



## STUDIES ON BIOLOGY AND PHYSICAL MEASUREMENTS OF SHOOT AND FRUIT BORER (*LEUCINODES ORBONALIS* GUENEE) OF BRINJAL IN WEST BENGAL, INDIA

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### ABSTRACT

Shoot and fruit borer, *Leucinodes orbonalis* Gueneis one of the most destructive pests of Brinjal in India. Laboratory experiments were carried out during 2013-2014 in the Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (West Bengal) to study the biology and measurement of the different life stages of *Leucinodes orbonalis*. Studies on the biology of shoot and fruit borer, *L.orbonalis* revealed that the incubation period was  $3.8 \pm 0.84$  days. The developmental period of 1<sup>st</sup> instar larva was  $2.6 \pm 0.55$  days and the length and breadth of the body were  $2.03 \pm 0.36$ (mm) and  $0.26 \pm 0.05$ ( mm), respectively. The 2<sup>nd</sup> instar period varied  $2.8 \pm 0.71$  days,  $4.00 \pm 0.30$  mm in length and  $0.70 \pm 0.13$  mm in breadth. The 3<sup>rd</sup> instar larva was  $3.2 \pm 0.84$  days, measured  $8.03 \pm 0.64$  mm in length and  $1.48 \pm 0.20$  mm breadth. The mean of the 4<sup>th</sup> instar was  $3.4 \pm 0.89$  days,  $11.74 \pm 0.46$  mm in length and  $2.13 \pm 0.39$  mm breadth. The mean of 5<sup>th</sup> instar larval were  $2.8 \pm 0.55$  days,  $17.30 \pm 1.15$  mm in length and  $3.92 \pm 0.35$  mm breadth. The total larval period were  $16.2 \pm 1.48$  days. The pre-oviposition was found  $1.81 \pm 0.21$  days and the oviposition period was 2.55-0.42 days. The mean pupal period was  $8.6 \pm 0.89$  days, measured  $12.34 \pm 1.67$  mm length and  $4.40 \pm 0.47$  mm in breadth. The mean adult male moth longevity was  $4.2 \pm 0.84$ , recorded  $13.54 \pm 2.12$  mm in length and  $2.98 \pm 0.38$  mm in breadth with wingspan of  $20.55 \pm 1.41$  mm. The mean lifespan of female moth of *L. orbonalis* was observed  $5.8 \pm 0$ , measured  $14.53 \pm 1.23$  mm in length,  $4.41 \pm 1.33$  mm in breadth and wingspan of  $23.41 \pm 1.45$  mm. The duration of total life cycle varied  $35.2 \pm 1.72$  days. The mean fecundity was recorded as  $81.2 \pm 9.07$  eggs/female, the size eggs of shoot and fruit borer moth was recorded as 0.80 mm in length and 0.52 mm in breadth. The body measurements of *L. orbonalis* of the life stages revealed that the adult female is larger than male, by abdominal characteristics and wider wingspan.

**Key words:** Brinjal, biology, morphometric, shoot and fruit borer, *Leucinodes orbonalis*

### INTRODUCTION

Brinjal or eggplant or aubergine (*Solanum melongena* L.) is an important solanaceous crop grown throughout most of the part of India around the year. India ranks second to china in the global production of brinjal. Brinjal is the being grown extensively in gangetic zone of West Bengal. Of these, the shoot and fruit borer, *Leucinodes orbonalis* Guenee is the most serious pest as it starts damaging the plants soon after transplanting. Lal (1975) reported that brinjal fruit and shoot borer is one of the most destructive pests on eggplant in South and Southeast Asia. It is found throughout the tropics in Asia and Africa, where it can reduce yield by as much as 70%. It is easy to manage the pest population with the help of local resources and skills as well as to avoid continuous application of different stages of its life cycle. Moreover, it was thought that essential to study the biology and morphometric characteristics of this dreaded pest of brinjal.

### Materials and Methods

The biology of shoot and fruit borer and morphometric parameters of different stages was studied in the laboratory at BCKV, Kalayani, West Bengal during 2013-2014.

#### Biology of *Leucinodes orbonalis* Guenee.

The larvae collected from damaged fruits were kept in glass jars and fresh fruits of brinjal were used for feeding. The piece of fresh brinjal fruits was provided daily to avoid the fungal growth and were continued until to get the adults of shoot and fruit borer. Infested brinjal were maintained at room temperature and the emerging adults were used in the experiment. The moths were sexed using abdominal characteristics (female is larger than male).

The test insects were obtained from separate cultures raised from a single pairs of *Leucinodes orbonalis* on soft sliced of brinjal in the laboratory during 2013-2014. The newly emerged moths were paired and released in each of the glass jar containing 50% sugar solutions were supplied for moth feeding.

The mouth of the glass jar was tightened with cotton plug and kept at room temperature. The adults were removed from these glass jars after mortality and the total number of eggs laid by a single female (fecundity) on brinjal, ovipositional period and eggs laid in each day were kept in separate containers covered by muslin cloth and tightened with rubber bands and observations on incubation period, larval duration, pupal duration and total development period (egg to adult) were made adopting the procedure of Miller et al. (1969).

**Morphometric parameters of different stages of *L.orbonalis*:**

The length and breadth of eggs, different instars of larva, pupa and adult were measured by using a stereoscopic binocular microscope, fitted with an ocular micrometer calibrated with a stage micrometer during the developmental period and body development of the life stages of *Leucinodes orbonalis*.

**RESULTS AND DISCUSSION****Biology of shoot and fruit borer:**

The results of present investigation presented in table 1 and shown in plate 1 revealed that the incubation period ranged from 3 to 5 days with mean duration of  $3.8 \pm 0.84$  days. The duration of first instar larva ranged from 2-3 with a mean of  $2.6 \pm 0.55$  days. The larvae bored into the buds and fed on the inner content, and the fed portion within the fruits with excreta. The range of second instar period varied from 1-4 days with mean duration  $2.8 \pm 0.71$  days. The third instar larva was 2-4 days ranged with a mean of  $3.2 \pm 0.84$  days. The fourth instar larva was observed 3-4 days ranged with the mean of  $3.4 \pm 0.89$  days. The fifth instar larva was 2-3 days ranged with a mean of  $2.8 \pm 0.55$  days. The total larval period ranged from 14 to 18 days with a mean of  $16.2 \pm 1.48$  days. The pre-oviposition period of *L. orbonalis* was found 1-2 days ranged with mean of  $1.81 \pm 0.21$  days. The range of oviposition period was 2-3 days with a mean of 2.55-0.42 days. The mean pupal period was  $8.6 \pm 0.89$  days and ranged from 8 to 10 days. The mean adult male moth longevity was  $4.2 \pm 0.84$  with the range from 3 to 5 days. The mean lifespan of female moth of *L. orbonalis* was observed  $5.8 \pm 0.71$  with the range from 4-7 days. The results further showed that the duration of life cycle varied from 32 to 37 days with mean duration of  $35.2 \pm 1.72$  days. The mean fecundity was recorded as  $81.2 \pm 9.07$  eggs/female with a range of 48 to 83 eggs/female.

Onekutu *et al.* (2013a) reported that a single female of *L. orbonalis* lays, on an average of 123 eggs, usually within a week after mating and the developmental periods observed were eggs (5.93 days), 1st instar (1.00 day), 2nd instar (1.16 days), 3rd instar (1.48 days), 4th instar (2.63 days), 5th instar (4.46 days), pupa (11.2 days), female (4.14 days) and male (4.31 days). The reproductive parameters observed were incubation period (5.93 days), pre-oviposition period (1.19 days), oviposition period (2.71 days) and post-oviposition period (3.75 days). Laboratory studies reveal that *Leucinodes orbonalis* will complete its life cycle in 28.17 days. The variation in the duration of life stages may be due to variable food and other factors. Atwal and Dhaliwal (2005) also reported that a single female may lay 80-120 eggs in its life span of a week and the incubation periods was 3-6 days. Larvae grow through 5 larval stages and full fed in 9-28 days. The pupal stage lasts 6-17 days and the life-cycle is completed in 20-43 days during the active season.

**Morphometric parameters of different stages of *L. orbonalis*:**

The body measurements of *L. orbonalis* of the life stages during biology studies, presented in Table 2 revealed that the eggs of shoot and fruit borer moth were creamy white in colour that gradually turned to orange and before hatching a remarkable dark orange was observed. The eggs were flattened, oval in shape. The size of egg was recorded as 0.80 mm in length and 0.52 mm in breadth. The first instar larva was creamy white in colour, head was large broad and blackish in colour. Body length of the first instar was 2.03 mm and 0.26 mm in breadth. The second instar larva was whitish brown mixed with pink color, 4.00 mm in length with 0.70 mm in breadth. The pink colour was found to develop in third instar larva which was measured 8.03 mm in length and 1.48 mm breadth. The fourth instar larva was pinkish brown in colour, head brown to chestnut brown, somewhat more broad in the middle. The larvae measured 11.74 mm in length and 2.13 mm breadth. The fifth instar larvae were pinkish in colour and became full grown larva, 17.30 mm in length and 3.92 mm breadth. The pupa was soft bodied, generally soft and light brown in colour. The pupa measured 12.34 mm length and 4.40 mm in breadth. The adult female is larger than male, by abdominal characteristics and wider wingspan. The moths were pale yellow in colour. The male moth was recorded 13.54 mm in length and 2.98 mm in breadth with wingspan of 20.55 mm. The female moth was measured 14.53 mm in length, 4.41 mm in breadth and wingspan of 23.41 mm.

Y.P. Singh and P.P. Singh. (2001b) supported similar trend that the eggs were 0.75 mm in length and 0.53 mm in width and flattened. The average length and width of the larva were 1.02 mm and 0.20 mm, respectively. The fourth instar larvae had the average length and width of 12.38 mm and 2.42 mm, respectively. The average pupa length and width were 13.45 mm and 4.03 mm, respectively. The female was bigger than male in size and had the swollen abdomen. Similarly, Onekutu *et al.* (2013) also reported that the freshly laid creamy eggs were flat and oval shaped with mean length of 0.94 and 0.5 mm wide. Newly hatched larva had a mean body width of 0.47 mm and an average body length of 4.19 mm, while the second instar larva had body width (0.90 mm) and a body length (6.98 mm). For the third instar, body width (1.38 mm) and body length (11.10 mm). The fourth instar larva had a mean body width (1.71 mm) and body length (16.58 mm). The mean of the fifth instar larvae body width (2.15 mm), while the mean body length was 18.44 mm. The pupa had a mean length and width were 13.9 mm and 5.48 mm, respectively. Morphologically, the adult *L. orbonalis* measures 20-22 cm when its wings are widely spread. The male had a wingspan of 21.59 mm, mean body length of 13.26 mm, while the mean body width was 4.20 mm. The adult female on the other hand had a wingspan of 24.33 mm, mean body length of 14.17 mm, while the mean body width was 4.59 mm. Naresh (2002) revealed that the egg shell appears whitish after hatching and the average length of the first, second, third, fourth and fifth instar larva varied from 1.2-1.4; 2.25-3.5; 8-9.5; 10.25-12-75; 16.5-18.05 mm and width 0.45-0.65; 0.05-1.2; 1.25-1.75; 2-2.85, 3-3.5 mm. The pupa length without cocoon 11.65 mm and with cocoon is 13.8 mm. The adults wingspan and body length of adult was 21 to 26 mm and 11.5-13 mm, respectively.

**CONCLUSION**

The shoot and fruit borer completed its larval stages within  $16.2 \pm 1.48$  days and completed its life cycle within  $35.2 \pm 1.72$  days in the lower gangetic alluvial zone of West Bengal. A gravid female lays on an average of  $81.2 \pm 9.07$  eggs.

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## Annexure

**Table 1: Biological study of *Leucinodes orbonalis* Guen. On brinjal during the period December – January, 2013 - 2014.**

Biological events	Mean ± SE	Range
<b>Fecundity (Eggs/female)</b>	81.2 ± 9.07	48-83
<b>Incubation period (days)</b>	3.8 ± 0.84	3-5
<b>Larval period (days)</b>		
Instar -I	2.6±0.55	2-3
Instar –II	2.8±0.71	1-4
Instar –III	3.2±0.84	2-4
Instar-IV	3.4±0.89	3-4
Instar-V	2.8±0.55	2-3
<b>Total larval period (days)</b>	16.2 ± 1.48	14-18
<b>Pupal period (days)</b>	8.6 ± 0.89	8-10
Pre-oviposition period (days)	1.81 ± 0.21	1-2
Oviposition period (days)	2.55 ± 0.43	2-3
<b>Adult longevity (days)</b>		
Male	4.2 ± 0.84	3-5
Female	5.8 ± 0.71	4-7
<b>Total life cycle (days)</b>	35.2 ± 1.72	32-37

Data based on 10 pairs.

Table 2. Morphometric parameters of different stages of *Leucinodes orbonalis*.

Developmental stages	Length (mm)		Breadth(mm)	
	Mean $\pm$ SE	Range	Mean $\pm$ SE	Range
<b>Egg</b>	0.80 $\pm$ 0.07	0.73-0.90	0.52 $\pm$ 0.09	0.44-0.65
<b>Larvae</b>				
Instar-I	2.03 $\pm$ 0.36	1.6-2.45	0.26 $\pm$ 0.05	0.2-0.32
Instar-II	4.00 $\pm$ 0.30	3.56-4.68	0.70 $\pm$ 0.13	0.5-0.82
Instar-III	8.03 $\pm$ 0.64	6.55-9.25	1.48 $\pm$ 0.20	1.2-1.70
Instar-IV	11.74 $\pm$ 0.46	10.55-13.25	2.13 $\pm$ 0.39	1.76-1.95
Instar-V	17.30 $\pm$ 1.15	15.25-19.55	3.92 $\pm$ 0.35	3.3-4.25
<b>Pupa</b>	12.34 $\pm$ 1.67	10.45-14.65	4.40 $\pm$ 0.47	3.9-5.1
<b>Adults</b>				
Male	13.54 $\pm$ 2.12	10.3-15.6	2.98 $\pm$ 0.38	2.35-3.34
Female	14.53 $\pm$ 1.23	12.85-15.78	4.41 $\pm$ 1.33	2.6-5.78
Wingspan (Male)	20.55 $\pm$ 1.41	18.86-22.34		
Wingspan (Female)	23.41 $\pm$ 1.45	21.35-24.75		

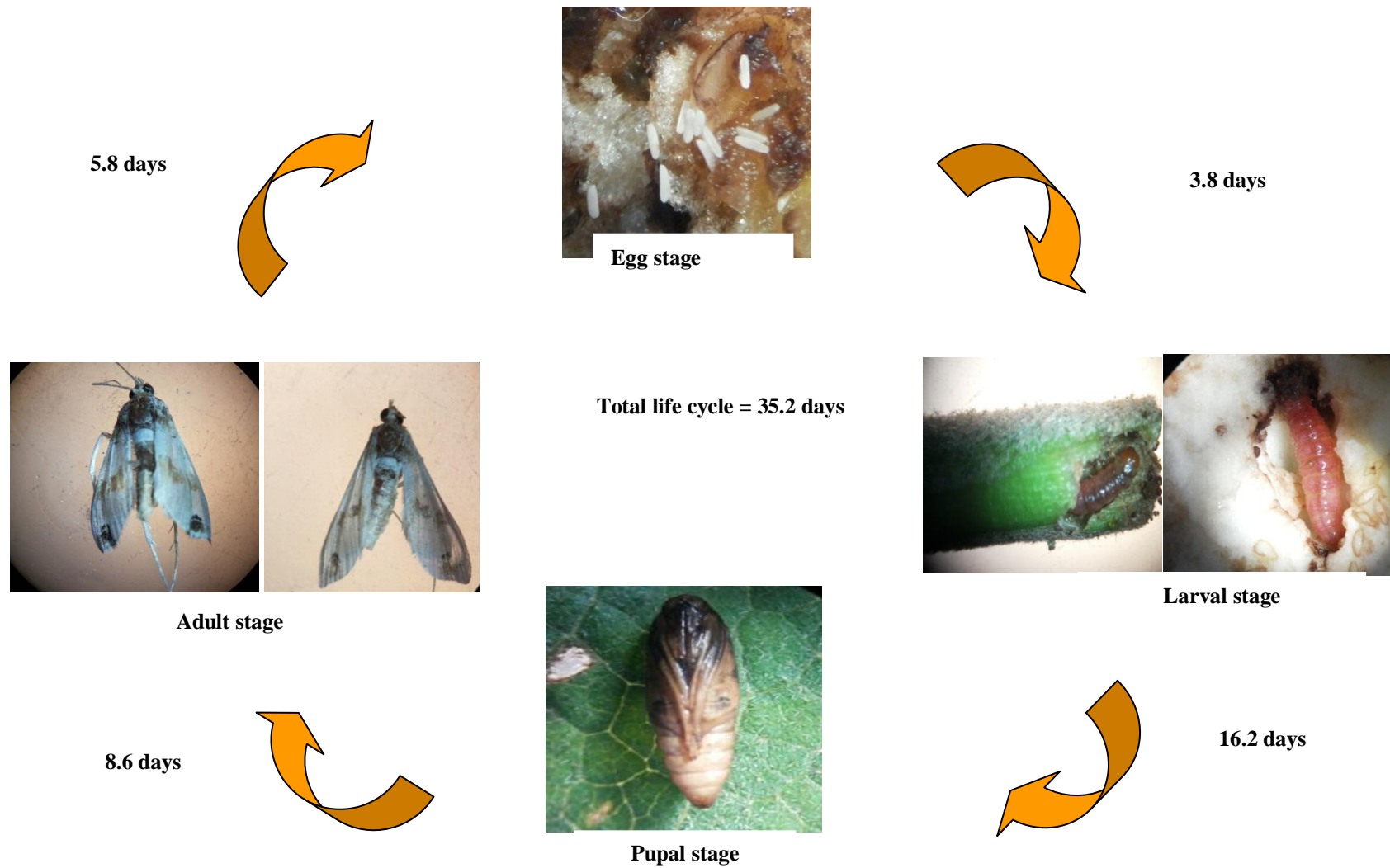


Plate 1: Complete life stages of shoot and fruit borer, *Leucinodes orbonalis*.