Eggs, which are laid in clusters on the back surface of leaves in the upper crown, take about a week to hatch. Larvae remain in leaf cases for 11 months, feeding in groups at the first two instars and individually thereafter. The third instar larvae diapause in leaf cases during summer and winter months and become active in early March (Xu Tiansen 1989, 1992a; Nakahara and Kobayashi 1963).

Crocidophora ptyophora Hampson

DISTRIBUTION

India and Myanmar.

BIOLOGY

The adult moth of this minor pest has bright yellow wings with broad purplish marginal bands. The larva rolls up green leaves with silken thread and feeds on the inner leaves. When about to pupate, it constructs a thick cocoon. The pupation period is 9-13 days.

Demobotys pervulgaris Hampson

Fig. 10: Adult of ***Demobotys pervulgaris***

DISTRIBUTION

China.

HOSTS

Attacks *Phyllostachys pubescens* in central China (Xu Tiansen 1992a).

BIOLOGY

The pyralid occurs one generation per year and overwinters as fully grown larvae. Adults emerge in May. They are active at night, with strong phototaxis, and need to feed for about a week before mating. Eggs are laid on the back of leaves in the upper crown and larvae hatch out in 8-11 days. There are 5-7 larval instars lasting 30-44 days. Very young larvae feed in groups, and fully developed larvae pupate in leaf litter on the ground.

CONTROL

This bamboo leaf roller usually keeps a low population level, mainly because of the parasitic *Acropimpla indicate* Fab. and *Chelonus* sp. as well as the white fungus which together cause about 65% death among the overwintering larvae. Soil-turning in winter to kill overwintering insects can be employed as a control measure (Cao Zhifang and Xia LJ 1987).

Cotton leaf roller - *Sylepta derogata* Fabricius

DISTRIBUTION

Bangladesh, India and Pakistan.

HOSTS

The pest is polyphagous, and attacks agricultural crops and forest plants apart from several bamboo species.

BIOLOGY

The moth is pale yellow in colour. The eggs are laid

Fig. 11: Adult of ***Sylepta derogata***

in rolled leaf cases. The larvae, on hatching, feed gregariously on the rolled leaf and subsequently migrate to form its own roll, where they feed. Pupation is in the soil or litter. The life cycle varies from 23 to 45 days, at times prolonged by larval aestivation and hibernation (Beeson 1941; Browne 1968).

Pionea flavofimbriata Moore

DISTRIBUTION

India and Sri Lanka.

HOST

Dendrocalamus strictus.

BIOLOGY

Adult moths are brown in colour with brownish-grey wings and actively fly about at dusk and night. The larvae gnaw through the upper tissue of the leaf causing a skeletonized effect on the leaf or eat the leaves from the edges in a ragged manner. The larvae

construct a silken cocoon on leaf surface and hibernate from November till the emergence of the moth in the following March (Mathur 1943).

CONTROL

The pest is a minor one, although sporadic epidemics do occur. It is parasitized by *Microgaster kuchingesnis* Walkn. Foliar spray of 0.1-0.2% fenitrothion or 0.1% carbaryl in water controls the pest.

Massepha absolutalis Walker

DISTRIBUTION

Bangladesh, India and Sri Lanka.

HOST

A regular defoliator of *Dendrocalamus strictus,* but not considered a pest of significance (Browne 1968).

BIOLOGY

The pest is fairly abundant in the monsoon and passes the winter in the larval stage inside a boat-shaped case made of leaves. Moths emerge only in the following spring (Beeson 1941).

CONTROL

The larvae is parasitized by some species of *Chelomus, Brachymeria* and *Tetrastichus* (Mathur 1943).

Microstaga jessica

DISTRIBUTION

Japan and Korea.

HOSTS

Phyllostachys edulis and *P. nigra.*

BIOLOGY

It has one generation per year and overwinters as matured larvae. An outbreak of the pest, together with several other leaf rollers, was observed in Kyoto, Japan in 1957 (Nakahara and Kobayashi 1963; Kim and Lee 1986).

A NOTE ON CONTROL OF LEAF ROLLERS

Control measures for suppressing pest population have proven effective against leaf rollers. Light-trapping of moths at nights during adult stage, and spraying insecticides on plants — such as *Castanea henryi* and *Ouercus* spp. — on which adult moths feed in groups are very effective in reducing the leaf-rollers' population in the following generation (Huang Ertian 1984). Artificial releasing of *Trichogramma* spp. in bamboo stands is practised and found effective (Xu Tiansen and Zhao Jingnian 1976a; Jin Changle et al. 1980; Liu Ruilan 1988). Chemical control may be necessary when heavy attacks occur. Satisfactory results can be obtained in bamboos with large culms by injecting systemic insecticides in the culm cavity (Anonymous 1979; Lan Linfu 1980).

Puss Moths (Lepidoptera: Notodontidae)

Eleven species of bamboo puss moths have been documented as bamboo pests (Cai Rongquan 1986). They are mostly large or middle-sized species. Their larvae can consume large amounts of foliage, often causing heavy defoliation.

Besaia goddrica Schaus

DISTRIBUTION

China.

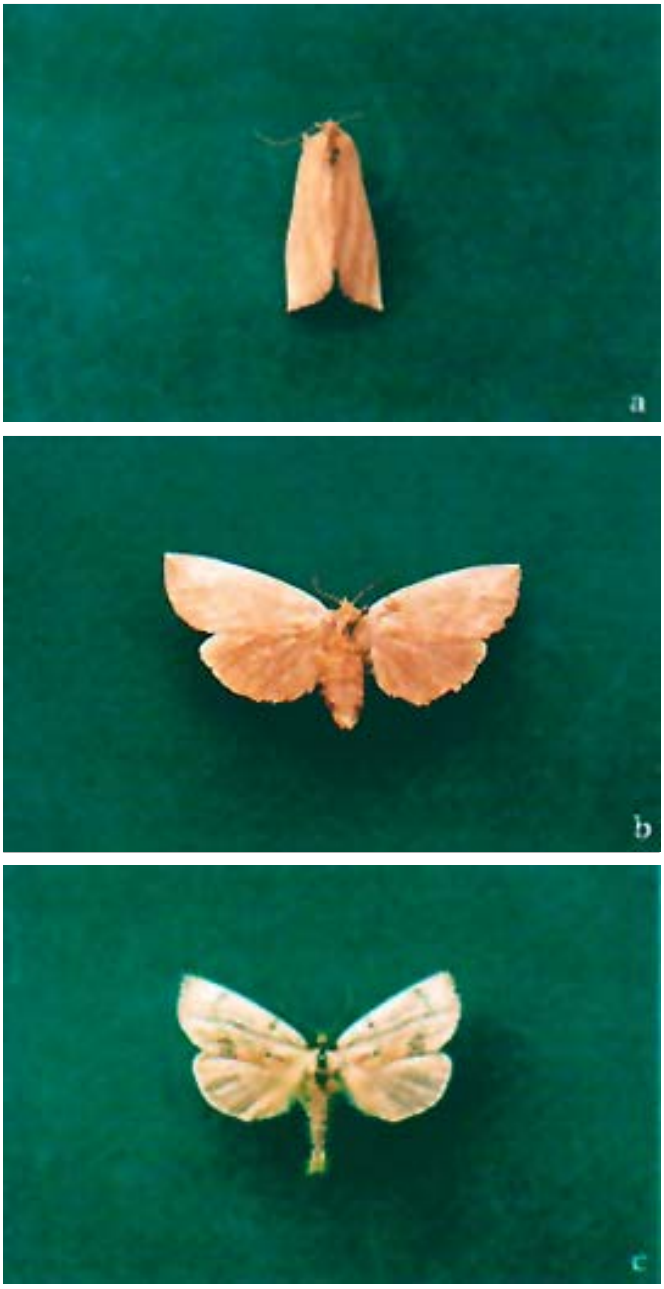


Fig. 12: Adults of ***Besaia goddrica*** a, b: female; c: male

HOST

One of the most common puss moth species on *Phyllostachys* species.

Fig. 13: Defoliation on *P. pubescens* caused by ***Besaia goddrica***

BIOLOGY

There are four generations per year. Larvae overwinter on leaves, but keep feeding when the weather is warm at day time. Moths, which are 20-25 mm long and light brown in colour, emerge in April-June, June-July, August-September and September-November, and are active at night showing strong phototaxis. The milk-white eggs are laid in a single row of 8-10 eggs on leaves. The egg stage lasts 6-10 days. The newly emerged larvae feed on the shell of eggs and are inert for 4-12 hours before starting to feed on leaves. There are 5-7 larvae instars, varying with generations. The fully grown larvae drop to the ground and pupate in earth cocoons at 2-3 cm depth.

CONTROL

Ants, spiders, mantis, birds and *Sirthenea flavipes* Stal. are found to be predators of the larvae. Parasitizing

Fig. 14: ***Besaia goddrica*** a: Larva; b: pupa and cocoon

enemies mainly include *Trichogramma* sp., *Telenomus* sp., *Exorista civilis* Rondani and *Tetrastichus* sp. (Xu Tiansen and Lu Ruoqing 1990).

Loudonta dispar Kiriakoff

DISTRIBUTION

Central and southern China.

HOST

Phyllostachys spp. and *Pleioblastus* spp.

BIOLOGY

The adult moth of this important pest is 13-23 mm long and light yellow or yellowish-brown in colour. The larvae are dark red but change to yellowish-brown from the second instar and subsequently to dark green when fully fed. There are three generations per year, overwintering as larvae on leaves. Adults are active at night and display phototaxis. Egg masses containing several rows of eggs are laid on young leaves in the upper crown. The eggs are light red in colour and turn to reddish-purple before hatching (but the parasitized ones turn dark brown or black). The egg stage lasts 4-12 days, varying with generations. There are 5-7 larval

Fig. 15: Adult of ***Loudonta dispar*** a: female; b: male

instars. The larvae feed on the shell of hatched eggs at the first instar and on leaves from the second. Fully fed larvae pupate in simple cocoons made from fallen leaves and soil particles in ground leaf litter.

CONTROL

Trichogramma spp. and *Telenomus* spp. are important egg parasites of the pest and can cause high mortality (up to 80%) of eggs of the third generation. Other parasites of the pest include *Rhogas* sp. and *Campoplex* sp. on larvae, and *Tetrastichus* sp. on pupae. (Anonymous 1976; Xu Tiansen and Lu Ruoquing 1987b).

Other Puss Moths

There are several other puss moth species commonly seen on bamboos: ***Stenadonta radialis*** Gaede in China and India (on *Phyllostachys* spp. and *Dendrocalamus latiflorus*); ***Mimopydna insignis*** Leech and ***Liccana terminicana*** Kiriakoff in China; ***Norraca retrofusca*** De Joannis and ***N. decurrens*** Moore in China, India and Vietnam; ***Oraura ordgara*** Schau. in China and the Philippines; and ***Niganda strigifascia*** Moore in Bhutan, China, India, Indonesia and Sikkim (on *Phyllostachys* spp. and *Arundinaria* spp.).

Fig. 16: Adult of ***Stenadonta radialis***

Fig. 17: Adult of ***Mimopydna insignis***

These species have similar life histories and damaging habits. There are 3-4 generations per year. Adults are active at night and show phototaxis. They lay eggs individually on leaves. Larvae feed on leaves during summer and autumn months. These species rarely cause an outbreak but are capable of considerable defoliation in isolated areas.

Protecting natural enemies, especially the egg parasites, soil-turning in early winter and light-trapping during adult stage are important methods for the suppression of population of these puss moths. Chemical control against outbreaks can be achieved by smoking or spraying dichlorvos, or by cavity-injection of systemic insecticides in the case of bamboo species with large-sized culms.

Tussock Moths (Lepidoptera: Lymantriidae)

Some 16 tussock moth species have been recorded feeding on bamboo and are classified to various genera, of which ***Pantana*** is the most important.

Pantana sinica Moore

DISTRIBUTION

Widespread in central and southern China.

HOST

Phyllostachys species.

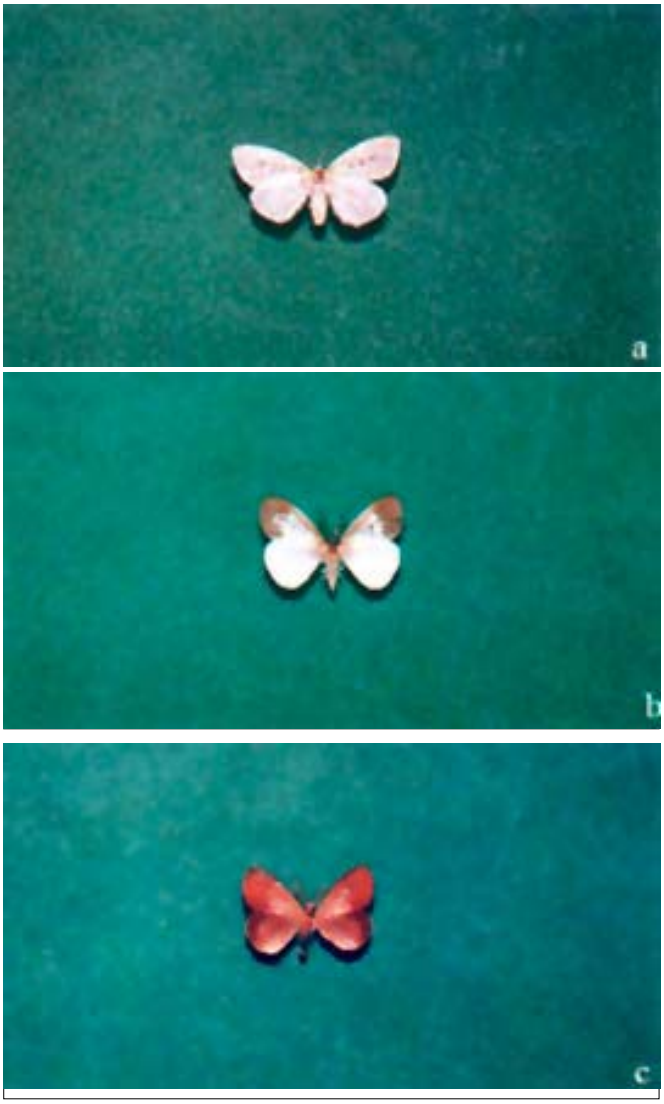


Fig. 18: Adults of ***Pantana sinica*** a: female; b: male occurring in summer; c: male occurring in winter

BIOLOGY

The adult ***P. sinica*** is 9-16 mm long, and white in colour in the case of females and dark brown or black in the case of males. The larvae vary in colour from yellowish-white to dark yellow. There are three generations per year, overwintering as pupae. Eggs are laid in single or double rows at the basal part of culms. Larvae feed on leaves from May to December. There are 5-8 larval instars varying within and between generations. Fully grown larvae pupate in cocoons made at the base of culms or in leaf litter on the ground.

CONTROL

Natural enemies of the pest are mainly *Telenomus* sp. and *Trichogramma dendrolimi* which parasitize eggs, and *Apanteles* sp., *Rhogas* sp., *Enicospilus* sp. and *Casinarria* sp. which parasitize larvae (Wei Houjian 1984; Xu Tiansen 1985b).

Pantana phyllostachysae Chao

DISTRIBUTION

Throughout central and southern China.

HOST

Phyllostachys species.

BIOLOGY

Adults of ***P. phyllostachysae*** are 10-13 mm long and yellow in colour. There is a reddish spot on each of the forewings of male moths. Larvae vary in colour from light yellow to dark grey. There are 3-4 generations per year, overwintering as eggs or young larvae on leaves. Adults are active at night, with strong phototaxis. Eggs, laid in single or double rows on

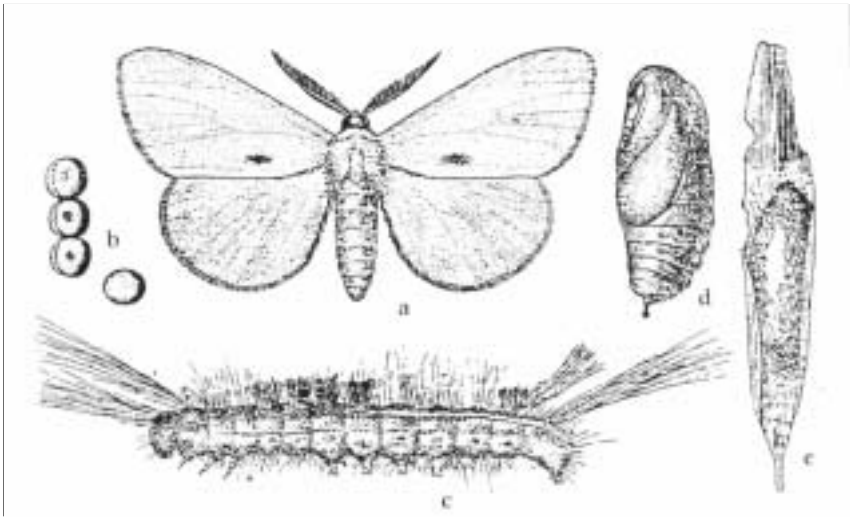


Fig. 19: Bamboo tussock moth ***Pantana phyllostachysae*** a: adult; b: eggs; c: larva; d: pupa and cocoon

leaves in the lower crown or on culms, take 6-12 days to hatch. Larvae feed on leaves from March to October and, when fully fed, pupate in cocoons on leaves or culms in the upper crown.

CONTROL

The important natural enemies of the insect include *Telenomus* sp. and *Eupelmus* sp. which parasitize eggs, and *Apanteles* sp. and *Tachina* spp. which parasitize larvae. Diseases caused by the white fungus and viruses were observed on the insect (Xing Longping 1980; Chen Yangchun 1982; Xie Qinmei 1983).

Pantana pluto Leech

DISTRIBUTION

Widely occurs in southern China, India, Indonesia, Myanmar and Vietnam.

HOSTS

Phyllostachys pubescens.

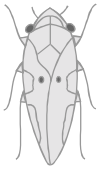
BIOLOGY

The moth is 11-16 mm long and light yellow (female) or dark brown (male) in colour. There are five larval instars, and larvae vary in colour from dark brown to yellowish-brown. Adult moths are active at night, with strong phototaxis. Eggs are laid in single rows on leaves, sheaths and culms. Larvae feed on leaves from March to November. The larvae of the second generation occurring in May-July cause the most severe damage. There are 3-4 generations per year (Chen Darong 1983).

A NOTE ON CONTROL OF TUSSOCK MOTHS

Tussock moths are abundant in dense stands at low-lying, wet sites, and extend to nearby stands in favourable environmental conditions. Cold weather in early spring results in high mortality of newly-hatched larvae. Dry, hot conditions in summer and autumn are unfavourable to egg-hatching and larvae development. Keeping bamboo stands at reasonable culm density, light-trapping during adult stage, and hand-destroying eggs and pupae at the basal part of culms are effective in reducing the insect population. High infestation and mortality of larvae can be achieved by applying the white fungus.

Leaf Skeletonizer Moths (Lepidoptera: Zygaenidae)



Although bamboo leaf skeletonizer moths remain mostly at low population levels, outbreaks causing serious defoliation have been recorded. Four species have been reported, among which ***Allobremeria plurilineata***

Alberti and ***Brtona funeralis*** Butler are the most widespread.

Brtona funeralis

DISTRIBUTION

China, India, Japan and Korea.

Fig: 20: Adult of ***Brtona funeralis***

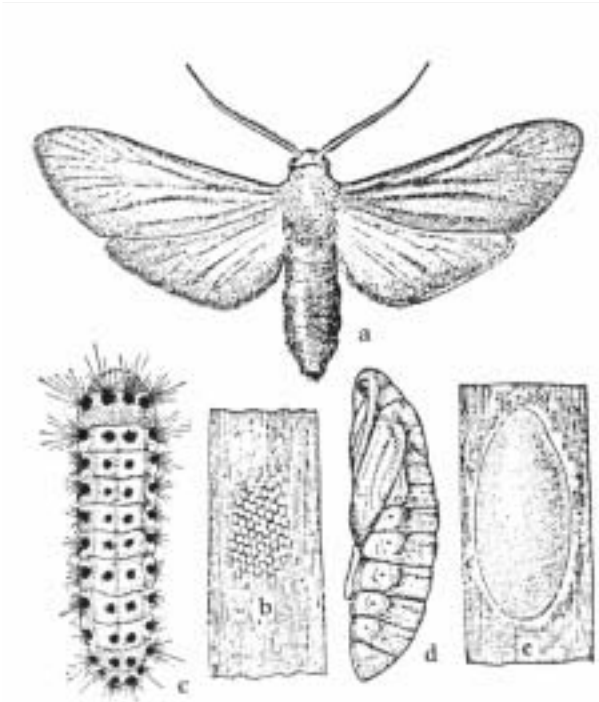


Fig. 21: Life stages of ***Brtona funeralis*** a: adult; b: egg mass; c: larva; d: pupa; e: cocoon

HOSTS

Attacks *Phyllostachys, Bambusa, Arundinaria* and *Pseudosasa* species.

BIOLOGY

The pest prefers dry, hot conditions, and occurs mostly on the edge of stands and on the plants growing with lower culm density on dry and hot slopes. Adult moths are 9-11 mm long and bright dark green in colour. The centre of the hindwings is transparent. The elongated eggs are bright cream in colour and about 0.7 mm long. Fully grown larvae are 16-19 mm long, brick-red in colour, and have four verrucae arranged transversely on the back of each segment. There are 3-5 overlapped generations per year, varying with locality, overwintering as fully fed larvae in cocoons. Eggs are laid in single-layer masses on the back surface of leaves in the lower crown. Very young larvae feed in groups on the leaf surface, leaving characteristic white spots, and older ones consume leaves fully. There are six larvae instars. Fully developed larvae pupate in cocoons made under the ground leaf litter.

CONTROL

Heavy rains in May will causes high mortality of eggs and larvae of the second generation. About 20 natural enemies, such as *Goryphus* sp. which parasitizes pupae and a virus which infects larvae, have been found and play some role in the suppression of the pest (Wu Jianfen and Wang Shufen 1980; Wu Jianfen 1984).

Allobremeria plurilineata Alberti

DISTRIBUTION

China.

HOST

Phyllostachys pubescens.

BIOLOGY

The adult moth is 7-9 mm long and yellowish-brown in colour, densely covered with dark brown scales. The milk-white eggs are laid in single-layer masses on the back surface of leaves on lower branches or on small plants. The egg stage lasts 3-10 days, varying with generations. Larvae, varying in colour from milky white to light yellow, pass through six instars and feed on leaves in a way similar to ***Brtona funeralis***. Pupation occurs in cocoons made in the ground leaf litter. There are 3-4 generations per year. Contrary to ***B. funeralis***, ***A. plurilineata*** mostly occurs in stands with high culm density, on wet, low-lying sites.

CONTROL

Hot and dry weather in July causes high mortality of larvae of the second generation (Anonymous 1978).

Other Leaf Skeletonizers

Brtona intermediana Alberti and ***Balateae gracilis*** Walker are less abundant and cause minor damage to *Phyllostachys* spp. in central China.

A NOTE ON CONTROL OF LEAF SKELETONIZERS

Keeping bamboo stands at reasonable culm density, soil turning after the fully grown larvae drop to the ground, protecting the natural enemies and destroying eggs on lower branches are effective measures in the management of these defoliators. (Wei Shanqun 1966; Anonymous 1978). Various insecticides — such as dichlorvos, malathion, fenitrothion and pyrethrin —

are recommended against outbreaks of the pest (Wu Jianfen and Wang Shufen 1980).

Slug Moths (Lepidoptera: Eucleidae)

Only two species are known in this group: ***Parasa bicolor*** Walker and ***Latoria parapuneta***. The latter causes only minor damage, in central China.

Parasa bicolor Walker

Fig. 22: Adult of ***Parasa bicolor***

DISTRIBUTION

P. bicolor widely occurs in China, India, Myanmar, Nepal, Sikkim and Sri Lanka.

HOSTS

Many species of *Phyllostachys, Bambusa, Sinobambusa, Arundinaria* and *Pleioblastus.*

BIOLOGY

As suggested by its name, the 13-19 mm long adult has green coloured head, thorax and forewings, and brown-coloured abdomen and hindwings. Fully developed larvae are 26-32 mm long and yellowish-

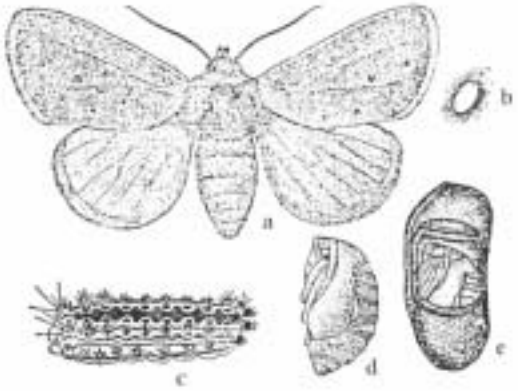


Fig. 23: The slug moth ***Parasa bicolor*** a: adult; b: egg; c: larva; d: pupa; e: cocoon

green in colour. Adults are active at night, with phototaxis. Eggs are laid in single or double rows on the back surface of leaves and take 6-10 days to hatch. There are eight larval instars. Young larvae feed in groups on leaf surface, leaving brownish-white leaf epithelium, but older ones consume all leaf tissue. The fully developed larvae drop to the ground, burrow into the soil and pupate in cocoons at 2-5 cm depth. There are three generations per year in southern China. Larvae occur from April to June, July to August and September to November. But the insect has only one generation a year in central China and larvae feed on leaves from June to August. In both cases, the pest overwinters as fully fed larvae in cocoons in the soil.

CONTROL

This pest can be maintained at a low population level by light-trapping during adult stage, and soil-turning in winter to kill overwintering larvae in the soil surface (Xu Fuyuan 1981; Wu Jianfen et al. 1984; Chen Jiwen et al. 1984).

Noctuid Moths (Lepidoptera: Noctuidae)

Seven noctuid species have been reported as occasionally causing significant damage to bamboo leaves through feeding.

Eustotia sp.

DISTRIBUTION

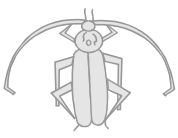
Central China.

HOST

Phyllostachys spp.

BIOLOGY

The adult moth is 8-9 mm long and yellowish-brown in colour. The forewings are light yellow, with a large Y-shaped blotch on them. The larva is about 20 mm long when fully fed, and green in colour with four black blotches on the protergum. There is only one generation per year. Adults are active at night, with strong phototaxis, and need to feed on flower juice of some wild grass for about one week before mating. Eggs are laid individually on the back surface of leaves in the middle and lower crowns and take five days to hatch. Larvae take about 25 days to develop and pass through four instars. The fully fed larvae drop to the ground and pupate in earthen cocoons just below the ground surface. Pupae remain in the soil from July to the following June. The pest favours hot and humid weather conditions (Fang Li and Yuan ZT 1992).



CONTROL

Light-trapping and clearing wild grass in and around the stands can be used to control this and other noctuid

pests, such as ***Rivula biatomea*** Moore on *Phyllostachys* spp. and *Sinocalamus oldhami* in Taiwan (Chang Yuzhen and Xue XQ 1994), and ***Lichacodia idiostygia*** Suqi, ***L. squalida*** Leech and ***L. stygia*** Butler in central China. Applying black or white fungus can result in high larval mortality.

Tent Caterpillar Moths (Lepidoptera: Lasiocampidae)

Cosmotriche sp.

DISTRIBUTION

China.

HOSTS

Phyllostachys spp. and *Bambusa textilis.*

BIOLOGY

It is a large and the most abundant among the four known tent caterpillar moth species. The adult moth is 23-26 mm long and yellow or greyish-yellow in colour. There are two generations per year. Larva is black and 70-90 mm long when fully fed. It feeds on leaves from June to November, overwinters on the ground and emerges to feed on leaves during April-May. Pupation occurs in cocoons made on small bamboo branches. Adults are active at night, displaying strong phototaxis. Eggs are laid individually or in groups on leaves and take 8-13 days to hatch.

Other Species

Philudoria albomaculata Bremer and ***Philudoria potatoris*** Lin attack *Phyllostachys* spp. in northern

Fig. 24: Adults of ***Philudoria divisa sulphurea***
a: female; b: male

China. ***Philudoria divisa sulphurea*** Aur. is recorded in central and southern China.

Tent caterpillar moths rarely reach epidemic populations, although heavy defoliation would result when outbreaks occur. Control of the pest can be achieved by injecting systemic insecticides in culm cavities (Liao Xueen 1984; Xu Tiansen 1984b).

Coccygomimus sp. is known to be the major larval parasite of ***Cosmotriche* sp.**

Leaf Miners

Several species classified as Glyphipterigidae, Cosmopterigidae, Lyonetiidae (Lepidoptera), Agromyzidae (Diptera) and Buprestoidae (Coleoptera) are reported as leaf miners on bamboo. The larvae of these species mine into leaves and feed inside, causing wilting of the leaves.

Glyphipterix semiflavana Issiki

DISTRIBUTION

China and Japan.

HOST

Phyllostachys spp.

BIOLOGY

The adult of this moth (Lepidoptera: Glyphipterigidae) is 4-5 mm long and greyish-brown in colour. There is one generation per year. Adults emerge in late April and May, and are active at daytime. Eggs are laid individually on leaves and there are five larval instars. Larvae mine into the main vein of newly sprouted leaves and feed inside, causing wilting of the damaged leaves. When they reach the terminal end of the vein they get out and move on to other leaves. The larvae are light-green and 7-10 mm long when fully fed. They develop fully in June and remain in cocoons during summer and winter.

CONTROL

Natural enemies are mainly predatory spiders, mantis and birds, and two minor chalcids (Lu Ruoquing and Xu Tiansen 1988).

Cosmopterix phyllostachysae Kuroko

DISTRIBUTION

Japan and China.

HOST

Phyllostachys pubescens.

BIOLOGY

This moth (Lepidoptera: Cosmopterigidae) has one generation per year, overwintering as larvae in mined tunnels on leaves. Adult moths occur from mid May to late June. Eggs are deposited individually on leaves. Larvae mine into leaves, feed on leaf tissue and leave white blotches on the leaves. There is only one larvae per leaf. Mining tunnels extend from thin lines to wide, big blisters as larvae move forward feeding and growing up. Overwintering larvae feed again in March and pupate in chambers made in the wider part of the tunnel. There are six larvae instars.

Fig. 25: The damage caused by ***Cosmopterix phyllostachysae***

CONTROL

Pristomerus vulnerator Panzer, *Itoplectis alternaus spectabilis* Mat., *Macrocentrus* sp. and *Cotterellia* sp. parasitize larvae of the pest. The spider, *Myrmarachne japonica* Karsch, is a common predator of the larvae (Togashi 1974).

Calmochrous pentasaris Meyrick

DISTRIBUTION

Bangladesh and India.

HOST

Dendrocalamus strictus.

BIOLOGY

This is a very small, pale ochre moth with narrow, conspicuously fringed wings. The larvae mine the leaves, eating away patches of internal tissues, leaving the outer layers of cells intact. This feeding habit results in large blotch mines on either side of the leaf midrib. Fully grown larvae may severe the margins of the blotch, roll one layer inwards and pupate within. The mined leaves turn yellowish-white on drying (Beeson 1941). The pest is heavily parasitized (Browne 1966; Fletcher 1920).

Satyr Butterflies (Lepidoptera: Satyridae)

Forty-five species belonging to 13 genera of this group are recorded as feeding on foliage of various bamboos in China. The more common of these include ***Neope muirheadi*** Felder, ***Lethe europa*** Fab., ***L. syrcis*** Hewitson, ***L. diana*** Butler, ***Paraplesia adelma*** Felder, ***Kirinia epaminondes*** Staudinger and ***Mycalesis***

gotoma Moore. Six ***Lethe*** species are associated with bamboos and cause moderate damage in India: ***L. drypetis todara*** Moore defoliates *Bambusa* spp., and ***L. incana*** Kollar, ***L. verma*** Kollar, ***L. yama*** Moore, etc. defoliate *Drepanostachyum falcatum.* They are mostly active from May to July. Most of the satyr butterflies are primarily pests on rice and generally less abundant in bamboo stands, although some can cause significant defoliation. The larvae tie leaves to form cases and feed inside.

Neope muirheadi Felder

Fig. 26: Adult of ***Neope muirheadi***

DISTRIBUTION

Throughout bamboo-growing areas in China.

HOST

Phyllostachys spp.

BIOLOGY

The adult butterfly is 18-23 mm long and greyish-brown in colour. There are four black spots each on all four wings. The larvae are green in colour and change

to yellowish-brown after the third instar. The pest occurs two generations per year, with larvae feeding on foliage from June to July and August to October, respectively, and overwintering as pupae. The butterflies are active at daytime. They need to feed before mating and prefer rotten food. Eggs are deposited in masses, consisting of 3-5 rows, on the back surface of leaves in the middle and lower crowns. They take 5-7 days to develop. There are five larvae instars. Young larvae feed in large groups on the leaf edge. From the third instar onwards, they tie leaves as cases and feed inside in groups. The fully developed larvae drop to the ground and pupate under the ground leaf litter.

CONTROL

Natural enemies of the pest are mainly the larvae/ pupa parasite, *Exorista civilis* Rondani, and two egg parasites, *Trichogramma* sp. and *Telenomus* sp. (Xu Tiansen and Lu Ruoqing 1991).

Lethe europa Fabricius

DISTRIBUTION

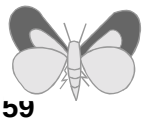
Mainly in southern China.

HOST

Phyllostachys spp.

BIOLOGY

The butterfly is 17-24 mm long and reddish-brown in colour. The larvae vary from light yellow to yellowish-brown in colour as they grow up. The fully grown larvae are 43-51 mm long. There are three overlapping generations per year. Pupae overwinter and emerge as adult butterflies in the following April.



The adults feed for 5-10 days before mating and laying eggs. Egg clusters, containing 40-60 eggs in 3-5 rows, are laid on the under side of leaves, and eggs take about 6-10 days to develop. The larvae first consume the shell of eggs and then feed on leaf edges in large groups. There are six larval instars. After the third instar, they tie several leaves with silk to form a leaf case and feed inside in small groups. Pupation occurs either on leaves or under leaf litter on the ground (Lan Shiwen et al. 1993).

Other Satyr Butterflies

Lethe syrcis Hewistson is yellow in colour and has three overlapping generation per year. ***Paraplesia adelma*** Felder has only one generation. Both lay eggs individually on leaves. The larvae feed on leaves from June to November and overwinter on the foliage.

Fig. 27: Adult of ***Lethe syrcis***

Mycalesis gotoma Moore feed on bamboo, rice and sugar-cane. It occurs in 2-3 generations per year in northern China. ***Kirinia epaminondes*** Staudinger is reported only on *Phyllostachys* spp. in northern China.

There is one generation per year, overwintering as larvae on foliage. Adult moths emerge in summer months.

Common Skippers (Lepidoptera: Hespeciidae)

Twenty-seven common skipper species have been recorded on various bamboos.

Matapa aria Moore

DISTRIBUTION

Southern China.

HOSTS

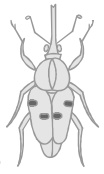
Phyllostachys, Bambusa and *Dendrocalamus* species.

BIOLOGY

The adult butterfly is 14-18 mm long and dark brown in colour with red-coloured eyes. The young larva is reddish with a large, black head, while the fully fed larva is 28-32 mm long and light green in colour. There are four generations per year. Eggs are laid individually on the back surface of the leaves of new culms and take 7-10 days to develop. Larvae occur from May to the following April. Larvae feed in leaf cases and pupate inside when fully fed. There are five larvae instars. Larvae of the fourth generation overwinter in leaf cases after November. Adults, emerging at daytime, need to feed on flower juice from shrubs or wild grass before mating (Huang Jinshui and Lin QY 1992).

Parnara ganga Evans

The adult butterfly of ***P. ganga***, a common rice pest, is 15-18 mm long and dark brown in colour but



with 4-5 white marks on the forewings. There are 1-2 generations per year depending on locality. Pupae overwinter from late November to March on the ground. Adults prefer to feed on flower juice of some agricultural crops; those that fail to find food die in about three days. Eggs are laid individually on the back surface of leaves and take about one week to develop. Larvae roll single leaves as cases and feed inside from April to June and August to November for the two generations, respectively. There are five larval instars. The fully developed larvae drop to the ground together with the leaf case and pupate inside (Xi Gengsi and Zheng ZM 1989).

Other Skippers

Several well-known pests on rice — such as ***Parnara guttata*** Bremer et Grey, ***Pelopidas agna*** Moore and ***P. mathia***s Fab. — are found attacking *Fargesia spathacea* Franch and *Phyllostachys* spp. in China. ***Potanthus confucius*** Felder and ***Onryza* sp.** are quite commonly seen on *Phyllostachys* spp. in central China. They have three markedly overlapped generations per year, and overwinter as larvae in leaf cases on bamboo plants.

Fig. 28: Adult of ***Calaenorrhinus ambareesa***

Adults need to feed before mating. Eggs are deposited individually on leaves. Larvae, which emit light (lucifugous), feed in leaf cases from May to November and pupate inside when fully grown.

Calaenorrhinus ambareesa Moore is recorded as a new pest feeding on leaves of *Bambusa bambos* in Kerala, India. The larvae cut and fold small flaps on the bamboo leaves and feed from within. Widespread occurrence of the pest is not observed.

Leaf Beetles (Coleoptera: Chrysomelidae)

Thirty-five leaf beetle species have been found attacking bamboo. Most of them feed on leaves as adults and cause defoliation. In the case of the genus ***Leptispa,*** both adult and larva feed on leaf surface in leaf cases.

Leptispa godwini Baly

DISTRIBUTION

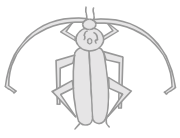
Southern China.

HOSTS

Sinocalamus, Dendrocalamus, Phyllostachys and *Pleioblastus* species.

BIOLOGY

L. godwini is most common among the leaf-rolling beetles. Liao and Shen (1981) have described the biology of the pest. Both adults and nymphs feed on leaves, causing drying out of damaged leaves. The black coloured adult beetle is 6 mm in length and 2 mm in width. The thin nymph is about 6 mm long and yellowish-white in colour. There is one generation



per year, overwintering as adults in leaf cases. Elongated, milky white eggs are laid in a single row on newly sprouted leaves. Nymphs gather on half of the leaves and feed on leaf surface. The damaged half leaves roll vertically and wrap the nymphs inside. Adults emerge in June and remain inside for feeding, or emerge and damage other leaves in the same manner as nymphs. The overwintering adults become active in March and lay eggs in May.

Other Leaf Beetles

Leptispa abdominalis mevidiana Chen et Yu and ***Leptispa longipennis*** Gestro are found on *Phyllostachys* spp. and *Bambusa pervariabilis* in southern China and cause damage similar to ***L. godwini***.

Other leaf beetles are mostly classified to such genera as ***Callispa***, ***Downesia***, ***Lasiochila***, ***Lema*** and ***Monolepta***. Although a common sight in stands of various bamboo species, these phytophagous species attack mainly agricultural crops, and forest trees and shrubs, and cause only minor damage to bamboo in most cases.

Sawfly (Hymenoptera: Tenthredinidae)

Eutomostethus nigritus Xiao

DISTRIBUTION

Central China.

HOST

Phyllostachys spp.

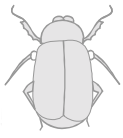
BIOLOGY

The black-coloured adult is 5-7 mm long in the case of male and 7-9 mm in the case of female. The larva is

yellow. The sawfly occurs in 1-2 generations per year and overwinters as pre-pupae in the soil. Pupation occurs in May, and adults emerge in June and prefer to feed in groups on the flower of *Polygonum cuspidatum* in bamboo stands. Eggs are deposited in single lines in leaf tissue and take 9-12 days to develop. Larvae feed in groups on leaves and develop fully in about 30 days, passing through seven instars. The fully grown larvae move to the ground and make earthen cocoons just beneath the ground. Some of them remain in cocoons until the following May. The rest pupate in August and develop the second generation, with larvae occurring in September-October.

CONTROL

Outbreaks of the pest have resulted in heavy defoliation and high mortality of culms. Spraying insecticides on the adults when they gather on flowers for feeding is recommended as an effective way to control the sawfly. Culm cavity injection of systemic insecticides can be employed when heavy infestation occurs (Wang Maozhi 1989).



2. SAP SUCKERS

There are several genera of sap-sucking insect pests. In many cases, both adults and nymphs of these insects suck sap from culm and branches, causing their death.

Stink Bugs (Hemiptera: Pentatomidae)

Hippotiscus dorsalis Stal.

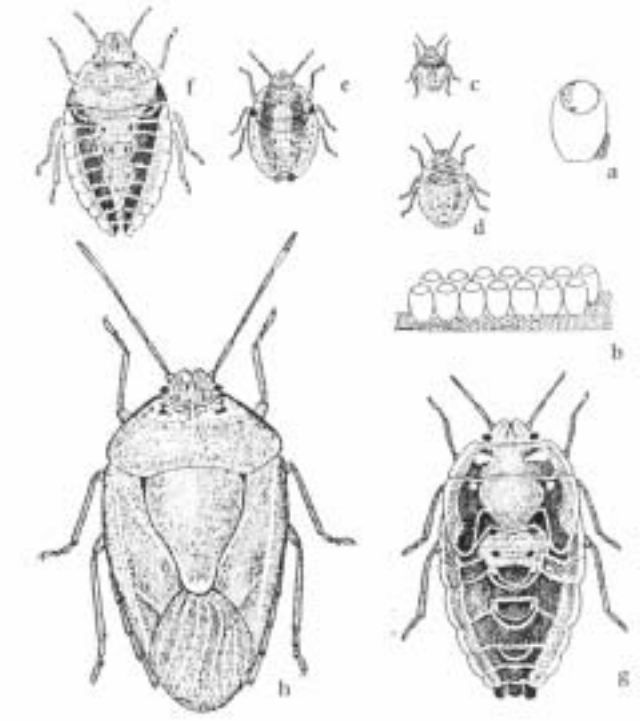


Fig. 29: Life stages of ***Hippotiscus dorsalis*** a-b: egg and egg cluster; c-g: 1st-5th instars of nymph; h: adult

DISTRIBUTION

China, especially the central parts.

HOST

Phyllostachys spp.

BIOLOGY

Hippotiscus dorsalis is the most serious pest among bamboo sap suckers in China. The adult bug is 13-15 mm long, 7-8 mm wide and yellowish-red in colour. The nymphs vary in colour from yellowish-white to greyish-brown as they grow up. There is only one generation per year. Adults, which usually emerge in June, are less active and feed in groups on culms, with preference to stressed and over-mature culms. They move to 1 or 2-year-old culms for egg-laying. Eggs are laid in groups mostly on the back surface of leaves but also on branches or twigs. The egg stage lasts 4-7 days. Nymphs start to feed from the second instar on twigs, branches and culms, and

Fig. 30: Culm-painting for controlling ***Hippotiscus dorsalis***

drop to the ground after November for overwintering under the ground leaf litter. In April, nymphs move back onto culms and feed in groups around the nodes.

CONTROL

Telenomus sp. parasitizes 5-76% of eggs. Painting of sticky material around the basal part of culm in early spring to prevent overwintering nymphs climbing on to bamboo plants has proven effective in controlling the pest (Xu Tiansen et al. 1988, 1989; Tao Dexin and Zhang AL 1989).

Aenaria pinchii Yang
Brachymna tanuis Stal.

BIOLOGY

These two insect species often occur together with ***H. dorsalis*** and cause very similar damage. Both species have an annual life cycle and overwinter as adults under ground leaf litter. The overwintering adults move onto culms in March and feed on branches. Eggs are laid in groups on leaves and take 6-12 days to develop. Nymphs feed on branches and culms for 45-60 days. Adults burrow into the ground leaf litter in late July and remain there until the following April. The adult of ***A. pinchii*** is 11-12 mm long, 5-6 mm wide and light green in colour. The oblong adult of ***B. tanuis*** is 14-17.5 mm long, 5.5-7 mm wide and varies in colour from yellowish-brown to greyish-brown (Xu Tiansen 1987).

Other Stink Bugs

Besides the three mentioned above, there are about 30 other stink bug species recorded on the leaves and minor branches of various bamboos, but no serious outbreaks

have been reported. ***Megarrhamphus hastatus*** Fab. and ***M. truncatus*** Westwood — occurring in China, India, Japan, Korea, Malaysia, Myanmar and Vietnam — are common pests on rice, sugar-cane and other agricultural crops. These have two generations per year, overwintering as adults under ground leaf litter. Eggs are laid in groups on leaves and culms. In China, ***Cressona divaricata*** Zheng et Zou, ***C. valida*** Dallas and ***Halyabbas unicolor*** Distant are found only on bamboos. These three species also occur in India, Myanmar, Thailand and Vietnam, although there are no reports on the damage they cause to bamboo. All the three have one generation each per year, overwintering as nymphs (Chen Zhenyao 1989a).

Lygaeid Bugs (Hemiptera: Lygaeidae)

Pirkimerus japonicus Hidaka

DISTRIBUTION

China and Japan.

HOST

Phyllostachys spp.

BIOLOGY

The elongated adult bug is 8-9 mm long, black in colour and covered with long, golden hairs. The nymph is yellowish-brown in colour, with dark brown protergum, and 7-8 mm long when fully fed. The bug burrows into the culm through wounds and cracks. Eggs are laid in groups on the inner surface of the culm and take 3-5 days to develop. Nymphs pass through four instars. There are four generations per year.

DAMAGE

Both adults and nymphs feed throughout the year on sap on the inner surface of the culm. The damaged culm blackens in colour and is susceptible to breakage in wind. The pest is photophobic and prefers old culms.

CONTROL

Proper silvicultural measures — such as removing bamboo shoots damaged by shoot borers and weevils, and thinning old culms — can significantly reduce the incidence of the bug (Gao Zhaowei 1979, 1980; Qiu Zilin and Hu YL 1982).

Malcus setosus Stys. and several ***Macropes*** species are also found on bamboos, but their biology and effects are not yet clear (Zheng Leyi and Wang ZF 1987).

Mirid Bugs (Hemiptera: Miridae)

▮ *Mecistoscolis scitetoides* Reuter
▮ *Mystilus priamus* Distant

DISTRIBUTION

Widespread in China, Myanmar and Sri Lanka.

HOSTS

Phyllostachys, Bambusa, Sinocalamus and *Dendrocalamus* species.

BIOLOGY

There are several generations a year which are significantly overlapped. It takes 27-47 days to complete one generation for females and 28-46 days for males. Eggs hatch in 3-4 days and nymphs take

16-18 days to develop, passing through six instars. Both adults and nymphs suck saps on the back surface of leaves throughout the year except for a short inactive stage in winter.

DAMAGE CAUSED

Damage is caused by sucking sap from leaves, resulting in reduction in vigour and shoot yield of bamboo plants. ***M. scitetoides*** is reported to be one of the important insect pests on bamboos in Taiwan, attacking about 30 bamboo species/varieties and showing a preference for *Dendrocalamus oldhami* and *D. latiflorus.* Over 95% reduction in shoot yield has occurred from heavy attacks by the pest.

CONTROL

Over 23% eggs of the pest are parasitized by *Telenomus* sp. Painting culm nodes with tamarous 50%, carried out at least 18 days before shoot-harvesting, can achieve 96-98% mortality of the pest (Chang Yuzhen 1981, 1986; Chang Yuzhen and Xue XQ 1994).

Coreid Bugs (Hemiptera: Coreidae)

Coreid bugs are a common sight on bamboo shoots in spring and summer months and 28 species have been recorded so far (Xiao Caiyu 1963). Both adults and nymphs feed on bamboo shoots by sucking sap. Damages will cause general reduction in vigour and growth rate of shoots, and result in wilting and death of young shoots in severe cases.

Notobitus meleagris Fabricius

DISTRIBUTION

Occurs in southern China, India, Myanmar, Singapore and Vietnam.

HOSTS

It is found only on sympodial bamboos and prefers *Dendrocalamus* species.

BIOLOGY

There are five generations per year. Adults of the fifth generation overwinter when the daily mean

Fig. 31: Adults and nymphs of ***Notobitus meleagris***

temperature is below 25°C and feed again from early spring. Eggs are deposited on shoot sheath or the back surface of leaves and are arranged in two rows containing about 30 eggs in total. Egg stage lasts 3-20 days depending on temperature. Adults and nymphs feed mostly on shoots at 1-2 m high and emit a strong, unpleasant odour when disturbed. Some birds, spiders and wasps are found preying on nymphs of the pest. ***Notobitus sexguttatus*** Westwood often occurs together with ***Notobitus meleagris*** (Chen Zhenyao 1989b).

Notobitus montanus Hsiao

DISTRIBUTION

China.

HOST

Attacks mainly *Phyllostachys* species.

BIOLOGY

There is one generation per year in central China. Single-row egg masses, each containing 20-30 eggs, are laid on the back side of leaves. Nymphs hatch in 15-20 days, turn in colour from red to dark brown in about 3 hours after hatching, and feed in groups on shoot sap for 30-50 days. Adults emerge from overwintering site in spring when bamboo shoots are available. In July, when all shoots develop into young culms, adults usually gather at dry sites in or around bamboo stands to find suitable sites for overwintering (Zeng Lin 1981).

Other Coreid Bugs

Other coreid bugs include ***Notobitus excellens*** Distant, ***Acestra sinica*** Dallas, ***Fracastorius cornutus*** Distant, ***Cloresmus pulchellus*** Hsiao and ***C. modestus*** Distant on sympodial bamboos, ***Derepteryx fuliginosa*** Uhler on monopodial bamboos in China, Japan and Korea, and ***Acanthocoris scaber*** Linn., ***Riptortus linearis*** Fab. and ***R. pedestris*** Fab. on both sympodial and monopodial bamboos in China, India, Myanmar, Sri Lanka and Malaysia.

Froghoppers (Homoptera: Cercopidae)

Aphrophora horizontalis Kato

DISTRIBUTION

China.

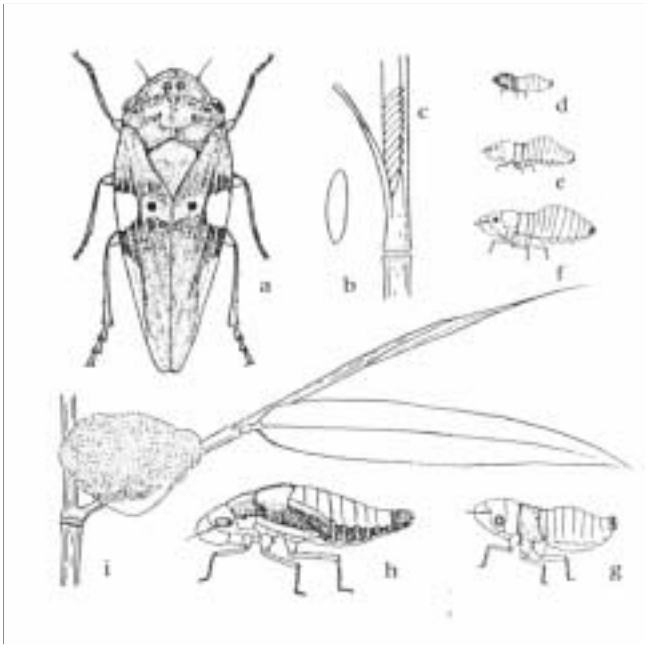


Fig. 32: Different life stages of ***Aphrophora horizontalis*** a: adult; b-c: egg and egg cluster; d-h: 1st-5th instar nymphs; i: cuckoo-spit

HOST

Phyllostachys pubescens.

BIOLOGY

Both adults and nymphs suck sap from leaf sheaths, branches and twigs, causing defoliation and wilting of twigs and branches. The adult is 8-10 mm long and dull yellowish-grey in colour. There are four black blotches on the protergum of the adult. Nymphs pass through five instars and vary from 1.5 to 8 mm in length, and from reddish to light yellow in colour as they grow up. There is one generation per year. Nymphs, hiding in cuckoo-spit, suck sap from leaf buds, leaf sheaths and twigs during April-June. Adults emerge in June and feed on sap in the top crown and move down to lower branches in September. They keep

feeding and mating alternatively for about one month. Egg-laying occurs in October. Eggs are deposited in slits, made in a single line by females on small branches. Eggs hatch in the following April.

Fig. 33: Cuckoo-spit of ***Aphrophora horizontalis***

Species such as ***Callitettix braconoides*** Walker and ***Cosmoscarta mandarina*** Distant occur together with ***A. horizontalis*** sometimes but much less in number.

CONTROL

Heavy infestation of these froghoppers can be effectively controlled by culm-cavity injection of systemic insecticides (Lu Ruoqing and Xu Tiansen 1992).

Planthoppers and Leafhoppers

Thirty-six delphacid planthopper species (Homoptera: Delphacidae) have been recorded on various bamboos in China, classified to a number of genera involving

mainly ***Bambusiphaga***, ***Belocera***, ***Epeurysa*** and ***Purohita*** (Ding Jinghua and Hu CL 1987). Although some of them are found only on bamboo, none cause any significant damage. Their biology is poorly documented.

Various cicadellid leafhopper species (Homoptera: Cicadellidae) also can be found on bamboos. They are mostly common pests of agricultural crops and cause only minor damage to bamboo, by sucking sap from leaves.

Aphids (Homoptera: Aphididae)

More than 50 aphid species have been found as pests on foliage, shoots or culms of bamboos in the Asian region (Liao Huitang 1976; Xu Tiansen et al. 1993; Agarwala 1981). Sap-sucking by these aphids results in wilting of damaged leaves and shoots, reduction in the vigour of bamboo plants and stunted growth. Most species are present only in low numbers in bamboo stands, although an outbreak of some species can cause significant damage.

Oregma bambusae Buckton

DISTRIBUTION

Bangladesh, China, India, Pakistan and Sri Lanka.

HOSTS

Bambusa spp. and *Dendrocalamus* spp.

BIOLOGY

Nymph and adult aphids feed on bamboo shoots by sucking sap. The wingless sap-sucker depends for its dispersal and migration on mechanical means such as strong breeze and oscillations of bamboos, or on birds and terrestrial animals. The dispersed adults settle down

on new shoots by piercing the tissues. Subsequently through rapid multiplication, cluster formation takes place around the mother aphid and the whole shoot gets covered. In heavy outbreaks, aphids usually cover the entire shoots. Large populations of aphids cause the plants to be smothered with a black fungus which grows on the honey dew secreted by the aphids.

DAMAGE CAUSED

It is a serious pest of bamboo, and an epidemic was reported on *Bambusa tulda* in Dehra Dun, India, in 1962 (Chatterjee and Sebastian 1964). Excessive drainage of sap results in low vitality, and stunted growth because of the wilting of soft growing points of shoots. While larger shoots wilt, the smaller shoots are killed outright.

CONTROL

A coccinelid predator, *Synonycha grandis* Thub. has been recorded as feeding on the pest in Sri Lanka (Hutson 1933). Chatterjee and Sebastian (1964) recommended the use of kerosene oil in soap emulsion as a measure of control. Spraying 0.01-0.02% water solution of systemic insecticides — such as dimethoate or monocrotophos — is effective against the pest. Foliar spray of 0.04% dimacron or Rogor and 0.02% fenitrothion has also been suggested (Singh 1990).

Pseudoregma sp.

DISTRIBUTION

Thailand.

HOSTS

Bambusa, Dendrocalamus, Gigantochloa and *Thyrsostachys* species.

DAMAGE CAUSED

A colony of the aphid can cover the shoots and young branches entirely from the bottom to the top. Heavy damage results through significant reduction in vigour, and even the death of the growing shoots may occur.

CONTROL

Spraying of 2.5% liquid soap is practised as a control measure (Choldumrongkul and Hutacharern, pers. comm.).

Astegopteryx bambusifoliae Tak.

DISTRIBUTION

China, Japan and Southeast Asian countries.

HOSTS

Found on several species of *Bambusa, Phyllostachys, Dendrocalamus* and *Sinocalamus.*

BIOLOGY

It is one of the most common species among bamboo aphids. Both adults and nymphs suck sap from the back surface of leaves or from culm. The aphid is most abundant in spring and winter, but hard to find on bamboo during hot summer. Air temperature, nutritional quality of the available food and intra-specific competition are important to the population dynamics of the aphid.

CONTROL

The ladybird beetles *Scymmus* sp. and *Lemnia* sp. are proven predators of the aphid, and effective against the pest (Liu YC and Chang Yuzhen 1976; Chang Yuzhen 1986).