



# BIOLOGY OF BRINJAL SHOOT AND FRUIT BORER, *LEUCINODES ORBONALIS* G. UNDER LAB CONDITION AT 35°C TEMPERATURE AND 90% RELATIVE HUMIDITY DURING 2009 AND 2010

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## Abstract

Biology of a brinjal shoot and fruit borer, *Leucinodes orbonalis* Guen. have been studied during both the years under laboratory condition. Mating has been observed on the same day or a day after emergence. Female starts eggs laying on the same day or a day after mating. During both the years the average pre-oviposition period has been recorded to be  $1.293 \pm 0.071$  and  $1.334 \pm 0.060$  days, oviposition period  $2.223 \pm 0.103$  and  $2.192 \pm 0.099$ , fecundity  $170.13 \pm 0.945$  and  $170.90 \pm 1.823$  eggs/female, incubation period  $4.867 \pm 0.231$  and  $5.33 \pm 0.750$  days, larval period  $13.27 \pm 0.416$  and  $13.27 \pm 0.416$  days, pre-pupal period  $1.60 \pm 0.200$  and  $1.40 \pm 0.200$  days, respectively. The pupation took place on the glass jars, soil, muslin cloth, sometimes inside the fruits and on the leaves of the plants. The pupal period has been recorded to be  $6.73 \pm 0.305$  and  $6.40 \pm 0.400$  days during both the years, respectively. During 2009 and 2010, the male average developmental period has been observed to be  $25.20 \pm 0.916$  and  $24.70 \pm 0.500$  days, respectively with  $3.20 \pm 0.200$  and  $3.33 \pm 0.230$  days of male longevity, respectively.

**Key words :** Relative humidity, shoot and root borer, larval period, pupation period, brinjal, *L. orbonalis*.

## Introduction

Brinjal (*Solanum melongena* L.) is one of the most important solanaceous annual vegetable crop. It occupies an important position among vegetable crops because of its high yield potential, low input cost and ability to grow under various agro climatic conditions. It is grown extensively in India, Bangladesh, Pakistan, China and other parts of the world. In India, it is mainly grown in Bihar, Orissa, West Bengal, U.P. and other parts. Brinjal is being cultivated round the year during *kharif*, *rabi* and summer season. The area under brinjal cultivation is estimated as 0.51 million ha with the total production of 8,200,000 metric tones (NHB, 2009). Its fruits are fairly good source of nutrients like carbohydrate, protein, vitamin and minerals. Being high in economic values, now-a-days cultivation of brinjal is becoming menace to the farmers because of attack by many insect pests at various stages of its growth, which act as limiting factors in its successful cultivation. In which shoot and fruit borer *Leucinodes orbonalis* Guen is the most destruction as well as in the quality of the crop. This pest is reported to cause as high

as 74% yield loss to brinjal fruits. The productivity of the brinjal crop has been substantially reduced as a result of boring and feeding on the shoot and fruits. *L. orbonalis* is the most noxious and ubiquitous pest of brinjal. The study of biology of an insect provides the growth rate statistics, which can be used as a predictive basis of pest control. The biological activities of *L. orbonalis* are at their peak during the summer at around 35°C. Hence, the present investigation was attempted to find out the pre-oviposition, oviposition, fecundity, incubation, larval period, pupation period and adult longevity of *L. orbonalis* on brinjal in the laboratory conditions at 35°C temperature and relative humidity 90%, during 2009 and 2010.

## Materials and Methods

The biology of shoot and fruit borer was studied in the Research Laboratory of Department of Entomology, S.V.P. University of Agriculture & Technology, Meerut, U.P., India. The pest larvae were collected in large number from the infested shoots and fruits in experimental field. These larvae were kept separately in clean glass tubes size (3" × 1"). The fresh fruits of brinjal were cut and small pieces were provided daily in the glass tubes to

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serve as a food for developing larvae. The pieces of brinjal fruits were changed daily to avoid any fungal and microbial pathogenic growth. The mouth of each glass tube was plugged with cotton. In view of trouble-free pupation, the folded and grooved paper was placed in each Petri-dish when larvae turned to 5<sup>th</sup> instars. The freshly formed pupae were collected and transferred to a glass jar (size 360 mm × 150 mm) covered with muslin cloth for adult emergence. The male and female moths were collected from the jar, separated and transferred in pair to other glass jar and covered with muslin cloth. A cotton piece soaked in 5 per cent honey solution was provided in jar by hanging through the muslin cloth with the help of thread to feed the adults. A tender twig of the brinjal in a 50 ml beaker having water was placed inside the glass jar for egg laying. The eggs received from these female moths were counted and left as such in glass jars, as many of the eggs were found to be attached with the wall of the jars. The newly hatched larvae were transferred in petri-dishes with the help of soft camel hair-brush and were provided with very soft slices of brinjal. From the second instars, larvae were fed with the slice of brinjal, which was changed daily. The growth and development of *L. orbonalis* was noted every day till adult emergence.

## Results and Discussion

### Pre-ovipositional period, ovipositional period and fecundity

At 35°C and 90% RH the pre-ovipositional period ranged from 1.218 to 1.360 days with a mean of  $1.293 \pm 0.071$  days and the ovipositional period ranged from 2.118 to 2.324 days with a mean of  $2.223 \pm 0.103$  days and the fecundity ranged from 169.40 to 171.20 with a mean of  $170.13 \pm 0.945$  eggs. The length and breadth of eggs varied from 0.872 to 0.898 mm and 0.624 to 0.642 mm with an average of  $0.883 \pm 0.0136$  mm and  $0.630 \pm 0.010$  mm, respectively during 2009. Similarly, during 2010 at 35°C and 90% RH, the pre-ovipositional period ranged from 1.267 to 1.383 days with a mean of  $1.334 \pm 0.060$  days and the ovipositional period ranged from 2.08 to 2.269 days with a mean of  $2.192 \pm 0.099$  days and the fecundity ranged from 168.90 to 172.50 with a mean of  $170.90 \pm 1.823$  eggs, the length and breadth of eggs varied from 0.864 to 0.920 mm and 0.625 to 0.642 mm with an average of  $0.889 \pm 0.028$  mm and  $0.634 \pm 0.008$  mm, respectively. The present result is almost similar with that of Singh and Singh (2001), Jat *et al.* (2003) and Harit and Shukla (2005), who reported. The female lay eggs ranged from 150-168.80 with on an average of 166.27 and the length and breadth of eggs varied from 0.71-0.83 mm and 0.406 to 0.616 mm with an average of 0.833 and

0.612 mm.

### Incubation period

Freshly laid eggs were translucent and yellowish or light orange in colour. They were elongated and oval in shape. As incubation period advanced the translucent eggs became orange with a prominent black spot before egg hatching. The incubation period of *L. orbonalis* at 35°C and 90% RH, varied from 4.60 to 5.00 days with an average of  $4.867 \pm 0.231$  and 4.60 to 6.10 days with an average of  $5.33 \pm 0.750$  days during both the years. These findings are supported by Singh and Singh (2001); Jat *et al.* (2003) and Pal *et al.* (2003) who had also found the same results.

### Larval period

Larvae were usually dirty white in colour, which changed to pinkish within 3 to 4 hours with a prominent dark brown head three pair of thoracic leg and five pair of prolegs. The neonate larvae were oval in shape and they were highly mobile. During that stage male and female were indistinguishable. The duration of first instar larvae lasted for 1.20 to 1.40 days with a mean of  $1.33 \pm 0.115$  days During 2009 at 35°C and 90% RH. The length of first instar larvae varied from 1.396 to 1.41 mm with an average  $1.402 \pm 0.007$  mm and width varied from 0.336 to 0.390 mm with an average from  $0.362 \pm 0.0271$  mm. Similarly, during 2010 at 35°C and 90% RH, the duration of first instar larvae varied from 1.20 to 1.30 days with a mean of  $1.267 \pm 0.058$  days. The length and breadth of first instar larvae varied from 1.41 to 1.46 mm and 0.34 to 0.39 mm with an average of  $1.433 \pm 0.025$  mm and  $0.363 \pm 0.025$  mm, respectively. As the stage advanced colour changed from light orange to pink and entered second instar.

The second instar larvae were larger than first instar larvae and slightly dark in colour. At 35°C and 90% RH, the duration of second instar larvae lasted for 2.20 to 2.60 days with a mean of  $2.47 \pm 0.231$  days and 2.20 to 2.40 days with an average of  $2.33 \pm 0.115$  days respectively, during 2009 and 2010. During both the years, the length of second instar larvae of *L. orbonalis* varied from 6.804 to 6.952 mm and 6.81 to 6.97 mm with an average of  $6.871 \pm 0.075$  mm and  $6.883 \pm 0.080$  mm, respectively. The width varied from 0.906 to 0.97 and 0.917 to 0.97 mm with an average  $0.929 \pm 0.035$  and  $0.936 \pm 0.029$  mm, respectively.

During 2009 and 2010 at 35°C and 90% RH, the duration of third instar larvae of *L. orbonalis* lasted for 2.40 to 2.60 days with a mean of  $2.50 \pm 0.18$  days and 2.20 to 2.80 days with an average of  $2.53 \pm 0.306$  days,

**Table 1 :** Developmental period of brinjal shoot and fruit borer, *L. orbonalis* at 35°C and 90% RH during 2009 and 2010.

S. no.	Stage	Duration (days)			
		2009		2010	
		Range	Mean ± SD	Range	Mean ± SD
1.	Pre-oviposition period in days	1.218–1.36	1.293 ± 0.071	1.267–1.383	1.334 ± 0.060
2.	Oviposition period in days	2.118–2.324	2.223 ± 0.103	2.08–2.269	2.192 ± 0.099
3.	Fecundity in numbers	169.40–171.20	170.13 ± 0.945	168.90–172.50	170.90 ± 1.823
4.	Incubation period in days	4.60–5.00	4.867 ± 0.231	4.60–6.10	5.33 ± 0.750
5.	Larval period				
	First instar	1.20-1.40	1.33 ± 0.115	1.20-1.30	1.267 ± 0.058
	Second instar	2.20–2.60	2.47 ± 0.231	2.20–2.40	2.33 ± 0.115
	Third instar	2.40-2.60	2.50 ± 0.018	2.20-2.80	2.53 ± 0.306
	Fourth instar	3.40–3.60	3.47 ± 0.115	2.80–3.40	3.067 ± 0.306
	Fifth instar	3.20–3.60	3.4 ± 0.200	3.40–3.60	3.50 ± 0.100
	Total larval period	12.80–13.60	13.27 ± 0.416	12.80–13.60	13.27 ± 0.416
6.	Pre-pupation period in days	1.40–1.80	1.60 ± 0.200	1.20–1.60	1.40 ± 0.200
7.	Pupation period in days	6.40–7.00	6.73 ± 0.305	6.00–6.80	6.40 ± 0.400
8.	Adult longevity in days				
	(a) Male	3.00–3.40	3.20 ± 0.200	3.20–3.60	3.33 ± 0.230
	(b) Female	4.4–4.6	4.47 ± 0.115	4.4–4.8	4.53 ± 0.230
9.	Total period taken from egg emergence to adult emergence in days				
	(a) Male	24.20–26.00	25.20 ± 0.916	24.20–25.20	24.70 ± 0.500
	(b) Female	28.60–30.40	29.67 ± 0.945	29.00–29.60	29.23 ± 0.321

\*Mean of three replications each consisting eggs-50, larvae and pupae-25 and adults-15 pair of male and female.

respectively, during 2009 and 2010. During both the years the length of third instar larvae of *L. orbonalis* varied from 9.10 to 9.412 and 9.20 to 9.46 with an average of  $9.279 \pm 0.161$  and  $9.36 \pm 0.140$ , respectively. The width varied from 1.974 to 2.114 and 1.21 to 2.11 with an average  $2.046 \pm 0.070$  and  $1.772 \pm 0.490$ , respectively.

During 2009, at 35°C and 90% RH the duration of fourth instar larvae lasted for 3.40 to 3.60 days with a mean of  $3.47 \pm 0.115$ . The length of fourth instar larvae varied from 14.306 to 14.488 with an average  $14.398 \pm 0.091$  and width varied from 2.84 to 2.876 with an average from  $2.858 \pm 0.018$ . Similarly, during 2010 at 35°C and 90% RH, the duration of fourth instar larvae varied from 2.80 to 3.40 days with a mean of  $3.067 \pm 0.306$  days. The length and breadth of fourth instar larvae varied from 14.32 to 14.52 mm and 2.84 to 2.876 mm with an average of  $14.435 \pm 0.099$  mm and  $2.858 \pm 0.018$  mm, respectively.

The final and fifth instars larvae was cylindrical in

shape and pinkish brown in colour having three distinct segments of thorax and five pair of well developed prolegs. The duration of fifth instar larvae lasted for 3.20 to 3.60 days on brinjal with a mean of  $3.40 \pm 0.200$  days. The length and breadth of fifth instar larvae varied from 21.14 to 21.33 mm and 3.77 to 3.896 mm with an average of  $21.21 \pm 0.101$  mm and  $3.816 \pm 0.069$  mm, respectively, during 2009 at 35°C and 90% RH. Similarly, in the year 2010 at same temperature and relative humidity the fifth instar larvae period varied for 3.40 to 3.60 days with a mean of  $3.50 \pm 0.100$  days, the length and breadth of fifth instar larvae varied from 21.18 to 21.37 mm and 3.79 to 3.912 mm with an average of  $21.247 \pm 0.106$  mm and  $3.840 \pm 0.063$  mm, respectively. Larval period of *L. orbonalis* was on an average of 13.20 days (ranged 12.80-13.60 days) and there were 5 larval instars. Singh and Singh (2001), Jat *et al.* (2003) and Pal *et al.* (2003) reported the similar trend however, Saxena (1965) and Allam *et al.* (1982), who recorded 6 larval instars.

**Table 2 :** Measurement of brinjal shoot and fruit borer, *L. orbonalis* at 35°C and 90% RH during 2009 and 2010.

S. no.	Stage	Measurement	2009		2010	
			Range (mm)	Average (mm)	Range (mm)	Average (mm)
1.	Egg	Length	0.872–0.898	0.883 ± <b>0.0136</b>	0.864–0.920	0.889 ± <b>0.028</b>
		Width	0.624–0.642	0.630 ± <b>0.010</b>	0.625–0.642	0.634 ± <b>0.008</b>
2.	Larva					
	First instar	Length	1.396–1.41	1.402 ± <b>0.007</b>	1.41–1.46	1.433 ± <b>0.025</b>
		Width	0.336–0.390	0.362 ± <b>0.0271</b>	0.34–0.39	0.363 ± <b>0.025</b>
	Second instar	Length	6.804–6.952	6.871 ± <b>0.075</b>	6.81–6.97	6.883 ± <b>0.080</b>
		Width	0.906–0.97	0.929 ± <b>0.035</b>	0.917–0.97	0.936 ± <b>0.029</b>
	Third instar	Length	9.10–9.412	9.279 ± <b>0.161</b>	9.20–9.46	9.36 ± <b>0.140</b>
		Width	1.974–2.114	2.046 ± <b>0.070</b>	1.21–2.11	1.772 ± <b>0.490</b>
	Fourth instar	Length	14.306–14.488	14.398 ± <b>0.091</b>	14.32–14.52	14.435 ± <b>0.099</b>
		Width	2.84–2.876	2.858 ± <b>0.018</b>	2.84–2.876	2.858 ± <b>0.018</b>
	Fifth instar	Length	21.14–21.33	21.21 ± <b>0.101</b>	21.18–21.37	21.247 ± <b>0.106</b>
		Width	3.77–3.896	3.816 ± <b>0.069</b>	3.79–3.912	3.840 ± <b>0.063</b>
3.	Pupa	Length	11.44–11.64	11.52 ± <b>0.105</b>	11.493–11.69	11.608 ± <b>0.102</b>
		Width	3.882–3.916	3.898 ± <b>0.017</b>	3.894–3.918	3.908 ± <b>0.012</b>
4.	Adult					
	(a) Male	Length	8.828–8.912	8.873 ± <b>0.042</b>	8.882–8.915	8.903 ± <b>0.018</b>
		Width	22.56–22.61	22.58 ± <b>0.023</b>	22.65–22.685	22.66 ± <b>0.018</b>
	(b) Female	Length	11.022–11.044	11.033 ± <b>0.011</b>	10.998–11.068	11.026 ± <b>0.037</b>
		Width	24.132–24.164	24.149 ± <b>0.016</b>	24.119–24.21	24.155 ± <b>0.048</b>

\*Mean of two replications each consisting eggs-50, larvae and pupae-30 and adults-10 pair of male and female.

### Pre-pupal period

Fully grown larva found its way for pupation which in laboratory conditions took place at the bottom of the glass jar or inside the top of the lid where cocoons formed and changed into pupa. The pre-pupal period of *L. orbonalis* was varied from 1.40 to 1.80 days and 1.20 to 1.60 days during 2009 and 2010 at 35°C and 90% RH, respectively, with an average mean pre-pupation period 1.60 ± 0.200 and 1.40 ± 0.200 days.

### Pupal period

The laboratory studies showed the pupa of *L. orbonalis* is dark brown in colour with wider cephalic and narrow anal end with eight hook shape fine spines at the posterior end of the abdomen. During 2009 and 2010 at 35°C and 90% RH, the pupal period lasted from 6.40 to 7.00 days and 6.00 to 6.80 days with an average 6.73 ± 0.305 and 6.40 ± 0.400 days, respectively. During 2009 and 2010 at 35°C and 90% RH, The length of *L. orbonalis* varied from 11.44 to 11.64 mm and 11.493 to 11.69 with a mean 11.52 ± 0.105 and 11.608 ± 0.102 mm, respectively, and width varied from 3.882 to 3.916 mm and 3.894 to 3.918 with a mean 3.898 ± 0.017 and 3.908

± 0.012 mm, respectively. Similar results on pupal period were reported by Pal *et al.* (2003).

### Adult

Adult of *L. orbonalis* emerged out of pupa in morning hours, remain motionless for a while and then starts flying in the glass jar under laboratory conditions. The adult moth was white in colour with blackish brown head and thorax. The female is slightly larger than male with a broader and dilated abdominal tip. The forewings were white with pinkish brown markings. During 2009 at 35°C and 90% RH, the wing expanse and length of male and female moth measured 22.56 × 8.828 mm and 24.132 × 11.022 mm, respectively. Similarly, the next year at same temperature and relative humidity the wing expanse and length of male and female moth measured 22.65 × 8.882 mm and 24.119 × 10.998 mm, respectively.

### Longevity of adult

During 2009 and 2010 at 35°C and 90% RH, the longevity of male was varied from 3.00 to 3.40 days and 3.20 to 3.60 days with a mean 3.20 ± 0.200 and 3.33 ± 0.230 days, respectively. During both the years at same temperature and relative humidity the longevity of female

of *L. orbonalis* was found to be ranged from 4.40 to 4.60 days and 4.40 to 4.80 days with an average  $4.47 \pm 0.115$  days and  $4.53 \pm 0.230$  days, respectively.

#### Duration of life cycle

The average duration of *L. orbonalis* from egg to adult emergence on brinjal during 2009 at 35°C and 90% RH, in case of male and female was  $29.67 \pm 0.945$  and  $25.20 \pm 0.916$  days, respectively. During 2010 at 35°C and 90% RH, the average duration occupied by the male and female was  $29.23 \pm 0.321$  and  $24.70 \pm 0.500$  days, respectively. Singh and Singh (2001), Jat *et al.* (2003) and Prakash *et al.* (2005) also observed similar results on biology of *L. orbonalis*. under laboratory conditions.

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