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

By
M.S.I. El-Dakrouy M.S.T. Abbas, A.H. El-Heneidy
Parasite Laboratory, Plant Protection Research Institute, Agricultural Research Centre, Ministry of Agriculture

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 period, 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 (Nyira, 1970) and Bulgaria (Lever, 1941). Other unidentified species of Apanteles were also recorded on H. armigera, e.g., A. papillontis 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°C and 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 confined 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 larva was placed in a glass vial 7 × 2cm 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 spun 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)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Duration in hours</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>Egg Larva</td>
<td>24</td>
<td>27</td>
</tr>
<tr>
<td>First larval instar</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>Second larval instar</td>
<td>45</td>
<td>52</td>
</tr>
<tr>
<td>Third larval instar</td>
<td>48</td>
<td>72</td>
</tr>
<tr>
<td>Pre-pupa</td>
<td>19</td>
<td>26</td>
</tr>
<tr>
<td>Pupa</td>
<td>72</td>
<td>168</td>
</tr>
<tr>
<td>Total developmental period</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 5 mm. 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 super-parasitism 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>
<thead>
<tr>
<th>Oviposition activity &amp; longevity</th>
<th>Mated females</th>
<th>Unmated females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-oviposition period (days)</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Oviposition Period (days)</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Post-oviposition Period (days)</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Longevity (days)</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Total number of eggs/Female</td>
<td>6</td>
<td>47</td>
</tr>
</tbody>
</table>

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

1. The pre-oviposition, 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 parthenogenetically. 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.

REFERENCES.


الذي يتفلل

Apanetes sp.

دراسة بيولوجية على الطفيلة
على دودة اللوز الأمريكية
(Heliotis armigera Hb.)

(Hymenoptera : Braconidae)

معطى سيد ابراهيم الدكروشي
محمد سعيد توفيق عباس
أحمد حسين الوثيدى

اجريت دراسة بيولوجية على الطفيلة
على دودة اللوز الأمريكية
(Heliotis armigera Hb.)
وذلك في المعمل على درجة حرارة 27 ± 2 درجة مئوية ورطوبة نسبية 65 ± 5%.
قد تم قدرة حياة الطفيلة في الكاملة للطفيلة حيث وجد أن متوسط كل من فترات حضانة البيض،
ومدة كل من الطور الوراثي وطور ما قبل العديد، والمراة كان 14.20 يوماً.
وجاءت النتائج تأثير على الإنتاج التناسلي للانثى، تقع الاناثة النافة
حوالي 27.12 بيضة خلال مدة حياتها الآتية تبلغ 8.1 يوماً. بينما بقيت
حياة الذكور تحت نفس الظروف 7.91 يوماً فقط. أما للانثى غير النافية
فإن متوسط الهب له من البيض هو 3.29 بيضة خلال مدة حياتها التي تبلغ
7.11 يوماً. وقد وصل أقصى عدد من البيض الذي يمكن أن تشتهي الطفيلة
الفي اليوم الواحد إلى 17 بيضة بينما المعدل الإجمالي للاناث غير النافية
هو 9 بيضات فقط. أما فترة ما قبل وضع البيض وفترة وضع البيض وفترة
اتهام وضع البيض فكان متوسطها على التوالي أقل من يوم 1.21 يوماً
و1.1 يوماً واحداً في حالة الاناثة النافة وهذا يعادل الاناثة غير النافية
وضع البيض في هذه الحالة الأخرى تطول إلى 10 أيام. كانت النسبة الجنسية
للطفيلة في الطبيعة 1: 1، بينما تبلغ هذه النسبة في المعمل 1: 0.2.
هذا يشير إلى ضرورة تغيير ظروف انعكاس تزاوج الطفيليات تحت الظروف العملية
حيث أن الاناث غير النافية تنتج ذرية كثيرة من الذكور.