids of corn borers. Ph. D. Thesis, Fac. of Agric. Ain-Shamis Univ.

3. Gautam, R.D. 1986. Effect of cold storage on the adult parasitoid *Telenomus remus* Nixon (Scelionidae: Hymenoptera) and the parasitized eggs of *Spodoptera litura* (Fabr.) (Noctuidae: Lepidoptera). J. Entomol. Res. 10 (2): 125- 131.

4. Gesraha, M. A. M. 1993. Ecological and biological studies on the Hymenopterous parasitoid *Meteours* spp. (Braconidae: Hymenoptera). Ph. D. Thesis, Fac. of Agric., Cairo Univ.

5. Ismail, I. I. 1968. Studies of ecology and control of corn borer in Giza region. Ph. D. Thesis, Fac. of Agric., Cairo Univ.

6. Jalali, S. K., S. P. Singh, C. R. Ballal and P. Kumar. 1990. Response of *Cotesia marginiventris* (Cresson) (Hymenoptera: Braconidae) to low temperature in relation to its biotic potential. Entomon 15 (3-4) 217 -220.

7. Kira, M. T., I. I. Ismail and A. K. Azab. 1974. Determination of the number of the annual generations of the pink borer *Sesamia cretica* Led. in Giza region, Egypt. Bull. Fac. of Agric. 25 (1) 87 -83.

8. Yacoub, S. S. 1999. Non-chemical control methods for reducing the losses due to the corn stalk borer, *Sesamia cretica* Led. M. Sc. Thesis, Fac., of Agric. Moshtohor Zagazig Univ.

دراسات مرفولوجية وبيولوجية على الطفيل *CONOMORIUM* SP. (غشائى الاجنحة) على عذارى دودة القصب الكبيرة

فوزى فائق شلبى[1] ، عصمت عبد الملك كارس[2] ،
عادل عبد الحميد حافظ[1] ، جورج حلمى عبيد[2]

١ *كلية الزراعة بمشتهر – فرع بنها جامعة الزقازيق*
٢ *معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – الجيزة*

يعتبر الطفيل *Conomorium* sp. احد الطفيليات الهامة الذى يهاجم عذارى دودة القصب الكبيرة فى حقول الذرة المصرية. والبحث الحالى يهدف الى دراسة بيولوجية الاطوار غير الكاملة وكذلك طور الحشرة الكاملة عندما يتطفل على عذارى دودة القصب الكبيرة- كما يتناول البحث ايضا دراسة النواحى المرفولوجية الرئيسية لكل طور من هذة الاطوار ووصفة بالتفصيل وذلك بغرض تسهيل تعريف هذا النوع وعدم الخلط بينة وبين الانواع الاخرى من نفس جنسة والتى تتشابه معة.

اوضحت الدراسة ان الطفيل *Conomorium* sp. هو طفيل جماعى داخلى وان متوسط مدة حضانة البيضة يبلغ ١,٧٥ ± ٠,٢٥ يوماً وذلك على درجة حرارة ٢٥ م ورطوبة نسبية ٦٥ ± ٥ ٪ - بلغ متوسط طول مدة الطور اليرقى الذى يضم اربعة اعمار ٢,٢٥ ± ٠,٢٥، ٣,٥ ± ٠,٢٠، ٣,٧٥ ± ٠,٢٠، ٤ ± ٠,١٨ يوماً على التوالى بينما كانت لطور قبل العذراء والعذراء ١,١٣ ± ٠,١٢، ٨,٥ ± ٠,٢٣ يوماً على التوالى.

اوضحت الدراسة ايضا الفروق المرفولوجية المميزة لكل من ذكور واناث هذا الطفيل كما تضمنت تقديم وصف لعملية خروج الحشرة الكاملة من عذراء العائل ولعمليتى التزاوج ووضع البيض- وعند تعريض الطفيل لانواع مختلفة من عذارى رتبة حرشفية الاجنحة فى المعمل وجد انة يتطفل على عذارى دودة القصب الكبيرة والدودة القارضة- وقد ربى هذا الطفيل فى المعمل على درجات حرارة مختلفة ووجد ان الظروف المثلى للتربية هى ٢٥ م ورطوبة نسبية ٦٥ ± ٥ ٪ حيث بلغ متوسط طول حياة انثى الطفيل ٢٧ يوماً وان متوسط عدد الافراد التى تخرج من عذراء واحدة من دودة القصب الكبيرة ١٨٩,٣ وبنسبة جنسية ١ : ١٠,٤٧ ذكر لكل انثى- وجد ان انثى الطفيل يمكنها وضع بيضا بكريا الا ان النسل الناتج من هذا البيض يكون كلة ذكور حيث لا تؤثر عملية التزاوج على نشاط وضع البيض او على تعداد البيض الموضوع كما لا تؤثر على متوسط طول حياة الحشرة الكاملة- كما اوضحت التربية المعملية ايضا وجود ١٣ جيل لهذا الطفيل فى السنة - اختبر ايضا افضل انواع التغذية التى يمكن تربية الحشرات الكاملة للطفيل عليها وتأثير تلك الانواع على طول عمر الحشرة الكاملة (ذكور واناث).

اما عن الدراسات التى اجريت على تخزين الحشرات الكاملة للطفيل على درجة ١٠ م فكان الهدف الاساسى منها الوصول الى اطول فترة تخزين لتلك الحشرات دون ان تتأثر حيويتها بهدف استخدامها فى المكافحة وذلك بالحصول على اعداد كبيرة من الطفيل فى وقت مبكر لاطلاقها قبل حدوث ضرر اقتصادى لافة دودة القصب الكبيرة- حيث اوضحت نتائج تلك الدراسة ان نسبة الموت بين ذكور الحشرات الكاملة للطفيل كانت اعلى من نظيرتها فى الاناث عند فترات التخزين المختلفة- مما يوضح ان اناث هذا الطفيل اكثر تحملا للتخزين على درجات الحرارة المنخفضة عن الذكور- كما ان الذكور فقدت حيويتها بعد التخزين لاكثر من ٢٥ يوماً - اوضحت الدراسات انة يمكن تخزين اناث الطقيل الملقحة او غير الملقحة لمدة ٩٠ يوماً دون ان تتأثر حيويتها.