BIOLOGY OF *APANTELES* SP. APARASITE OF THE AMERICAN COTTON BOLLWORM, *HELIOTHIS ARMIGERA* HB., IN EGYPT (HYMENOPTERA : BRACONIDAE)

By

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SUMMARY

The biology of the internal parasite, *Apanteles* sp. parasitising the larvae of the American bollworm, *Heliothis armigera* Hb. was studied under laboratory conditions of 27±2°C and 65±5% R.H. The duration of immature stages was determined. The incubation peried, total larval period, pre-pupal and pupal periods averaged about 1, 5.3, 1 and 4.8 days respectively. The total developmental period averaged 12.5 days. Mating occurs few hours after emergence of adults. Mating did not prove to affect fecundity. The mated female deposits about 27.2 eggs during its life-span which lasts 8.1 days. At the same conditions, longevity of males was only 6.7 days. The unmated female deposits 29.3 eggs during a life-span of 11.7 days. The maximum number of eggs laid by a mated female in one day was 17 eggs, whereas it was 9 eggs in case of unmated females.

The pre-oviposition, oviposition and post-oviposition periods of mated females averaged less than one day, 6.4 days and one day respectively. In case of unmated females, these periods were similar to mated females except for the oviposition period which was expanded to 10 days. Sex ratio in the field was about 1:1 while it was 1 ♀♀ : 4 ♂♂ in the laboratory, indicating the need for improving chances for more effective mating, since unmated females oviposit parthenogenetically and all produced progeny are males.

INTRODUCTION

A survey of the parasites attacking *Heliothis armigera* Hb. in Egypt was made during 1974 - 1976 (Megahed *et al*, 1977). The internal parasite, *Apanteles* sp. was included in the list of recorded parasites. Unidentified species of *Apanteles* were recorded on *H. armigera* in several countries in the world such as E. Africa (Russo, 1947) Uganda (Nyiira, 1970) and Bulgaria (Lever, 1941). Other indentified species of *Apanteles* were also recorded on *H. armigera*, e.g., *A. papilionis* Vier, *A flavipes* Cam. in Australia (wilkinson, 1929) ; *A. maculitarsis* Cam. in S. Africa (Parsons, 1940) ; *A marginiventris* Cress. in U.S.A. (Blanchi, 1946) and *A. kazak* Telenge in U.S.S.R. (Bogush, 1960).

The aim of this investigation is to study the biology of *Apanteles* sp, parasitising larvae of *H. armigera* in Egypt. Samples of this species were identified in the British Museum as *Apanteles* sp. (glumeratus group).

MATERIALS AND METHODS

In order to secure a large number of *Apanteles* sp., the following methods proved satisfactory for rearing the parasite and its host, *H. armigera* in the laboratory at 27 ± 2°Cand 65 ± 5% R.H.

Host rearing :

Moths *H. armigera* were confined for oviposition in glass chimneys, 17cm high and about 8cm in diameter, covered by cloth and placed on half petri-dishes. Inside the chimneys, pieces of tissue paper were fixed to the cover of the chimneys for oviposition. Within each chimney, the moths were provided with a piece of cotton wool soaked in 10% sugar or honey solution. Strips carrying eggs were transferred to breeding jars, 11 × 7cm. The newly hatched larvae were provided with a semi-synthetic diet (Shorey & Hale, 1965) until they reach the second instar. The larvae were then separated, kept individually in glass vials 7 × 2cm and provided with the same food until pupation. The pupae were placed in glass jars 11 × 7cm containing dry sterilized sand to a depth of 5cm. and covered with muslin cloth until emergence of adult moths.

Parasite rearing :

Adults of *Apanteles* sp. were obtained in the laboratory from parasitised larvae of *H. armigera*. Each couple of parasites was confind in a glass vial 12×4cm for mating. Small droplets of a mixture of honey and protein hydrolyzate were scattered on the vial's wall to serve as food.

The second instar larvae of *H. armigera* were introduced to each mated female for 24 hours after which the larvae were removed. Fresh larvae were then introduced and this process continued until the death of the parasite female. Each parasitised larvae was placed in a glass vial 7×2 cm stoppered with a piece of cotton wool. The larvae were provided with semi-synthetic diet until the mature parasite larvae came out of the host larvae and spinned their cocoons.

To ascertain the progress of the different developmental stages of the parasite, certain number of parasitised *H. armigera* larvae that were exposed to mated parasite females for one hour only were dissected at 12-hour intervals.

RESULTS AND DISCUSSIONS

Immature stages and their durations :

The duration of various immature stages of *Apanteles* sp. when parasitising *H. armigera* larvae are presented in table 1.

These data indicate that, at the conditions of the experiment, the incubation period averaged 25 hours, and the total larval period averaged 135.2 hours (about 5.6 days). The pre-pupal and pupal stages lasted 23.8 and 115.2 hours (about 4.8 days) on the average respectively. The total developmental period of the parasite averaged about 12.5 days.

TABLE 1.—**Duration of immature stages of *Apanteles* sp. at 27±2°C and 65±5% R.H. (Based on 30 individuals in each case)**

Stage	Duration in hours		
	Min.	Max.	Aver.
Egg Larva	24	27	25.0 ± 0.24
First larval instar	24	26	24.5 ± 0.27
Second larval instar	45	52	48.0 ± 0.49
Third larval instar	48	72	62.7 ± 0.53
Pre - pupa	19	26	23.8 ± 0.21
Pupa	72	168	115.2 ± 0.85
Total developmental period	252 (10.5 days)	371 (15.5 days)	299.2 ± 4.62 (12.5 ± 0.19days)

Prior to pupation, the mature larva of the parasite gnaws its way out through the integument of the host larva and pushes its head and body through the hole made by it. This hole is mostly situated in the posterior part of the host larva. The host larvae remain alive for some days (1 - 5 days) after issuance of the parasite larvae, but they cease feeding and remain still in their places until they finally die.

Few minutes after leaving the host larvae, the parasite larva begins to spin its cocoon.

Emergence :

When ready to emerge, the adult of *Apanteles* sp. pushes by the head capsule a preformed operculum located at the wide end of the cocoon, through which it makes its way out helped by movements of the legs. This process lasts about one hour. Few minutes after leaving the cocoon, the adult becomes dry, and then it starts moving actively before flying.

Mating :

The two sexes of *Apanteles* sp. could be differentiated during the imaginal stage, by the naked eye, by the evidence of the female ovipositor which appears clearly at the end of its abdomen.

Mating occurs few hours after emergence. The process lasts for a few seconds. The male is often quite attentive, while the female refuses

many attempts. However, the couple usually appear rather excited, moving quickly and vigorously. The female is usually perceived by the male only at a short distance of about 5mm. The couple may meet more than once and touch each other without pairing.

Oviposition :

Oviposition occurs mostly at day light. Upon emergence from the cocoon, the ovaries of the female parasite are packed with a number of developed eggs which could be deposited as soon as host larvae are provided. When ready to oviposit, the female attacks its host once she perceives it and stings it mostly laterally in the middle abdominal segments. However, eggs may be deposited also in any other body segments, but not in the head. The female parasite may sting a parasitised larva several times and therefore superparasitism occurs, but only one develop from one host larva. The maximum number of eggs found in a single parasitised larva was 9 eggs.

Oviposition activity of the mated and unmated parasite females and their longevity have been studied at 27 ± 2°C and 65 ± 5% R.H. (Table 2).

TABLE 2.—**Oviposition activity and longevity of mated and unmated females of** *Apanteles* **sp. parasitising larvae of** *H. armigera* **at** 27±2°C **and** 65± 5% **R.H. (Based on** 10 **females in each case)**

Oviposition activity & longevity	Mated females			Unmated females		
	Min.	Max.	Aver.	Min.	Max.	Aver.
Pre-oviposition period (days)	<1	<1	<1	<1	<1	<1
Oviposition Period (days)	3	10	6.4±0.75	8	13	10.0±1.58
Post-oviposition Period (days)	0.5	1.5	1.0±0.13	0.5	1.5	1.0±0.11
Longevity (days)	5	13	8.1±1.42	10	16	11.7±1.85
Total number of eggs/ Female	6	47	27.2±1.93	12	54	29.3±2.95

The data and observations collected during the experiments indicate the following :

1.—The pre-oviposoition, oviposition and post-oviposition periods average less than one day, 6.4 and 1.0 days respectively, for mated females, whereas they average less than one day, 10.0 and 1.0 days for unmated females. Mating does not seem to affect pre-and post-oviposition periods, but unmated females continue to oviposit for a longer period than mated ones.

2.—Mating does not affect the fecundity of females significantly. Total number of eggs deposited by female at the conditions of the experiments averaged 27.2 and 29.3 eggs in case of mated and unmated females respectively. However, both the minimum and maximum total numbers

of eggs deposited was considerably higher for unmated than for mated females.

3.—The maximum daily number of eggs deposited per female was 17 and 19 eggs in case of mated and unmated females respectively.

4.—Probably mating causes a reduction of the life-span of the females. At the conditions of the experiment, longevity of mated females averaged 8.1 days whereas that of unmated females averaged 11.7 days.

5.—In general, males live shorter than females. At the same above mentioned conditions, parasite males lived between 4 and 14 days and averaged 6.7 days.

6.—Unmated females deposit their eggs parthenogentically. Immature stages develop normally and all resulted adults are males.

Sex ratio :

The mean sex ratio of adults of *Apanteles* sp. emerged from samples collected from the field is 1 : 1. Under laboratory conditions, an average ratio of 1♀ : 4 ♂ was obtained. This indicates that the laboratory rearing conditions still stand for improvement, especially for securing more optimum conditions for achieving more effective mating process, since unmated females produce a whole progeny of males.

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دراسة بيولوجية على الطفيل *Apanteles* sp. الذى يتطفل على دودة اللوز الامريكية *Heliothis armigera* Hb. فى مصر

(Hymenoptera : Braconidae)

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اجريت دراسة بيولوجية على الطفيل *Apanteles* sp. ، وهو طفيل داخلى على دودة اللوز الامريكية *Heliothis armigera* Hb. وذلك فى المعمل على درجة حراره ٢٧ + ٢م ورطوبة نسبية ٥٦٪ ± ٥٪ . قدرت فترة حياة الاطوار غير الكاملة للطفيل حيث وجد أن متوسط كل من فترة حضانة البيض ، ومدة كل من الطور اليرقى وطور ما قبل العذراء والعذراء كان ١ر٣، ٥ر١، ٨ر٤ يوما تقريبا على التوالى . وكان متوسط فترة حياة الاطوار غير الكاملة للطفيل ٥ر١٢ يوما. يحدث التزاوج بعد ساعات قليلة من خروج الحشرات الكاملة ولكن ليس للتزاوج تأثير على الكفاءة التناسلية للانثى . تضع الانثى الملقحة حوالى ٢ر٢٧ بيضة خلال مدة حياتها التى تبلغ ١ر٨ يوما . بينما تبلغ مدة حياة الذكر تحت نفس الظروف ٦ر٧ يوما فقط . اما للانثى غير الملحقة فان متوسط ماتضعة من البيض هو ٣ر ٢٩ بيضة خلال مدة حياتها التى تبلغ ٧ر١١ يوما . وقد وصل اقصى عدد من البيض الذى يمكن ان تضعة الانثى الملقحة فى اليوم الواحد الى ١٧ بيضة بينما العدد الاقصى للانثى غير الملقحة هو ٩ بيضات فقط. اما فترة ما قبل وضع البيض وفترة وضع البيض وفترة مابعد وضع البيض فكان متوسطها على التوالى اقل من يوم ، ٤ر٦ يوما يوما واحدا فى حالة الانثى الملقحة وهذا يماثل الانثى غير الملقحة الا ان فترة وضع البيض فى هذه الحالة الاخيرة تطول الى ١٠ ايام . كانت النسبة الجنسية للطفيل فى الطبيعة ١:١ بينما تبلغ هذه النسبة فى المعمل ٤ ذكر: ١ انثى وهذا يشير الى ضرورة تهيئة ظروف افضل لاتمام تزاوج الطفيليات تحت الظروف المعملية حيث ان الاناث غير الملقحة تنتج ذرية كلها من الذكور .