

MORPHOLOGICAL AND BIOLOGICAL OBSERVATIONS ON THE APHID PARASITOID *LYSIPHLEBUS FABARUM* MARCHALL (HYMENOPTERA: BRACONIDAE)

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Abstract

The cowpea aphid, *Aphis craccivora* Koch. is the most common species attacks leguminous crops in Egypt. Among the parasitoid species which attack *A. craccivora* on faba bean was the braconid parasitoid, *Lysiphlebus fabarum* Marchall. Morphological and biological studies on the parasitoid species were conducted under the laboratory conditions, 20°C and 70% R.H. Egg, larva, pupa and adult of the parasitoid were described. Biological studies included duration of immature stages, emergence process of the parasitoid adult, mating behavior, egg-laying process, adult longevity and sex ratio. Duration of *L. fabarum* immature stages averaged 0.4 ± 0.03 , 5.2 ± 0.2 and 4.1 ± 0.1 days under laboratory conditions for the incubation period, larval and pupal periods, respectively. Adult longevity lasted 1.9 ± 0.1 and 4.1 ± 0.2 days for male and female, respectively. Sex ratio was estimated as 1:2.8 ♂:♀ under the laboratory conditions.

Key Words: *Lysiphlebus fabarum*, *Aphis craccivora*, Faba bean, Biology.

INTRODUCTION

In Egypt the cowpea, aphid, *Aphis craccivora* Koch., is the most common species on leguminous crops including cowpea, bean, lentil and broad bean. Little work has been done on the natural enemies of this aphid in Egypt, (Bishara *et al.*, 1984 and Attia *et al.*, 1986). Salim *et al.* (1987) reported that the highest percentage of parasitism recorded on *A. craccivora* was 5 % by *Lysiphlebus fabarum*. Abdel Samad (1996) recorded four parasitoid species namely; *Lysiphlebus fabarum* Marchall, *Aphidius matriariae* Haliday, *Trioxys angelica* Hal. and *Chalcid* sp., parasitizing upon the cowpea aphid on faba bean in nature. *L. fabarum* was the most common.

The biology of *L. fabarum* was studied by Devletshina and Gomolitskaya (1975) in Uzbekistan, El-Heneidy (1981) in Germany, Marullo (1987), and Jarry and Tremblay (1989) in Italy. This study focuses on certain morphological and biological characteristics of *L. fabarum* when reared under laboratory conditions on *A. craccivora*.

MATERIALS AND METHODS

A pure culture of *A.craccivora* was established by cultivating faba bean seeds in pots, left till germination and then covered with muslin cages (75 x 50 x 50 cm). Faba bean plants heavily infested with aphids were collected from the fields and transferred to the laboratory for infesting the seedlings in the pots as well for obtaining parasitoid adults. Infested samples were placed in glass jars covered with muslin and kept under observation until parasitoid emergence. Emerged parasitoid adults were collected daily and transferred to similar glass jars supplied with droplets of honey. Specimens from the emerged parasitoid species were separated and preserved in 70% alcohol. Identification was made by Prof. P. Stary, Institute of Entomology, Academy of Science, Czech Republic. *L.fabarum* adults were isolated by the use of an aspirator and then sexed. The parasitoid was allowed to parasitize healthy individuals of *A.craccivora* by exposing aphid nymphs to pairs of the parasitoid in glass tubes (7.5 x 2.5 cm) for 24 hours. Parasitized aphids were replaced by newly ones every 24 hours until death of the parasitoid females.

Certain morphological characters were described by dissecting the parasitized aphids. Immature stages of *L.fabarum* were mounted in glycerin jelly medium on glass slides for internal systems. Specimens were left for two hours under room temperature to get dry and to be ready for microscopic examination. (Hodoges 1952). Certain biological characteristics including life span, duration of immature stages, longevity of adults, sex ratio and mating and ovipositional behavior of the parasitoid individuals were studied under laboratory conditions of 20°C and 70% R.H. Obtained data were statistically analyzed.

RESULTS AND DISCUSSION

1. Morphological Characters of the Different Stages of *L.fabarum*

Egg Stage

Ovarian Egg: Oval (elliptical) in shape with the anterior end broader than the caudal end and measures at its widest part 84 ± 5 and 30μ .

Deposited Egg: The chorion is thin, transparent and colourless. As development proceeds, the embryo renders easily detected inside the egg through the translucent chorion with its head and caudal evagination. Deposited eggs were considerably larger than ovarian eggs with average measurements $560 \pm 10 \mu$ in length and 190μ in width.

Larval Stage

Due to the difficulty of discerning exuviate skins of the different larval instars of the internal parasitoids, they are determined by morphological changes such as the length and width of mandibles and head capsules as well as the size and shape of the body. Three larval instars of *L.fabarum* were detected.

1st Larval Instar: Newly hatched larva is colourless and translucent. Mandibles measured $74 \pm 3 \mu$ in length and head capsule 146 ± 5 and $157 \pm 6 \mu$ in length and width, respectively. The body measured 594 ± 13 and $188 \pm 5 \mu$ in length and width, respectively.

2nd Larval Instar: Body segmentation and alimentary canal are easily distinguished. Mandibles measured 210 ± 5 and $130 \pm 7 \mu$ in length width, respectively. The head capsule reached 283 ± 6 and $298 \pm 6 \mu$ in length and width, respectively. The body measured 1244 ± 26 and $330 \pm 7 \mu$ in length and width, respectively. The percentage of body growth between the 2nd and the 1st instars was 27.3 and 22.4% for length and width, respectively.

3rd Larval Instar: The body is darker in colour and midgut is clear and occupied most of the larval body. Segmentation and mouthparts were evident. Mandibles measured 285 ± 6 and $214 \pm 8 \mu$ in length and width, respectively. The head capsule reached 416 ± 18 and $480 \pm 25 \mu$ in length and width, respectively. The body measured 2054 ± 69 and $560 \pm 20 \mu$ length and width, respectively. The percentage of body growth between the 3rd and the 2nd instars was 39.4 and 49.2% for length and width, respectively.

Pupal Stage

Prepupal stage: Dark yellow in colour. The anal visical is more obvious than the cephalic part inside the last larval ecdysis. Length and width of the prepupal body averaged 1607 ± 73 and $590 \pm 30 \mu$, respectively.

Pupa: Exarate, dark yellow with reddish-brown eyes. By the end of the stage, the body changes completely to dark beginning from the head, antennae then thorax and abdomen. Legs and wings are light dark and heavily sclerotized. The pupa measured 1733 ± 86 and $525 \pm 45 \mu$ in length and width, respectively.

Adult Stage

The differences in the measurements of several parts of the body of the two sexes of the parasitoid are slight. Males are slightly longer than the females (maximum body length 2160 ± 20 and 2100 ± 50 μ , respectively). Females are recognized by their ovipositors and by the number of antennae segments. Flagellum is composed of 10 segments in females and 11 in males, Fig. 1.

2. Biological Data

Observations under constant laboratory conditions of 20°C and 70% R.H. indicated the following:

Table 1. Average duration of different immature stages of *Lysiphlebus fabarum* under laboratory conditions of 20°C and 70% R.H.

Stage	Average duration (days)
Incubation period	0.4 ± 0.03
Larval stage	
1st larval instar	1.0 ± 0.02
2nd larval instar	1.2 ± 0.1
3rd larval instar	3.0 ± 0.1
Total larval stage	5.2 ± 0.2
Pupal stage	
Prepupal period	1.0 ± 0.02
Pupal period	4.1 ± 0.1
Total development period	10.8 ± 0.2

Duration of Immature Stages

Incubation period was estimated by the dissection of parasitized aphids after successive periods (hours) from egg deposition until hatching. Incubation period lasted for an average of 0.4 ± 0.03 day. El-Heneidy (1981) stated that the incubation period of *L. fabarum* at 22°C and 40% R.H. was 1.25 ± 0.06 days.

Larval instars lasted for average periods of 1.0 ± 0.02 , 1.2 ± 0.1 and 3 ± 0.1 days for the 1st, 2nd and 3rd instars, respectively with a total larval period of 5.2 ± 0.2 days. El-Heneidy (1981) mentioned that the 1st, 2nd and 3rd larval instars lasted 1.15 ± 0.05 , 1.55 ± 0.12 and 1.75 ± 0.13 days.

Prepupal and the pupal duration averages were 1.0 ± 0.02 and 4.1 ± 0.1 days, respectively. Data are in agreement with the findings of El-Heneidy (1981) for prepupal period and disagreement with them for the pupal period.

The total developmental stages of *L.fabarum* (from egg deposition until adult emergence) averaged 10.8 ± 0.2 days.

Adult Stage

Emergence

L.fabarum is a solitary endo-parasitoid with only a single adult emerging from every single host individual.

Upon reaching adulthood, emerged adults tear mummies' skin with their mandibles to make a round emergence hole near the posterior end of the abdominal tergites of the host. The adult pushes itself directly towards the emergence hole with assistance of its legs. This process lasts few minutes. Emerged adults usually rest for a while then start to move.

Mating Behavior

Pre-mating period

Adults were sexed soon after emergence and each couple was introduced into a glass vial, provided with honey and/or water. Each vial was considered as replicate. Frequent observations indicated that virgin females and males copulated for the first time after a period of 115-260 minutes, with an average of 178 ± 23.9 minutes.

Mating Process

Through continuous observations, it was found that both sexes remained quiet for 1-3 minutes, then they began to get excited and moved quickly and vigorously toward each other. However, males were rather aggressive. Then the two adults touched each other by antennae more than once but without pairing. Later on, the male mounted on the body of the female and held it by its legs. Afterwards, the male contacted the female with its genitalia by bending tip of the abdomen ventrally and anteriorly to insert the intermittent organ into the female genitalia. During mating process, antennae of the two sexes were in touch. Wings of the female were folded in normal position

upon its body, while those of the male were directed up. After copulation the male dislodged the female's body. Mating process lasted for 14-25 seconds with an average of 17.8 ± 2.27 seconds when fed on honey.

Number of copulations/female

After emergence, adults were sexed and one male was introduced to 10 females in each vial. Vials were provided with honey to serve as food. A male mated an average of 2.7 females. Observations showed that females are monogamous, while males are polygamous.

Egg-laying Process

Pre-ovipositional Period: The type of food affected the pre-ovipositional period. Shortest period 20-47 min., with an average of 34.2 ± 4.8 minutes occurred when females were fed on a solution of honey and water and ranged 49-65 mi. with an average of 57.8 ± 2.9 minutes, when they were offered water only.

Ovipositional Period: Mated females showed active movements towards its host. The female started waving its antennae, examining the host body and then drawing itself close to it. Aphids usually try to defend themselves against the parasitoid's attack by elevating their abdomina upwards and moving them in cycling waves. The parasitoid female started to sting the host by twisting its abdomen anteriorly between its hind legs with the ovipositor lying at right angle with the host's body. Constantly, the host was stung in the dorsal side of its abdominal segments. The parasitoid female repeated its trials several times to ensure laying eggs. Sting process elapsed 6-13 seconds with an average of 8.6 ± 0.7 seconds.

Egg deposition process required an average period of 98 ± 2.2 seconds (60-120). *L.fabarum* females were able to recognize parasitized aphids from unparasitized ones. Total period from emergence until successful oviposition of the female lasted for 217.27 minutes.

Adult Longevity

Adult longevity of *L.fabarum* was estimated by confining newly emergd adults in glass vials (12x14 cm). Vials were divided into two groups; one fed on honey and the other without food. Longevity of both sexes was increased when honey was offered as food. Longevity of males reached 1.9 ± 0.1 days (1.4-2.2 days) and 1.3 ± 0.1 days (1.2-1.8 days) with and without honey, respectively. Longevity of females lasted 4.1 ± 0.2

days (3.3-4.7 days) and 2.0 ± 0.2 days (1.6-2.5 days) with honey and without honey, respectively. Statistical analyses showed a significant difference between the two groups for both sexes.

Sex Ratio

250 parasitoid adults emerged out of which were 184 and 66 were females and males, respectively with a sex ratio of 2.8: 1. For field samples, this ratio was estimated as 3:1 females to males. Statistical analyses revealed that no significant difference in sex ratio in nature and in the laboratory.

Previous results seem to agree with Marullo (1987) who stated that the mating period lasted about 18.8 seconds, ovipositional period exceeded one minute and sex ratio was 2.87: 1 in nature for the favor of females.

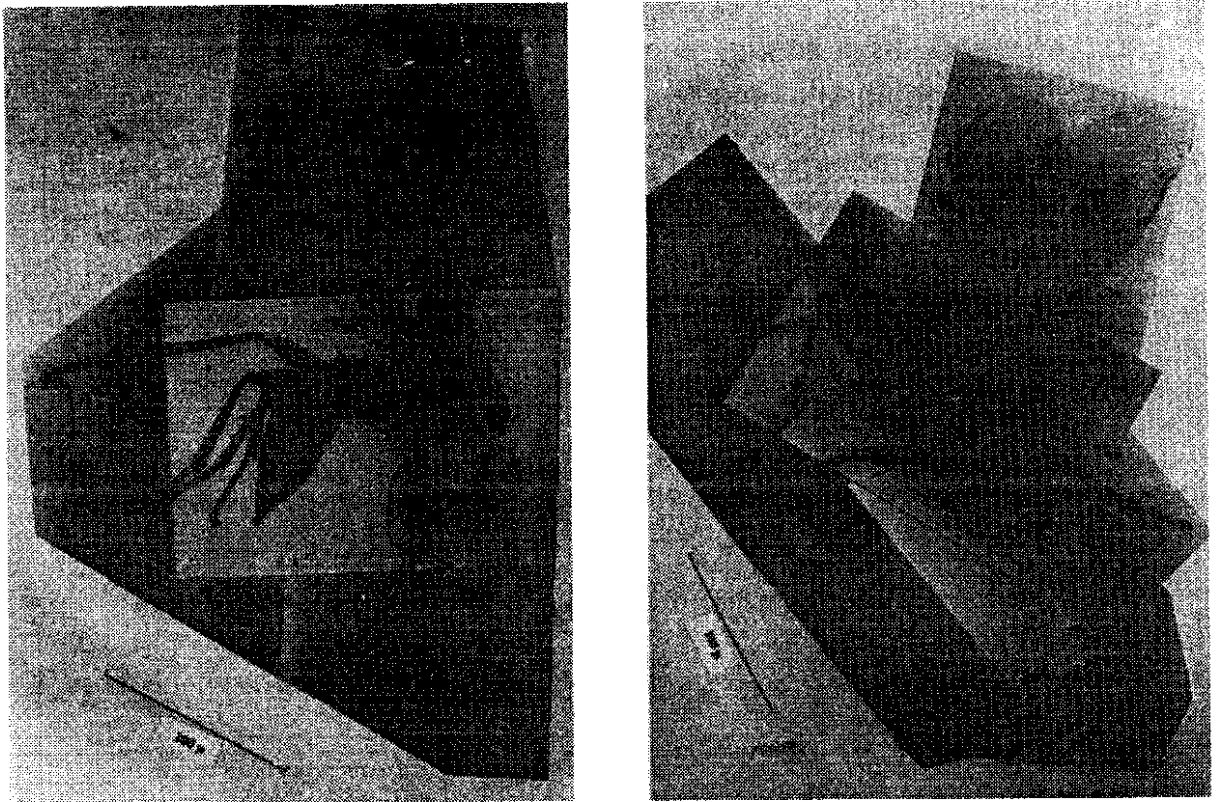


Fig. 1. Male (A) and Female (B) of *Lysiphlebus fabarum*.

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ملاحظات مورفولوجية وبيولوجية علي طفيل المن
LYSIPHLEBUS FABARUM MARCH.
 (HYMENOPTERA: BRACONIDAE)

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من البسلة. *Aphis craccivora* Koch. من أهم أنواع المن التي تهاجم المحاصيل البقولية في مصر، ومن بين الطفيليات الهامة التي تتطفل عليه خاصة في حقول الفول البلدي الطفيل *Lysiphlebus fab-* *arum* Marchall من عائلة Braconidae ورتبة غشائية الأجنحة. درست بعض الصفات المورفولوجية لهذا الطفيل وأخذت بعض الملاحظات البيولوجية تحت الظروف المعملية الثابتة ٢٠ درجة مئوية و ٧٠٪ رطوبة نسبية.

وقد بلغت متوسطات مدد عمر الأطوار غير الكاملة للطفيل 0.3 ± 0.6 و 0.2 ± 0.2 و 0.1 ± 0.1 يوما لفترة حضانة البيض، والطور اليرقي، و طور العذراء علي التوالي، كما بلغت متوسطات فترة حياة الحشرة الكاملة 0.1 ± 0.9 و 0.2 ± 0.1 يوما للذكور والإناث علي التوالي، وقد رت النسبة الجنسية تحت الظروف المعملية ١ : ٨، ٢ ذكور : إناث.