



NOCTUID SHOOT BORERS IN *DENDROCALAMUS* AND *BAMBUSA* SPECIES

by

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Introduction and literature review

Over the past few years noctuid shoot borers from the genus *Pareuplexia* have been found to cause widespread damage in bamboo clumps in Nepal. Their life cycles and the patterns of associated damage in several species have been studied to determine the threat which they pose and potential methods of control.

There have been several reports of shoot borer damage to bamboos in China. In addition they are known to occur in Bangladesh (Boa and Rahman, 1984) and Thailand (Jackson 1984).

Cheng (1981) reported the incidence of the moth *Atrachea vulgaris* in *Phyllostachys* species in Zhejiang and Anhui provinces of China. This species requires small grasses or sedges as a secondary host and can be controlled by their removal. Chen (1982) described the bionomics of the noctuid *Oligia apameoides* which overwinters as eggs. Wang (1982) reported five pyralid species from Zhejiang including *Algedonia coclesalis*, *Denobotys pervulgaris*, *Crocidophora aurealis*, and *Enmorphobolys obscuralis*, which all co-exist with different life cycles making control extremely difficult. Houjian (1984) reported the occurrence of the lymantrid *Pantana sinica* in Zhejiang. This moth has three generations each year, which enables it to build up large populations very quickly, and it overwinters as widely dispersed pupae which are difficult to find.

In all these cases satisfactory control only followed a close examination of life cycles. Various techniques were developed to reduce damage to acceptable levels, relying mainly on physical removal of the insects at a susceptible stage of their life cycle, without resorting to the use of insecticides on a large scale. As Wang (1982) pointed out, the use of insecticides has several drawbacks. He found that as well as being dangerous and expensive, they also killed the natural predators, encouraging other moths to multiply and cause damage for the first time, and eventually allowing the target moths to increase beyond their original levels.

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Description of life cycle and pattern of damage

The life cycle of the insects has been determined from examination of infected poles of several species at different times of year in different sites, and from rearing adult moths from larvae seen causing the damage.

Adult moths emerge in the monsoon months and lay eggs at the top of the culm sheaths on the newly arisen shoots. The larvae move down the shoots between the culm and its sheaths until they reach tissues which are soft enough to eat, in the region of intercalary growth approximately $\frac{3}{4}$ of the way down an internode. Here they eat through into the cavity leaving a distinctive oval hole, see fig (i), which is eventually visible at a height of 0.5–2m after the culm sheath falls off. Once inside the cavity they move upward toward the softest tissues at the shoot tip, leaving a small round hole in each nodal diaphragm. As they reach the softer new internodes they eat an increasing amount of the interior wall tissues. As the internodes extend, this shows through to the outside as characteristic slits or streaks which increase in extent up the culm, see fig (ii). This interior damage reduces the degree of internodal extension (intercalary growth) so that the affected area has short internodes. This may be the only indication of the structural damage apart from the entry hole lower down. Where damage is extensive the tip of the new shoot may die or break off.

At the time of maximum damage the larvae are up to 5 cm in length and up to 100 may be found in a single culm. They are white with brown head capsules, see fig (iii). After causing the damage the larvae show an interesting pattern of behaviour. Instead of leaving the culm through the slits to disperse and pupate, they return down the inside of the culm and congregate in the internode which they first entered. They plug the hole in the upper diaphragm to prevent water entering and overwinter as larvae within the protection of the culm. The original entry hole provides air but the loosely attached culm sheath outside prevents the entry of predators. A few weeks prior to emergence as adults they pupate suspended from a rubbery membrane at the top of the cavity, see fig (iv) and see fig (v). Meanwhile the culm sheath outside has fallen off, and the adult moths can emerge through the original entry hole, which has enlarged through the extension of this region of the internode.

The adult moths are typical heavy-bodied noctuids, 2–3 cm in length and a drab brown colour. As they emerge at night they are inconspicuous and rarely associated with the damage.

Susceptibility of different species and extent of damage

The most severely damaged of all species studied has been *Dendrocalamus hamiltonii*, a species with soft thin walls. By comparison *Dendrocalamus hookeri* shows less evidence of damage, possibly because of its tougher walls or its faster growth rate which may allow it to outgrow the larvae. The *Bambusa* species studied¹ show a reaction of the inner surface of the culm to damage whereby a gelatinous substance is produced in abundance. This is sometimes enough to kill the larvae outright and all that remains as evidence of their role is the brown head capsules. Where larvae survive they are capable of inflicting damage as usual, but they cannot overwinter in the normal manner. A few larvae pupate where the walls are not damaged and still dry, and a few survive where the cavity dries out because of the slits. The numbers of successfully overwintering insects are always low, however, compared to the numbers in *Dendrocalamus* species. One *Drepanostachyum*² species

¹ Identified in 1994 as *Bambusa nutans* subsp *cupulata*

² Identified in 1994 as *Himalayacalamus falconeri*

produces a gelatinous exudate on the outside of new shoots, which may be an adaptation to prevent larvae from gaining access.

A small survey of one area of Dhankuta district in East Nepal at an altitude of between 1,400 and 1,800 m showed an overall incidence rate of 10.5% in 287 culms which had arisen in 1982 from a sample of 60 managed clumps of *Dendrocalamus* species³. Brief examinations of *Dendrocalamus* species there and elsewhere in eastern, central, and western Nepal in the two subsequent years have indicated a similar rate of occurrence. It would appear that at the moment there is a fairly uniform level of incidence throughout the range of *Dendrocalamus* species in Nepal from year to year. Lepidopteran populations are notorious for their unpredicted fluctuations, however, and changes in agricultural practices such as the use of more insecticides could allow populations to rise in the future.

Potential control measures

Present management practices seem to effectively control the insects to a certain degree. Local knowledge concerning the insect itself is usually limited, but the routine removal of culms and the associated clearing out of obviously damaged culms in well managed clumps seems to make a substantial contribution to reducing damage. Neglected and unmanaged clumps were seen to have a much higher incidence of damage (about 30%).

If all infected culms were recognised and removed, population numbers should be reduced sufficiently to almost eliminate damage. As the larvae congregate to overwinter and pupate they are much easier to remove than the Chinese insects described. The culms without extreme damage can harbour many insects and all culms with the symptoms of shortened internodes along with the characteristic entry hole require attention. It may well not be necessary to remove the entire culms. While the larvae have developed a well protected refuge, they have at the same time become more susceptible to interference. Several potential measures suggest themselves. Enlarging the entrance hole might effectively encourage destruction of the larvae by a wider range of predators. Blocking the hole should prevent adult moths from emerging. Inserting insecticides or even just water might also be satisfactory. As the majority of insects overwinter in *Dendrocalamus* species attention to these alone may well be all that is necessary, even when damaged *Bambusa* species are also present.

Summary

At the present time these shoot borers are a pernicious and widespread pest, damaging an estimated 10% of new shoots every year throughout the country. Should anyone be interested in reducing the incidence below present levels, or should the population rise to seriously threaten these very important crops it should be technically possible to control the insects by simple physical measures. Because of the congregation of larvae and pupae inside the culms of a restricted range of species at an accessible height in readily recognisable locations these insects should be much easier to control than most shoot borers, which are usually more dispersed and harder to find. Further studies are necessary to find the range of species involved, whether they all adhere to this life cycle, and how effective the proposed control measures are in practice.

³ Identified in 1994 as *D. hamiltonii* var *hamiltonii*, *D. hamiltonii* var *undulatus*, *D. hookeri*, and *Bambusa nepalensis*

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Fig (i). Location and appearance of typical entry hole.



Fig (ii). Characteristic streaks, slits and broken shoot apex of a severely damaged culm.

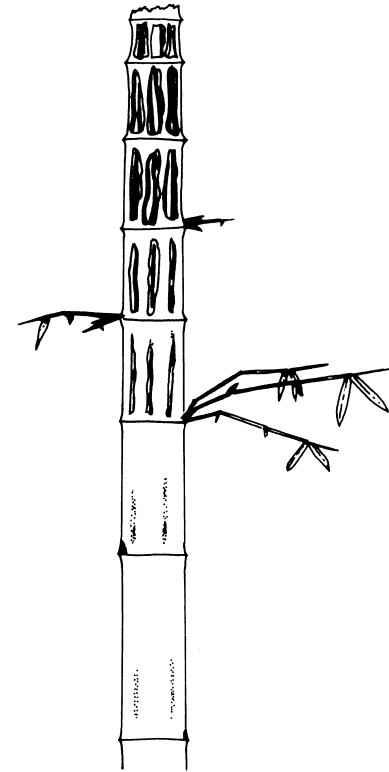


Fig (iii). Fully grown larva, $\times 3$.

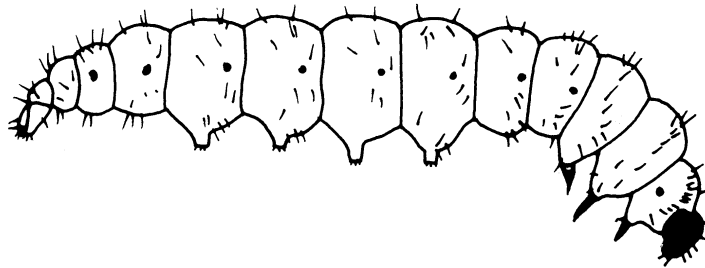


Fig (iv). Pupa, dorsal and lateral views.

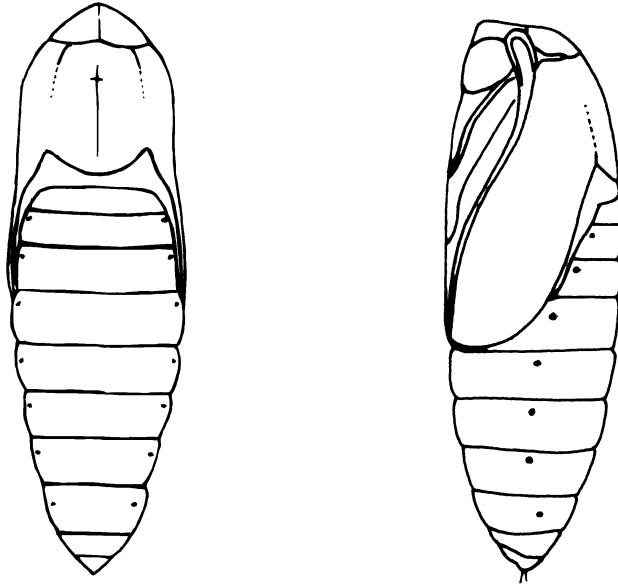


Fig (v). Cross-section through top of culm cavity, showing pupating position and blocked hole in diaphragm.

