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BIOLOGY AND DEVELOPMENTAL STUDIES OF THE PEA BLUE BUTTERFLY (*LAMPIDES BOETICUS* L.) ON COWPEA

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ABSTRACT

The pea blue butterfly, *Lampides boeticus* (Linnaeus) (Lepidoptera: Lycaenidae), is a cosmopolitan pest of leguminous crops and a major limiting factor in cowpea (*Vigna unguiculata*) production. The present study on its biology revealed that females laid small, dome-shaped, whitish to bluish eggs singly on flower buds, tender pods, and occasionally on young shoots, with an incubation period of 2.50 – 5 days. The larvae, which passed through four instars lasting 2.80, 3.00, 2.75, and 4.50 days, respectively, with the total larval period completed in 13.05 days, were greenish, dorsoventrally flattened, slug-like, and cryptically colored, feeding voraciously inside flower buds and developing pods by boring into ovules and seeds. The pre-pupal and pupal stages extended for 2.25 and 6.25 days, respectively. The adult butterflies were medium-sized with a wingspan of 25–35 mm; males were violet-blue with dark borders, while females were brownish with bluish scales near the wing base, and both sexes possessed hindwing tails with a black eye-spot near the margin. Adult longevity was higher in females (7.00 days) than males (5.50 days) when food was provided, whereas in the absence of food longevity was reduced to 3.25 and 2.00 days for females and males, respectively. The pre-ovipositional, ovipositional and post-ovipositional periods averaged 3.25, 2.50, and 2.25 days, respectively. Fecundity averaged 77.50 eggs per female, with egg hatchability of 75 percent. The total life cycle was completed in 29.13 days, indicating that the species can complete multiple overlapping generations within a single cropping season of cowpea. The relatively short life cycle, moderate fecundity and considerable egg viability contribute to the pest's ability to multiply rapidly and cause significant damage to flowers and pods, underscoring its economic importance and the need for effective management strategies.

***Key words*:** Pea blue butterfly, cowpea, biology, pod borer, Pod damage.

Introduction

Pulses are the richest plant protein source and an essential part of the diet (Roshan and Rohilla 2007). Common pulse crops include chickpea, pigeonpea, mungbean, urdbean, horsegram, mothbean, lathyrus, lentil, cowpea, drybean and peas. Cowpea (*Vigna unguiculata* (L.) Walp.) is one of the most important pulse crops grown in tropical and subtropical regions of the world, valued both as a food legume and a fodder crop. Belonging to the family Fabaceae, it is a hardy, drought-tolerant crop well adapted to diverse agro-climatic conditions and poor soils, making it a vital component of sustainable farming systems. Cowpea grains are rich in protein (20–25%), carbohydrates, vitamins and minerals, and serve as a cheap source of nutrition in many developing countries, particularly in Asia and Africa. Additionally, cowpea has a vigorous vegetative growth, makes good feed, and completely covers the ground preventing soil erosion. Additionally, silage and a green manure crop are produced (Oyewale and Bamaiyi, 2013).

The crop also improves soil fertility through symbiotic nitrogen fixation, thereby reducing dependence on synthetic fertilizers and contributing to soil health. In addition to its grains, the tender leaves and green pods are consumed as vegetables, while the haulms serve as nutritious fodder for livestock. Despite its agronomic and

nutritional importance, cowpea production is seriously constrained by several insect pests that attack the crop from seedling to harvest. Among them, the cowpea aphid (*Aphis craccivora*), spotted pod borer (*Maruca vitrata*), legume pod borer (*Helicoverpa armigera*), pea blue butterfly (*Lampides boeticus*) and leafhopper (*Empoasca kerri*) are considered major pests, causing damage to leaves, flowers and pods and leading to severe yield losses (Srivastava, 1964). According to Reed (1983) who revealed the actual damage caused to the pulses by the insect pests.

The pea blue butterfly, *Lampides boeticus* (Linnaeus) (Lepidoptera: Lycaenidae), commonly known as the long-tailed blue, is one of the most destructive insect pests of cowpea (*Vigna unguiculata*) and other leguminous crops. The pest is widely distributed in tropical and subtropical regions and causes significant economic losses by attacking the reproductive parts of the plant (Umesh *et al.,* 2010). Females lay eggs singly on flower buds and young pods, and the emerging larvae bore into these structures, feeding internally on ovules and developing seeds. Such feeding results in flower drop, pod malformation, and seed destruction, ultimately reducing both yield and quality. The cryptic larval habit inside flowers and pods, combined with its short life cycle and overlapping generations, enables *L. boeticus* to build up rapidly under favorable conditions (Miah *et al.,* 2015).

In severe infestations, yield losses may range from 30% to more than 70%, making it a pest of major concern in cowpea production systems. Yield losses of up to 75% were caused by insects attacking cowpea during the flower bud and flowering stages, and of 23% by insects attacking during pod development, (Alghali, 1992). Kayumbo (1975) also reported by cowpea yields below 400 kg/ha are typically regarded as low due to poor crop management. A clear understanding of its biology and seasonal occurrence is therefore crucial for designing sustainable and effective pest management strategies to protect cowpea yield and productivity Karboli and Janabi (2017).

Materials and Methods

The present investigation on the biology of the blue butterfly, *Lampides boeticus* (L.), on cowpea was carried out under laboratory conditions in the Department of Entomology, College of Agriculture, Vijayapura, Karnataka. During the study period, the maximum and minimum laboratory temperatures recorded were 30.2 °C and 17.6 °C, respectively, while the maximum and minimum relative humidity were 91% and 59%, respectively. A brief account of techniques employed and materials used in the present study is described below.

Pure culture maintenance

Field-collected larvae of *L. boeticus* were reared in Petri plates (1 cm height × 10 cm diameter) containing fresh immature cowpea pods as food. The cut ends of pods were wrapped with cotton lint soaked in water to maintain freshness and turgidity for a longer time. Fresh food was provided daily in the morning until larvae pupated. The pupae thus obtained were transferred into separate Petri dishes until adult emergence Verma *et al.*, (2020).

For culture maintenance, two pairs of freshly emerged male and female adults were released into a wooden cage (40 × 36 × 24 cm) containing cowpea plants grown in earthen pots with buds, flowers, and immature pods to serve as oviposition substrates. A sponge soaked in 5% honey solution was provided as adult food. Eggs laid on buds, flower calyces and pods were collected and used for further investigations.

Egg period

Freshly laid eggs (10 per replication) were carefully removed and glued onto glass slides, which were placed inside glass Petri dishes. These were observed daily under a microscope to record the duration of the egg stage as well as egg hatchability.

Larval period

Newly hatched larvae were transferred individually onto fresh cowpea flowers and buds using a moist hairbrush and later provided with immature pods as food. Moulting was determined by the presence of cast-off head capsules and changes in larval coloration. The duration of each larval instar, total larval period and morphometrics of larvae were recorded.

Pupal period

The onset of pupation was determined by cessation of feeding, sluggish behavior, and reduction in body length of fully grown larvae. Pupae were observed daily to record pupal duration.

Adult longevity and fecundity

Freshly emerged single pairs of male and female adults were confined in rearing cages (40 × 36 × 24 cm) containing fresh twigs of cowpea with buds, flowers, and pods, along with muslin cloth strips for oviposition. A sponge dipped in 5% honey solution was provided as adult food. Adults were transferred daily to new cages and the number of eggs laid was counted to estimate fecundity. The oviposition period, post-oviposition period and adult longevity of males and females were recorded. The sex

ratio under laboratory conditions was determined by recording the relative proportion of male and female adults.

Total life cycle

The total life cycle was calculated by summing the durations of egg, larval, pre-pupal, pupal, and adult stages.

Results and Discussion

The biology of the pea blue butterfly, *Lampides boeticus* (L.), on cowpea was studied under laboratory conditions at the Department of Entomology, College of Agriculture, Vijayapura. The observations recorded on various developmental stages of the insect are presented and discussed below.

Incubation period

The eggs of *L. boeticus* were pale bluish-white, round and flattened disc-shaped with a finely sculptured surface. They were laid singly on flower buds, sepals and young pods. The incubation period varied from 2.50 to 5.00 days, with a mean of 3.75 ± 1.25 days. The egg colour gradually turned creamy-white to light yellow before hatching and a small dark spot appeared on the surface indicating larval development inside. These observations are consistent with Jagginavar *et al.*, (1991), who reported that the eggs are round, whitish and hatch in 5–8 days on cowpea. Vijayachander and Arivudainambi (2007) also reported that eggs were pale green to ashy grey with mean incubation period was 74.08± 0.89 hrs.

Larval period

The larva passed through four instars with a total larval duration of 8.60–17.50 days (13.05 ± 4.45 days) which are in conformity with the observations of Sontakke (2018), who recorded as four larval instars. Whereas, first instar was pale yellowish-green, slender and cylindrical, with a dark head capsule. They remained concealed inside flower buds with duration was 2.80 ± 0.20 days. Second instar larvae became green with faint dorsal lines, slightly flattened and more slug-like with mean duration 3.00 ± 1.00 days. When the body colour turned greenish with pinkish tinge (third instar), densely covered with short setae and waxy secretions with average duration 2.75 ± 1.25 days. Fourth instar caterpillars were dark green to brownish, dorsoventrally flattened and slug-shaped. They were most voracious, boring into developing pods and feeding on seeds with mean duration 4.50 ± 2.00 days.

The variation in body colour from green to brown served as camouflage against predators. Similar morphometric features and colour changes were described by Palem *et al.*, (2015) who reported that from first to fourth larval instars durations were 2-3, 2-3, 2-3 and 2-3 days, respectively. The marginal difference in the larval durations in larval instars might be attributable to the difference in the food provided and environment conditions during study period.

Table 1: Biology of blue butterfly, *Lampides boeticus* (L.) on cowpea under laboratory conditions.

Sl. No.	Particulars	Duration (days)		
		Min.	Max.	Avg. ± S.D.
		Developmental stages		
1	Egg	2.50	5.00	3.75 ± 1.25
2	1st instar	2.60	3.00	2.80 ± 0.20
	2nd instar	2.00	4.00	3.00 ± 1.00
	3rd instar	1.50	4.00	2.75 ± 1.25
	4th instar	2.50	6.50	4.50 ± 2.00
	Total LP	8.60	17.50	13.05 ± 4.45
3	pre -pupal	1.50	3.00	2.25 ± 0.75
	pupal	4.50	8.00	6.25 ± 1.75
Adult longevity (with food)				
4	Male	3.50	7.50	5.50 ± 2.00
	Female	4.50	9.50	7.00 ± 2.50
Adult longevity (without food)				
5	Male	1.50	2.50	2.00 ± 0.50
	Female	3.00	3.50	3.25 ± 0.25
6	Pre- ovipositional period	1.50	5.50	3.50 ± 2.00
	Ovipositional period	1.00	4.00	2.50 ± 1.50
	Post- ovipositional period	1.50	6.50	4.00 ± 2.50
7	Fecundity	65.00	90.00	77.50 ± 12.50
8	Egg hatchability	65.00	85.00	75.00 ± 10.00
9	Total LC	25.50	32.75	29.13 ± 3.63

*SD- Standard Deviation, *LP- Larval period, *LC- Life cycle

Pupal period

The larvae ceased feeding, shrank in size and turned yellowish to dark greyish in colour. They remained inactive for 1.50–3.00 days (2.25 ± 0.75 days) before pupation. The pupae were obtect, brownish to dark brown, smooth and slightly curved. They measured about 7–9 mm in length and were attached loosely to dried leaves or soil particles with silken threads. Pupal duration lasted 4.50–8.00 days (6.25 ± 1.75 days).

The results were close agreement with the findings of Sontakke (2018), revealed that pre-pupal and pupal duration lasted for 1.40 and 5.20 days, respectively. The pre-pupal and pupal period were 1.37 and 5.80 days, respectively, recorded by Vijayachander and Arivudainambi (2007).

Adult longevity and fecundity

Adults of *L. boeticus* were slender, small butterflies with violet-blue wings on the dorsal side and grayish-white with wavy lines on the ventral side. The hindwings

possessed black eye spots and filamentous tails, which are characteristic of lycaenids and help distract predators.

- **Male longevity:** 3.50–7.50 days (5.50 ± 2.00 days) with food; only 2.00 ± 0.50 days without food.
- **Female longevity:** 4.50–9.50 days (7.00 ± 2.50 days) with food; 3.25 ± 0.25 days without food.

Feeding with honey solution prolonged adult survival, confirming the importance of nectar sources in the field.

The present investigations were similar to findings of Jagginavar *et al.*, (1991), who recorded that the longevity of male and female were 6.10 and 9.00 days, respectively (with food). In absence of food male and female survived for 2.7 and 4.60 days, respectively. Sontakke (2018), who observed that mean longevity of adult was 2.40±0.24 days

Reproductive parameters

- **Pre-ovipositional period**: Females became ready for oviposition in 1.50–5.50 days (3.50 ± 2.00 days).
- **Ovipositional period**: Eggs were deposited singly on tender pods and floral parts over 1.00–4.00 days (2.50 ± 1.50 days).
- **Post-ovipositional period**: Females survived 1.50–6.50 days (4.00 ± 2.50 days) after egg laying.

The mean fecundity was 77.50 ± 12.50 eggs, with egg hatchability of 75.00 ± 10.00%. Eggs laid on tender flower buds had higher hatchability than those on mature pods.

These observations were close agreement with observations made by Jagginavar *et al.*, (1991) who recorded that the pre-ovipositional, ovipositional and post-ovipositional period were 13.5, 5.8 and 2.90 days, respectively and number of eggs laid by each female 160.00 eggs. Vijayachander and Arivudainambi (2007),

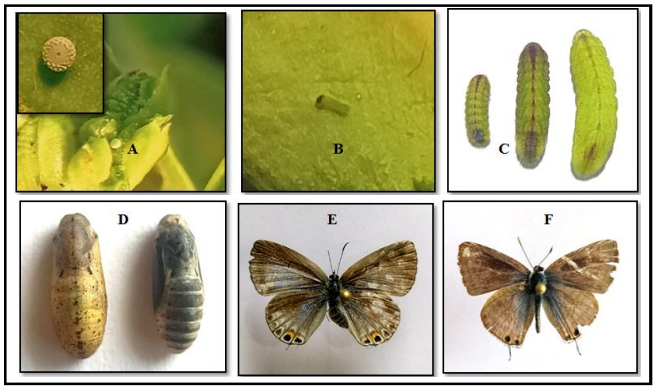

Fig. 1: **A.** Egg; **B.** 1st Instar; **C.** 2nd to 4th Instars; **D.** Pupa; **E.** Adult female; **F.** Adult male.

Table 2: Morphometric observations of different stages of *Lampides boeticus* (L.) on cowpea under laboratory conditions.

Stage	Length (mm)		Breadth (mm)	
	Range	Avg. ± S.D.	Range	Avg. ± S.D.
Egg	0.60 - 0.65	0.63 ± 0.03	0.55 - 0.60	0.58 ± 0.03
Larval instars				
1st instar	1.20 - 1.25	1.23 ± 0.03	0.15 - 0.19	0.17 ± 0.02
2nd instar	2.00 - 2.64	2.32 ± 0.32	0.50 - 0.56	0.53 ± 0.03
3rd instar	5.65 - 5.86	5.76 ± 0.11	0.95 - 1.00	0.98 ± 0.03
4th instar	10.54 - 10.70	10.62 ± 0.08	1.65 - 1.20	1.43 ± 0.23
Adult				
Male	11.25 - 11.35	11.30 ± 0.05	28.50 - 29.50	29.00 ± 0.50
Female	12.60 - 12.70	12.65 ± 0.05	30.50 - 31.50	31.0 ± 0.50

Head capsule measurements of larval instars of *Lampides boeticus* (L.)				
Stage	Length (mm)		Breadth (mm)	
	Range	Avg. ± S.D.	Range	Avg. ± S.D.
1st instar	0.22 - 0.26	0.24 ± 0.02	0.12 - 0.15	0.14 ± 0.02
2nd instar	0.46 - 0.65	0.56 ± 0.10	0.35 - 0.45	0.40 ± 0.05
3rd instar	1.15 - 1.20	1.18 ± 0.03	0.95 - 1.10	1.03 ± 0.08
4th instar	1.40 - 1.85	1.63 ± 0.23	1.20 - 1.30	1.25 ± 0.05

who stated that the total number of eggs laid by a single female during its life time varied from 120.57±5.32 and egg hatchability was 82%.

Total life cycle

The complete life cycle, from egg to adult emergence, lasted 25.50–32.75 days (29.13 ± 3.63 days) under laboratory conditions. Morphologically, the insect exhibited gradual colour changes and body adaptations at each stage, which facilitated survival and host utilization.

Similar life cycle durations were reported by Sontakke (2018), who stated that entire life span varied from with an average of 20.8 ± 2.32 days. The variation observed in the present study can be explained by differences in host plant quality and laboratory climatic conditions.

Morphometric observations

The morphometric studies revealed distinct variations in the size, shape, and colouration of different developmental stages of the insect.

Egg stage

The freshly laid eggs were minute, oval, and creamy-white in colour, gradually turning pale yellow before hatching. They measured 0.60–0.65 mm in length with an average of 0.63 ± 0.03 mm and 0.55–0.60 mm in breadth with an average of 0.58 ± 0.03 mm. Their small size and smooth surface facilitate firm adhesion on the plant surface, thus ensuring protection from dislodgement due to environmental factors. The low standard deviation

indicates a high degree of uniformity in egg size.

Larval instars

The larval period comprised four instars, each showing a progressive increase in length and breadth along with changes in colour and appearance.

The first instar larva was very small, slender and creamy-white to pale green in colour. It measured 1.20–1.25 mm in length (1.23 ± 0.03 mm) and 0.15–0.19 mm in breadth (0.17 ± 0.02 mm). The body was semi-transparent with a distinct brown head capsule. It possessed a very minute and narrow head capsule, measuring 0.22–0.26 mm in length with an average of 0.24 ± 0.02 mm, and 0.12–0.15 mm in breadth with an average of 0.14 ± 0.02 mm. The second instar larva was pale green with a slightly cylindrical body and well-defined segmentation. Its size increased to 2.00–2.64 mm in length (2.32 ± 0.32 mm) and 0.50–0.56 mm in breadth (0.53 ± 0.03 mm). The increase in breadth compared to the first instar was almost threefold, indicating rapid growth. The second instar exhibited a noticeable increase in head capsule size, ranging from 0.46–0.65 mm in length (mean 0.56 ± 0.10 mm) and 0.35–0.45 mm in breadth (mean 0.40 ± 0.05 mm).

The third instar larva showed remarkable growth, attaining 5.65–5.86 mm in length (5.76 ± 0.11 mm) and 0.95–1.00 mm in breadth (0.98 ± 0.03 mm). The body became robust, cylindrical and bright green, which served as camouflage against foliage. The head capsule became darker and feeding activity was vigorous during this stage and measuring 1.15–1.20 mm in length (mean 1.18 ± 0.03 mm) and 0.95–1.10 mm in breadth (mean 1.03 ± 0.08 mm). The fourth instar larva reached maximum size before pupation, measuring 10.54–10.70 mm in length (10.62 ± 0.08 mm) and 1.20–1.65 mm in breadth (1.43 ± 0.23 mm). The larva appeared stout, with a distinct green body and well-marked segmentation. The fourth instar displayed the maximum head capsule dimensions before pupation, with a length of 1.40–1.85 mm (mean 1.63 ± 0.23 mm) and breadth of 1.20–1.30 mm (mean 1.25 ± 0.05 mm).

The larval growth pattern followed a nearly exponential trend, with length and breadth more than doubling between successive instars. The shift in colour from pale white to bright green and the gradual thickening of the body indicated progressive maturity, preparing the insect for pupation.

Adult stage

The adults were delicate moths, with sexual dimorphism evident in both body length and wingspan. Males measured 11.25–11.35 mm in length (11.30 ± 0.05 mm) with a wingspan breadth of 28.50–29.50 mm (29.00 ± 0.50 mm). Females were relatively larger, measuring 12.60–12.70 mm in length (12.65 ± 0.05 mm) and 30.50–31.50 mm in wingspan (31.00 ± 0.50 mm). The body colouration was generally light brown with characteristic wing markings. The larger size of females, particularly the broader abdomen, facilitates fecundity by accommodating a greater number of eggs. Such sexual dimorphism is a common adaptive feature in Lepidoptera.

These results were close agreement with the observations made by Palem *et al.,* (2015) who reported that first to fourth larval instars attained an average length of 1.0 -1.3, 2.50 ± 0.40, 3.30 ± 0.21 and 6.33 ± 1.24 mm, respectively. The first, second, third and fourth larval instars measured up to an average of 0.45 – 0.65, 0.80 ± 0.08, 1.26 ± 0.20 and 2.10 ± 0.94 mm, respectively, in breadth. Jagginavar *et al.*, (1991) who recorded as width of head capsule from first to fourth instar were 0.29, 0.42, 0.65 and 1.12 mm, respectively.

Conclusion

The biology of the blue butterfly, *Lampides boeticus* Linnaeus, was studied on cowpea under laboratory conditions during kharif 2022–23 at the College of Agriculture, Vijayapura. The results revealed that freshly laid eggs were greenish blue, later turning white and finally ashy grey before hatching, with an incubation period of 2.50–5.00 days. The larva passed through four instars, showing progressive changes in size, colour, and body markings. The total larval period ranged from 8.60 to 17.50 days, with distinct growth increments in head capsule measurements supporting Dyar's rule. The pre-pupal and pupal stages lasted for 1.50–3.00 days and 4.50–8.00 days, respectively, with pupae being obtect in form and females larger than males. Adults emerged in the morning, exhibiting sexual dimorphism, males with violet-blue wings and females with brownish wings. Adult longevity with food ranged from 3.50–7.50 days in males and 4.50–9.50 days in females, whereas without food, it was shorter. Fecundity ranged between 65 and 90 eggs per female, with 65–85% hatchability. The complete life cycle was completed in 25.50–32.75 days with an average of 29.13 ± 3.63 days.

The study concludes that *Lampides boeticus* completes its life cycle rapidly and possesses high fecundity and hatchability under favourable laboratory conditions, indicating its potential to cause severe damage to cowpea. The short developmental period and high reproductive capacity confirm its multivoltine nature, making it a persistent pest in leguminous crops. A thorough understanding of its biology, including egg laying behaviour,

larval development, pupation and adult longevity, provides essential baseline information that can be utilized for forecasting pest outbreaks and developing integrated pest management (IPM) strategies for cowpea and other legumes.

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