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Biology and morphometry of shoot and fruit borer, *Leucinodes orbonalis* (Guenee) on Brinjal, *Solanum melongena* (Mill.)

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Abstract

Biology of brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee), a major pest of brinjal was studied in the year 2015-2016 in the laboratory. The incubation period was 4.10 ± 0.88 days. Length and breadth were 0.64 ± 0.04 and 0.35 ± 0.02 mm, respectively. The duration of 1st, 2nd, 3rd, 4th and 5th larval instar was 1.33 ± 0.48 , 2.77 ± 0.43 , 2.56 ± 0.72 , $.03 \pm 0.85$ and 3.50 ± 0.80 days, respectively. The total larval duration was 13.20 ± 1.15 days, prepupal period 1.44 ± 0.50 days and the pupal period 8.7 ± 0.75 days. The full grown larvae measured 14.09 ± 1.01 mm in length and 3.34 ± 0.21 mm in breadth. The total developmental period was 27.43 ± 1.75 days. The adult longevity of the male and female was 3.27 ± 0.45 days and 5.23 ± 0.73 days, respectively. The pre-oviposition, oviposition and post oviposition periods were 1.17 ± 0.38 , 2.53 ± 0.51 and 2.63 ± 0.67 days, respectively. Body length of male and female was 8.54 ± 0.90 and 11.01 ± 0.71 mm, respectively. The fecundity was 160.2 ± 32.42 eggs per female and the sex ratio was 1:1.40 (male to female).

Keywords: Biology, Brinjal, *Leucinodes orbonalis*, Morphometry

Introduction

Brinjal (*Solanum melongena* L.) also known as aubergine or eggplant, is an important solanaceous vegetable crop, which is grown all over the world. It is grown throughout the year in one or other parts of the country as a continuous source of income to vegetable farmers. It is grown extensively in India, Bangladesh, Pakistan, China and other parts of the world. India ranks second in the world and its contribution is 27.1 per cent. 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 0.68 million ha with the total production of 12706 thousand MT^[1]. The productivity of brinjal is still below the expected due to various constraints of which insect and non-insect pests that attack the crop at various physiological growth stages from the nursery stage to harvest considered to be major one. Brinjal fruit and shoot borer, *Leucinodes orbonalis* (Guenee) (Lepidoptera: Pyralidae) is reported most destructive^[2] as the pest species may cause fruit damage as high as 95% and losses up to 70% in commercial plantings^[3]. Only the larva of this pest causes 12-16% damage to shoots and 20-60% to fruits^[4]. The study of biology of an insect provides the growth rate statistics, which can be used as a predictive basis for pest control. Hence, the present investigation on the study of biology of *Leucinodes orbonalis* on brinjal crop was undertaken in the Varanasi condition.

Materials and Methods

The biology of shoot and fruit borer was studied under the laboratory condition in the department of Entomology and Agricultural Zoology, BHU, Varanasi, U.P., India. To maintain culture, different stages of larvae were collected from brinjal field and confined in glass jars in the laboratory and daily fresh brinjal fruits were provided as a food. The pupae were kept in a glass jar for adult emergence. After adult emergence, the adult was provided with honey solution fortified with multivitamins and a twig of the brinjal plant inside a glass jar and the moist absorbent sponge was kept over muslin cloth in each jar to maintain humidity and for better egg laying. Eggs laid by the females on twigs and muslin cloth were removed daily with the help of moist camel hair brush and transferred to another petridish having a circular filter paper.

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After hatching of eggs, the larvae were transferred to petriplates immediately to record observations. The rearing of larvae was carried out individually in petriplates and observations pertaining to, larval period and pupal duration and total development were recorded. For calculating male and female longevity, pre-oviposition period, oviposition period, post-oviposition period, fecundity, the male and female adults were kept in glass jars. The length and breadth of eggs, different instars of larvae and pupae was measured by using a zoom stereomicroscope. In case of adults the body length was obtained by measuring the length from the anterior portion of the head to the tip of the last abdominal segment with the help of measuring scale. For measuring the wing span the insects were spread in a horizontal position and pinned on a standard setting board. The wing span was measured across, both at the tip of each fore wing with the help of measuring scale. Based on the visual characters like variation in the abdomen with projections in the female and the bigger size of the female than that of male, the insect were separated sex wise for sex ratio.

Results and Discussion

The data on the biology of different stages of brinjal shoot and fruit borer were presented in table 1 and 2 under laboratory condition.

Egg: The eggs of *L. orbonalis* (Guenee) were laid mostly single but sometimes in clusters three to eight eggs glued to the surface. Eggs were oval to elongate in shape freshly laid eggs were translucent and yellowish or light orange in colour. The average incubation period was 3-5 days with a mean of 4.10 ± 0.37 days, the average length and breadth of egg was 0.54 to 0.66 mm and 0.31 to 0.38 mm with a mean of 0.64 ± 0.0 mm and 0.35 ± 0.02 mm, respectively. These findings are in conformity with [5] observed that the incubation period lasted for 4.867 ± 0.231 days, [6] and [7] also found the similar results.

Larval period: Five larval instars were recorded in the present investigation under laboratory condition. The newly hatched larvae were cream to brownish pink in colour, it was cylindrical with a conspicuous head and had between 9 or 10 abdominal segments and they were highly mobile. The duration of first instar larvae lasted for 1 to 2 days with a mean of 1.34 ± 0.29 days. The length of first instar larvae varied from 1.21 to 1.40 mm with an average 1.31 ± 0.06 mm and width varied from 0.21 to 0.39 mm with an average from 0.32 ± 0.06 mm. As the stage advanced colour changed from light orange to pink and entered to the second instar. The second instar larvae were larger than first instar larvae and slightly dark in colour. The duration of second instar larvae lasted for 2 to 3 days with a mean of 2.77 ± 0.43 days the length and width of second instar larvae of *L. orbonalis* varied from 4.50 to 6.90 mm and 0.72 to 0.99 mm with an average of 6.03 ± 0.76 mm and 0.88 ± 0.06 mm, respectively. The third instar larvae yellowish brown in colour lasted for 2 to 4 days with a mean of 2.56 ± 0.72 days. It measured 8.0 to 10.25 mm in length and 1.24 to 2.66 mm in width with mean of 9.19 ± 0.79 and 1.92 ± 0.33 mm, respectively. Fourth instar larvae was brownish in colour varied from 2 to 4 days with an average of 3.03 ± 0.85 days. The length and width varied

from 10.0 to 14.31 mm and 2.04 to 3.0 mm with an average of 12.62 ± 1.33 and 2.69 ± 0.27 mm, respectively. The final and fifth instar larvae was cylindrical in shape and pinkish brown in colour having three distinct segments of thorax and five pairs of welldeveloped prolegs. The duration lasted for the period of 3 to 4 days with mean of 3.50 ± 0.51 days. The length and width varied from 12.23 to 15.50 mm and 3.0 to 3.8 mm with an average of 14.09 ± 1.01 and 3.34 ± 0.21 mm, respectively. Larval period ranged from 11 to 15 days with an average of 13.20 ± 1.15 and there were five larval instars (table 1 and 2). Earlier reported a larval period of 12.83 days which passed through five instars [7]. The larval period lasted for 13.27 ± 0.41 days [5], [8, 9, 10], reported similar trend however, [4] reported six larval instars.

Pre-pupal period: Mature larvae came out of their feeding tunnels and pupated in tough silken cocoons and remained inside. The pre pupal period varied from 1 to 2 days with mean of 1.43 ± 0.50 days. Length and width varied from 9 to 11 and 2.91 to 4.10 mm with an average of 9.76 ± 0.62 and 3.46 ± 0.37 mm, respectively.

Pupal period: The cocoon was light brown in colour later on changed to dark brown in colour. The pupal period lasted for 8 to 10 days with an average of 8.7 ± 0.75 days. Length of pupal cocoon was 10.0 to 14.01 mm with mean of 11.59 ± 1.58 mm and width varied from 3.33 to 5.58 mm with mean of 4.45 ± 0.64 mm. The observations are in agreement with those of [11, 7, 12, 13] reported pupal period completed in 8 days.

Adult: The adult moth was white in colour with blackish brown head and thorax. Females were slightly bigger than males. The abdomen of male moth tends to be pointed and curl upwards, whereas the female moth possesses a blunt abdomen. The female and male measured 23.62 ± 0.92 and 21.28 ± 0.67 mm across the spread of the wings and the body length of female and male measured 11.01 ± 0.71 and 8.54 ± 0.90 mm, respectively. Females lived longer (5.23 ± 0.73 days) than males (3.27 ± 0.45 days) the results corroborate the findings of [14, 9] revealed the longevity of male and female was 3.0 and 5.20 days. [5] Also found similar trends. The total developmental period from egg to adult was 23 to 31 days with a mean of 27.43 ± 1.75 days. The present results are in conformity with [5] found that total development completed in 25.20 ± 0.916 days. [8, 15] who also found similar results.

Pre-oviposition, oviposition, post- oviposition period, fecundity and sex ratio: Pre-oviposition and oviposition periods were 1.17 ± 0.38 and 2.53 ± 0.51 days. The post-oviposition period varied from 1 to 3 days with an average of 2.63 ± 0.67 days. [8] Observed similar results for the pre-oviposition, oviposition and post-oviposition period 1.19, 2.71 and 3.75 days, respectively. Pre-oviposition and oviposition period was 1.37 ± 0.09 and 2.04 ± 0.02 days reported by [6]. The fecundity varies from 78 to 186 eggs/female (average of 160.2 ± 32.42 eggs/female). Similar results were observed by [9, 11]. The sex ratio was observed 1:1.40 (male to female) which is in conformity with [16].

Table 1: Different developmental stages of *Leucinodes orbonalis*

Insect developmental stages	Duration (Days)	
	Range*	Mean \pm SD
Egg	3 - 5	4.10 \pm 0.88
Larval Period		
First instar	1 - 2	1.33 \pm 0.48
Second instar	2 - 3	2.77 \pm 0.43
Third instar	2 - 4	2.56 \pm 0.72
Fourth instar	2 - 4	3.03 \pm 0.85
Fifth instar	3 - 4	3.50 \pm 0.51
Total larval period	11 - 15	13.20 \pm 1.15
Pre-pupation	1 - 2	1.43 \pm 0.50
Pupa	8 - 10	8.7 \pm 0.75
Total Developmental Period	23 - 31	27.43 \pm 1.75
Adult		
Male	3 - 4	3.27 \pm 0.45
Female	4 - 6	5.23 \pm 0.73
Pre-oviposition Period	1 - 2	1.17 \pm 0.38
Oviposition period	2 - 3	2.53 \pm 0.51
Post-oviposition	1 - 3	2.63 \pm 0.67
Fecundity (eggs/female)	78 - 186	160.2 \pm 32.42
Sex ratio	1:1.35	

*Average of 20 observation

Table 2: Morphometrics of different stages of *Leucinodes orbonalis*

S. No	Insect stage	Length range in mm*	Width range in mm*
1.	Egg	0.54 - 0.66 (0.64 \pm 0.04)	0.31 - 0.38 (0.35 \pm 0.02)
Larvae			
2.	First instar	1.21 - 1.40 (1.31 \pm 0.06)	0.21 - 0.39 (0.32 \pm 0.06)
	Second instar	4.50-6.90 (6.03 \pm 0.76)	0.72-0.99 (0.88 \pm 0.06)
	Third instar	8.0-10.25 (9.19 \pm 0.79)	1.24-2.66 (1.92 \pm 0.33)
	Fourth instar	10.0-14.31 (12.62 \pm 1.33)	2.04-3.0 (2.69 \pm 0.27)
	Fifth instar	12.23-15.50 (14.09 \pm 1.01)	3.0-3.8 (3.34 \pm 0.21)
3.	Pre-pupa	9.0-11.0 (9.76 \pm 0.62)	2.91-4.10 (3.46 \pm 0.37)
Pupa			
4.	With cocoon	10.0-14.01 (11.59 \pm 1.58)	3.33-5.58 (4.45 \pm 0.64)
	Without cocoon	8.0-10.31 (8.77 \pm 0.70)	2.03-3.10 (2.77 \pm 0.32)
Adult			
5.	Male	7.4-10.2 (8.54 \pm 0.90)	20.0-22.2 (21.28 \pm 0.67)
	Female	10.0-12.5 (11.01 \pm 0.71)	21.86-24.87 (23.62 \pm 0.92)

*Average of 20 observation Figures in the parentheses are mean \pm S.D.

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