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Biology of *Earias insulana* (Spiny bollworm) Lepidoptera: Noctuidae on different temperatures in laboratory

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Abstract: *Earias insulana* (spiny bollworm) is a major lepidopteron pest of cotton crop and other vegetables. In Pakistan, especially in Sindh *Earias insulana* cause severe infestation to cotton crop. The biology of *Earias insulana* was carried out in the laboratory on different temperatures (27, 31, and 35±1 °C) on their natural diet. During present study, it was observed that development rate was high on 35±1 °C temperature while low development rate on 27 °C temperature. Maximum mortality was observed in egg and first larval instars while minimum mortality observed in fourth larval instars. Present study reveals that we can control this pest at egg to 3rd larval instars.

Keywords: Earias insulana, Lepidoptera, Biology, Sindh, Pakistan

1. INTRODUCTION

Cotton (*Gosspium hirsutum* L) is one of the main cash crops of Pakistan. Yarn and garments are big source of foreign exchange and account for 1.9 % of G.D.P. Pakistan Economic Survey of Pakistan (2008-2009). In Pakistan, it is cultivated on 28.20 million hectors with total 11.81 million bales Economic Survey of Pakistan (2008-2009). This production is much less in comparison to advanced countries and is decreasing day by day. Main cause of this low yield is the attack of different bollworms pest.

Cotton bollworm *Earias vittella* (spotted bollworm) and *Earias insulana* (spiny bollworm) are major lepidopteron pest of many crops and distributed in North Africa and Sub continent (Indo-Pak) Abdul-Nasr *et al.* (1973), Arif and Atique (1990), while Arora *et al*. (2006), reported *Earias* species mostly found in tropical and subtropical parts of world such as Paleoarctic, Ethiopian, Australian and oriental region. In Pakistan specially in Sindh *Earias* species present throughout province and being a polyphagous cause severe attack to cotton and many vegetables particularly okra. In Sindh among all boll worm species maximum damage caused by *Earias* species. Qureshi and Ahmed (1991), reported 10 % damage of fruiting bodies, Leghari *et al.* (2002), Leghari and kalroo (2002), reported that in Sindh maximum damage caused by *Earias* species which were 3.8 to 12.6 %.

Keeping importance of the bollworms, the study of biology of *Earias insulana* (spiny bollworm) was carried out on three different temperatures (27, 31, and 35±1 °C) on their natural diet cotton bolls, flowers and squares in laboratory during July-November 2006-2007. Present study revealed that biology of *Earias insulana* play important role in bollworms management, especially we will aware of the larval stages, mortality and survival rate.

2. MATERIALS AND METHODS

The studies of the biology of *Earias insulana* (spiny bollworm) have been carried out in the laboratory during July to November 2006-2007. Four generations were reared on different temperatures as to get average development time of months at which usually occurred in the field (27, 31, and 35±1 °C). We have collected larvae from the field and reared them in Petri dishes and chimneys in the laboratory on their natural food (young bolls, flowers and squares). The layer of cotton was placed on the bottom of each Petri dish and covered it with filter paper. To maintain the humidity, the Petri dishes were kept wet daily by dropping few drops of water .The eggs hatching took place in same Petri diseases. Temperature was controlled by putting these Petri dishes in incubator.

The adult moths were reared in cages 1 x 1 foot on the artificial diet 10% sucrose solution. Black cloth was placed on the bottom and top of each cage for egg laying. Measurements of different stages of life cycle were taken by ocular micrometer (sample of ten / stage was taken for measurement). The mortality and survival of each stage was observed and recorded through cumulative % by using the following formula.

$$\frac{\text{Total number survived o f each stage X 100}}{\text{Total No. reared at fist stage}}$$

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3. RESULT AND DISCUSSION

Table 1: Life cycle of *Earias insulana* observed on different temperatures

Temperature °C	Incubation period (days)	Larval period (days)	Pupal period (days)	Adult life Span (days)		Complete life cycle (days)
				Male	Female	
27 ±1°C	4.5	17	16	14	16	51.5-53.5
31±1°C	3.5	11	11.5	7	11	34-38
35±1°C	3	9	8	9	10	29-30

To determine the effect of different temperatures on the development of life stages of *Earias insulana*, the eggs, laid by female (which collected from rearing cages) we kept in incubator at three different temperatures 27, 31 and 35°C. Mostly these temperatures because in almost all cotton growing areas of Sindh, temperature in the fields usually varies in between 27 to 35°C during cotton season, May-September. The development of different life stages are co-related with temperature it directly affects the population so severity of infestation in the field.

Incubation

It was observed that lowest incubation period was 3 days on 35±1 °C and highest incubation was 4.5 days on 27±1 °C **(Table-1).** Other researchers also has been reported same findings like Kiray (1964), recorded 3.5 days incubation period, Wilcocks (1937), 4-8 days and Unlu (2001), 4 days incubation period.

Larvae

Like other lepidopteron pests the most injurious stage of this insect are larvae (because of their chewing and biting type of mouth parts), their growing and development rate is very important, which directly affects the cotton production. Like *E. vittella, E. insulana* also possess four larval instars and their mode of feeding also same so it is difficult to differentiate their mode of infestation. After emergence from the egg, first instars larvae start feeding on buds, squares and flowers. The development of larvae was faster on 35±1 °C while slow on 27±1 °C (Table-1). The shortest larval period was recorded 9 days and longest 17 days on 35±1 °C and 27±1 °C respectively (Table-1). These results are partially in agreement with Kiray (1964), reported larval period 8 days, Kelin (1981), 14-22 days on 25±2 °C, Hermith (1987), larval period 14.1 days and Unlu (2001) recorded 13.56 days on 29±2 °C.

Pupae

Full-grown larvae after last molt convert in to pupil stage. Pupal stage is resting stage of the insect in which development of moth takes place. Before converting in to pupae, the full grown larvae stopped feeding and went in to the resting position and get rest at bottom of jar and Petri- dishes and covered body with leaves (as in the field they pupate on the ground under the debris) . Overall the shortest developmental time was 8 days on 35±1 °C temperature but longest period was 16 days on 27±1 °C (Table-1). These results are partially in agreement with Wilcocks (1937), reported 10-14 days, Kiray (1964), 12 days on 26.9°C and Unlu (2001) reported 7.90 days on 29±2 °C.

Adult life span

Life span of Earias insulana was almost same like Earias vittella. Life span of male moth was recorded 9 and 14 days while female 16 and 10 days respectively on 35±1°C and on 27±1 °C (Table-1). The life span of adult female is little bit longer than male.

Duration of life cycle

Duration of life cycle directly co- related with temperature. Minimum duration of life cycle was 30- 31 day's on 35±1°C and maximum time period of life cycle was 51.5-53.5 days on 27±1 °C (Table-1)

Mating and Oviposition

After 2-3 days of emergence adult moth start mating, this mating process took place at night time egg lying process took 6-8 days. Female laid eggs singly beneath the cloth placed on the top of the cage. Each female laid about 75-150 eggs during life span. Past researchers have different findings about the number of eggs such as, Wilcocks (1937), reported that each female laid 200 eggs while Hermith (1987), reported 112 egg.

Table 2: Measurements of different developmental stages of *Earias insulana*

S.No.	Name of life stage	Measurement (mm)
1.	Egg	0.3
2.	Newly hatched larvae	1.3 – 2.5
3.	Full grown larvae	7 – 14
4.	Pupa	13 – 15
5.	Female	10 – 11.5
6.	Male	7.3 – 10
7.	Wing span	16.3 – 22.5

Total ten number of each stage observed for measurements

Morphology of different stages of life cycle of *Earias insulana*

Egg

Newly laid eggs are whitish blue, after few hours of hatching they became bluish green before hatching they become brownish.

Larvae

The newly hatched larvae of *Earias insulana* are light yellowish brown in colour with black spots on its body measures about 1.3 – 2.5 mm; while 3rd and 4th (full grown) larval instars are yellowish green or deep orange in colour and it measures about 7 – 14 mm. The measurements of *E. vittella* and *E. insulana* larvae were observed almost same.

Pupae

Brown coloured pupae enclosed in a woven shaped cocoon made of dirty white colored silk.

Adult (Moth)

The adult moth of *E. insulana* is pigmy grass green in colour and relatively smaller in size than *E. vittella.* Male is smaller in size than female and posses hair at the anal part.

Table 3: Life table of *Earias insulana* (spiny bollworm) laboratory on different temperatures (27-35± 1°C)

Life Stages	No. Of Each Stage For Rearing	Number dying during Each stage	%age of Mortality	Cumulative %age of Survival
Egg	150	15	10	90
1st instars larvae	135	23	15.3	74.7
2nd instars larvae	112	9	6	68.7
3rd instars Larvae	103	5	3.3	65.4
4th instars Larvae	98	2	1.3	64.
Pupae	96	2	1.3	63
Adult	94			

Table- 3 indicates that highest mortality was recorded in 1st larval instars 15.3 % while Egg mortality was recorded 10%. Result indicates that the larvae of *Earias insulana* were easy to control up to 2nd larval instars because these stages are very sensitive. When pest reached at fourth larval instars it was difficult to control.

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