



Biology of *Eutectona machaeralis* (Walker) (Lepidoptera: Crambidae) on *Tectona grandis* L. (Lamiaceae)" from Saharanpur, Uttar Pradesh

Om Datta

Department of Zoology, Maharaj Singh College, Saharanpur, Uttar Pradesh, India

*Corresponding author: Om Datta

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Abstract

The present study was carried out on the biology of the teak skeletonizer, *Eutectona machaeralis* Walker. The female moth placed spherical, transparent, greenish-white eggs on the underside of the leaves, close to the midrib, either alone or in clusters. The female produced 250 to 300 eggs (272.2 ± 26.35). The hatching rate of eggs ranged from 70 to 80%, with an average of 74.15 ± 5.60 . The oviposition period was recorded as 4 to 5 days, with an average of 4.21 ± 0.59 days. The eggs were measured from 0.25 to 0.31 mm in diameter, with an average of 0.28 ± 0.04 mm in diameter. The hatching percentage of the eggs varied from 70 to 80%, with an average of 74.15 ± 5.60 . First, second, third, fourth, and fifth instar larvae were measured at 2.09 ± 0.23 , 7.51 ± 1.14 , 11.62 ± 1.66 , 17.64 ± 1.79 , and 24.41 ± 1.05 mm in length and 0.27 ± 0.02 , 0.98 ± 0.13 , 1.31 ± 0.26 , 1.73 ± 0.31 , and 2.15 ± 0.16 mm in width, respectively. The prepupa measured 17.58 ± 2.72 mm in length and 2.86 ± 0.83 mm in width, having a duration of 1 to 2 (1.63 ± 0.71) days. The male pupa measured 11.57 ± 1.12 mm long and 2.75 ± 0.34 mm wide, having a duration of 6.31 ± 0.41 days, whereas the female pupa was 14.40 ± 0.62 mm long and 3.50 ± 0.41 mm wide with an almost similar duration to the male pupa. The male moth measured 11.68 ± 0.64 mm in length, 1.96 ± 0.39 mm in width, and 24.40 ± 1.10 mm in wing expanse. The female was 9.72 ± 0.63 mm in length and 2.92 ± 0.41 mm in width with a wingspan of 19.48 ± 1.11 mm. The average duration of larval stages was 13.51 ± 0.99 days. The female's pre-oviposition, oviposition, and post-oviposition periods were 3.25 ± 0.58 , 4.21 ± 0.59 , and 2.43 ± 0.61 days, respectively. Males and females completed their life cycles in 31.6 ± 1.63 and 33.9 ± 4.45 days, respectively.

Keywords: Biology, *Eutectona machaeralis*, *Tectona grandis*

Introduction

Teak, *Tectona grandis* L. (Lamiaceae), is a highly valuable tropical timber species native to southeastern Asia, primarily found in India, Sri Lanka, Indonesia, Malaysia, Thailand, Myanmar, and Bangladesh (Moya *et al.* 2014) [9]. It is also called the "king of timber." Teak grows naturally in 9 million hectares of southern tropical deciduous forests in Peninsular India situated below 24° N latitude (Seth and Kaul 1978) [14]. There are already 1.5 million hectares of teak plantations in India, with an additional 50,000 ha planted each year (Subramanian *et al.* 2000) [15]. Teak is one of the top five tropical plantation species in the world, as well as in India. It is grown in large-scale monocultures in many states of India, including Kerala, Karnataka, Gujarat, Madhya Pradesh, Rajasthan, Odisha, Tamil Nadu, and Uttar Pradesh (Tewari 1992) [16]. Pests that attack teak include root and stem feeders, sap suckers, defoliators, tree borers, fruit borers, and gall inducers. There are two defoliator species: *Eutectona machaeralis* Walker and *Hyblaea purea* Cramer. *E. machaeralis* is known as the teak skeletonizer. The teak skeletonizer, *Eutectona machaeralis* (Walker) (Lepidoptera: Crambidae), is a primary pest of teak trees in plantations and natural forests (Zhang *et al.*, 2018) [18]. The larvae of *Eutectona machaeralis* only feed on fleshy leaf tissues, leaving veins intact. This negatively impacts growth and vigor, causing abnormalities that result in both quantitative and qualitative

diminutions in timber production (Champion, 1934; Beeson, 1941) [4, 3]. The teak skeletonizer, *E. machaeralis* W., is one of the most common teak pests in India, responsible for the annual epidemic defoliation in plantations, nurseries, and natural forests of all teak-growing areas (Beeson, 1941; Brown, 1968; Mathur, 1960) [3, 2, 7]. According to Nayak *et al.* (2002), the teak skeletonizer caused 35.79% loss in annual growth in teak nurseries and 60.00 to 81.77% loss in teak plantations. The goal of this study is to describe the biology of the teak skeletonizer.

Materials and Methods

A survey of the Horticulture Garden, Saharanpur, was conducted during the kharif season of 2022-2023 to record the insect pests of teak plants. During the survey, the teak plants were found to be infested with lepidopteran larvae (*Eutectona machaeralis* Walker). The larvae were collected from afflicted teak plants, brought to the research laboratory, and raised on a natural diet (fresh teak leaves) in (25 cm $\times$ 20 cm $\times$ 20 cm) perforated plastic jars. The larvae were fed daily on young and soft leaves of teak. The jars were cleaned every day by removing the leftover and half-eaten leaves. After the larvae pupated in silken cocoons, they were transferred to a separate jar. The pupae were separated from the cocoons and identified as male and female by examining the position between the anal and genital slits under a stereoscopic zoom microscope. The male and female pupae were kept in separate jars. Five pairs of

freshly emerged adult males and females of *E. machaeralis* were individually selected and placed in a rearing jar with fresh teak leaves to facilitate mating and egg laying. They were maintained at room temperature for the purpose of studying their biology. A cotton swab soaked in a 10% honey solution was kept for the feeding of adults; the adults were raised for up to two generations at room temperature in the research laboratory of the Department of Zoology, Maharaj Singh College, Saharanpur, Uttar Pradesh, India, while various biological parameters were examined, including egg count, incubation time, pre-oviposition period, larval instar durations, total larval duration, prepupal period, pupal period, and longevity, which were observed periodically. Photographs of the life stages of *E. machaeralis* were taken with the help of a digital camera and a Dewinter stereo zoom microscope. The mean values of all the biological parameters with standard deviation were calculated using Microsoft Excel software.

Results and Discussion

The results obtained on the biology of the teak leaf skeletonizer *Eutectona machaeralis* revealed that the female laid round greenish-white translucent eggs (Fig-1), which turned brownish-red in colour before hatching. The eggs were measured from 0.25 to 0.31 mm in diameter, with an average of 0.28 ± 0.04 mm in diameter. The eggs were laid singly or in batches near the midrib or on the underside of the leaves. The egg-laying capacity of a female was recorded from 250 to 300 (272.2 ± 26.35) eggs. The hatching percentage of the eggs varied from 70 to 80%, with an average of 74.15 ± 5.60 . The oviposition period ranged from 4 to 5 days, with an average of 4.21 ± 0.59 days. First instar larvae (Fig-2) emerged from the egg by making a small hole in the egg-shell. The head wriggles out first, then the thorax and abdomen. The larvae took approximately 2 to 4 minutes to emerge from the eggshell. The larvae were typically cruciform, with a pair of true legs on each thoracic segment and two prolegs on the third, sixth, and tenth abdominal segments. The young neonate larvae were greenish-white with a conspicuous light brown head capsule, transparent integument, and clear, distinct abdominal segments. The first instar larvae measured 2.09 ± 0.23 mm long and 0.27 ± 0.02 mm wide. The duration of the first instar larvae varied from 2 to 3 days, with an average of 2.32 ± 0.41 days. More or less similar observations on the duration of first instar larvae were recorded by Patil and Thontadarya (1987a), Mishra and Singh (2004), Chauhan, N. R. *et al.* (2013), and Mukesh Kumar Sirvi *et al.* (2022) [11, 8, 12, 5, 10]. The second instar larvae were significantly different from the first instar. The head capsule varied in color from light brown to greenish brown. The six black spots on each segment were more prominent. The second instar larvae measured 7.51 ± 1.14 mm long and 0.98 ± 0.13 mm wide. The duration of second instar larvae varied from 2 to 3 (2.51 ± 0.72) days, which is almost in accordance with the findings of Patil and Thontadarya (1987a); Mishra and Singh (2004); Chauhan, N. R. *et al.* (2013); Dhobe and Naik (2015); and Mukesh Kumar Sirvi *et al.* (2022) [11, 8, 12, 5, 10]. Third instar larvae were distinguished from the second instar larvae due to the presence of more black spots on each body segment, and

the position of the six spots became more prominent, while the rest of the morphological characters remained the same. The third instar larvae were 11.62 ± 1.66 in length and 1.31 ± 0.26 in width. The duration of the third instar was recorded from 2 to 3 (2.61 ± 0.69) days. The third instar larvae had additional longitudinal brown, yellow, and green colour bands on lateral sides. The present results are more or less in accordance with the reports of Patil and Thontadarya (1987a), Mishra and Singh (2004), Chauhan, N. R. *et al.* (2013), Dhobe and Naik (2015), and Mukesh Kumar Sirvi *et al.* (2022) [11, 8, 12, 5, 10]. Fourth instar larvae were almost identical to third instar larvae, but with additional longitudinal brown, yellow, and green color bands on lateral sides. The fourth instar larvae measured 17.64 ± 1.79 mm in length and 1.73 ± 0.31 mm in width, having a duration of 2 to 3 (2.41 ± 0.85) days. These results are more or less similar to the earlier findings of Patil and Thontadarya (1987a), Mishra and Singh (2004), Chauhan, N. R. *et al.* (2013), Dhobe and Naik (2015), and Mukesh Kumar Sirvi *et al.* (2022) [11, 8, 12, 5, 10]. The fifth instar larva was similar to the fourth instar larva, except that its color changed from green to brown or purplish. Four black or brown spots, two on either side of the mid-dorsal line, were found on the anterior half of each segment. The duration of fifth instar larvae ranged from 3 to 4 (3.72 ± 0.84) days. The fifth instar larvae measured 24.41 ± 1.05 mm long and 2.15 ± 0.16 mm wide. These results are more or less similar to the earlier findings of Patil and Thontadarya (1987a), Mishra and Singh (2004), Chauhan, N. R. *et al.* (2013), Dhobe and Naik (2015), and Mukesh Kumar Sirvi *et al.* (2022) [11, 8, 12, 5, 10].

Prepupa

Before going to pupation, the fully grown final instar larva stop feeding, normal mobility and start spinning a transparent whitish cocoon in triangular folded or dead fallen leaves and became prepupa. The prepupa is a non-feeding stage between the last feeding larval instar and the pupa. It is less common in Lepidoptera, where most species move on directly from feeding cessation to pupation (Timothy, 2021). The caudal region of prepupa was firmly attached to the leaves. The prepupa was pale green in color, with hooks on the anal segment that allowed it to attach to the silken cocoon. The prepupa measured 17.58 ± 2.72 mm in length and 2.86 ± 0.83 mm in width having duration of 1 to 2 (1.63 ± 0.71) days. The present results are in accordance with (Patil and Thontadarya, 1987a; Mishra and Singh, 2004; Chauhan, N. R. *et al.*, 2013; Dhobe and Naik, 2015; Mukesh Kumar Sirvi *et al.*, 2022) [11, 8, 12, 5, 10].

Pupa

Pupation takes place inside a white oval shaped flat cocoon on green or fallen dry teak leaves. The pupa (Fig-3) was cylindrical in shape and creamy in color, which gradually turned creamy yellow and finally reddish brown. The segments and appendages were clearly visible with the naked eye in fully mature pupa. The segments and appendages were clearly visible to the naked eye in fully mature pupa, and the spiracles on thoracic segments as well as the hairs and spines on

abdominal segments could be seen clearly under a microscope only. The male pupa was pointed at the end of the abdomen, and its wings ended on the 8th abdominal segment. The male pupa measured 11.57 ± 1.12 mm long and 2.75 ± 0.34 mm wide having duration of 6.31 ± 0.41 days. The female pupa had a slightly blunt abdominal end, and the wing ended on the 10th abdominal segment. The female pupa was 14.40 ± 0.62 mm long and 3.50 ± 0.41 mm wide with duration of 6.31 ± 0.41 days, which is more or less similar to the reports of (Patil and Thontadarya, 1987a; Intachat, 1999; Roychoudhary, 1999; Mishra and Singh, 2004; Chauhan, N. R. *et al.*, 2013; Dhobe and Naik, 2015; Mukesh Kumar Sirvi *et al.*, 2022) [11, 6, 13, 8, 12, 5, 10].

Male adults

The newly emerged adults rested for a while to expand and harden their wings and other body parts. Adult moths have transverse markings in their forewings and bands in their hind wings. Male and female moths lived for 5.8 and 7.1 days, respectively. The abdomen of the male was pointed and tapering. The anterior seven segments were brown in color. The male moth measured 11.68 ± 0.64 mm in length, 1.96 ± 0.39 mm in width, having wing span of 24.40 ± 1.10 mm. The males lived for 6.0 to 7.0 (6.50 ± 0.4) day. More or less similar observations were recorded by ((Wu *et al.*, 1979; Patil and Thontadarya, 1987a; Intachat, 1999; Roychoudhary, 1999; Mishra and Singh, 2004; Chauhan, N. R. *et al.*, 2013; Dhobe and Naik, 2015; Mukesh Kumar Sirvi *et al.*, 2022) [19, 11, 6, 13, 8, 12, 5, 10].

Female adults

Females had wider, thick and bluish abdomens. The anterior six segments of the abdomen were brown in color. The female was 9.72 ± 0.63 mm in length, 2.92 ± 0.41 mm in width having a

wing span of 19.48 ± 1.11 mm. The male and female moths were bright yellowish with ochreous yellow, orange, or pinkish transverse zigzag lines and a reddish marginal line or band on the forewings. The hind wings were yellowish-white with a serrated marginal line. The antennae were filiform, light yellow, and covered with hairs. Similar findings were recorded by (Wu *et al.*, 1979; Patil and Thontadarya, 1987a; Mishra and Singh, 2004) [19, 11, 8]. The females lived for 8.0 to 9.0 (8.50 ± 0.5) days, which is more or less similar to the findings of (Patil and Thontadarya, 1987a) and Intachat, 1999) [11, 6]. The total duration of male and female life cycles is more or less close to the findings of (Beesson, 1941; Patil and Thontadarya, 1987a; Intachat, 1999), Mishra and Singh, 2004 and Alam *et al.*, 2004) [3, 11, 6, 8, 1].

Conclusion

In conclusion, *Eutectona machaeralis* is a serious pest of teak plants in Saharanpur, Uttar Pradesh, India. The teak skeletonizer causes considerable foliar damage (Fig. 6) to the teak plants. Although *E. machaeralis* has been reported from various parts of India, but in Saharanpur, it is the first record of its occurrence. Understanding the biology and behavior of an insect pest is the key for proper insect pest management. The larval stages of *E. machaeralis* cause serious damage to the teak plants; hence, there is a need to develop an effective IPM strategy to control this pest, or suitable teak clones resistant to *E. machaeralis* need to be identified and planted in the plantation areas to reduce the economic damage.

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Table 1: Morphometric observations and longevity of the life stages of *Eutectona machaeralis* (Walker) on *Tectona grandis*

Life stages	Length (in mm)	Width (in mm)	Duration in days (Mean±SD)
Eggs	0.28 ± 0.04	0.28 ± 0.04	4.0 ± 0.71
1 st instar larva	2.09 ± 0.23	0.27 ± 0.02	2.32 ± 0.41
2 nd instar larva	7.51 ± 1.14	0.98 ± 0.13	2.51 ± 0.72
3 rd instar larva	11.62 ± 1.66	1.31 ± 0.26	2.61 ± 0.69
4 th instar larva	17.64 ± 1.79	1.73 ± 0.31	2.41 ± 0.85
5 th instar larva	24.41 ± 1.05	2.15 ± 0.16	3.72 ± 0.84
Prepupa	17.58 ± 2.72	2.86 ± 0.83	1.63 ± 0.71
Male pupa	11.57 ± 1.12	2.75 ± 0.34	6.31 ± 0.41
Female pupa	14.40 ± 0.62	3.50 ± 0.41	6.31 ± 0.41
Male adult	11.68 ± 0.64	1.96 ± 0.39	6.52 ± 0.51
Female adult	9.72 ± 0.63	2.92 ± 0.41	8.53 ± 0.81
Wing span of male		24.40 ± 1.10	
Wing span of female		19.48 ± 1.11	
Total duration of larval stages			13.51 ± 0.99
Pre-oviposition period			3.25 ± 0.58
Oviposition period in female			4.21 ± 0.59
Post oviposition period			2.43 ± 0.61
Duration of life cycle in male			31.6 ± 1.63
Duration of life cycle in female			33.9 ± 4.45
Fecundity (no of eggs laid by female)			272.2 ± 26.35
Hatching % of the eggs- 80%			

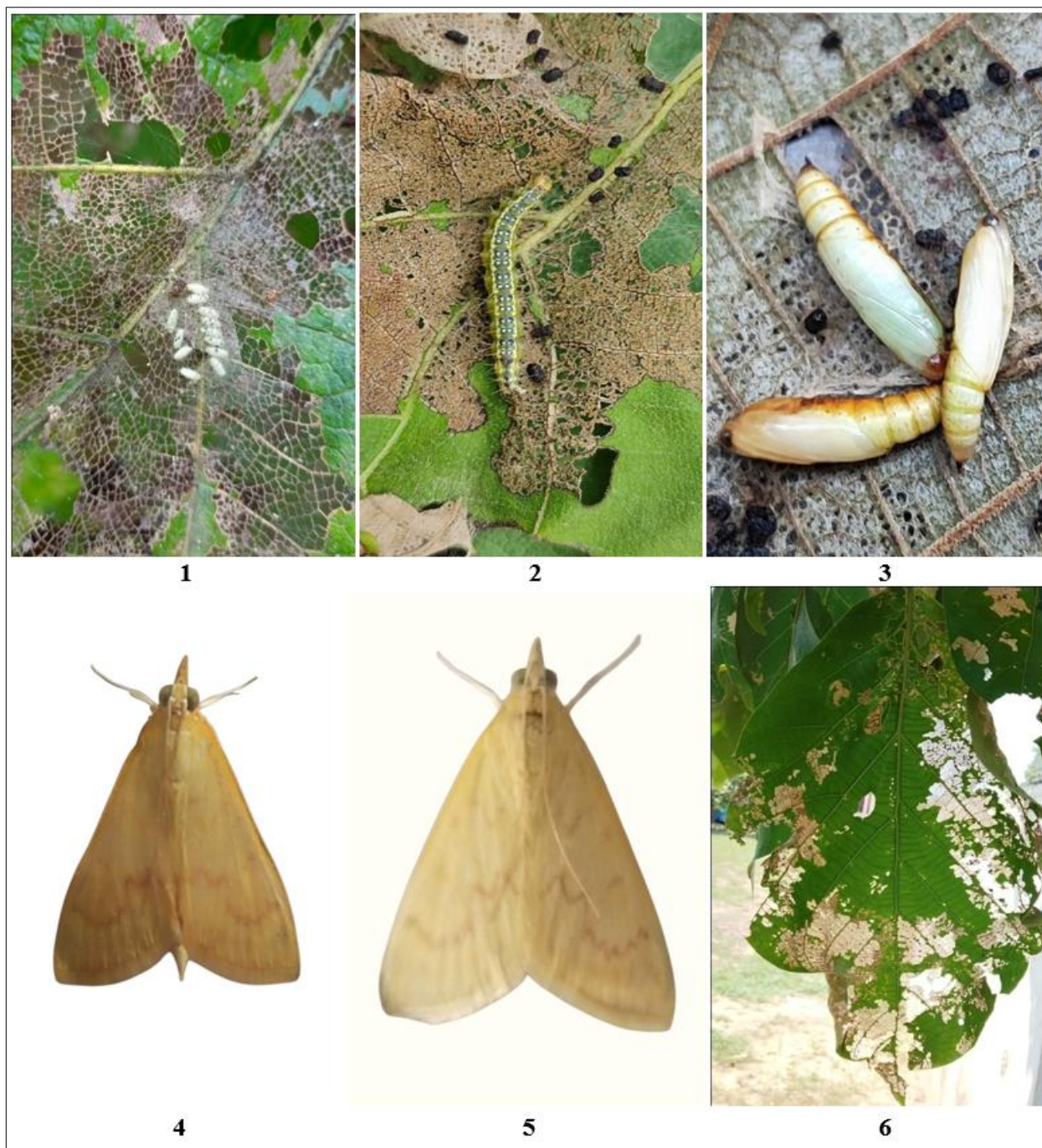


Fig: (1) Eggs (2) Larva (3) Pupa (4) Male adult (5) Female adult (6) Skeletonized leaf of *Tectona grandis*

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