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Effect Of Different Temperatures On The Development Of Spotted Bollworm, *Earias Vittella* (Fab.) (Lepidoptera: Noctuidae) In The Laboratory

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Abstract: *Earias vittella* is a major lepidopteron pest of cotton in Pakistan and it causes heavy infestation in cotton crop. Present study of biology of *Earias vittella* carried out in the laboratory under controlled conditions at different temperatures (27, 31 and 35±1°C). *E. vittella* was reared on its natural diet cotton shoots, flowers and bolls. Highest mortality recorded in the first larval instars and Egg, 14 % and 10 % respectively; the lowest mortality recorded in the fourth larval instars and pupae 1.2, 1.65%. Total cumulative % of survival recorded 62.85%. Life cycle completed in 23-47 days. Male dies after few days of mating. Present study revealed that temperature played vital role in the development and growth rate of *vittella;* highest rate was on 35±1°C but even then its control is possible if management measures could have taken at first and second larval instars which are relatively more vulnerable than other stages; it was also observed that most strong was the fourth larval stage.

Keywords: *Earias vittella*, Larval instars, Cumulative survival % age, Lepidoptera

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 of 1.9% of G.D.P of Pakistan, (Economic Survey of Pakistan 2006-7). Total 68% of foreign exchange we earn only from cotton crop (Khan and Khan 1995). This production is much less in comparison to advanced countries and decrease day by day. Main cause of this low yield (20-30%) mainly is the attack of different cotton bollworms species. Ahmed (1980) reported that cotton crop is most susceptible to bollworm, which inflect heavy damage that may vary from year to year but generally cause 20-30% of yield.

Cotton boll Worm *Earias vittella* and *Earias insulana are* major lepidopteron pest of many crops and present mostly in tropical and subtropical parts of world such as Paleoarctic, Ethiopian, Australian and oriental rejoin (Indo- Pak*)* (Abdul-Nasr *et al.,* 1973, Arif and Atique 1990 and Arora *et al*., 2006).

In Pakistan specially in Sindh *Earias* species present throughout province and being a polyphagous cause severe attack to Cotton and many vegetables particularly okra. Among all boll worm species the most injurious species are *Earias species* and the damage reaches up to 11-12 % in the month of August and September (Shah *et al* 2011). Qureshi and Ahmed (1991) reported 10% damage of fruiting bodies; (Leghari *et al* 2002), and Leghari and kalro 2002) reported that in Sindh maximum damage caused by *Earias* species is 3.8 to 12.6.

To keep in mind the importance of cotton crop and infestation level of *Earia*s species in Sindh which is an agriculture based province of Pakistan, presently we have done the biology of one of the most destructive species of boll worms, *E. vittella* on different temperatures under controlled condition in the laboratory to monitor the developmental rate of its different stages, which can be helpful in the management. Beside that we have also observed the biology in the fields, which also have almost same results as we have in the laboratory, although we did not include the data of field observation in present paper.

2. MATERIALS AND METHODS

Study of biology has been done under the control conditions in the laboratory on different temperatures (27, 31 and 35±1°C). Three generations have been reared on their natural diets fresh cotton bolls at three different temperatures. Biology of *Earias vittella* (Spotted bollworm) was carried out in the laboratory during the cotton season 2006-2007 August to November. 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

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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 dishes. Temperature was controlled by putting these Petri dishes in incubator for 2-3 hours

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 following formula.

Total number survived o f each stage X 100
Total No. reared at fist stage

Table- 01 Time period of different life stages of *Earias Vittella* observed on different temperatures.

Temperature °C	Host	Incubation period (days)	Larval period (days)	Pupal period (days)	Adult life Span (days)		Complete life cycle (days)
					Male	Female	
27 °C	Young Cotton bolls	4	14	15	12	14	45-47
31°C		3	12	11	9	12	35-38
35°C		2	8	7	6	9	23-26

3 RESULT AND DISCUSSION

For the determination of time period of all life stages of *Earias vittella* we kept the eggs which we have collected from rearing cages in incubator at three different temperatures 27, 31 and 35°C. We have chosen these temperatures because during cotton season, May-September in almost all cotton growing areas of Sindh temperature in the fields usually varies in between 28 to 35°C and development of different life stages are co-related with temperature that directly affects the severity of infestation of bollworm in the field.

Our results indicates that the lowest incubation period was 2 days, that was on high temperature 35±1 °C and highest 4 days, on 27±1 °C. Other researchers also have same findings like Al- Muhammady (2000) reported lowest incubation period 2-2.15 on 32.6±0.81°C, highest incubation period 3-5 days on 23.2±1.94°C, Haq (1973), Singh and bichoo (1989) and Reham and Ali (1981) reported 3-4 days in September and October. Although, 30 ± 5°C seems, an ideal temperature for incubation (lowest period) by all researchers including our results, but Rukhsana (1995) reported the highest incubation period 6.33 ±0.99 on 30±5°C which is quite interesting and highest incubation period than all other researchers.

The most injurious stage is larvae, their growing and development rate is very important, which directly affects the cotton production. *Vittella* possess four larval instars; after emergence from egg young larvae (1st larval instars) immediately started feeding, they preferred to feed on flowers and squares while full grown larvae fed on young and mature bolls. The development of larvae was faster at 35±1°C (once again 30±5° seems favourable temperature for over all development that accelerate the rate of development at all stages), larvae become full-grown in 08 days, which is a normal temperature in Sindh during May- August therefore it definitely cause severe damage to cotton during these months and create a big population of moths during August- September for all upcoming crops. Because of short developmental time during these months there will be many overlapping generations in the field at the same time. The highest larval period was 14 days 27±1 °C. Sayed (2011) reports 11.5±1.1 days on 34.12°C and 12.4±1.4 days on 32.6 days on cotton, Ambegankar and Billapate (1984) observed 11.3 days larval period on cotton flowers, Sunderaraj and David 1987 reported 13.76 days on cotton, Singh and Bichoo (1989) reported larval period 9-17 days, Al Muhammady (2000) reports 8-15 days larval duration on 31.2±0.971 °C, Dhillon and Sharma (2004) observed larval period 9.2- 12.2 days on 28±2°C.

Full grown larvae after last molt convert in pupae. Pupal stage is resting stage in which development of moth takes place. Before it was converting in pupae the full grown larvae stop feeding and got in resting position on the bottom of jars and Petri- dishes, covered the body with leaves. Overall the shortest developmental time was on 35±1 °C temperature but longest period was on 27±1 °C. Al Muhammady (2000) reports 5-12 days on 27 to 31°C, Singh and bichoo (1989) reported 6-14 days, Nayar et al (1976) reported 7-10 days.

Life span of *Earias vittella* was observed on different temperatures. Life span of male moth recorded 6, 12 and female 9, 14 days respectively on 35±1°C and on 27±1 °C. Adult life Span of female is a little bit longer than male. Similarly Rehman and Ali (1981) reported 9.25 days male longevity while female 13.91 days, our results partially agreed with Al Muhammady (2000) reported male longevity 12.42, 23.77 and female 14, 21.35 respectively on 32.6+0.81°C and 23.2+1.94. Contrary Syed (2011) reports 9.5 days male longevity and 7.5 days female longevity, according to his observations male life span is longer than female.

Duration of life cycle depends upon temperatures minimum period recoded 23-26 day's on35±1°C and maximum time period of life cycle

recoded 45-47 days on27±1 °C. Rehman and Ali (1981) reported 24 to 45 days at 36.7°C , Sharma et al (1985) reported 29-49 days Al Muhammady reported 31 to 49 days on 27.80 -32.90°C.

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 cloth covered on top of the cage. Each female laid about 150-250 eggs singly. Syed et al reports 3.50 days pre mating days and oviposition period 3-11days, Rehman and Ali reports 5.83 oviposition days.

Table 02 Morphological Characteristics of different stages of *Earias vittella* and their measurements

S. No.	Life Stages	Measurement In m.m.
1.	EGG	0.3 mm
2.	Newly hatched larvae	1.3, 2.5 mm
3.	Full grown larvae	7 , 14 mm
4.	Pupa	13 , 15 mm
5.	Adult Moth	7.3 , 14 mm
6.	Female	10 , 14 mm
7.	Male	7.3 , 10 mm
8.	Wing span	16.3 , 22.5 mm

Egg:
Newly laid eggs are whitish blue, after few hours of hatching they became bluish green before hatching they become brownish. Egg measures 0.3 mm (Table 02).

Larvae:
The newly hatched larvae of *Earias vittella* are brownish white, with black head and become full grown after 3 molts. The full grown larvae possess four pairs of abdominal appendages and three pairs of thoracic appendages. Rehman and Ali (1981) observed, body blackish brown with whitish spots on the dorsal side and setae present on the side of the body. First instars larvae measurers 1.3-2.0 mm while full grown larvae measure 7.0 -14 mm (Table 02).

Pupae:
Brown colored Pupae enclosed in a woven shaped cocoon made of dirty white colored silk, measured 13 – 15 mm (Table 02)

Adult (Moth):
The adult moths of *Earias vittella* creamy white in colour, possessed a green colour band on its fore wings, male is smaller than female. Male moth measured 7.3 – 10 mm and female moth measured 10 – 14 mm. Average wing span of adult moth was 16.3 – 22.5 mm **(Table-3).**

Table 03 Life table of *Earias vittella* (Spotted bollworm) in laboratory Under Control conditions (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	250	25	10	90
Larvae 1st instars	225	35	14	76
2nd instars	190	19	7.6	68.4
3rd instars	171	7	2.8	65.6
4th instars	164	3	1.2	64.4
Pupae	161	4	1.6	62.8
Adult	157	0	0	

Present study revealed that maximum mortality occurs in 1st larval instars 14 and Egg 10 % while lowest mortality observed in 4th larval instars and Pupae (1.2 and 1.6 %) (Table 03). Al Muhammady (2000) recoded 8.13 % at Egg stage on 31.3°C., Syed (2011) reported 71.68% fertility of eggs. Cumulative %age of survival showed that all adult remain live and survived till their natural life span.

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