

COMPARATIVE BIOLOGY OF *LEUCINODES ORBONALIS* GUENEE FROM DIFFERENT REGIONS OF INDIA IN PARTICULAR REFERENCE TO ITS DEVELOPMENTAL STAGES

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(Accepted 3 January 2018)

ABSTRACT : The present experiment was carried out in the Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India. The *Leucinodes orbonalis* populations collected from different agro climatic zones of India were cultured in the laboratory and comparative biology were studied. The average of different biological parameters were observed. Fecundity was ranged from 70.20±21.27 to 160.50±45.94 eggs; pre-oviposition period was ranged from 1.20±0.42 to 1.70±0.67 days; oviposition period was ranged from 1.90±0.57 to 2.20±0.42 days; post-oviposition period was ranged from 0.80±0.42 to 1.20±0.63 days; incubation period was ranged from 3.10±0.57 to 3.90±0.88; larval period was ranged from 9.6±1.35 to 11.7±1.83 days; pupal period was ranged from 7.10±0.74 to 8.80±1.14 days; longevity of male was ranged from 2.30±0.67 to 3.40±0.84 days; longevity of female was ranged from 4.20±0.92 to 5.00±0.82 days; total developmental period of male was ranged from 23.90±1.37 to 25.80±1.99 days; total developmental period of female was ranged from 26.30±1.25 to 27.60±1.43 days.

Key words : *Leucinodes orbonalis*, comparative biology, agro climatic zones, total developmental period.

INTRODUCTION

Brinjal (*Solanum melongena*) also called as king of vegetables in India accounted for the fact that it holds a permanent place in most of the foods. In addition to featuring a host of vitamins and minerals, eggplant also contains important phytochemicals which have antioxidant activity (Dias, 2012). It is also used as a raw material in pickle making (Singh *et al*, 1963). It is grown on over 678000 ha, which is about 37% of the world eggplant area with a production of 10.50 Mt (FAO, 2007). Despite of the fact that brinjal is a summer season crop; it is being grown throughout the year under irrigated condition. Hence, it is subjected to attack by number of insect pests right from nursery stage to till harvesting (Regupathy *et al*, 1997). The crop is attacked by number of insect pests but the major ones include jassid (*Amrascabiguttula biguttula*), aphid (*Aphis gossypii*), whitefly (*Bemisia tabaci*) and shoot and fruit borer (*Leucinodes orbonalis* Guenee) (Gangwar and Sachin, 1981) of these, *L. orbonalis* is considered the main constraint as it damages the crop throughout the year with yield loss of 70 to 92% (Kalawate and Dethé, 2012; Reddy and Srinivas, 2004). Management of insect pests is based on the availability of data on insect biology, ecology and population dynamics. It is important to know the life cycle of that particular insect pest so that control measures may be

incorporated at the most susceptible stage of life cycle (Mannan *et al*, 2015). The present study was carried out to find out any changes in biological parameters are present in the population of *L. orbonalis* from the different places of different agro climatic zones of India.

MATERIALS AND METHODS

The live samples of *L. orbonalis* were collected from different agro climatic zones of India (20-50 samples from each zone), which are as follows :

1. Varanasi, Middle/lower Gangetic plain
2. Delhi, Transgangetic plain
3. Raipur, Central plateau and hills
4. Pune, Western plateau and hills
5. Bengaluru, Southern plateau and hills.

The population of these regions were maintained and reared in the Bio-control laboratory of the Department of Entomology and Agricultural Zoology, B.H.U., Varanasi at the 27±1°C temperature and 80 ± 5% humidity on natural diet.

Maintenance of collected population

Infested fruits collected from field were transferred to glass jars, covered with muslin cloth and blotting paper at the bottom. Larva pupated on the muslin cloth, which were covered on glass jar or on the blotting paper, which

were placed at the bottom of glass jar, after pupation; male and female pupae were separated as per sexual dimorphism characters (Padwal and Srivastava, 2017) and transferred to separate container; after emergence of adults from pupae, male and female adults were transferred to another glass jars with inner surface lined with muslin cloth and provided with cotton swab soaked with 10 per cent honey solution for mating. Female moths started egg laying after 1 to 2 days, which were counted and left as it is in the glass jars as the eggs are attached to the muslin cloth. Eggs hatched after 4 to 5 days. As Potato is a suitable alternative host for brinjal shoot and fruit borer, Boopal *et al* (2013), neonates were collected by using No. 0 camel hair brush and transferred on the slices of potato as a food for developing larvae. As per need; food *i.e.* potato slices were changed and provided for growing larva to avoid any bacterial and fungal growth till they go to pre-pupal stage. Each day larval measurements were recorded by using computerised stereo-microscope. After pupation pupa were also collected and subjected to measurement and then transferred to glass jar till adult emergence.

Biometric studies on the collected population of *L. orbonalis* from various agro climatic zones of India

The biological traits of *L. orbonalis* have been studied by rearing at the appropriate temperature, relative humidity, which are $27 \pm 1^\circ\text{C}$ and $80 \pm 5\%$, respectively in the laboratory.

Data on the different developmental stages of *L. orbonalis* were observed as follows :

1. Fecundity
2. Pre-oviposition period
3. Oviposition period
4. Post-oviposition period
5. Incubation period
6. Larval period
7. Pupal period
8. Longevity of adult male
9. Longevity of adult Female
10. Total life cycle of *L. orbonalis*

RESULTS AND DISCUSSION

The important biological parameters of *L. orbonalis* collected from different agro climatic zones of India are recorded and shown in Table 1 and graphical representation of those parameters are presented in Figs. 1 and 2.

Pre-oviposition period

The pre-oviposition, oviposition and post-oviposition period of *L. orbonalis* did not differ significantly. The pre-oviposition period ranged from 1.20 ± 0.42 days from Bengaluru population to 1.70 ± 0.67 days from Varanasi population. Yadav *et al* (2015) found the similar results and recorded the pre-oviposition period 1.293 ± 0.071 days. The findings of Onekutu *et al* (2013) also supports the present finding, who reported pre-oviposition period 1.19 days.

Oviposition period

The oviposition period ranged from 1.90 ± 0.57 days from Pune, Varanasi and Bengaluru population to 2.20 ± 0.42 days from Delhi population. Whereas, it was 2.00 ± 0.67 days from Raipur population. The present findings are in agreement with Yadav *et al* (2015), who found the oviposition period 2.22 ± 0.10 days and 2.192 ± 0.099 days during 2009 and 2010, respectively. The present findings also supported by the result of Onekutu *et al* (2013), who reported the oviposition period 2.71 days.

Post-oviposition period

The post-oviposition period of *L. orbonalis* collected from different agro-climatic zones also did not differ significantly. It was ranged from 0.80 ± 0.42 days from Raipur population to 1.20 ± 0.63 days from Bengaluru population.

Fecundity

The fecundity of *L. orbonalis* collected from different agro-climatic zones differed significantly. It was ranged from 70.20 ± 21.27 eggs from Delhi population to 160.50 ± 45.94 eggs from Varanasi population. Whereas, it was 85.60 ± 33.72 eggs, 102.70 ± 44.57 eggs and 142.60 ± 38.46 eggs from Pune, Bengaluru and Raipur population, respectively. The results of present findings are similar to Yadav *et al* (2015), who found the fecundity 170.13 ± 0.945 eggs per female and 170.90 ± 1.823 eggs per female during 2009 and 2010, respectively. According to the study of Onekutu *et al* (2013), the actual fecundity was 123 eggs and potential fecundity was 207 eggs.

Incubation period

Freshly laid eggs were elongated, oval-shaped and yellowish in colour which changed their colour as incubation advanced and became orange in colour. Before hatching the prominent black spot was found on the eggs, which can be observed by naked eyes. The incubation period of eggs of the *L. orbonalis* collected from different agro-climatic zones did not differ significantly and ranged from 3.10 ± 0.57 days from Varanasi population

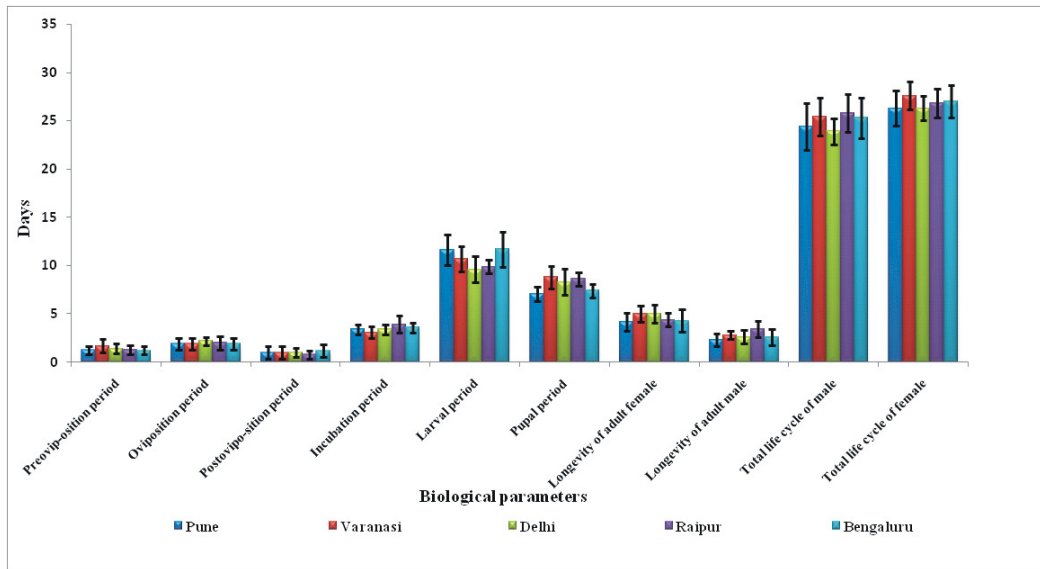


Fig. 1 : Graphical representation of important biological parameters of *L. orbonalis* collected from different agro climatic zones of India.

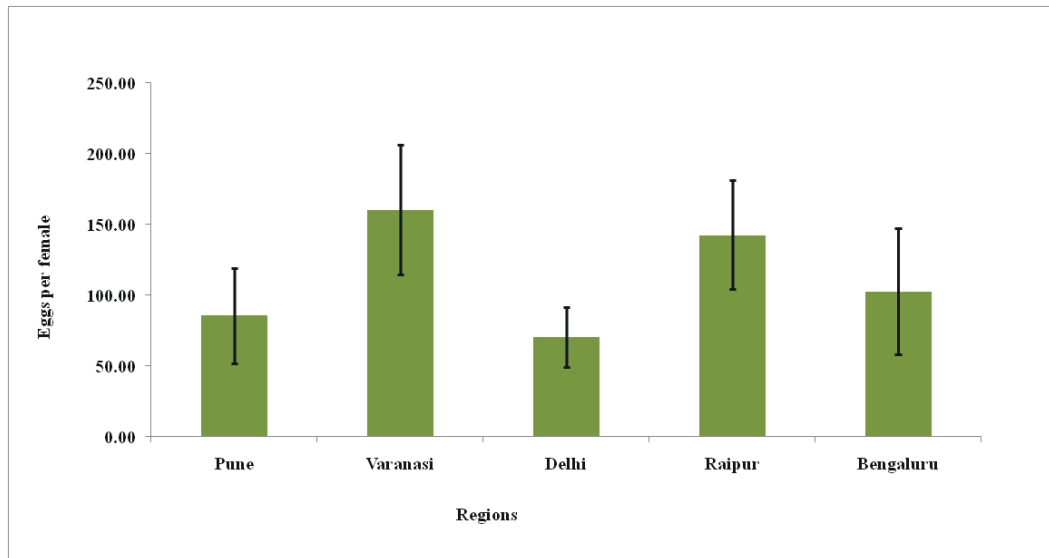


Fig. 2 : Graphical representation of fecundity of *L. orbonalis* collected from different agro-climatic zones of India.

to 3.90 ± 0.88 days from Raipur population. These findings are conformity with the findings of Wankhede *et al* (2009) and Maravi *et al* (2013), who recorded incubation period 3.8 ± 0.18 days and 3.49 days, respectively.

Larval period

The neonate larvae were usually off-white in colour with dark brown head, three pairs of thoracic legs and five pairs of prolegs. Larva changed its colour as grown older from off-white to sometimes Congo pink, paradise pink, terracotta or remain same as off-white colour at last instar. The significant variation in the larval period among the population was noticed and the total larval period ranged from 9.6 ± 1.35 days to 11.7 ± 1.83 days. The maximum larval period of *L. orbonalis* was recorded from Bengaluru (11.7 ± 1.83 days), which was at par with

Pune (11.6 ± 1.58 days) and Varanasi (10.7 ± 1.34 days) populations and significantly different from Delhi (9.6 ± 1.35 days) and Raipur (9.9 ± 0.74 days) populations. Maravi *et al* (2013) also reported the larval period of *L. orbonalis* was 11.50 days.

Pupal period

The pupa of *L. orbonalis* was whitish yellow in colour just after pupation and became yellow-orange to brick coloured as stage advanced (Plate 2a, 2b). Before the emergence of an adult, pupa showed the pattern of wings and abdominal patches (Plate 2b). The pupal period differed significantly in the range of 7.10 ± 0.74 days to 8.80 ± 1.14 days. The maximum pupal period was recorded from the population of Varanasi (8.80 ± 1.14 days), which was at par with Delhi (8.30 ± 1.34 days) and Raipur

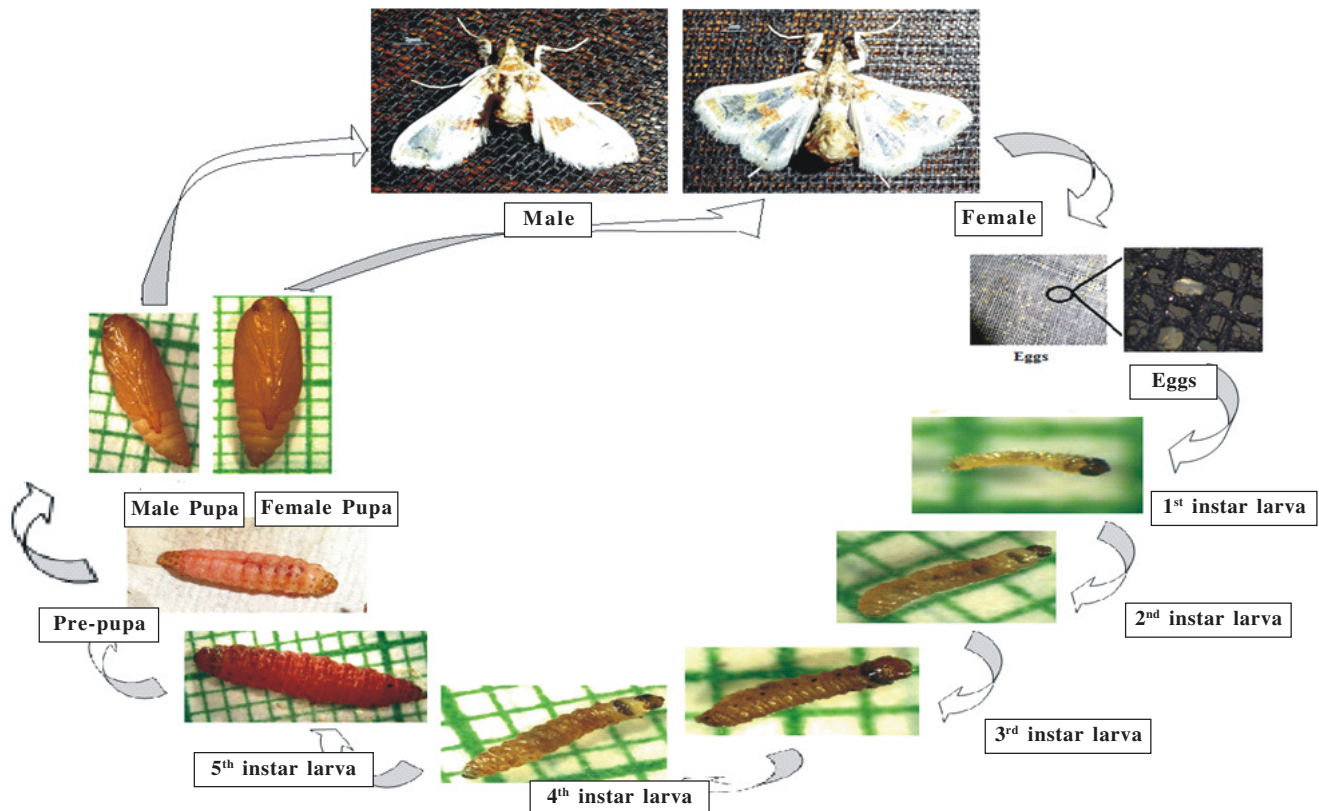


Plate 1 : Life cycle of *L. orbonalis* showing different stages of development.

(8.60 ± 0.70 days) population and significantly different from Pune (7.10 ± 0.74 days) and Bengaluru (7.40 ± 0.70 days) populations. The results of present finding were similar with Maravi *et al* (2013), who reported the pupal period of *L. orbonalis* was of 8 days. Bindu *et al* (2015) and Pramanik *et al* (2012) also reported the pupal period was 8 to 10 days and 7.6 days, respectively.

Longevity of male moth

The male moths of *L. orbonalis* were usually smaller to females and their abdomen was slender and blunt at the posterior end. The longevity of male *L. orbonalis* varied significantly from 2.30 ± 0.67 to 3.40 ± 0.84 days. The maximum male moth's longevity was observed from Raipur (3.40 ± 0.84 days), which was at par with Varanasi (2.80 ± 0.42 days) population and significantly different from Pune (2.30 ± 0.67 days), Bengaluru (2.60 ± 0.84 days) and Delhi (2.60 ± 0.70 days) population. The results were partially in conformity with Maravi *et al* (2013), who found the longevity of adult as 4.60 days. The results of present study are also in partial agreement with Pramanik *et al* (2012), who found the longevity of adult as 3.8 days.

Longevity of female moth

The female moths of *L. orbonalis* were often larger as compared to males as their abdomen was puffer and pointed at the posterior end. The longevity of female moths

of *L. orbonalis* did not differ significantly and ranged from 4.20 ± 0.92 days to 5.00 ± 0.94 days. The highest female moth longevity was observed in the population brought from Delhi (5.00 ± 0.94 days) followed by Pune (4.20 ± 0.92 days), Varanasi (5.00 ± 0.82 days), Raipur (4.40 ± 0.70 days) and Bengaluru (4.30 ± 1.16 days). The findings of present the study were partially supported by Maravi *et al* (2013), who found the longevity of adult as 4.60 days. The findings are also in partial agreement with Pramanik *et al* (2012), who recorded the longevity of adult as 3.8 days.

Total life cycle of *L. orbonalis*

The life cycle of *L. orbonalis* showing different development stages is shown in the Plate 1. Period required for completing the total life cycle of male as well as a female of *L. orbonalis* collected from different agro-climatic zones did not differ significantly. The total life cycle of a male was ranged from 23.90 ± 1.37 days of Delhi population to 25.80 ± 1.99 days of Raipur population, whereas, the life cycle of a female was ranged from 26.30 ± 1.83 days of Pune population to 27.60 ± 1.43 days of Varanasi population. The present findings are in conformity with the findings of Maravi *et al* (2013), who reported the total life cycle of *L. orbonalis* was 27.59 days. The results of present study are also similar with

Table 1 : Biological parameters of *L. orbonalis* populations collected from different agro climatic zones of India.

Region	Parameters (Mean \pm SD)										
	Preoviposition period (in days)	Oviposition period (in days)	Fecundity* (eggs/female)	Postoviposition period (in days)	Incubation period (in days)	Larval period (in days)	Pupal period (in days)	Longevity of adult female (in days)	Longevity of adult male (in days)	Total life cycle of male	Total life cycle of female
Pune	1.25 \pm 0.42 ^a	1.90 \pm 0.57 ^a	85.60 \pm 33.72 (1.94) ^{ab}	1.00 \pm 0.67 ^a	3.40 \pm 0.52 ^{ab}	11.6 \pm 1.58 ^b	7.10 \pm 0.74 ^a	4.20 \pm 0.92 ^a	2.30 \pm 0.67 ^a	24.40 \pm 2.41 ^a	26.30 \pm 1.83 ^a
Varanasi	1.70 \pm 0.67 ^a	1.90 \pm 0.57 ^a	160.50 \pm 45.94 (2.21) ^c	1.00 \pm 0.67 ^a	3.10 \pm 0.57 ^a	10.7 \pm 1.34 ^{ab}	8.80 \pm 1.14 ^b	5.00 \pm 0.82 ^a	2.80 \pm 0.42 ^{a,b}	25.40 \pm 1.96 ^a	27.60 \pm 1.43 ^a
Delhi	1.40 \pm 0.52 ^a	2.20 \pm 0.42 ^a	70.20 \pm 21.27 (1.85) ^a	1.00 \pm 0.47 ^a	3.40 \pm 0.52 ^{ab}	9.6 \pm 1.35 ^a	8.30 \pm 1.34 ^b	5.00 \pm 0.94 ^a	2.60 \pm 0.70 ^a	23.90 \pm 1.37 ^a	26.30 \pm 1.25 ^a
Raipur	1.30 \pm 0.48 ^a	2.00 \pm 0.67 ^a	142.60 \pm 38.46 (2.16) ^c	0.80 \pm 0.42 ^a	3.90 \pm 0.88 ^b	9.9 \pm 0.74 ^a	8.60 \pm 0.70 ^b	4.40 \pm 0.70 ^a	3.40 \pm 0.84 ^b	25.80 \pm 1.99 ^a	26.80 \pm 1.48 ^a
Bengaluru	1.20 \pm 0.42 ^a	1.90 \pm 0.57 ^a	102.70 \pm 44.57 (2.02) ^b	1.20 \pm 0.63 ^a	3.60 \pm 0.52 ^{ab}	11.7 \pm 1.83 ^b	7.40 \pm 0.70 ^a	4.30 \pm 1.16 ^a	2.60 \pm 0.84 ^a	25.30 \pm 2.11 ^a	27.00 \pm 1.70 ^a

*Values in parenthesis are $\log_x + 1$ transformed values.

Wankhede *et al* (2009), Onekutu *et al* (2010) and Pramanik *et al* (2012), who observed the total life cycle of *L. orbonalis* was 27.59 days, 27.8 \pm 1.24 days 28.17 days and 26.9 days, respectively.

CONCLUSION

This study mostly deals with the comparative biology of *Leucinodes orbonalis* from different agro climatic zones of India and concluded that although differences in the most of the biological parameters of *Leucinodes orbonalis* from different agro climatic zones of India are very less; significant differences were observed in the fecundity, larval period, pupal period and longevity of male from some regions. To know more about the differences in the populations, it is needed to study not only biology, but also morphometric and genetic characters of *Leucinodes orbonalis* from different agro climatic zones of India on large scale.

ACKNOWLEDGEMENT

Corresponding author is highly grateful to Department of Science and Technology, New Delhi for providing Inspire Fellowship during course of study. We also wish to thank the Head of Department, Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi for providing the facilities for this investigation.

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