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The Life Cycle of Shoot and Fruit Borer *Leucinodes orbonalis* (Guen.) on Eggplant in different Seasons under Samastipur conditions of Bihar, India

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ABSTRACT: Shoot and fruit borer (*Lucinodes orbonalis* G.) is considered the most destructive pest of brinjal. The experiment on the life cycle of shoot and fruit borer was accompanied during *Rabi* 2019-20 and *Kharif* 2021 in the Department of Entomology, RPCAU, Pusa, Bihar, India. The matured larvae were collected from the field for the experiment of the life cycle in both the season. The results during *Rabi* 2019-20 exhibited that the incubation period was documented as 3.93 days. The growth periods of 1st, 2nd, 3rd, 4th and 5th instar larvae were noticed as 2.60, 2.68, 3.36, 3.85 and 3.95 days. The complete larval duration was documented as 15.86 days whereas the mean pupal period was recorded as 5.76 days. The Pre-oviposition was detected at 1.51 days whereas the oviposition period was observed at 2.95 days. The longevity of the male moth was recorded at 4.05 days whereas the female was 5.50 days. In the case of *Kharif* 2021, the incubation period was noticed as 3.86 days. The developmental periods of 1st, 2nd, 3rd, 4th and 5th instar larvae were noticed as 2.01, 1.83, 2.18 2.73 and 3.15 days. The complete larval period was recorded as 11.83 days whereas the pupal period was documented as 5.28 days. The Pre-oviposition was detected at 1.30 days whereas the oviposition period was observed at 2.00 days. The longevity of the male moth was recorded at 3.41 days whereas the female was 4.55 days. The life cycle of shoot and fruit borer provides the growth rate of insects, which can be used for predicting sources for pest management.

Keywords: Shoot and fruit borer, life cycle, incubation period, pest management.

INTRODUCTION

In India, vegetables are the most important dietary component which supplies essential minerals, vitamins, and amino acids. The cultivated eggplant (*Solanum melongena* L.) be a member of the Solanaceae family. It is one of the dominant, popular, principal crop grown in humid and sub-humid regions of the earth. It is cultivated throughout the year, even in the hot summer season, and contributes 17.8 per cent to the overall production of vegetables in India. The eggplant is defined as a poor man's vegetable due to its popularity among the diminutive farmers and middle-class people but also termed as 'King of vegetables'.

Shoot and fruit borer is one of the most dangerous pest in brinjal production. It is more vigorous during the hot weather conditions, mainly during the rainfall period than the cooler season (November to February) due to the influence of climatic conditions on the life cycle. It takes more time to complete its life period in winter than summer months. Shoot and fruit borer causes severe loss to the fruits in autumn and the entire crop can be devastated. The population of *L. orbonalis* increases by average temperature, relative humidity, and precipitation. Hence, fecundity increases and the duration of the life cycle decreases when temperature increases and humidity decreases (Anon., 2003). The losses caused by *L. orbonalis* vary from season to season depending upon climatic conditions (Patel *et al.*, 1988).

The life cycle of shoot and fruit borer supplies the growth rate of insects, which can be used for predicting sources for pest management. The life cycle of shoot and fruit borer varies from palce to place and season to season. Bindu *et al.*, (2013) reported that the different life stages such as incubation period 3.8 days, total larval stage 16.2 days and pre-oviposition period 1.81 days and oviposition days 2.55 days. The total pupal stage was 8.6 days. The longevity of adult moth was 4. Days and female 5.8 days. The total life duration was 35.2 days. In this view, detailed information about the life cycle of brinjal shoot and fruit borer has given below.

MATERIALS AND METHODS

Culturing of insect. The experiment on the life cycle of the shoot and fruit borer was conducted in the Department of Entomology, RPCAU, Pusa, Bihar, India. The shoot and fruit borer larvae were collected from the brinjal field and shifted to plastic containers that contain fresh pieces of brinjal fruit, which were closed with a muslin cloth to confine the larvae inside and the food was changed daily in the morning time to avoid fungal infection until the 5th instar larvae entered

for pupation. The matured larvae were transferred to another jar, comprising sand covered by muslin cloth for pupation. Water was sprinkled over the sand to provide sufficient moistness for the survival of pupae. The sand was autoclaved to prevent any contamination before larvae were kept for pupation.

The adult moths were kept for pairing on the same day of emergence from pupae. A single pair of male and female moths were released in a separate glass jar covered by muslin cloth for oviposition. Ten containers were used for the life cycle study. The eggs were used for the assessment of biological studies. The experiment was conducted at room temperature and observations made on:

Egg stage. To record the egg stage, newly laid eggs were examined daily until the emergence of fresh larvae.

Larval stage. Ten newly emerged larvae were shifted by camel hairbrush into plastic vials consisting of pieces of brinjal. The food was changed daily in the morning hours in the vials to avoid fungal contamination. The larvae were considered mature when they stopped feeding and became sedentary as the cessation of the larval stage and beginning of the pupal stage occurred.

Pupal stage. The completely matured larvae were transferred to small vials containing a moist layer of sterilized sand and the pupal duration was recorded.

Oviposition duration and egg-laying capacity. The mated females were considered as the existence of a cluster of hairs at the proximal end of abdomen and increased body size where males were reduced in size and lack of abdominal cluster of hairs. A couple of adults were kept in each plastic jar closed with a black colour chart on the top and the cotton swabs which were dipped in 5% honey solution were kept inside the jar to afford food to the adult moths. The oviposition duration and egg-laying capacity were recorded with these couple of adult moths. The total numbers of eggs were counted to calculate the egg-laying capacity of the female.

Adult stage. Both male and female moths were observed from emergence until death to record adult duration.

RESULTS AND DISCUSSION

Life cycle studies of *L. orbonalis*

Incubation period. The eggs of *L. orbonalis* were laid in oval-shaped and creamy white. They laid eggs singly or in batches of 6 to 7 on the lower surface of the brinjal leaves or muslin cloth. The eggs changed into dark orange with a noticeable dark spot at the tip of the egg when the egg was about to hatch. The incubation period was recorded 3.93 days in *Rabi* 2019-20 and 3.86 days in *Kharif* 2021. Wankhede *et al.,* (2009) recorded that the incubation period was around 3.80 days in *Kharif* whereas it was 4.30 days reported by Jat *et al.,* (2003). Kumar *et al.,* (2011) was recorded an egg duration of 3.66 days. Van Hung *et al.,* (2020) was reported the egg duration 5-6 days in winter (Table 1&2).

Table 1: The life cycle of *L. orbonalis* in *Rabi* season 2019-20.

Development stages	Maximum (days)	Minimum (days)	Development duration (days) Mean ± SD
Incubation period	6.5	3	3.93 ± 1.03
1st instar	3.5	1.5	2.60 ± 0.13
2nd instar	3.0	1.5	2.68 ± 0.17
3rd instar	3.5	2.0	3.36 ± 0.51
4th instar	4.5	2.0	3.85 ± 0.50
5th instar	5.5	2.5	3.95 ± 0.45
Total larval period (days)	19.5	12.5	15.86 ± 0.96
Pupal period (days)	8.5	3.0	5.76 ± 0.94
Pre-oviposition period (days)	2.5	1.0	1.51 ± 0.15
Oviposition period (days)	4.0	2.0	2.95 ± 0.08
Adult longevity (days)			
Male	5.5	3.5	4.05 ± 0.30
Female	7.0	4.0	5.50 ± 0.52

Larval period. The larvae after emergence, moulted 4 times and passed 5 instars during the larval stage. The number of moults were represented by exuviae formed during ecdysis. The freshly emerged larva was creamy white whereas matured larvae were tubular shaped and pinkish. The larvae had a dark brown head capsule with robust mandibles.

There were three dissimilar segments with 3 pairs of well-developed thoracic legs. The prolegs were located on the 3,4,5,6 and 10th abdominal segments. The total larval period was recorded 15.86 days in *Rabi* 2019-20 and 11.83 days in *Kharif* 2021. The total larval period was recorded as 12.83 days by Jat *et al.,* (2003) whereas 15.72 days by Kumar *et al.* (2011). And also Van hung *et al.,* (2020) reported 10-12 days in winter.

First instar. The first instar larvae were creamy white. The duration of first instar larvae was documented as 2.60 days in *Rabi* 2019-20 and 2.01 days in *Kharif* 2021. Varma and Anandhi, (2009) recorded that the first instar larval period of 1.40 days of *L. orbonalis* on brinjal. Bindu *et al.,* (2013) was reported a first instar period of 2.6 days whereas it was around 1.33 days reported by Laichattiwar *et al.,* (2017).

Second instar. The second instar larvae directly started feeding on fresh brinjal pieces and formed regular holes in the brinjal pieces packed with faecal matters.

The larvae discontinued the feeding a few minutes before ecdysis. The duration of the second instar was recorded 2.68 days in *Rabi* 2019-20 and 1.83 days in *Kharif* 2021. Varma and Anandhi, (2009) were recorded that the second instar larval period of 2.00 days of *L. orbonalis* on brinjal. The second instar larval period was around 2.8 days reported by Bindu *et al.,* (2013) whereas it was 2.77 days as reported by Laichattiwar *et al.,* (2017).

Third instar. The third instar larvae had small brown spots on the dorsal and ventral sides of the body. The number of spots was more on the dorsal region than the ventral region and every spot had fine bristle. The period of the third instar was documented as 3.36 days in *Rabi* 2019-20 and 2.18 days in *Kharif* 2021. The third instar larval period of 1.90 days of *L. orbonalis* on brinjal was recorded by Varma and Anandhi, (2009) whereas it was 3.2 days as reported by Bindu *et al.,* (2015). Laichattiwar *et al.,* (2017) recorded the third instar larval period to be around 2.56 days.

Fourth instar. The fourth instar larvae fed voraciously. The duration of the fourth instar larva was recorded at 3.85 days in *Rabi* 2019-20 and 2.73 days in *Kharif* 2021. The fourth instar larval period of 1.90 days of *L. orbonalis* on brinjal was reported by Varma and Anandhi, (2009) whereas it was around 3.4 days as reported by Bindu *et al.* (2013). Laichattiwar *et al.,* (2017) recorded the fourth instar larval period to be around 3.03 days.

Fifth instar. The appearance of the fifth instar larva was almost the same excluding that the body size. Pupation was additional distinct behaviour at this time. The matured larva was stopped feeding and entered into the pupa. The period of fifth instar larva was noticed 3.95 days in *Rabi* 2019-2020 and 3.15 days in *Kharif* 2021. The fifth instar larval period of 1.7 days of *L. orbonalis* on brinjal by Varma and Anandhi, (2009). The fifth instar larval period was around 2.8 days reported by Bindu *et al.,* (2013) whereas it was around 3.50 days recorded by Laichattiwar *et al.* (2017).

Pupal stage. The matured larvae undergone pupation takes place in plastic jars, sand, muslin cloth and sometimes inside the fruits. The newly formed pupa was pinkish which turned to dark brown later. Pupa was elongated and oval-shaped. The pupa was slightly tapering and wing margins reached up to the end of the abdominal segment. The pupal period was noticed 5.76 days in *Rabi* 2019-20 and 5.28 days in *Kharif* 2021. Jat *et al.,* (2003) reported that the pupal period of 9.42 days. The pupal period of *L. orbonalis* was 9.66 days reported by Kumar and Singh, (2012) whereas it was around 8-9 days as noticed by Van Hung *et al.,* (2020).

Adult stage. The newly emerged adults had their head and thorax region covered with brownish scales. The front wings were creamy white and had light brown coloured bulky patches whereas, hind wings with a pale black curvy stripe were noted near the apical margin. The wings were marginally fringed. The male moth was normally smaller than the female. The female moths had a bunch of hairs at the tip of the abdomen. The longevity of the male moth was recorded 4.05 days in *Rabi* 2019-20 and 3.41 days in *Kharif* 2021 whereas the female with 5.50 days in *Rabi* 2019-20 and 4.55 days in *Kharif* 2021. The duration of males and females was 3 and 5.20 days (Kumar and Singh, (2012). The duration of male individuals was 3.20 days and female was 3.33 days (Yadav *et al.,* 2015) whereas it was 3.27 and 5.23 days as noticed by Laichattiwar *et al.* (2017).

Table 2: The life cycle of *L. orbonalis* in *Kharif* season 2021.

Development stages	Maximum (days)	Minimum (days)	Development duration (days) Mean & S.D
Incubation period (days)	5.5	2.5	3.86 ± 0.10
1st instar	3	1	2.01 ± 0.11
2nd instar	2.5	1.5	1.83 ± 0.10
3rd instar	3	1	2.18 ± 0.35
4th instar	3.5	2	2.73 ± 0.05
5th instar	4	2	3.15 ± 0.05
Total larval period (days)	15	10	11.83 ± 0.40
Pupal period (days)	7	2	5.28 ± 0.16
Pre-oviposition period (days)	2.5	0.5	1.30 ± 0.08
Oviposition period (days)	3	1	2.00 ± 0.44
Adult longevity (days)			
Male	4	2.5	3.41 ± 0.12
Female	6.5	3.5	4.55 ± 0.40

Pre-oviposition period. The Pre-oviposition was observed as 1.51 days in *Rabi* 2019-20 and 1.30 days in *Kharif* 2021. Kavitha *et al.,* (2008) reported that the pre-ovipositional period of 1.35 days whereas it was 1.17 days as recorded by Laichattiwar *et al.,* (2017).

Oviposition period. The oviposition period was observed 2.95 days in *Rabi* 2019-20 and 2.00 days in *Kharif* 2021. Kavitha *et al.,* (2008) reported that a pre-ovipositional period of 2.01 days whereas it was 2.53 days recorded by Laichattiwar *et al.,* (2017).

CONCLUSION

The life cycle of *L. orbonalis* was observed in two different seasons viz. *Rabi* (2019-20) and *Kharif* (2021). It had taken more duration to finish its life cycle in *Rabi* than *Kharif* season. Abiotic factors like average temperature, relative humidity and rainfall play a substantial role in the development of *L. orbonalis.* The development period may differ from place to place and season to season or climatic conditions. The duration of different life stages is also more in *Rabi* than *Kharif* season.

FUTURE SCOPE

The shoot and fruit borer is a dangerous insect pest in brinjal production. So, effective management of this pest necessities through awareness of its reproductive capacity and developmental stages. This study can be provides the growth rate of insects, which can be used for predicting sources for pest management. It can be easy to manage the shoot and fruit borer.

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Conflicts of Interest. None.

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