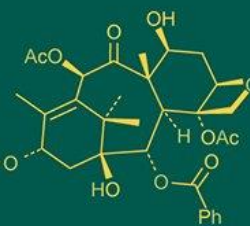
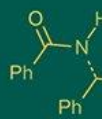


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## Bio-ecology of brinjal shoot and fruit borer, (*Leucinodes orbonalis*) under laboratory conditions

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### Abstract

The present study was conducted to evaluate biology, of brinjal shoot and fruit borer and under laboratory condition season 2025 at Kamla Nehru Institute of Physical & Social Science Sultanpur U.P Biological studies indicated that the total life cycle ranged from  $29.19 \pm 1.55$  to  $30.5 \pm 3.35$  days, with an incubation period of  $3.85 \pm 1.05$  days, larval period of  $16.55 \pm 1.90$  days, and pupal period of  $8.65 \pm 1.45$  days. The average fecundity was  $147.91 \pm 48.50$  eggs per female, with a sex ratio of 1:1.00. Morphometric observations showed gradual increase in size across larval instars, confirming normal growth and development.

**Keywords:** Brinjal, *Leucinodes orbonalis*, biology

### Introduction

Brinjal or eggplant (*Solanum melongena* L.) is one of the most important. Solanaceous vegetable crops having diploid chromosome number  $2n = 2x-24$ . It is grown in the tropics and subtropics of India and other parts of the world. It is called Brinjal in India and Aborigine in Europe. It is widely grown in India, Japan, Indonesia, China, Bulgaria, Italy, France, USA, Pakistan, Bangladesh, Philippines, and several African countries. It is also known as the poor man's crop because of its high productivity and wide adaptability

Brinjal, an annual herbaceous plant has inflorescence with a cluster of 2-5 flowers. Solitary and cluster type are found. Heterostyly is common feature, four types of flowers have been reported depending upon the length of style, there are long styled with large ovary, medium styled with medium ovary, pseudo styled with rudimentary ovary and true short styled with very rudimentary ovary. Fruit setting in long style is 70-85% while medium style varies from 12-15%.

Brinjal is almost cultivated in India except higher altitudes. It is susceptible to severe frost. A long and warm growing season with a mean temperature of  $20-30^\circ\text{C}$  is most favourable for its successful production. In northern India it is adversely affected during December to February due to low night temperature. Optimum temperature for growth and fruit set is  $15.5-21.1^\circ\text{C}$ . Usually round fruited varieties are more susceptible to frost than long fruited varieties.

Young caterpillar bores into tender shoots near the growing point, into flower, flower buds or into fruits. When available, fruits are preferred, one caterpillar may destroy as many as 4-6 fruits. Both nymphs and adults of leaf hopper *Amrasca devastans* (Cicadellidae: Hemiptera) suck the sap from the lower leaf surfaces through their piercing and sucking mouth parts. While sucking the plant sap. They also inject toxic saliva into the plant tissues, which leads to yellowing. When several insects suck the sap from the same leaf, yellow spots appear on the leaves, followed by crinkling, curling, bronzing, and drying, or hopper burn. Among the sucking pests, whitefly *Bemisia tabaci*, (Aleyrodidae: Hemiptera) is a serious pest. They suck the sap from under surface of leaves which result in chlorotic spots and are also dropped pre-maturely. It also acts a vector of yellow mosaic virus. Thrips, palmi (Thripidae: Thysanoptera) prefer to feed mostly on foliage, sometimes on fruit. Slightly infested leaves exhibit silvery feeding scars on the lower leaf surfaces, especially along the mid-rib and veins. In severe infestations, the leaves turn yellow or brown and dry on the lower leaf surfaces.

Aphid, *Aphis gossypii* (Aphididae: Hemiptera), both the nymphs and adults possess piercing and sucking mouthparts. They occur in large numbers on the tender shoots and lower leaf surfaces, and suck the plant sap. In the tropics, eggplant production is severely constrained by several insect and pests. The major pests include eggplant shoot and fruit borer, leafhopper, whitefly, thrips and aphid, shoot and fruit borer *Leucinodes orbonalis* (Pyralidae: Lepidoptera) is one of the most destructive pest of eggplant. The Slightly infested leaves exhibit yellowing.

Brinjal is low in calories and rich in macro-and micro-minerals beneficial to human health. The fruit contains high levels of potassium (200-600 mg/100 g of fresh fruit), as well as iron, calcium, and magnesium. It also comprises 92.7% moisture, organic acids, and vitamins such as vitamin A (12.4 IU), vitamin C (12.0 mg), and vitamin B1 (0.04 mg). In Ayurveda, brinjal is used as a cardi tonic, appetizer, and remedy for balancing vita and kapha. It is also reported to benefit people with diabetes by enhancing intrahepatic metabolism of blood cholesterol, there reducing cholesterol levels. This effect is attributed to minerals like magnesium and potassium, as well as polyunsaturated fatty acids such as linoleic acid.

### Materials and Methods

The present investigation Entitled “Bio-ecology brinjal shoot And fruit borer (*Leucinodes orbonalis*)” was conducted at The Student’s Instructional Farm and Vegetable Research Farm, Kamla Nehru Institute of Physical & Social Sciences, Sultanpur (U.P.).

### Biology of brinjal shoot

Larvae of the brinjal shoot and fruit borer, *Leucinodes orbonalis*, were collected from the Student’s Instructional Farm and reared individually in plastic vials containing fresh brinjal fruits. Food was replaced daily until pupation. Fully grown larvae were transferred to sterilized sand-filled glass jars for pupation. Emerged adults were sexed and paired in glass jars supplied with a 10% honey solution and fresh brinjal twigs for oviposition.

Eggs, larvae, pupae, and adults were observed daily to record incubation period, larval duration, pupal period, adult longevity, and reproductive parameters. The study was conducted under laboratory conditions at  $25 \pm 1^\circ\text{C}$  to  $30 \pm 1^\circ\text{C}$  with suitable relative humidity.

### Eggs

Every morning, prior to hatching, ten freshly laid eggs were observed daily to determine the average incubation period. The emergence of a minute larva from the egg was considered as egg hatching, and such larvae were referred to as neonate larvae

### Larva

Observations on larvae were recorded immediately after hatching. The different larval instars were distinguished based on their morph metric characteristics. A total of five larval instars were observed during development. First-instar larvae were reared in petri dishes containing tender brinjal buds and soft leaves. From the second instar onwards, larvae of *L. orbonalis* were provided with soft slices of brinjal fruits as food, which were replaced daily. The duration from egg hatching until the onset of pupation was considered as the larval period.

### Pupa

Larvae were kept undisturbed to complete their larval development and subsequently pupated inside the petri dishes. The period from pupation to the emergence of the adult moth (eclosion) was recorded as the pupal period.

### Adult

The freshly emerging adults were kept similar by feeding them a 10% honey solution cotton swabs in order to evaluate adult longevity. From the moment of eclosion till death, the adult lifetime was documented.

### Results and Discussion

The present investigation Entitled “Bio-ecology brinjal shoot And fruit borer (*Leucinodes orbonalis*)” was conducted at The Student’s Instructional Farm and Vegetable Research Farm, Kamla Nehru Institute of Physical & Social Sciences, Sultanpur (U.P.).

### Biology of brinjal shoot & fruit borer

The present study generated detailed observations on the biology and morpho metry of the experimental insect species under laboratory conditions. The findings are presented below:

### Duration of Developmental Stages

The incubation period of eggs ranged from 3 to 5 days, with a mean duration of  $3.85 \pm 1.05$  days. After hatching, the larvae passed through five distinct instars.

- The duration of different larval instars was recorded as follows:
- The first instar lasted for 1-3 days, with a mean of  $1.65 \pm 0.67$  days.
- The second instar ranged from 2-4 days (Mean:  $2.3 \pm 1.15$  days).
- The third instar lasted 3-4 days (Mean:  $3.45 \pm 0.74$  days).
- The fourth instar ranged from 3-5 days (Mean:  $4.21 \pm 0.83$  days).
- The fifth instar lasted 4-5 days (Mean:  $4.73 \pm 0.58$  days).

The total larval period ranged from 15 to 21 days, with an average duration of  $16.55 \pm 1.90$  days.

The pupal period varied from 7 to 11 days, with a mean of  $8.65 \pm 1.45$  days.

Adult longevity showed slight variation between sexes. The male adults survived for 2-4 days (Mean:  $3 \pm 0.95$  days), whereas female adults lived for 3-4 days (Mean:  $3.4 \pm 0.5$  days).

The total life cycle duration ranged from 25 to 35 days in males (Mean:  $30.5 \pm 3.35$  days) and 26 to 36 days in females (Mean:  $29.19 \pm 1.55$  days).

Reproductive periods were also recorded. The pre-oviposition period ranged from 1-2 days (Mean:  $1.5 \pm 0.50$  days), the oviposition period from 2-3 days (Mean:  $2.5 \pm 0.50$  days), and the post-oviposition period from 1-2 days (Mean:  $1.5 \pm 0.50$  days).

The fecundity ranged between 80 and 200 eggs per female, with a mean of  $147.91 \pm 48.50$  eggs.

The sex ratio was recorded as 1:1.00, indicating an equal proportion of males and females.

**Table 1:** Developmental period of various life stages of *Leucinodes orbonalis*

| Biological Parameters           | Mean $\pm$ SD      | Range  |
|---------------------------------|--------------------|--------|
| Egg                             | 3.3 $\pm$ 0.65     | 3-5    |
| Incubation Period               | 3.85 $\pm$ 1.05    | 3-5    |
| Larval Period-I Larval Instar   | 1.65 $\pm$ 0.67    | 1-3    |
| Larval Period-II Larval Instar  | 2.3 $\pm$ 1.15     | 2-4    |
| Larval Period-III Larval Instar | 3.45 $\pm$ 0.74    | 3-4    |
| Larval Period-IV Larval Instar  | 4.21 $\pm$ 0.83    | 3-5    |
| Larval Period-V Larval Instar   | 4.73 $\pm$ 0.58    | 4-5    |
| Total Larval Period             | 16.55 $\pm$ 1.90   | 15-21  |
| Pupal Period                    | 8.65 $\pm$ 1.45    | 7-11   |
| Adult Longevity-Male            | 3 $\pm$ 0.95       | 2-4    |
| Adult Longevity-Female          | 3.4 $\pm$ 0.5      | 3-4    |
| Total Life Cycle-Male           | 30.5 $\pm$ 3.35    | 25-35  |
| Total Life Cycle-Female         | 29.19 $\pm$ 1.55   | 26-36  |
| Pre-Oviposition Period          | 1.5 $\pm$ 0.50     | 1-2    |
| Oviposition Period              | 2.5 $\pm$ 0.50     | 2-3    |
| Post-Oviposition Period         | 1.5 $\pm$ 0.50     | 1-2    |
| Fecundity                       | 147.91 $\pm$ 48.50 | 80-200 |
| Sex Ratio                       | 1:1.00             | 1:0.66 |

### Morphometric

The Morphometric measurements of different life stages indicated a progressive increase in size with advancement in developmental stages.

The egg measured 3.04  $\pm$  2.30 mm in length and 0.26  $\pm$  0.06 mm in breadth.

### The larval measurements were as follows

The first instar larva measured 1.42  $\pm$  0.01 mm in length and 0.34  $\pm$  0.05 mm in breadth.

The second instar larva measured 3.8  $\pm$  0.58 mm in length and 0.43  $\pm$  0.28 mm in breadth.

The third instar larva measured 7.33  $\pm$  0.16 mm in length and 1.48  $\pm$  0.08 mm in breadth.

The fourth instar larva measured 12.98  $\pm$  1.01 mm in length and 2.38  $\pm$  0.18 mm in breadth.

The fifth instar larva measured 17.42  $\pm$  1.30 mm in length and 3.52  $\pm$  0.27 mm in breadth.

The pupa measured 12.74  $\pm$  1.80 mm in length and 3.98  $\pm$  1.38 mm in breadth.

Among adults, the male measured 10.23  $\pm$  2.05 mm in length and 18  $\pm$  2.58 mm in breadth, whereas the female measured 12.00  $\pm$  1.85 mm in length and 12.08  $\pm$  9.45 mm in breadth.

**Table 2:** Morphometric of different life stages of *Leucinodes orbonalis*

| S. No. | Stage        | Length (mm)      | Breadth (mm)     |
|--------|--------------|------------------|------------------|
| 1      | Egg          | 3.04 $\pm$ 2.30  | 0.26 $\pm$ 0.06  |
| 2      | I Instar     | 1.42 $\pm$ 0.01  | 0.34 $\pm$ 0.05  |
|        | II Instar    | 3.8 $\pm$ 0.58   | 0.43 $\pm$ 0.28  |
|        | III Instar   | 7.33 $\pm$ 0.16  | 1.48 $\pm$ 0.08  |
|        | IV Instar    | 12.98 $\pm$ 1.01 | 2.38 $\pm$ 0.18  |
|        | V Instar     | 17.42 $\pm$ 1.30 | 3.52 $\pm$ 0.27  |
| 3      | Pupa         | 12.74 $\pm$ 1.80 | 3.98 $\pm$ 1.38  |
| 4      | Adult Male   | 10.23 $\pm$ 2.05 | 18 $\pm$ 2.58    |
|        | Adult Female | 12.00 $\pm$ 1.85 | 12.08 $\pm$ 9.45 |

### Discussion

The results of the present investigation clearly indicate that the insect undergoes complete metamorphosis, comprising egg, and larval, pupal, and adult stages.

The incubation period of 3-5 days reflects rapid embryonic development under laboratory conditions. The larval stage was found to be the longest phase of the life cycle, contributing the major proportion of total developmental time (mean 16.55 days). The gradual increase in duration from the first to fifth instar is characteristic of holometabolous insects, where later instars require more time for feeding and growth.

The fifth instar exhibited the longest duration, suggesting maximum feeding activity and accumulation of reserves prior to pupation. The pupal period (mean 8.65 days) represents a relatively stable and nonfeeding stage during which transformation into the adult form occurs. Minor variations observed in pupal duration may be attributed to environmental factors such as temperature and humidity.

Adult longevity was comparatively short, with females living slightly longer than males. This difference may be associated with reproductive requirements, as females need additional time for egg laying.

The total life cycle duration (approximately 29-31 days) indicates that the species is capable of completing multiple generations in a year, especially under favorable environmental conditions. This characteristic suggests a high potential for population increase.

The reproductive parameters further support this observation. The relatively high fecundity (up to 200 eggs per female) indicates strong reproductive potential, while the balanced sex ratio (1:1) ensures population stability and continuity.

Morphometric observations showed a consistent increase in body size with each successive larval instar, confirming normal growth and development. The significant increase in length and breadth from the first to fifth instar reflects active feeding and biomass accumulation. The pupal stage exhibited a compact structure, whereas adults showed sexual dimorphism, with females generally larger than males.



I Instar



II Instar



III Instar



IV Instar



V Instar



Pupa



Adult

### Summary and conclusions

The insect completed its life cycle in about 29-31 days, exhibiting complete metamorphosis.

- Egg stage: 3-5 days
- Larval period: 15-21 days (longest stage)
- Pupal period: 7-11 days
- Adult longevity: 2-4 days

The species showed high fecundity (up to 200 eggs/female) and a balanced sex ratio (1:1), indicating strong reproductive potential and capacity for rapid multiplication. Morphometric observations confirmed progressive growth across larval instars, with the fifth instar being the most active feeding stage.

### Conclusions

The pest has a short life cycle, moderate fecundity, and rapid larval development, enabling quick population build-up under favourable conditions. Therefore, early detection and timely management of egg and larval stages are essential for effective control in brinjal crops.

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