

BIONOMICS OF *HYBLAEA PUERA* (LEPIDOPTERA: HYBLAEIDAE), A SERIOUS PEST OF TEAK (*TECTONA GRANDIS*) FROM JAMMU (INDIA)

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[Sharma, S., Tara, J. S. & Bhatia, S. 2013. Bionomics of *Hyblaea puera* (Lepidoptera: Hyblaeidae), a serious pest of teak (*Tectona grandis*) from Jammu (India). Munis Entomology & Zoology, 8 (1): 139-147]

ABSTRACT: *Hyblaea puera* (Lepidoptera: Hyblaeidae), commonly known as teak defoliator, is recognized as the most serious pest of teak (*Tectona grandis*) in the area under study. Outbreaks of this insect which feeds on young tender leaves occur during the early part of the growth season, soon after the trees have put forth the new flush of leaves. The observations were recorded on the biology of the pest in Jammu under laboratory conditions. The pre-mating period of both sexes of moth was one to three days after emergence. Mating occurred during night and lasts for about an hour. A characteristic courtship behavior was exhibited by the adult moths. Pre-oviposition period was 20- 24 hours and the mean oviposition period was 6 days. It was revealed that the incubation period varies from 1.5 to 3.05 days with an average of 2.51 ± 0.648 days. The larvae passed through five instars and total larval period varies from 15.2 to 20.15 days with an average of 17.62 ± 1.64 days. Pupal period ranges from 6.2 to 8.4 days with an average of 7.16 ± 0.85 days. Total life cycle varied from 21.4 to 28.15 days with an average of 24.79 ± 2.42 days. Pest completed 7 generations in a year from June to November.

KEY WORDS: Biology, *Hyblaea puera*, Lepidoptera, *Tectona grandis*, Jammu, India.

Teak (*Tectona grandis* Linn. f.) is one of the most important and valuable timber trees of the world. It is predominantly tropical or sub-tropical in distribution. Teak forests occur naturally in India, Myanmar, Thailand and Laos and cover an area of about 23 million ha. Teak is also grown in plantations in at least 36 countries throughout the tropics and about 5.7 million ha of teak plantations are recorded (Bhat and Ma 2004) Teak constitutes about 75% of the world's high-quality tropical hardwood plantations (FAO 2001). About 43% of all teak plantations are located in India, 31% in Indonesia, 7% in Thailand, 6% in Myanmar and 5% in tropical Africa. In Africa, teak plantations are mainly concentrated in Côte d'Ivoire, Nigeria, Ghana, Sudan, Togo, Benin and Tanzania. Teak is one of the few woods in the world that has a natural oil to retard water and keeps teak from wrapping, cracking or becoming brittle. It is extensively used in ship building, house building, bridge and wharf construction, furniture, railway carriages, carving, wheel spokes and numerous other purposes. Teak faces many challenges, among which is its susceptibility to insect pests, in particular the defoliators. About 174 species of insects are reported associated with teak (Mathur 1960), but most of them are minor or occasional pests. However, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) is considered as major pest as defoliation caused by them often affects the plant growth adversely (Mathur and Singh, 1960). The present study deals with occurrence, nature of damage and life cycle of the pest on teak in Jammu (J&K) as no report on these aspects from the region is available in order to plan a suitable control measure.

MATERIALS AND METHODS

Larvae and pupae were collected from teak plantations from four different sites viz. Vijaypur, Janipur, Narwal and Arnia. Studies were conducted during the period 2009-2011 when the occurrence of the pest was at peak. Potted teak (*Tectona grandis*) plants were used for the oviposition by the adult females. After oviposition the adults were removed from the cage and eggs were counted by using the stereomicroscope. Eggs laid on the potted plants were allowed to hatch in situ and then the freshly hatched larvae were transferred individually with the help of fine brush to young tender leaves and reared till the adult emergence by changing the food daily. Larvae were reared in normal room temperature and observations were recorded daily to determine the incubation period, number of moultings, number of larval instars, pupal period and total developmental period. The sex of the adults that emerged from the cage was recorded. Number of moultings was determined based on the casted head capsule. The culture was maintained continuously till last generation to know the number of generations completed in one year by the insect pest.

OBSERVATIONS AND DISCUSSION

Distribution

The results revealed the distribution in Jammu and Samba districts of Jammu (J&K); In India pest is found in Dehra Dun – Uttarakhand (Mathur, 1960); Faizabad–U.P. (Pandey et al., 2007); Kerala (Sudheendrakumar, 2003; Nair & Mohandas, 1996; Mathew et al., 1990); Madhya Pradesh (Mishra & Joseph, 1982; Roychoudhary et al., 2003); Coimbatore–Tamil Nadu (Murugan & Kumar, 1996); Mandya–Karnataka (Patil & Naik, 1997) Andhra Pradesh (Pawar & Bhatnagar, 1989) and Port Blair–Andaman (Veenakumari & Mohanraj, 1996).

Hyblea puera is distributed across the tropics and subtropics, covering Asia-Pacific, Africa, Central America, the Caribbean and South America. Pinhey (1979) reported its wide spread in Asia, Australia and America.

Hosts

It is oligophagous pest with teak (*Tectona grandis*) as its principal food plant. Other known food plants, on which it breeds regularly, belong chiefly to the family Verbenaceae (13 species) Bignoniaceae (13 species) and a few other families, such as Araliaceae, Juglandaceae and Oleaceae (1 species each) (Beeson, 1941; Mathur, 1960).

Seasonal occurrence

For most of the year there is no visible defoliator activity. The teak trees put forth a new flush of leaves, generally by April-May, following a brief deciduous period. Then about a month later, usually between June and July, a widespread infestation occurs suddenly, with hundreds of similar aged caterpillars gregariously on the teak canopy. During these outbreaks, each tender leaf of the infested trees may harbor some 30-50 larvae they remain in the field upto the first week of November. When the outbreak is in progress, the faecal pellets falling on dry leaves on the ground can be heard. Larvae descend on silk threads from defoliated trees and are wafted to adjacent trees still holding green leaves. Mature larvae pupate on the ground under litter. Within a week or two, extensive areas of plantations are left totally leafless. Large-scale outbreaks are common in Myanmar, Thailand, Bangladesh, Sri Lanka and Indonesia during the main

flushing period of teak. (Beeson, 1941; Hutcharern, 1990; Tilakaratna, 1991; Nair, 2000).

Nature of damage

Only the larvae feed voraciously and cause significant damage to the tree thereby affecting growth and vigour of the plant. The first instar larva feeds first on the soft parenchyma of the young leaves but acquires soon the power of biting through the smaller veins and cuts a small semicircular or rectangular flap out of the edge of the leaf which it pulls over and fastens to the upper leaf surface, thus forming a small shelter inside which it lies and feeds under the folded or curled leaf edge. As the second and third instar larvae grow, the shelter is to be made large to accommodate within. The whole of the green leaf tissue is destroyed by the larvae, only the largest ribs being left, with small portions of uneaten green tissue.

The fourth and fifth instar larvae prepare shelters everyday by folding over side. The larva feeds within the protection and all the tissues of infested leaves are consumed except larger veins but more veins are left in older leaves. The last instar larvae are voracious feeders. In Jammu conditions, the larvae remain active in field from June to November with peak activity period observed during mid July to September. During this period, it causes maximum damage to the tree. Katagall (1991) reported first and second instar larvae were found to skeletonise the leaf, whereas third instar larvae consume the tender leaves entirely. The fourth and fifth instar larvae were found to feed entire leaf leaving only veins. Further, the observations made by Beeson (1941) indicated that under certain conditions the terminal buds of the tender and lateral shoots are gnawed or wholly destroyed by the larva. This usually occurs only under compulsion of extreme hunger and after complete stripping the leaves. Later forking symptoms are observed because of the death of the terminal bud.

LIFE CYCLE

Premating and mating behavior

Before mating, sexually active adults exhibited characteristic courtship behavior which involves rapid movements within the cage including running or flying, periodic fluttering of wings and raising of body on legs. The female courtship behavior included lifting of wings, curving of abdomen and protrusion and retraction of terminal abdominal segments. At the end of the courtship the mating took place within one to three days after emergence at night only. The male approached the female and exhibited either a clockwise or anticlockwise circling movements and finally remained quite facing the back of the female. At this stage, the male kept its wings raised up. The male then took a 90 degree anticlockwise turn and extended and curved its abdomen towards the female genitalia and established genital contact. Subsequently the male took another 90 degree anticlockwise turn and closed its wings and took the normal position. Thus in copulation the male and female assumed a back-to-back position. On an average the duration of mating was about an hour.

Pre-oviposition and oviposition behavior

A female *Hyblea puera*, which mated during the early morning hours of a particular day, laid its first batch of eggs on the same day evening; the preoviposition period lasted for 18-24 h after mating. Oviposition continued upto a maximum of six days. The moths found to lay eggs in the evening hours. The

eggs were usually laid singly near the veins sticking to the lower side of leaf, particularly on young tender foliage. The number of eggs laid was maximum on the first day of oviposition and thereafter decreased. A single female moth lies between 230-300 eggs. Katagall (1991) reported fecundity of moths to vary from 52-686 with an average of 308 eggs whereas Sudheendrakumar (2003) reported that total number of eggs laid by *Hyblea puera* to vary from 287-606 in the laboratory.

Incubation period and hatching

Freshly laid eggs were small, oval, flat and white in color and measured 0.91 mm in length and 0.53 mm in width. One day prior to hatching, the dark head of the young larva was observed inside the egg shell before hatching. The incubation period varied from 1.5 to 3.05 days with an average of 2.51 ± 0.648 . Almost all the eggs laid by a single female were found to hatch when laid during monsoon and post monsoon and was reduced considerably when laid during late October. Chen and Wu (1984) recorded the incubation period as 1.5-5.0 days, Nair (1988) reported 2.0 days and Katagall (1991) recorded 2.0-3.0 days in the laboratory.

Larva and the number of instars

Newly hatched larva was active and pale-reddish or greenish-yellow in color with a black head. It was found to move briskly all over the cage in the laboratory and the first instar fed mainly on the leaf surface. They make shallow depressions on the surface of tender leaf and protect themselves with the strands of silk. The later instar larvae cuts a leaf flap, usually at the edge of the leaf, folds it over, fasten it with silk and feeds from within. There is considerable color variation in the fourth and fifth instars, the body either wholly black or dark grayish to black with longitudinal colored bands that may include a dorsal orange or ochreous band and lateral white lines. The dark and light forms occur together in the same populations. The larva irrespective of the instar, when disturbed wriggled themselves quickly and climbed down the threads from the leaves on which they were feeding. The larvae especially the fourth and fifth instar, when irritated, emitted a dark green fluid, ejected to a considerable distance from its mouth. The larvae were found to undergo ecdysis within the leaf fold. Larvae stop feeding before moulting. Under laboratory conditions, the number of larval instars has been observed to be five on *Tectona grandis*. The total larval duration varies from 15.2 to 20.15 days with an average of 17.62 ± 1.64 days. Katagall (1991) observed five larval instars and total life cycle occupied 17 to 20 days in the laboratory.

Pupation

The full grown larva constructed normally a loose silken cocoon in a triangular leaf fold after stopping feeding but was also observed to construct silken cocoon inside the faecal pellets and parts of eaten leaves inside the cage. The color of the prepupa was pale yellowish. The normal prepupal period lasts for one day in all the seasons. The last larval exuvium and head capsule remained inside the cocoon. The freshly formed obtect pupa was yellowish and gradually reached to dark brown. The total pupal duration ranged between 6.2 to 8.4 days with an average of 7.16 ± 0.85 days in the laboratory. Chen and Wu (1984) recorded the pupal period 6 to 15 days, Nair (1988) 6-8 days and Katagall (1991) 5.0 and 9.5 days during May and July under laboratory conditions.

Adult emergence

Emergence of the adult took place during night and early morning hours. Emergence process took about 7-10 minutes where in the males emerged earlier to female moth remained inactive till the wings are fully stretched and dried.

Natural enemies

The investigations helped to recover a total of 9 natural enemies which, consisted of two species of parasitoids, three species of spiders, three species of birds and one species of insect predator. Present observations are more or less in accordance with the reports of Beeson (1934), Beeson and Chatterjee (1935), Garthwaite and Desai (1939), Mathur(1960) who recorded different species of parasites on *Hyblaea puera*.

Number of generations

It was observed that the *Hyblaea puera* completed 7 to 8 overlapping generations in a year in Jammu on *Tectona grandis*. Beeson (1928; 1941) indicated the occurrence of 13 to 15 generations in a year in South India with no resting period either in winter or summer and about 8-10 generations in North India.

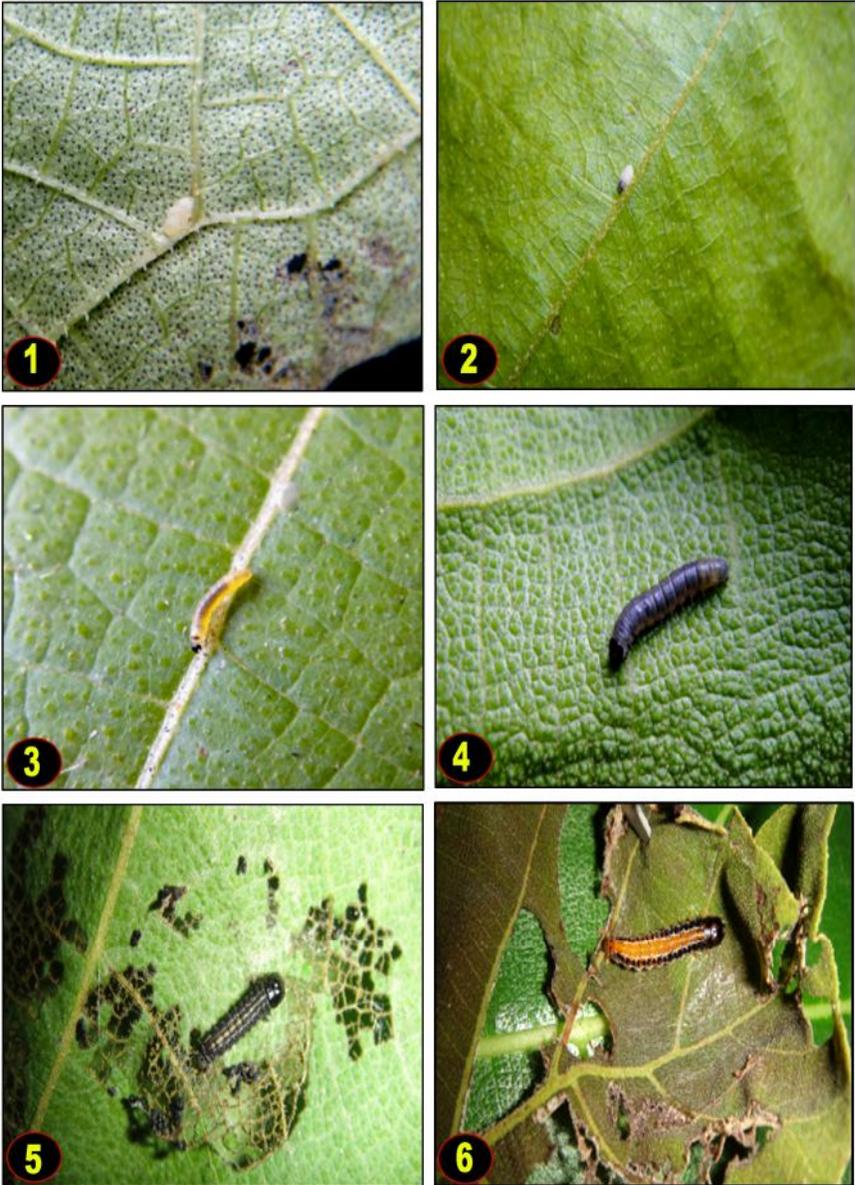
ACKNOWLEDGEMENTS

The authors are greatly thankful to Professor K.K.Sharma Head, Department of Zoology, University of Jammu for providing necessary facilities to work.

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1. Freshly laid egg of *Hyblaea puera*, 2. Egg prior to hatch, 3. 1st instar larva, 4. 2nd instar larva, 5. 3rd instar larva, 6. 4th instar larva.



7 & 8. Two color forms of 5th instar larva, 9. Prepupation, 10. Pupation, 11. Adult male, 12. Adult female.



13 to 15. Damage caused by the pest to *Tectona grandis*.