***Original Research Article***

**Biology of brinjal shoot and fruit borer *(Leucinodes orbonalis* Guenee*)* at room temperature**

**Abstract:**

The present study investigates the biology of the brinjal shoot and fruit borer (Leucinodes orbonalis Gue.) under normal room temperature conditions during 2022 and 2023. Key developmental parameters, including egg hatching, larval and pupal duration, fecundity and total life span, were recorded. Egg hatching percentage remained consistent at 54%, with an incubation period of 3-5 days (3.6 ± 0.40 days). The total larval period was 12.4 ± 0.60 days in 2022 and 13.4 ± 0.68 days in 2023, while the pupal period remained stable at 9 ± 0.45 days. The total developmental period varied from 23-30 days (26.4 ± 1.21 days) in 2022 to 22-26 days (23.8 ± 0.66 days) in 2023. Female fecundity ranged from 148-257 eggs (193.6 ± 23.82) in 2022 and 139-267 eggs (202 ± 25.52) in 2023. The sex ratio (Male: Female) varied slightly, being 0.83:1 in 2022 and 0.67:1 in 2023. The total lifespan was longer for females (31 days in 2022, 28.5 days in 2023) than males (29.5 days in 2022, 27 days in 2023).

**Keywords:** Brinjal shoot, fruit borer, biology, room temperature, developmental period, sex ratio

**Introduction**

Brinjal (*Solanum melongena* L.), belongs to family Solanaceae and native to India in South Asia during the 3rd century. It is also known as eggplant, aubergine or “King of vegetables”. The cytological studies have indicated that basic chromosomal number is 2n = 24 in most of varieties and species. Brinjal is susceptible to attack of various insect-pests from seedling to fruiting stage. The brinjal crop is attacked by about 140 species of insect pests in India and abroad (Dwivedi *et al.*, 2014), out of which, the Shoot and fruit borer (*Leucinodes orbonalis* Gue.), Hadda/spotted beetle (*Henosepilachna vigintioctopunctata*), Stem borer (*Euzophera perticella*), Ash weevils (*Myllocerus subfasciatus*), Brown leafhopper (*Cestius phycitis*) and Aphid (*Aphis gossypii*) are considered as major insect-pests of brinjal crop. In Asia, Shoot and fruit borer is the most harmful and the first ranked pest of India, Pakistan, Srilanka, Nepal, Bangladesh, Thailand, Philippines, Cambodia, Laos and Vietnam (AVRDC, 1994). Among the various pests it is highly monophagous, most destructive and considered as a key pest damaging brinjal crop from seedling stage to maturity throughout Asia. It is the major limiting factor causing 70-92% yield loss in brinjal farming (Patil P.D., 1990). Brinjal shoot and fruit borer causes the most damage from May to August and becomes less active in December and January. (Ghos and Senapati, 2009). Brinjal Shoot and fruit borer (*L*. *orbonalis*) is distributed throughout India, Bangladesh, Malaysia, Thailand, Burma, Srilanka and South Africa. Its eggs are creamy white in colour and laid singly or in group about 150-350 eggs on leaves, tender shoots, flowers and developing fruits. Its larvae are stout, pink coloured with sparsely distributed hairs on warts on the body and brownish head. It bores into tender shoots and fruits and cause withering. Attacked fruits are with boreholes plugged with excreta making unfit for consumption and losing their marketable values. Its egg incubation, larval and pupal period completed in 3-4, 15 and 6-8 days, respectively with 5 larval instars. Its pupa makes a boat shaped cocoon and emerges an adult with white wings with triangular brown and red markings on forewing. It is complete their entire life cycle within 17-50 days. The economic threshold level of Shoot and fruit borer in brinjal crop is estimated about 5% shoot and 10% fruit infestation (Shirale *et al.*, 2012) 5 or 8-10 moths/day/trap.

**Materials and Methods**

**Collection and Rearing of Insects**

To study the biology of the brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee), mass rearing was conducted in laboratory conditions at normal temperature. Infested brinjal fruits containing larvae were collected from a brinjal field and placed in glass Petri dishes (10 × 10 cm) lined with cut pieces of paper. Each Petri dish was covered with muslin cloth and secured with a rubber band to ensure aeration and containment. The food source was replaced every alternate day, maintaining hygienic conditions throughout the experimental period. The full-grown larvae emerging from the infested fruits pupated in spun cocoons, located at the periphery of muslin cloth covers and between paper folds. These pupae were transferred to separate glass Petri dishes for adult emergence. Upon eclosion, a single pair of male and female moths was introduced into individual glass chimneys containing black paper strips for oviposition. The adult moths were provided with a 10% sugar solution soaked in cotton, placed in watch glasses inside the chimneys. Each chimney was covered with muslin cloth and secured with a rubber band. Eggs laid by the moths were transferred onto egg-bearing paper strips placed inside glass Petri dishes (10 × 10 cm). Upon hatching, larvae were reared individually for an additional generation on brinjal fruit. The subsequent generation's eggs were used for detailed biological studies.

**Experimental Design and Observations Procedure**

For the biological observations of brinjal shoot and fruit borer, ten eggs per petri dish, replicated five times, were incubated at room temperature. Upon hatching, newly emerged first instar larvae (0-8 hours old) were transferred to larger glass Petri dishes (20 × 15 cm) and immediately fed on brinjal fruit slices. To prevent microbial contamination, food was replaced regularly. The ambient temperature and relative humidity (R.H.) during the rearing period were recorded using a dry and wet bulb thermometer.

**Biological Parameters Studied**

The following biological parameters of *Leucinodes orbonalis* were recorded:

1. Egg hatching (%)
2. Incubation period (days)
3. Larval period
4. Pre-pupation period
5. Pupal period
6. Total developmental period
7. Pre-oviposition period
8. Oviposition period
9. Post-oviposition period
10. Fecundity (eggs per female)
11. Sex ratio (Male: Female)
12. Total life span of male and female

**Results and Discussion**

The present study on the biology of the brinjal shoot and fruit borer, *Leucinodes orbonalis* Gue., conducted under normal room temperature conditions during 2022 and 2023, revealed key insights into its developmental parameters. The egg hatching percentage ranged from 40-70%, with a mean of 54%, while the incubation period was stable at 3-5 days (3.6 ± 0.40 days). The total larval period varied slightly across years, with duration of 12.4 ± 0.60 days in 2022 (Table 1) and 13.4 ± 0.68 days in 2023. The pupal period was relatively stable at 8-10 days (9 ± 0.45 days) and the total developmental period ranged from 23-30 days (26.4 ± 1.21 days) in 2022 and 22-26 days (23.8 ± 0.66 days) in 2023. The fecundity of females varied between 148-257 eggs (193.6 ± 23.82 eggs) in 2022 and 139-267 eggs (202 ± 25.52 eggs) in 2023 (Table 2).

Comparing these findings with previous studies, several similarities and differences can be observed. Laichattiwar *et al.* (2017) reported an incubation period of 3-5 days (4.10 ± 0.88 days), which aligns with the present study. However, their study recorded a total larval period of 11-15 days (13.20 ± 1.15 days). The pupal period recorded in their study (8.7 ± 0.75 days) is consistent with the findings of the present study. Similarly, Wali *et al.* (2022) observed an incubation period of 3-5 days (3.8 ± 0.76 days) and a larval period of 11-15 days (13.87 ± 1.04 days), which are in close agreement with the present study. Their study reported a total developmental period of 22-32 days (27.35 days), slightly longer than the values observed in 2023 but consistent with 2022. Furthermore, their findings on fecundity (147-262 eggs, with a mean of 197.3 ± 37.17 eggs) are closely aligned with the values recorded in the present study. Khan *et al.* (2018) recorded an incubation period of 4.2-5.6 days (4.8 days), slightly longer than the findings of the present study. Their reported larval period ranged from 10.5-14.3 days (12.20 days), which aligns well with the present findings. Their total developmental period ranged from 22.60-73.09 days, suggesting significant variability in environmental influences. Chiranjiva *et al.* (2023) reported a longer total larval period (13-20 days, mean 16.8 ± 2.41 days) and a pupal period of 9-15 days (12.3 ± 1.76 days), indicating a slight variation from the present study, possibly due to differences in environmental conditions. Their total developmental period (31-39 days, mean 34.9 ± 2.19 days) was also longer than the present findings, which could be attributed to laboratory conditions differing from natural room temperature settings. Variations in the developmental stages of *Leucinodes orbonalis* Gue. across different studies can be attributed to several factors, including environmental conditions, host plant varieties, and rearing methodologies.

**Conclusion**

The present study provides valuable insights into the developmental biology of *Leucinodes orbonalis* Gue. under normal room temperature conditions. The findings indicate that the species exhibits a total developmental period ranging from 22 to 30 days, with slight variations between years. The egg hatching percentage, incubation period, larval and pupal durations, as well as fecundity, were consistent with previous studies (Laichattiwar *et al.*, 2017; Wali *et al.*, 2022; Khan *et al.*, 2018), though minor variations were observed due to environmental factors. Comparisons with Chiranjiva *et al.* (2023) suggest that laboratory-controlled conditions may lead to longer developmental periods compared to natural room temperature environments.

Future research should focus on assessing the influence of climatic variability on the life cycle parameters of *L. orbonalis* Gue. across diverse agro-climatic zones. Additionally, molecular and genetic studies could provide deeper insights into the adaptive mechanisms of this pest under fluctuating environmental conditions. Investigations into host plant resistance, natural enemy interactions, and integrated pest management strategies would further enhance sustainable control measures. These future directions will contribute to a more comprehensive understanding of *L. orbonalis* Gue. ecology and facilitate the development of targeted pest management interventions for brinjal cultivation.

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**Table 1: Biology of brinjal shoot and fruit borer *(L. orbonalis*) in normal room temperature during 2022**

|  |  |  |  |
| --- | --- | --- | --- |
| **Life stages** | | **Range** | **Mean ± S.D.** |
|
| **Egg hatching (%)** | | 40-70 | 54 ± 0.51 |
| **Incubation Period (in days)** | | 3-5 | 3.6 ± 0.40 |
| 1st instar larva (in days) | | 1-2 | 1.4 ± 0.25 |
| 2nd instar larva (in days) | | 2-3 | 2.4 ± 0.25 |
| 3rd instar larva (in days) | | 2-4 | 2.8 ± 0.37 |
| 4th instar larva (in days) | | 2-4 | 3 ± 0.32 |
| 5th instar larva (in days) | | 3-4 | 3.2 ± 0.20 |
| Total Larval Period | | 10-13 | 12.4 ± 0.60 |
| Pre-pupation | | 1-2 | 1.4 ± 0.25 |
| Pupal Period | | 8-10 | 9 ± 0.45 |
| **Total Development Period** | | 23-30 | 26.4 ± 1.21 |
| Adult Male | | 2-4 | 2.8 ± 0.37 |
| Adult Female | | 3-6 | 4.6 ± 0.51 |
| Pre-oviposition period | | 1 | 1 ± 0.00 |
| Oviposition period | | 2-4 | 2.8 ± 0.37 |
| Post-oviposition period | | 1-2 | 1.4 ± 0.25 |
| Fecundity (eggs/female) | | 148-257 | 193.6 ± 23.82 |
| Sex ratio (Male:Female) | | **0.83:1** | |
| **Total life span** | **Male** | 25-34 | 29.5 |
| **Female** | 26-36 | 31 |

**Table 2: Biology of brinjal shoot and fruit borer *(L. orbonalis*) in normal room temperature during 2023**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Life stages** | | **Range**  **(days)** | **Mean ± S.D.**  **(days)** | |
| **Egg hatching (%)** | | 40-70 | 54 ± 0.51 | |
| **Incubation Period (in days)** | | 3-5 | 3.6 ± 0.40 | |
| 1st instar larva (in days) | | 1-2 | 1.4 ± 0.25 | |
| 2nd instar larva (in days) | | 2-3 | 2.4 ± 0.25 | |
| 3rd instar larva (in days) | | 2-4 | 2.8 ± 0.37 | |
| 4th instar larva (in days) | | 2-4 | 3.2 ± 0.37 | |
| 5th instar larva (in days) | | 3-4 | 3.6 ± 0.25 | |
| Total Larval Period | | 11-15 | 13.4 ± 0.68 | |
| Pre-pupation | | 1-2 | 1.4 ± 0.25 | |
| Pupal Period | | 8-10 | 9 ± 0.45 | |
| **Total Development Period** | | 22-26 | 23.8 ± 0.66 | |
| Adult Male | | 2-4 | 2.8 ± 0.37 | |
| Adult Female | | 3-6 | 4.6 ± 0.51 | |
| Pre-oviposition period | | 1 | 1 ± 0.00 | |
| Oviposition period | | 2-4 | 2.8 ± 0.37 | |
| Post-oviposition period | | 1-2 | 1.4 ± 0.25 | |
| Fecundity (eggs/female) | | 139-267 | 202 ± 25.52 | |
| Sex ratio (Male:Female) | | **0.67:1** | |
| **Total life span** | **Male** | 24-30 | 27 | |
| **Female** | 25-32 | 28.5 | |