

**BIOLOGY AND CONTROL OF INSECT PESTS OF
FAST-GROWING HARDWOOD SPECIES**

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INTRODUCTION

This project was originally planned as a continuous study of insect problems in plantations of fast-growing hardwood species in Kerala, with a view to develop suitable measures of protection as the problems arose. Due to various reasons, plantations of some species did not become available for study, and for some others, although plantations were available, systematic studies could not be carried out. As the study progressed, stress was laid on *Albizia falcataria* and *Gmelina arborea*, and other species were dropped out of the scope of this project. This report is therefore restricted to the above two species.

Albizia falcataria (Mimosaceae) is exotic to India whereas *Gmelina arborea* (Verbenaceae) is native. In Kerala, most plantations of both species have been raised only recently, over the last 10-14 years. Knowledge about their present and potential pest problems and possible methods of control are essential for the success of plantation programmes.

METHODS OF STUDY

General observations on pest incidence were made by periodic surveys in various plantations. During these surveys insects associated with the trees were collected, reared in the laboratory when necessary, and identified.

In the case of *A. falcataria* about 350 ha of plantations distributed over the central and southern parts of the State were covered in the survey. In addition to general observations on the biology of pests and the nature of damage caused by them, detailed field and laboratory investigations were carried out on the biology, ecology, impact and control of one major pest encountered- the bagworm, *Pteroma plagiophleps*. The field observations were made over a period of three years from 1977 to 1979 in a 20-ha plantation raised in 1974 at Charpa, Vazhachal, where the bagworm incidence was first noticed. Experimental studies were carried out on bagworms maintained on potted seedlings or on field-planted, caged saplings.

In the case of *G. arborea* the study was conducted mainly in a 10 ha plantation raised in 1977 at Kottappara in the Kothamangalam Forest Division. Initial observations were made in 1978, followed by monthly observations, as far as possible, during 1980 and 1981. The observations were qualitative, except in the case of an outbreak of a tingitid bug when a systematic enumeration was made to assess the Infestation. Occasional observations were also made on isolated trees in natural forests at Peechi and Vazhani (Trichur Forest Division).

RESULTS AND CONCLUSIONS

1. *ALBIZIA FALCATARIA**

The pest complex

Twenty-five species of insects were found associated with *A. falcataria* in Kerala, of which all except 4 were recorded on this tree for the first time in India. They included 15 species of leaf-feeders, 7 sap-suckers and 3 live-tree borers. Most species, except those mentioned below, are minor pests, feeding on *A. falcataria* only occasionally.

The bagworm, *Pteroma plagiophleps* caused significant damage and is recognized as a major pest; it is dealt with separately below.

Caterpillars of the pierid butterfly, *Eurema blanda silhetana* was found to cause fairly intense, but localised, defoliation in young plantations on some occasions. This species is recognized as a potential, sporadic pest of young plantations.

A scolytid beetle, *Xyleborus fornicatus*, commonly known as the shot-hole borer of tea, was found to attack young saplings and cause small-scale mortality. With its record as a serious pest of tea plantations in India and Sri Lanka it is a potentially serious pest, particularly in poorer sites where the saplings are under physiological stress.

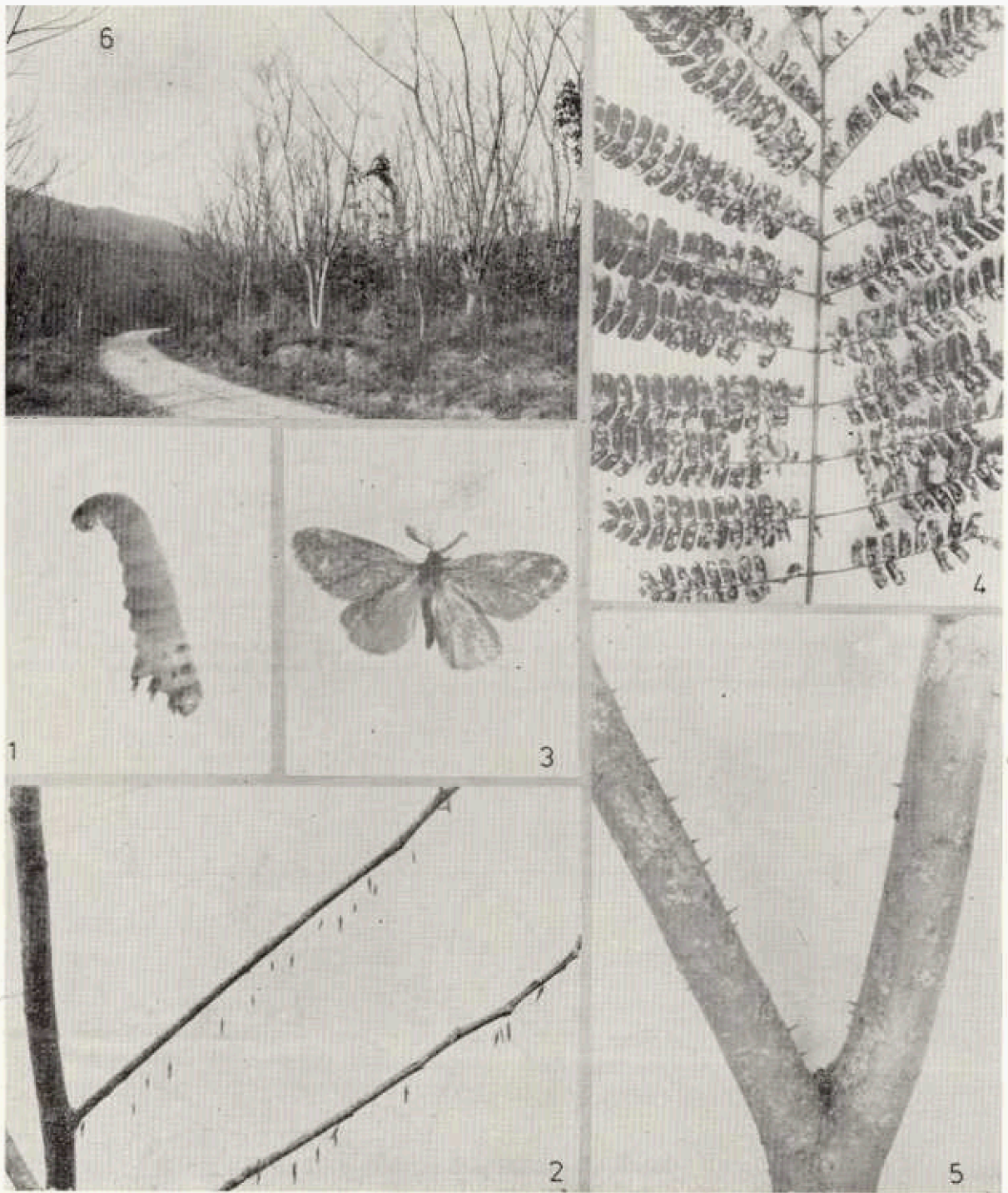
The Albizia bagworm

A bagworm, *Pteroma plagiophleps* Hampson (Lepidoptera, Psychidae), formerly known as a minor pest of tamarind insouthern India and Sri Lanka, has emerged as a serious pest of *A. falcataria* in Kerala. It was first noticed in a 3-yr old plantation at Charpa, near Vazhachal, in 1977 and has now spread to the roadside Gulmohr trees (*Delonix regia*) over most of Kerala. Since very little information on this insect was available in the literature, various aspects of its biology, ecology and control were investigated.

Biology

The life stages of the insect are shown in Figs. 1 to 3. The bagworm belongs to a group of highly specialised moths, the larvae of which inhabit

* In 1983 Nielson transferred *A. falcataria* into the genus *Paraserianthes*, and accordingly the current name of the species is *Paraserianthesfalcataria* (Linn.) Nielson



Figs. 1-6: 1, A full-grown larva of the bagworm, *PTEROMA PLAGIOPHLEPS* taken out of the bag; 2, Bagworm pupae (inside cocoons made of larval bags) hanging from branches of infested tree; 3, Adult male; 4, *ALBIZIA FALCATARIA* leaf showing the characteristic patchy feeding. Thorn-like projections on the main rachis are larval bags; 5, Stem of *A. FALCATARIA* showing feeding scars on bark and larvae inside bags; 6, General view of a defoliated 3-yr old *A. FALCATARIA* plantation at Vazhachal,

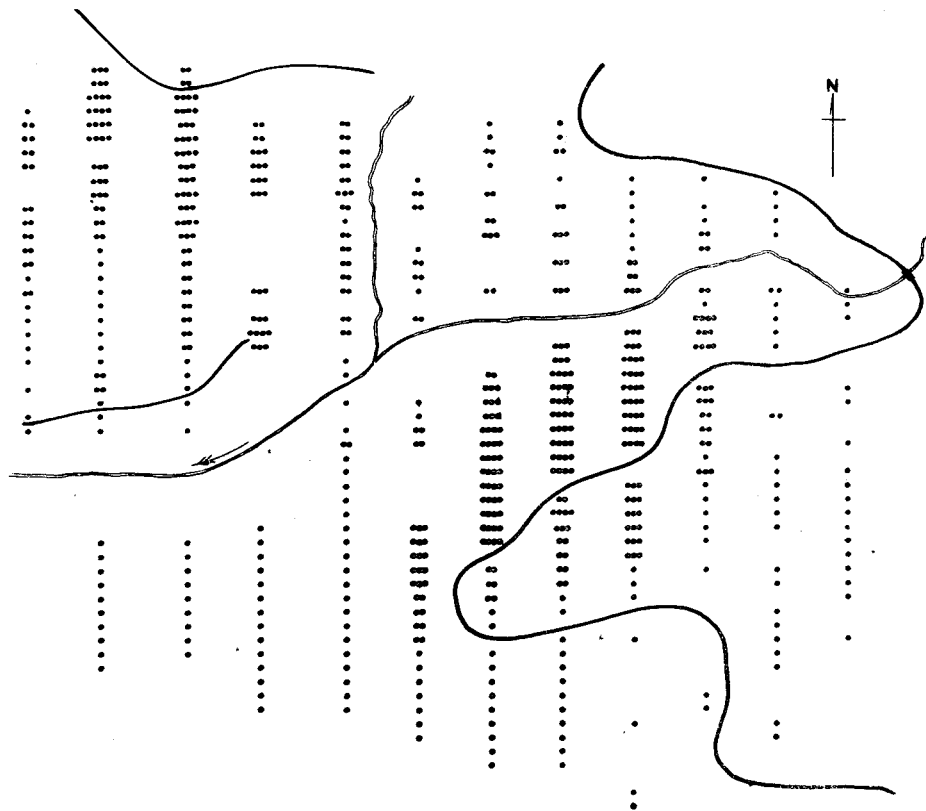


Fig. 7. Spatial distribution of bagworm infestation intensity in a 3-yr old *ALBIZIA FALCATA* plantation at Vazhachal. The number of dots indicate the intensity of infestation in every 20th row. Each data point represents the median score of 4 trees.

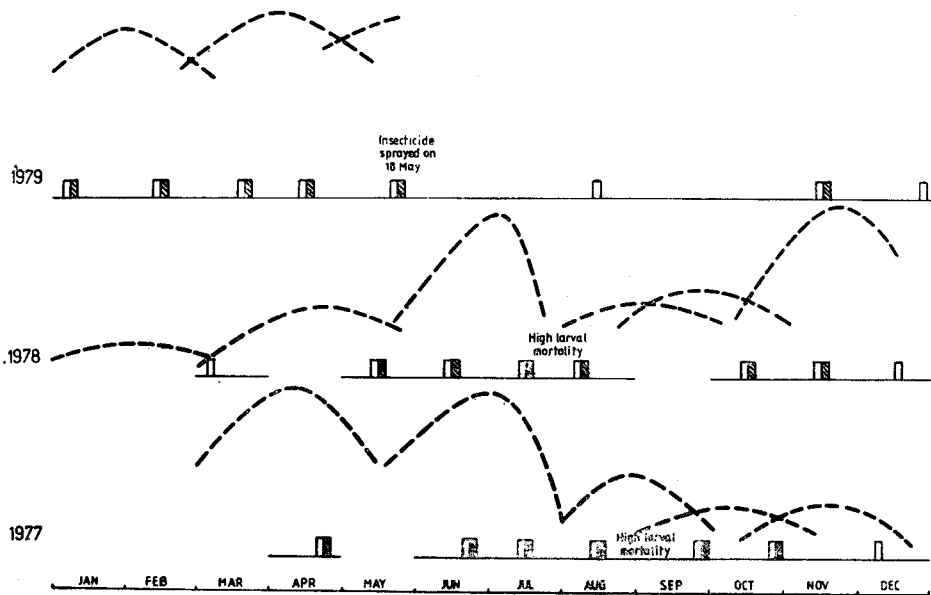


Fig. 8. Diagrammatic representation of the seasonal incidence of bagworm in the above plantation during 1977-79, based mainly on qualitative observations at monthly intervals. Bars indicate presence of larvae (open bar) and pupae (hatched bar) on the observation dates, gaps in the baseline showing months for which the observations were missed. The curves indicate the time span and size of the generations.

portable bags made of leaf bits or other extraneous material spun together with silk. The adult males are normal winged moths, but the adult female is larviform and degenerate. Various aspects of the biology of this insect were worked out. Mating is facilitated by the male flying on to the hanging female bag and inserting its abdomen through the open posterior end of the female bag. Fertilised eggs develop inside the female bag, each female producing 100 to 200 offsprings. The newly hatched larvae emerge from the bags and disperse on silken threads. They settle on leaves and soon construct the protective bag which they carry along. The damage is caused by the larvae. When the feeding is completed, the larvae move on to the stems and pupate inside bags hung from the branches (Fig. 2). The total developmental period is 2 to 2.5 months.

Nature of damage (Figs. 4 - 6)

The larvae feed gregariously, usually on the under surface of the leaf, leaving a layer of epidermis on the opposite surface. When the damage is extensive, the whole leaf dries up. Affected trees give a fire-scorched appearance from a distance. Older larvae usually migrate to the branch stems and often to the main trunk and feed on the live surface layers of bark, leaving feeding scars (Fig. 5). Larvae resting or feeding on stem with their conical bag; held upright give the appearance of thorns. In heavy infestations, thousands of pupal bags can be seen hanging from the branches.

A study of the distribution pattern of infestation within a plantation showed that it was characteristically clumped (Fig. 7), a pattern resulting from the flightlessness of the female.

Impact on trees

The bagworm-caused defoliation had a serious impact on trees; in addition to unestimated growth loss, it led to either partial or total death of many trees. During the first year of defoliation in the 3-yr old plantation at Vazhachai, out of 22 trees observed 3 were totally dead, 6 showed death of over half of the upper portion of the main stem and 13 showed die-back of small branches. About 3 years after the first infestation, a sampling of 5% of the trees in the 20 ha plantation showed that 22% of the trees were dead, 17% suffered die-back extending to one- to three-fourth of the stem and 61% were healthy. The last category may have suffered serious loss of growth increment.

Seasonal incidence

Population outbreaks of the bagworm occurred every year during the 3 year study period (Fig. 8). More than 4 complete generations are possible

per year theoretically, but only one or two outbreaks were noticed under field conditions, usually during the drier seasons.

Natural enemies

Natural enemies appeared to play a decisive role in regulating population outbreaks of this species. Heavy mortality of young or old larvae was noticed at times, particularly during July-August (Fig. 8). Most deaths appeared to have been caused by disease organism, but the organisms have not been isolated. In addition, 18 species of parasitic insects were found attacking the bagworm- all were hymenopterans belonging to the families Chalcididae, Eulophidae, Eurytomidae, Ichneumonidae and Braconidae. Parasitism was as high as 25 to 38% in some samples, showing that it was a significant natural control factor.

Host range and distribution

Prior to this study only 3 host plants were known for this insect; the list has now gone up to 17. Interestingly, three kind; of infestations can be distinguished - (1) Heavy, pest level infestation affecting a large number of trees, as in *A. falcataria* and *D. regia*; (2) Heavy infestation of isolated trees within a community of the same plant species, as in *Tamarindus indica*, *Trenia orientalis*, etc.; and (3) Sparse infestation, as in coconut palm, teak, etc. When the infestation was first noticed in *Albizia falcataria* in 1977, attempts to feed the larvae on *Delonix regia* failed, and yet, about two and a half years later, natural infestation occurred on the same species. The significance of these observations are not clear at present. It appears that *P. plagiophleps* is polyphagous but successful infestation is dependent on host-stress, either due to heavy population pressure of the bagworm itself or due to other stress factors. This is suggested by infestation of *Eucalyptus tereticornis* in the SO₂ - polluted premises at Kalamasseri in the industrial belt, but not in other extensive eucalypt plantations in the forest area.

The insect is distributed throughout Kerala. In *A. falcataria* outbreaks have occurred in some plantations at Vazhachal, at Arippa near Kulathupuzha and at Anakkulam near Punalur, but several plantations have remained unattacked. However, since 1979 outbreaks have become quite comm on avenue plantings of *D. regia* almost throughout Kerala.

Control

Natural suppression of outbreak populations have been observed in the field on some occasions. Several factors are apparently involved, including insect parasites and disease organisms. Assessment of their relative impacts and their potential for artificial manipulation of the pest population requires further detailed study which was beyond the scope of this project.

Since insecticides are sometimes helpful in suppressing an outbreak, some investigations were carried out to select suitable chemicals. Eight commonly available insecticides, viz., HCH (BHC), methyl parathion (Metacid), quinalphos (Ekalux), dimethoate (Rogor), monocrotophos (Nuvacron), carbaryl (Sevin), permethrin (Permasect) and cypermethrin (Ripcord) were tested, each in at least two concentrations, by feeding the larvae with leaves treated with the insecticides. Quinalphos and methyl parathion at 0.05 to 0.1% concentration were the most effective.

Although insecticides can kill the larvae, we do not recommend application of insecticide for control of bagworm infestation on a routine basis. Each bagworm pest situation must be examined carefully by qualified entomologists with respect to the level of population build-up, the life cycle stage of the field population, the level of activity of natural regulatory agents, etc. before a decision is taken on the need for insecticidal control.

During the period of study, outbreaks occurred only in some plantations and they appeared to subside naturally. Some evidences suggest that bagworm outbreaks are dependent on host stress brought about by adverse site or environmental factors, but more data are necessary on these aspects.

2. *GMELINA ARBOREA*

In this study 34 species of insects were found associated with *G. arborea* of which only 5 have been reported earlier from this species in India. Most of the species, however, caused only minor damage. Depending on the nature of damage, they can be classed into 3 groups- (1) leaf-feeders, which included 3 species of caterpillars and 19 beetles; (2) sap-suckers, which included 6 species of Hemiptera, and (3) live-tree borers, which included 2 species of beetles.

The most serious infestation was caused by the tingitid bug, *Tingis beelsoni* Drake (Hemiptera, Tingitidae). In an infestation during May 1978 in 1-yr old saplings at Kottappara, 67% of the plants in the 10 ha plantation were infested: 21% suffered total defoliation while the remaining suffered varying degrees of leaf fall. Severe infestation was concentrated over a patch of about 2 ha. Defoliated saplings showed die-back of terminal shoot resulting in epicormic branching.

Three other species listed below caused moderate level infestations and are considered to be potentially serious pests.

(1) *Epiplema fulvilinea* Walker (Lepidoptera, Epiplemidae): These leaf feeding caterpillars webbed the tender leaves and growing shoots together. Their feeding resulted in severe defoliation.

(2) *Calopepla leayana* Latr. (Coleoptera, Chrysomelidae): Adults as well as grubs of this beetle fed on leaves, making characteristic holes. Leaf loss was considerable in severe infestations. Although serious damage by this species has not occurred in Kerala, it is known to be a serious pest of *G. arborea* in other parts of the country.

(3) *Xyleborus fornicatus* Eichh. (Coleoptera, Scolytidae) : Infestation of this beetle (commonly known as the shot-hole borer of tea) which occurred during the summer months appear to be linked with moisture stress. As noted earlier, it is also a potential pest of *Albizia falcataria*.

Among the 4 pest species, the leaf feeding *E. fulvilinea* and *C. leayana* can attack older trees, but *T. beesoni* and *X. fornicatus* attack only saplings.