Developmental stages in the life cycle of *Helicoverpa armigera* (Hubner) under laboratory conditions

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Abstract

The cotton bollworm *Helicoverpa armigera* is a pod borer which feeds on many valuable crops causing large financial loss per year. The damage varies from different regions in India. Different control measures are available for the pest. This present work would prove to be useful in determining most effective, economical pest control method. The study of life cycle of *H. armigera* was conducted under laboratory conditions on Chickpea (*Cicer arietinum*) at 26±1°C. The observations were taken with respect to different stages of life cycle for two consecutive generations in two seasons namely, winter and summer. It took 55-61 days in winter and 42-50 days in summer to complete the generation. From these generations healthy insects were selected for further study. These observations would be helpful for determining suitability of host stage in the life cycle of the pest, which helps in determining the population trend and pest control strategies.

**Keywords:** *Helicoverpa armigera*, Life cycle, Chickpea (*Cicer arietinum*), Pest control.

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1. Introduction

*Helicoverpa armigera* (Hübner) of the Lepidoptera family is a very serious pest of many valuable crops. It is a polyphagous pest of a number of plant species, including chickpea (*Cicer arietinum*), pigeonpea (* Cajanus cajan*), tomato (*Lycopersicon esculentum*), okra (*Abelmoschus esculentus*), and cotton (*Gossypium* species), and is expected to become a fatal pest in other crops as well. For example sorghum (*Sorghum bicolor*), pearl millet (*Pennisetum glaucum*), maize (*Zea mays*), tobacco (*Nicotiana tabacum*) and groundnut (*Arachis hypogea*) [1]. As early instars larvae of *H. armigera* are greedy foliar feeders which later shift to the developing seeds, fruits, or bolls, leading to large reductions in yield [2]. This way the pest in the country causes large financial loss per year [3]. In addition to feeding on high value crops it is an extremely dangerous pest because its production rate is extremely high; and it can migrate over a long distance [4]. The different control measures include the growing resistant varieties, weeding, interrow cultivation, removing crop residues, deep autumn ploughing, winter watering to destroy the pupae, the use of insecticides or biological control through the release of entomophages such as *Trichogramma*.
spp. and *Habrobracon hebetor*. The monitoring is done by use of sex pheromone traps[5]. Now a day's use of Bt cotton (*Bacillus thuringiensis*) helps in improving the yields. Therefore the present work is carried out to develop more effective and economical pest control method having no side effects. A thorough knowledge of life history of insect and its status as a pest is thus essential for providing an important basis for developing efficient pest management strategies.

### 2. Materials and methods

The life cycle study of *Helicoverpa armigera* required fresh and healthy insects which were obtained from the local farmers from areas adjacent to Aurangabad (MS).

#### Rearing of *H.armigera*:

The insect was reared as per the procedure of [3-6]. In order to study the life cycle of *H.armigera*, the collected healthy insects were separated and kept in small plastic bottles with fresh diet of pods of Chickpea (*Cicer arietinum*). The bottles were kept at room temperature in winter season. The incubation period was 3.5 - 5.5 days.

The male and female moths were kept for egg laying in the wooden cage of size 35cm×35cm×50cm. The sides of the cage were covered with muslin cloth. The egg laying process was completed within 6 days. The freshly laid eggs were collected from the pods with the help of moist paint brush in plastic bottles (5.0 cm diameter×5.5 cm height) and kept at room temperature in the laboratory.

On hatching, the larvae were separated and transferred individually into small plastic bottles containing pods of Chick pea. These were provided with fresh Chickpea pods every day in the morning.

Observations on hatching, larval development, formation of pupae and successful emergence of adult and fecundity of female were recorded on a daily basis and continued till the death of the female.

### 3. Results

The results of detailed study of life cycle of *H.armigera* under the laboratory conditions are summarized in Table no. 1 and 2.

#### Stages in the life cycle:

**a) Eggs:** The eggs were spherical in shape with approximately 0.4 - 0.6 mm in diameter. Initially they were white in color and then darkened to grayish brown prior to hatching. The eggs were sculptured with vertical ridges of alternating length, which surround a smooth apical that contains the micropyle. A similar observation has also been recorded by [3].

**b) Larvae:** The larvae took 24-34 days in winter and 17-24 days in summer to develop and passed through five instars before turning into pupae. Their color was variable; usually the first instar larvae were black to brown head and yellowish-white body with a spotted appearance. The head, thoracic, anal shields and legs were brown in color. The setae were dark in color. These results were almost similar to those of [3]. The darkening of the larval color with successive molts for 6 instar stages observed for the period was found to range from 16-30 days. However some available reports suggest a span of 13-22 days [3]. The larvae were about 35-37 mm long greenish brown with dark grey yellow stripes along the sides of the body. They were found to be rather aggressive and if disturbed, they detached from the plant and curled up on the ground.

**c) Adult:** The adult were light brownish gray in color. The females were darker than males [7-8]. They were having body length range of 18-20 mm. In summer season, the life cycle was completed in 6- 7 weeks. The progeny fed on other plantings or on the same crop. Adults were light fawn forewings with a kidney-shaped spot in the middle. When resting, the wings were held roof-like over the body. One female moth may lay up to 1,500 eggs as determined microscopically. The dome-like eggs had ribbed surfaces and were pearly white when laid, but change to brown as they develop.
Table 1: Measurement of different stages of *H.armigera*

<table>
<thead>
<tr>
<th>SN</th>
<th>Stage</th>
<th>Length (mm)</th>
<th>Weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eggs</td>
<td>0.4-0.6 diameter</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Larva</td>
<td>35-37</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Pupae</td>
<td>12-23</td>
<td>132-140</td>
</tr>
<tr>
<td>4</td>
<td>Adult</td>
<td>18-20</td>
<td>-</td>
</tr>
</tbody>
</table>

Data based on measurement of 20 individuals.

Table 2: Development period of different stages of *H. armigera* under the laboratory conditions.

<table>
<thead>
<tr>
<th>Generation</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period of study</td>
<td>Dec end to Feb end</td>
<td>Feb end to 2nd week of April</td>
</tr>
<tr>
<td>Incubation period for larva</td>
<td>5-7 days</td>
<td>4-5 days</td>
</tr>
<tr>
<td>Average duration of larval stage</td>
<td>24-34 days</td>
<td>17-24 days</td>
</tr>
<tr>
<td>Incubation period for pupa</td>
<td>4-5 days</td>
<td>4-5 days</td>
</tr>
<tr>
<td>Average duration of pupal stage</td>
<td>17-24</td>
<td>14-17</td>
</tr>
<tr>
<td>Duration of life cycle</td>
<td>55-61</td>
<td>42-50</td>
</tr>
</tbody>
</table>

Data based on 20 individuals.

Stages in the life cycle:

d) Eggs: The eggs were spherical in shape with approximately 0.4 - 0.6 mm in diameter. Initially they were white in color and then darkened to grayish brown prior to hatching. The eggs were sculptured with vertical ridges of alternating length, which surround a smooth apical that contains the micropyle. A similar observation has also been recorded by [3].

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f) Adult: The adult were light brownish gray in color. The females were darker than males [7-8]. They were having body length range of 18-20 mm. In summer season, the life cycle was completed in 6-7 weeks. The progeny fed on other plantings or on the same crop. Adults were light fawn forewings with a kidney-shaped spot in the middle. When resting, the wings were held roof-like over the body. One female moth may lay up to 1,500 eggs as determined microscopically. The dome-like eggs had ribbed surfaces and were pearly white when laid, but change to brown as they develop.

4. Discussion

The *H.armigera* is one of the most polyphagous and cosmopolitan pest species. When it is growing in natural climatic conditions, different factors like temperature, humidity, rainfall, various crop patterns etc. affect the life cycle of pest, but in the maintained laboratory conditions the duration of each stage was dependent to some extent on temperature.

From the observations and results obtained in the present work we found that the insect would be successfully reared under laboratory conditions on the pods of chick pea plant. The sizes, color of legs and wings were as similar to the earlier findings. No variation in external structures or colors could be noted on the pest reared in the laboratory (Figure no.1).
Conclusion

In the present study the pest successfully completed two generations of its life cycle in the maintained laboratory conditions. It took 55-61 days in winter season and 42-50 days in summer season. The results were in accordance with earlier findings. Therefore it may be concluded that the pest can develop ability to adapt itself with available conditions in the laboratory for completion of life cycle. Thus this study provides a thorough knowledge regarding the different stages of life cycle which will be used in the developing effective pest management strategies in future.

Figure 1: The life cycle of H.armigera under laboratory conditions

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Reference