

# Biology of *Hyblea puera* Cramer (Lepidoptera: Hyblaeidae) on Teak *Tectona grandis* L. (Lamiaceae) in Saharanpur, Uttar Pradesh

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## Abstract

*Hyblaea puera*, commonly known as the teak defoliator, is one of the most destructive pests affecting *Tectona grandis* plantations throughout South and Southeast Asia. Its larval stages cause severe defoliation, leading to significant losses in timber quality and growth rate. The study revealed that *H. puera* is a serious pest of teak plants grown in farmer's fields and forest areas in Saharanpur, Uttar Pradesh, India. The female moth laid  $125.22 \pm 24.07$  eggs that hatched after an incubation period of  $2.51 \pm 0.41$  days. There were five larval instars with a total duration of  $13.76 \pm 2.96$  days. The duration of the male and female pupal periods was  $4.31 \pm 0.61$  and  $7 \pm 0.75$  days. Male and female adults survived for a period of  $6.31 \pm 1.21$  and  $7.52 \pm 0.85$  days.

**Keywords:** Teak defoliator, *Hyblea puera*, Life cycle, Egg, Larva, Pupa

## Introduction

Teak, scientifically known as *Tectona grandis* L. (Lamiaceae), is one of the most valuable tropical timber species native to southeastern Asia. It is primarily found in countries such as India, Sri Lanka, Indonesia, Malaysia, Thailand, Myanmar, and Bangladesh (Moya *et al.* 2014) [3].

Teak cultivation in Saharanpur, Uttar Pradesh, presents a viable opportunity due to the region's favorable climate and soil conditions, especially in the plains area. Teak can be grown using various spacing arrangements, including intercropping with agricultural crops. Teak (*Tectona grandis*) is a tropical hardwood that is one of the most highly prized woods in the world. It is known for its strength, durability, natural beauty, and resistance to environmental wear. Although the teak wood is resistant to various environmental factors, even then the plant is attacked by various insect pests time to time.

A wide range of insect pests may seriously harm teak trees' leaves, stems, and roots. The two most prominent insect pests are the teak leaf skeletonizer (*Eutectona machaeralis*) and the teak defoliator (*Hyblaea puera*). The larvae of both these pests feed on teak leaves, leading to considerable defoliation. Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Maharashtra, Orissa, Uttar Pradesh, Gujarat, and Rajasthan are the main states in India that cultivate teak (Kumaravelu, 1992) [6]. Defoliators are the primary destructive pests of teak, and defoliation is a major issue in teak nurseries, plantations, and wild forests. A common issue in teak is severe epidemic defoliation, which is brought on by the larvae of two well-known teak pests in India: *Eutectona machaeralis* (Walker) (Lepidoptera: Pyralidae), also known as the teak leaf skeletonizer, and *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae), also known as the teak defoliator (Tewari, 1992). The most common and devastating insect pest

that attacks teak is the teak defoliator, *Hyblaea puera* Cramer (Hyblaeidae, Lepidoptera), which decreases plant increment volume by approximately 44.1% (Tripathy *et al.*, 2018) [2]. The larvae of *H. puera* consume the entire leaf, leaving only the major veins, and they exclusively feed on young leaves. Although the biology and seasonal occurrence of *H. puera* have been described from various parts of India, no one has described them from Saharanpur. The present study aims to describe the biology of *H. puera* on teak in the Saharanpur region of western Uttar Pradesh.

## Materials and Methods

### Field survey and insect collection

A field survey was conducted on teak plants in Saharanpur from 2022-2024 to observe the major insect pests associated with *Tectona grandis*. During the survey, the teak plants were found severely infested with the larvae of *Hyblaea puera*. The larvae of teak defoliator were collected from different location and brought to the laboratory. The larvae were reared on fresh, tender leaves of teak plant individually in small, aerated plastic vials. Teak leaves were provided daily to the larvae in the morning till pupation and old leaves were removed. After pupation, the pupae were collected in a petri dish. Further, male and female pupae were identified under stereoscopic zoom microscope and kept in separate jars for the emergence of adults. The identification of male and female pupa was done by examining the position and distance between anal and genital slits.

### Insects rearing and data collection

For studying biology, the five pairs of newly emerged adults (males and females) of *H. puera* were released in a breeding cage for mating. A cotton swab soaked in 10% honey solution

was kept inside the rearing cage for adult feeding. A fresh twig of tender leaves dipped in water vial was kept inside the cage for egg laying. The insects were reared from egg to adult stage at the Research Laboratory, Department of Zoology, Maharaj Singh College, Saharanpur, Uttar Pradesh. After mating and egg laying, the adults were kept in another jar till their survival and this period was considered to be their longevity.

Biological parameters such as pre-oviposition, oviposition period, egg period, duration of the larval instars, prepupa, pupa, and longevity of males and female were observed. After mating and egg laying, the adults were kept in another jar till their survival and this period was considered to be their longevity. Morphometric observations of all the developmental stages of *H. puera* were taken with the help of oculometer and scale. Photographs were taken with help of Camera. Collected data were analyzed using M.S. Excel and mean values with standard deviation were calculated.

## Results and Discussion

### Eggs

The eggs (Fig.1) of *Hyblaea puera* were greenish-white, laid singly on the ventral side of young leaves near the leaf veins. The female moth laid  $125.22 \pm 24.07$  eggs that hatched after an incubation period of  $2.51 \pm 0.41$  days. The eggs were measured  $0.81 \pm 0.04$  mm long and  $0.41 \pm 0.02$  mm wide. Similarly, Kabade and Patel, (2015)<sup>[4]</sup>, Tripathy *et al.*, (2018)<sup>[2]</sup>, Seervi *et al.*, (2022)<sup>[8]</sup>, and Fadjeri *et al.* (2024) observed the egg period of  $2.52 \pm 0.45$ , 1.62,  $2.52 \pm 0.45$ , 2-3 days respectively, which support our results.

### Larvae

*Hyblaea puera* larvae undergo five instars. The initial larva appears greenish yellow and had a black head. The first instar larva (Fig.2) measured  $1.91 \pm 0.06$  mm in length and  $0.35 \pm 0.22$  mm in width with duration of  $2.52 \pm 0.49$  days, which is in accordance to Tripathy *et al.*, (2018) who measured the first instar larva  $1.90 \pm 0.04$  mm long and  $0.34 \pm 0.24$  mm wide with a period of  $2.25 \pm 0.41$  days. Seervi *et al.*, (2022)<sup>[8]</sup> also recorded the duration of first instar  $2.54 \pm 0.66$  days, which supports our findings.

The second instar larva (Fig.3) was darker green compared to the earlier instar, featuring scattered hairs across its body and a black head. It measured  $4.66 \pm 0.44$  mm in length and  $0.81 \pm 0.06$  mm in width, with a duration of  $2.45 \pm 0.41$  days. Nachane *et al.* (1999)<sup>[7]</sup>, Javaregowda (2005), Tripathy *et al.* (2018)<sup>[2]</sup>, and Seervi *et al.* (2022)<sup>[8]</sup> also observed the similar duration for the second instar. The length and width of the second instar in our study are in line with the results of Seervi *et al.* (2022)<sup>[8]</sup>, who recorded it as  $4.65 \pm 0.42$  mm in length and  $0.80 \pm 0.08$  mm in width. The third instar larva (Fig.4) was pale greenish to gray in color, featuring a black head and scattered hairs on its body. The body segmentation was distinctly visible. It was  $12.56 \pm 1.45$  mm in length and  $1.89 \pm 0.09$  mm in width. The duration was  $2.47 \pm 0.41$  days. These results correspond with Tripathy *et al.* (2018)<sup>[2]</sup> and Seervi *et al.* (2022)<sup>[8]</sup>, who also recorded the size of the third instar as  $12.54 \pm 1.42$  mm long and  $1.88 \pm 0.08$  mm wide with a duration of  $2.49 \pm 0.51$  and  $2.44 \pm 0.52$

days. The fourth instar larva (Fig-5) was entirely different from the previous instars. It was purple-gray on the dorso-laterally and grayish-green on the latero-ventrally. The head was black, and the body was covered with sparse hairs. It was measured  $21.28 \pm 1.48$  mm long and  $3.1 \pm 0.28$  mm wide. The mean duration of the fourth instar was recorded as  $2.48 \pm 0.43$  days. Our results more or less corroborate the earlier findings of Katagall (1991)<sup>[5]</sup> and Seervi *et al.* (2022)<sup>[8]</sup>, who also reported the fourth instar larva as purple-grey dorsolateral and greyish-green latero-ventrally. The mean duration of the fourth instar larva observed in our study is more or less in accordance with the findings of Katagall (1991)<sup>[5]</sup>, Nachane *et al.* (1999)<sup>[7]</sup>, Tripathy *et al.* (2018)<sup>[2]</sup>, and Seervi *et al.* (2022)<sup>[8]</sup>, who recorded it as 2 to 3 days. The fifth instar larvae (Fig-6) were dark purple-grey dorso-laterally and greenish-yellow latero-ventrally with a pale, distinct longitudinal line along the center of the back and two clear zigzag sub-dorsal white lines on each side of the central line. The morphological characters of first to fifth instar larvae are similar to the findings of Tripathy *et al.*, (2018)<sup>[2]</sup>. The fifth instar larva measured  $32.61 \pm 1.22$  mm in length and  $4.23 \pm 0.29$  mm in width, with a duration of  $3.84 \pm 0.71$  days. The morphometric observations of our study are more or less similar to the results of Tripathy *et al.* (2018)<sup>[2]</sup>, who measured the fifth instar larva  $29.40 \pm 1.24$  mm long and  $4.04 \pm 0.58$  mm wide with a period of  $3.85 \pm 0.75$  days. Similarly, Seervi *et al.*, (2022)<sup>[8]</sup>, also recorded the duration of fifth instar  $3.86 \pm 0.88$  days which supports our study. The total duration of the larval period was observed to be  $13.76 \pm 2.96$  days. The final instar larva stopped feeding and searched for a suitable place where it could remain sluggish. This behavior of the larva indicates that it is going into the prepupa stage.

### Pre-pupa and pupa

In pre-pupal (Fig-7) stage, the caudal region was firmly attached to the leaves. The body shrunk during the prepupal stage; the length and appendages were also contracted. The larva formed a white cocoon (Fig.8) in a triangular leaf fold and became quiescent. After that, the larva went to the pupal stage Seervi *et al.*, (2022)<sup>[8]</sup>. The pre-pupa was measured  $23.51 \pm 2.35$  mm in length and  $6.31 \pm 0.25$  mm in width with duration of  $2.25 \pm 0.41$  days. These observations are closely related to the findings of Javaregowda (2005), Tripathy *et al.* (2018)<sup>[2]</sup>, and Seervi *et al.* (2022)<sup>[8]</sup>, who recorded that the pre-pupa stage lasted for 1,  $1.35 \pm 0.28$ , and  $2.29 \pm 0.56$  days, respectively. The final instar larva of *H. puera* pupated beneath the leaves, especially on the basal half portion. The larva cut the leaf into pieces and webbed them with fecal pellets. In the absence of leaf litter, the pupation may take place within undergrowth leaves or on partially eaten teak leaves (Tripathy *et al.* 2018; and Seervi *et al.*, 2022)<sup>[2, 8]</sup>. The male pupa was measured  $16.47 \pm 0.87$  mm in length and  $4.23 \pm 0.45$  mm in width with duration of  $4.31 \pm 0.61$  days, whereas the female pupa was  $18.05 \pm 1.25$  mm long and  $5.25 \pm 0.42$  mm wide having a duration of  $7 \pm 0.75$  days.

The pupae (Fig-9) were broad and round at the anterior but tapered at the posterior end. The abdomen had ten segments. The spiracles were visible on the fourth and ninth abdominal

segments. The genital aperture of the male was situated on the ninth abdominal segment, whereas, in case of the female, it was on the eighth abdominal segment. The anal aperture was on the tenth abdominal segment in both male and female (Tripathy *et al.* 2018; and Seervi *et al.*, 2022)<sup>[2, 8]</sup>.

### Adults

Adult (Fig-10) males and females emerged from pupae after periods of  $4.31 \pm 0.61$  and  $7 \pm 0.75$  days, respectively. After emergence, the adults rested for some time to expand and harden wings and other body parts. The adults had slender body shapes with two pairs of wings. The forewings were grey in color, whereas the rear wings were dark brown with orange spots. The male moth was smaller in size as compared to the female. The males were  $14.06 \pm 1.72$  mm long, having a wingspan of  $30.43 \pm 2.82$  mm and longevity of  $6.31 \pm 1.21$  days, whereas the female moths were  $15.05 \pm 2.10$  mm in length with

a wingspan of  $32.43 \pm 2.07$  mm and a lifespan of  $7.52 \pm 0.85$  days. These findings are similar to the observations of Tripathy *et al.* (2018)<sup>[2]</sup>, Seervi *et al.* (2022)<sup>[8]</sup>, and Fadjeri *et al.* (2024). In the present study, the pre-oviposition, oviposition, and post-oviposition periods were recorded to be  $2.31 \pm 0.44$ ,  $3.55 \pm 1.26$ , and  $3.51 \pm 0.89$  days, respectively. The fecundity of the female was recorded as  $125.22 \pm 24.07$  eggs per female. Similarly, Tripathy *et al.* (2018)<sup>[2]</sup> and Seervi *et al.* (2022)<sup>[8]</sup> also recorded the pre-oviposition, oviposition, and post-oviposition period of  $2.35 \pm 0.45$ ,  $6.50 \pm 1.45$ ,  $2.18 \pm 0.85$  and  $2.22 \pm 0.41$ ,  $3.0 \pm 1.25$  and  $3.28 \pm 0.88$  days respectively, which supports our results. The total life cycle (from egg to adult) of male and female was completed in  $26.89 \pm 5.56$  and  $30.79 \pm 4.46$  days respectively, which is more or less similar to the results of Seervi *et al.* (2022)<sup>[8]</sup> who recorded it  $25.95 \pm 1.60$  and  $26.00 \pm 2.03$  days for male and female moths.

**Table 1:** Morphometric observations and durations of the developmental stages of *Hyblaea puera*

Life stages	Length (in mm)	Width (in mm)	Min.	Max.	Duration (in days)
Egg	$0.81 \pm 0.04$	$0.41 \pm 0.02$	2	3	$2.51 \pm 0.41$
First instar larva	$1.91 \pm 0.06$	$0.35 \pm 0.22$	2	4	$2.52 \pm 0.49$
Second instar larva	$4.66 \pm 0.44$	$0.81 \pm 0.06$	2	3	$2.45 \pm 0.41$
Third instar larva	$12.56 \pm 1.45$	$1.89 \pm 0.09$	2	3	$2.47 \pm 0.41$
Fourth instar larva	$21.28 \pm 1.48$	$3.1 \pm 0.28$	2	3	$2.48 \pm 0.43$
Fifth instar larva	$32.61 \pm 1.22$	$4.23 \pm 0.29$	3	5	$3.84 \pm 0.71$
Pre pupa	$23.51 \pm 2.35$	$6.31 \pm 0.25$	1.	3	$2.25 \pm 0.41$
Pupa male	$16.47 \pm 0.87$	$4.23 \pm 0.45$	3	5	$4.31 \pm 0.61$
Pupa female	$18.05 \pm 1.25$	$5.25 \pm 0.42$	6	8	$7 \pm 0.75$
Male adults	$14.06 \pm 1.72$	Wing span $30.43 \pm 2.82$	4	8	$6.31 \pm 1.21$
Female adults	$15.05 \pm 2.10$	Wing span $32.43 \pm 2.07$	5.5	9	$7.52 \pm 0.85$
Pre-oviposition period			2	3	$2.31 \pm 0.44$
Oviposition period			1	5	$3.55 \pm 1.26$
Post-oviposition period			2	5	$3.51 \pm 0.89$
Total duration of larval stages			12	16	$13.76 \pm 2.96$
Fecundity			58	156	$125.22 \pm 24.07$
Total life cycle of male			24	29	$26.89 \pm 5.56$
Total life cycle of female			25	32	$30.79 \pm 4.46$



1



2



3

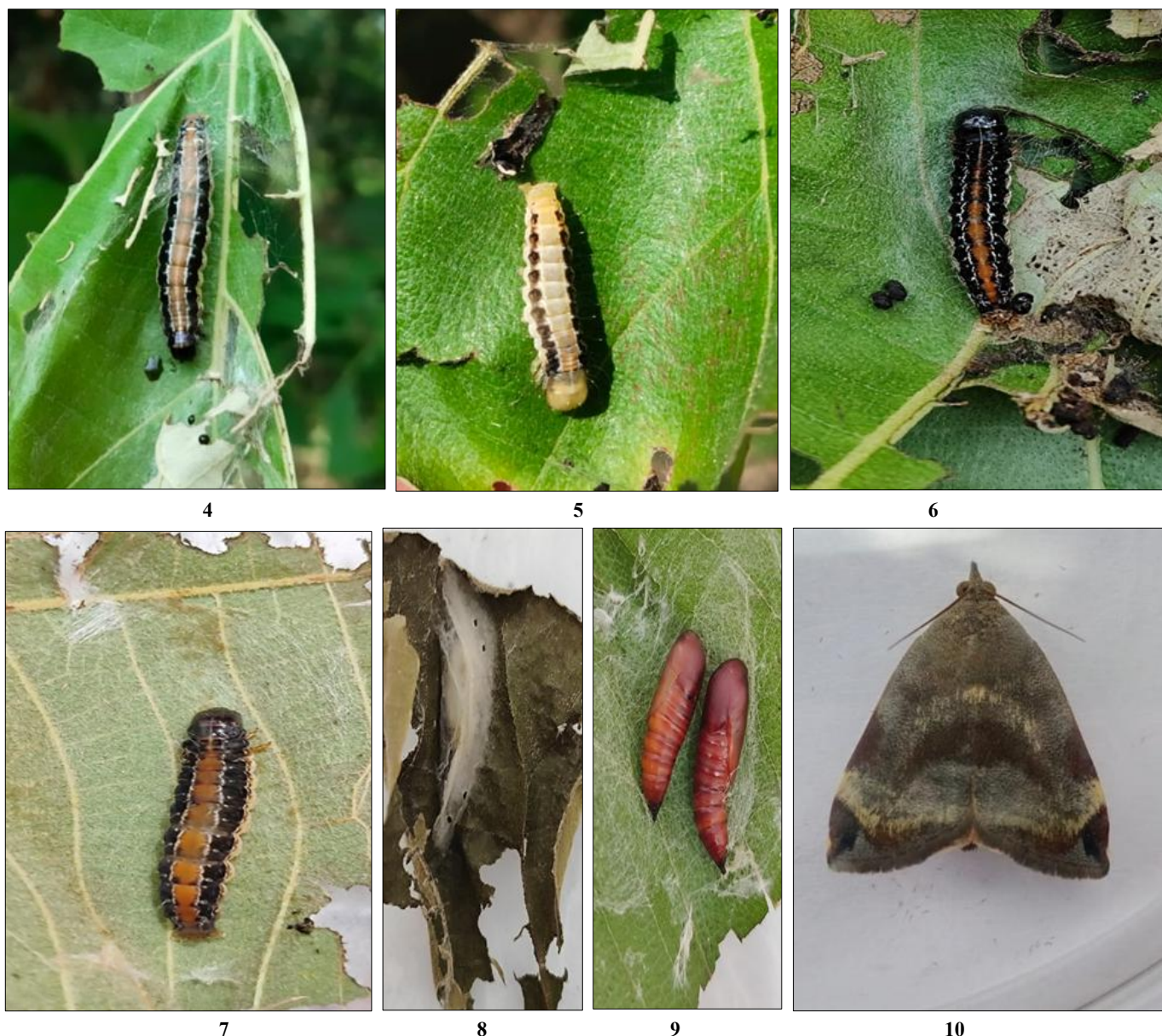


Fig : (1) Egg (2-6) First, second, third, fourth and fifth instar larvae of *Hyblaea puera* (7) Pre-pupa (8) Cocoon (9) Pupae (10) Adult

### Conclusion

The study concludes that *Hyblaea puera* is a significant pest in teak plantations in Saharanpur, which is observed for the first time in this region. The life cycle of male and female adults was completed in  $26.89 \pm 5.56$  and  $30.79 \pm 4.46$  days. Pre-oviposition, oviposition, and post-oviposition periods were recorded to be  $2.31 \pm 0.44$ ,  $3.55 \pm 1.26$ , and  $3.51 \pm 0.89$  days, respectively. Understanding the biology of *H. puera* will be helpful in developing effective and sustainable insect pest management strategies against this pest.

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