Biology and Ecology of *Zeuzera conferta* Walker (Cossidae : Lepidoptera) Infesting *Sonneratia apetala* Plantations in Bangladesh

M. W. Baksha and M. R. Islam
Bangladesh Forest Research Institute, P. O. Box 273
Chittagong 4000, Bangladesh

Abstract

This paper reports the distribution, nature and impact of damage, life history, number of generations in a year, host records and biocontrol agents of the beehole borer, *Zeuzera conferta* Walker (Cossidae : Lepidoptera) infesting keora (*Sonneratia apetala* Buch.-Ham.) plantations along the coastal belt of Bangladesh. The pest profusely tunnels in the stem rendering the tree to wind breakage. It probably completes two generations in a year. Besides keora, the pest attacks *Sonneratia caseolaris, Avicennia officinalis, A. alba* and *Tamarix indica*. Woodpeekers (*Dinopium benghalense* and *Picoides canicapillus*) and a small black ant were found to feed on the larvae and pupae of the pest.

সারসংক্ষেপ

বাংলাদেশের উপকূলীয় এলাকায় রোপিত কেওড়া বাগান আক্রমণকারী কেওড়ার কান্ড ছিদ্রকারী পোকার বিস্তৃতি, ক্ষতির প্রকৃতি ও প্রভাব, জীবন বৃত্তান্ত, বাৎসরিক প্রজন্মসংখ্যা, পোষক গাছ এবং প্রাকৃতিক শত্রু সম্বন্ধে এ প্রবন্ধে আলোকপাত করা হয়েছে। এ পোকা গাছের কান্ডে অসংখ্য সুড়ঙ্গ তৈরি করে, যার ফলে গাছ বাতাসে ভেঙ্গে পড়ে। বছরে এ পোকা সম্ভবতঃ দু'টি প্রজন্ম সম্পন্ন করে। কেওড়া ছাড়াও এ পোকা সয়লা, বাইন, সাদা বাইন এবং নোনা ঝাউ আক্রমণ করে। কাঠ ঠোকরা ও ছোট কাল পিপঁড়া এ পোকার শুককীট ও মূককীট ভক্ষণ করে।

Key words : Bangladesh, beehole borer, biology, ecology, mangrove pest, *Sonneratia apetala*, *Zeuzera conferta*

Introduction

The Forest Directorate of Bangladesh has undertaken a massive mangrove afforestation programme in the coastal belt with the primary objectives of creating a protective green belt against recurrent cyclones, tidal surges, etc. and enhancing land accretion and stabilization. So far, about 0.17 million hectares have been planted (Siddiqi 1999). About 95% of it is covered with keora, *Sonneratia apetala* Buch.-Ham. (Siddiqi and Shahjalal 1997). They are usually of single species plantations. These plantations have been attacked by the beehole borer, *Zeuzera conferta* Walker (Cossidae : Lepidoptera). The attack was first reported by Baksha (1983) from Char Kashem of Patuakhali Coastal Afforestation Division. Later heavy infestation (20-100%) was reported from Noakhali Coastal Afforstation Division (Dalmacio and Bajracharya 1989) and subsequently from all the four Coastal Afforestation Divisions

(Islam *et al.* 1989). A recent survey revealed an average infestation of about 21% (Baksha and Islam 1999). Though a number of insect pests attack keora (Baksha and Islam 1997), the beehole borer infestation has been one of the major problems of keora plantations in Bangladesh. A research project was, therefore, undertaken to study the biology and ecology of the pest and develop suitable pest management techniques. A description of various developmental stages of the pest has been given (Baksha *et al.* 1990) and some management options have been suggested (Baksha 1996). The present paper deals with the information so far generated on the biology and ecology of the pest.

Materials and methods

The study was conducted during 1989-1999 both in the field involving the four Coastal Afforestation Divisions, namely Patuakhali, Bhola (formerly Barisal), Noakhali and Chittagong, and in the Entomological Laboratory of the Bangladesh Forest Research Institute, Chittagong. Various stages of the pest were collected from the field and reared in the laboratory. Field collected pupae were reared in the rearing cages by keeping the basal portions of the stem containing the pupae in a bucket half-filled with water so that the stem remained as fresh as possible to rear up the adults. The emerged adults were reared with 15% sucrose solution as a food source. Fresh cut keora stems were placed in the rearing chamber containing the adult moths to carry out their normal activity. Biological and ecological notes were taken in the laboratory and in the field.

Results and discussion

Identification

The pest has been identified as *Zeuzera conferta* Walker (Cossidae : Lepidoptera), commonly known as leopard moth, goat moth, carpenter moth or beehole borer. The identification is based on a description in Hampson (1892). Holloway (1986) cited two synonyms, *Z. neuropunctata* Gaede and *Z. roricyanea* Walker (from Toxopeus 1948) for the species. However, Arora (1976) identified five species of *Zeuzera* including *Z. conferta* from the Indian Sub-region that includes Bangladesh.

Distribution

The species along with other cossids is most common in inundated forests - alluvial, swamp and mangrove. The absence of termites from such forests may favour its multiplication by reducing competition for standing timber. The pest is widely distributed in Indo-Australian tropics. The specific areas of its occurrence were reported to be Sylhet (Hampson 1892), north-east Himalaya, Indochina, Sundaland, Sulawesi, Moluccas, and New Guinea (Holloway 1986). The pest is frequently found in mangrove localities in the Bay of Brunei and Singapore (Murphy 1989, pers. com.).

Nature of damage

The young larva enters the bark of standing tree. Before entering the sapwood, it invariably makes a small irregularly shaped shallow chamber in the bark (Fig. 1). As the larva grows, it enters the sap- and heart wood and makes tunnels extending up and down the length of the stem. Where numerous larvae are in the same stem the tunnels appear to intersect. The mature larva makes large, oval and branched tunnels of pencil- size diameter (Fig. 2). The tunnels are kept free of frass and excrements. They are ejected through small, circular ejection holes located in the shallow outer sapwood chamber, which is much enlarged by the larvae as it increases in size. The frass and excrement are in the form of whitish or pinkish pellets, usually gummy and adhering in small lumps to the bark when the larva is young (Fig. 3), or collecting in heap on the ground below when the larva is mature. Stains of oozing sap on the bark is also the sign of initial attack. Unlike the ejection hole the emergence hole is larger and could easily be seen on the stem (Fig. 4). Both the holes are closed by subsequent tree growth

Figure 1. Shallow feeding chamber of *Zeuzera conferta* in the bark; outer bark removed.

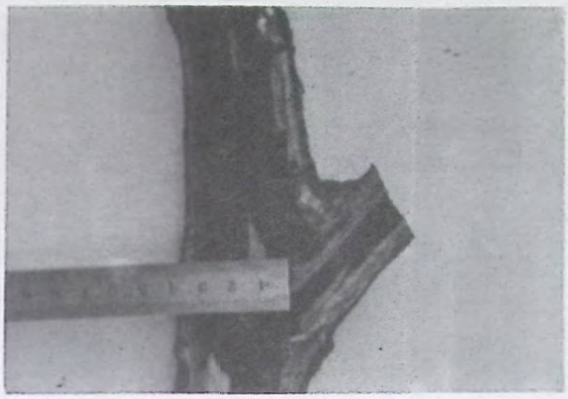

Figure 2. Stem of keora split open to show tunnels made by *Zeuzera conferta*.

Figure 3. Lumps of larval excretory pellets of *Zeuzera conferta* at the entrance holes on the bark.

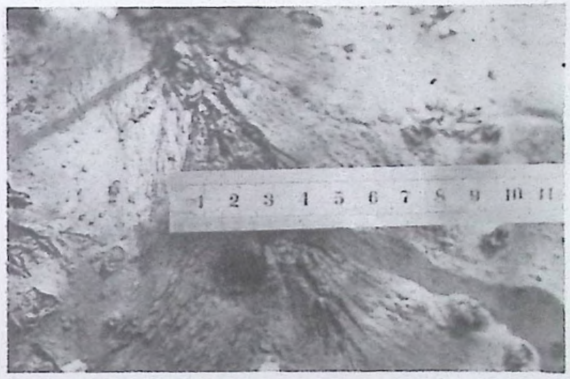

Figure 4. Emergence hole of *Zeuzera conferta* .

Figure 5. Keora pneumatophore infested by *Zeuzera conferta*. Note the excretory pellets and wood frass accumulating on the ground.

Figure 6. Egg masses of *Zeuzera conferta* on the trunk of keora.

Figure 7. Mature larva of *Zeuzera conferta.*

Figure 8. Stem of keora split open to show pupa of *Zeuzera conferta* inside.

Figure 9. Pupa of *Zeuzera conferta* taken out of its chamber.

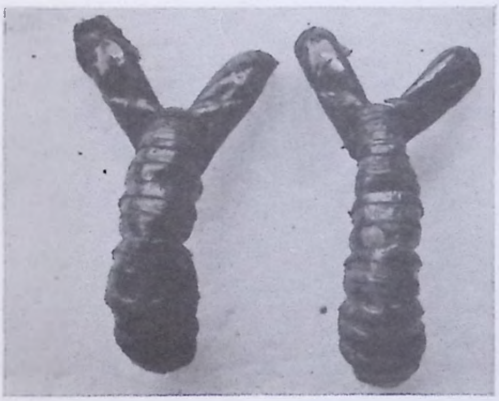

Figure 10. Empty pupal skin (exuvae) of *Zeuzera conferta.*

Figure 11. Adult male moth of *Zeuzera conferta.*

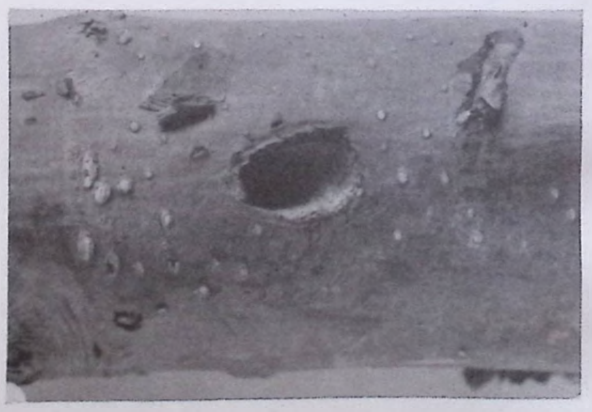

Figure 12. Drilling of woodpecker on keora trunk to feed on *Zeuzera conferta.*

leaving, in some cases, only the scars on the outside of stem. Thus at later age the presence of tunnels becomes burried within the wood and will only be revealed when the log is cut or open. The trunk of apparently healthy tree may thus contain many tunnels. Though twigs or branches are attacked, the trunk, specially the lower part, are most heavily attacked. In some cases, the pneumatophores are also attacked (Fig. 5). A single stem may contain hundreds of larvae inside.

Infestation starts at the age of three years, reaching its peak (about 21%) at the age seven, and then decreases slowly to about 8% at the age 20. Infestation is higher in highly inundated (>9 months tidal inundation), open canopy and single species plantations (Baksha and Islam 1999).

Impact of damage

The tunnels by itself do not usually cause death of the tree but render the tree to wind breakage. The tunnels affect the strength and quality of wood, restricting to its use as lumber, but only as fuelwood, pulpwood or perhaps hardwood chips.

Annual growth increment of the infested tree may be affected because all successful galleries in the sapwood beneath the cambium have an enlarged chamber where the faecal pellet ejection holes penetrate the outer bark. There may be some fungal rot and decay as rain water gets in the tunnel, but usually this does not happen, probably because the emergence holes to the surface is directed horizontally or obliquely downwards.

Biology

Egg : The eggs are whitish in colour. They are laid on the bark in strings of double rows (Fig. 6), numbering 15 ± 3 in each row. A female can lay 750 ± 20 eggs on an average. On hatching the larvae eat some part of their egg shells so that traces of egg shells are rarely seen. Incubation period is 15 ± 5 days. Oviposition period lasts for 12 ± 4 days.

Larva : The larva after hatching can survive without food for 4 ± 2 days before finding a suitable host to bore in. The young larva descends down ballooning on silken thread which they produce, and are blown by wind to land at random. By this method larvae hatching gregariously are dispersed widely. Those luckily landed on a suitable host are able to persue their development. The larva tunnels in the bark. If it is unsuitable, it leaves the site, bores in a new site on the same tree or in another one. The larva is pinkish to pale yellow in colour (Fig. 7). Since several larvae can attack the same stem, this habit of changing sites seems necessary. There is a very high mortality of the first instar larvae due to difficulty to find suitable sites. Eventually the survivor reaches the surface of sapwood and excavates a shallow patch or chamber which is the beginning of actual tunnelling. The larval period lasts for 135 ± 15 days depending primarily on temperature.

Pupa : When ready to pupate the larva makes a pupal tunnel, the exit of which is located on the stem surface, covered by a loose flap of bark. Then it spins a loose mesh of silk at the inner end of the tunnel that serves as the pupal chamber, plugs its ends with a loose wad of whitish silk and pupates with the head downwards, at the direction of the exit or emergence hole (Fig. 8). The pupa is obtect and brown coloured (Fig. 9). The pupal period lasts for 25 ± 5 days at the end of which the pupa wriggles towards the exit hole pushing aside the bark flap and extending its body about halfway through the hole. The moth emerges leaving the empty pupal skin (Fig.10) protruding from the hole in the bark.

Adult : After emergence the adult crawls out to the bark, takes about 10 minutes to expand its wings and further 20-30 minutes to dry off and stiffen. The moths are large with elongate, slender fore wings and much shorter hind wings. The fore wing pattern is of iridescent black striae or spots on a white or greyish ground, somewhat translucent. The hind wings are less spotted. The thorax and long abdomen are greyish white,

spotted and/or banded regularly in black. The thorax is usually with three pairs of spots (Fig. 11). The moths emerge, fly and mate during the night. After a preoviposition period of 3 ± 1 days the female starts laying eggs. Adult longivity is 18 ± 2 days in the laboratory. Light trap catches suggest that the main moth emergence periods are during March-April and August-September.

Ecology

Number of generations : There appears to be two generations (April-August and September - March) in a year. It completes its life cycle in 5 - 7 months depending primarily on the temperature. In the winter season the life cycle is extended. However, field observation suggests that the pest is capable of breeding all the year round, and was found in almost every stages of development in each month. There is, therefore, no seasonal sequence of generations. This finding corresponds with that of *Zeuzera coffeae* in South India and Myanmar (Beeson 1941). However, the presence of a large number of pupal exuvae protruding from trees of a plantation suggests that there is some synchrony in adult emergence.

Host records : Though keora is the preferred host, other host plants recorded in Bangladesh are soila (*Sonneratia caseolaris*), baen (*Avicennia officinalis, A. alba*) and nona jhau (*Tamarix indica*). Other hosts recorded elsewhere are *Barringtonia, Ochroma, Theobroma, Eucalyptus* (Holloway 1986), *Rhizophora mucronata* and *R. apiculata* (Murphy 1989, pers. com.).

Biocontrol agents : Little is known of the natural enemies of *Z. conferta*. Woodpeckers (*Dinopium benghalense* and *Picoides canicapillus* : Picidae) and a small black ant were found to feed on the immature stages of the pest. In rare cases pupal mortality, probably bacterial in origin, was also encountered. The woodpecker can locate the exact position of the larva or pupa inside the wood, and bore a conical hole down the wood to get them (Fig. 12). This is scarely desirable as it aids to enlarge the exit hole of the pest and causes rot to set in under the influence of water and fungi.

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