Impact of Infestation by the Leaf Feeders in Teak (*Tectona grandis* Linn. f.) and Ailanthus (*Ailanthus excelsa* Roxb.) Plantations

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***Abstract*—** Observations in teak plantations at Forest College and Research Institute, Mettupalayam, Coimbatore district, India, revealed that the teak defoliator, *Hyblaea puera* and the teak leaf skeletonizer, *Eutectona machaeralis* caused significant damage. Infestation by the teak defoliator, *Hyblaea puera* was high in teak plantations during the month of march 2012 (6.4%). Likewise, damage by the teak leaf skeletonizer, *Eutectona machaeralis* was found to be severe (19.6%) during December 2011. Ailanthus webworm, *Atteva fabriciella* and the ailanthus defoliator, *Eligma narcissus* was documented to infest ailanthus trees during the study period (2011-2012). Infestation by ailanthus webworm was high during November, 2011. A positive correlation was observed between relative humidity and the infestation by ailanthus webworm. As far as the ailanthus defoliator is concerned, the mean per cent infestation was found to be very low during November 2011 (1.2%), which subsequently increased to greater levels, reaching 7.4% infestation in March, 2012.

***Keywords*—**Atteva fabriciella, Eligma narcissus, Eutectona machaeralis, Hyblaea puera

I. Introduction

HERBIVOROUS insects are undividable components of natural ecosystems and form a part of energy cycle and serve as secondary consumers. But their population size remains low in number as it is regulated by biotic and abiotic factors. This regulation is the result of dynamic equilibrium between production and destruction. When this balance gets affected the population number gets altered resulting in pest outbreak or extinction.

In natural ecosystems, each tree species and its associated insects have co-existed and co-evolved over millions of years [1]. If either the host tree or its pests adversely affected the survival of the other, on or both would have been eliminated through the process of natural selection.

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The fact that they survive indicates that a balance has been struck between the adverse impact of the insect on the tree and of the tree defenses on the insects, so that there is dynamic balance in the abundance of both. Tree defenses against insects include static defenses such as hairs or spines on leaves, a vast array of unpalatable or toxic secondary chemicals, including waxes and resins or gum that can trap insects, as well as induced dynamic defenses such as wound healing reaction, timely mobilization of defensive chemicals to the sites of attack, etc.

The mechanisms which regulate insect numbers has two main schools of thought, density dependent factors (i.e., the direct or indirect negative feedback exerted by the increasing population) and density independent (abiotic, like weather factors) [8]. A negative feedback mechanism involves in maintaining stability, i.e., the dynamic equilibrium of insect numbers. For example when an insect population increases, its parasite population also increases. This increased parasite population exerts great pressure on the host population, reducing it to a lower level. Thus an initial stimulus (increase in the insect population which causes an increase in the parasite population) is fed back to the population, causing a negative impact [7].

When trees are moved from their natural communities to artificial monoculture plantations, many of the checks and balances that operate between the host trees and the associated insect populations are disrupted. Pest problems are thought to originate due to the disruption of ecological interrelationships. It is obvious that all insects that exist in nature do not become pests; among all those that become pest may not cause economic damage or make an outbreak. This indicates that development of pest status is not necessarily a function of plantation conditions, but has something do to with the intrinsic characteristics of the insect species.

Several factors promote the increase of pest population in plantations. Thus plantations are at greater risk of pest outbreaks than natural forests. In Asia, defoliation caused by the caterpillar, *Hyblaea puera* in teak plantations has resulted in the loss of 44% of the wood volume increment in a year [6]. This pest is becoming increasingly important in exotic plantations of teak in Latin America. Matchwood industries are highly dependent on the matchwood tree, *Ailanthus* sp. This tree species is affected largely by both the webworm and the defoliator resulting in a drastic reduction in the supply of

raw materials for matchwood industries. Leaf-feeding caterpillars of the moth *Eligma narcissus* cause defoliation of saplings of Ailanthus species [9]. Leaf feeders often results in widespread damage to forest plantations. Hence, attempts were made in this study to assess the intensity of infestation caused by the leaf feeders in teak and ailanthus plantations.

II. MATERIALS AND METHODS

A. Infestation

Observations on the incidence and infestation of leaf feeding caterpillars were recorded in teak and ailanthus plantations. The study was carried out in the plantations of Forest College and Research Institute (11°30' N and 76°56' E), Mettupalayam, Coimbatore district, India, from november 2011 to march 2012. To assess the percentage infestation in plants, 100 leaves were collected randomly and observed for the presence of damage symptoms. Five replications were maintained for each observation. This was done at varying intervals and average number of leaves infested with pests was calculated every month and the values were tabulated.

B. Statistical Analysis

The data pertaining to the observations were analyzed in a randomized block design. The mean values of the observations were separated using Duncan's Multiple Range Test [4].

III. RESULTS AND DISCUSSION

A. Tectona grandis

In the study area, teak was found to be infested with two major leaf feeding caterpillars, namely, the teak defoliator (*Hyblaea puera* Cramer) (Lepidoptera: Hyblaeidae) and the teak leaf skeletonizer (*Eutectona machaeralis* Walk.) (Lepidoptera: Pyralidae). *Hyblaea puera*, commonly known as the teak defoliator, is the most notable pest of teak in Asia-Pacific and is now becoming increasingly important in Latin America also, where teak is planted as an exotic. The species was first described by Cramer in 1777 as *Phalaena puera* and was originally included under the family Noctuidae. *H. puera* was first recognized as a pest of teak plantations in Kerala, India over 150 years ago [2]. Since then, vast literature has accumulated on its biology and ecology.

During the study period, the change in infestation pattern was observed. *Hyblaea puera* infestation was found to be comparatively low in the plantations during the month of november, with subsequent increase observed in the following months. Observations in the month of march showed a high percent of infestation (6.4), leading to drastic defoliation of the trees (TABLE I). By midsummer, due to increased defoliation rate and the loss of soil moisture content, the trees shed their leaves and as a result, a further decrease in population may follow in the later days.

TABLE I
INFESTATION BY THE DEFOLIATOR, *Hyblaea puera* AND THE LEAF SKELETONIZER, *Eutectona machaeralis* IN TEAK PLANTATIONS AT FOREST COLLEGE AND RESEARCH INSTITUTE, METTUPALAYAM, COIMBATORE DISTRICT, INDIA, DURING 2011-2012

Month	% infestation (mean ± S.E.)	
	Hyblaea puera	*Eutectona machaeralis*
November	1.6 ± 1.1 c	18.2 ± 0.8 ab
December	2.8 ± 0.8 d	19.6 ± 1.1 a
January	4.6 ± 0.5 b	17.4 ± 0.9 b
February	5.2 ± 1.3 ab	12.8 ± 1.6 c
March	6.4 ± 0.9 a	11.2 ± 1.3 c

Values are means of five observations (100 leaves per observation).
Means followed by the same letter in a column are not significantly different by Duncan's multiple range test (P = 0.05) (analysed separately for the different insect species).

The larva of teak leaf skeletonizer generally feeds on the green leaf tissue between the network of veins, leaving the skeleton of veins intact, thus earning the name skeletonizer. Partially damaged leaves are not shed and even the fully skeletonized leaves are retained by the tree for a long time, so that affected trees have a dry, fire-scorched appearance from a distance. A maximum of 19.6% infestation by *Eutectona machaeralis* was observed during the month of december. A gradual decline was noticed during the subsequent months, *viz.*, january, february and march.

B. Ailanthus excelsa

Ailanthus excelsa naturally occurs throughout the tropical and subtropical regions of the Indian peninsula, especially in drier areas, and *A. triphysa* occurs in South and South-East Asia, including peninsular India, Sri Lanka, Myanmar, Malaysia, the Philippines and parts of Indonesia, Thailand, Vietnam, Cambodia, Laos, southern China, and Queensland and northern New South Wales in Australia.

Infestation caused by the Ailanthus webworm, *Atteva fabriciella* Swed. (Lepidoptera: Yponomeutidae) revealed that there was a gradual decline in the per cent infestation in ailanthus plantations during the study period (november 2011 to march 2012). During the earlier stages of study, there was sporadic rainfall, during which the population was comparatively high. A decline in the population of the pest was visualized during the months of january, february and march in the plantations. A positive correlation was observed between relative humidity and the larval population of the Ailanthus web worm. The pest population of *A. fabriciella* was found to be high during the onset of monsoon [5].

Infestation by the Ailanthus defoliator, *Eligma narcissus* Cram. (Lepidoptera: Noctuidae), within the same plantation was spatially discontinuous and appeared only on a few plants. During november, the mean per cent infestation was found to be very low (1.2%), which subsequently increased to greater levels, reaching 7.4% infestation in march 2012 (TABLE II).

Another interesting feature noted during the study was that *E. narcissus* was found not only to infest *Ailanthus excelsa*, but also nearby plantations of *Acrocarpus fraxinifolius* and *Gmelina arborea*. It could be inferred that both *A. fraxinifolius* and *G. arborea* act as an alternate host to *E. narcissus*.

TABLE II
INFESTATION BY THE WEBWORM, *Atteva fabriciella* AND THE DEFOLIATOR, *Eligma narcissus* IN AILANTHUS TREES AT FOREST COLLEGE AND RESEARCH INSTITUTE, METTUPALAYAM, COIMBATORE DISTRICT, INDIA, DURING 2011-2012

Month	% infestation (mean ± S.E.)	
	Atteva fabriciella	*Eligma narcissus*
November	5.8 ± 0.8 a	1.2 ± 0.8 d
December	3.6 ± 0.5 b	2.8 ± 1.6 c
January	2.8 ± 1.6 b	4.0 ± 0.7 c
February	1.4 ± 0.9 c	5.8 ± 1.3 b
March	0.8 ± 0.4 c	7.4 ± 0.5 a

Values are means of five observations (100 leaves per observation).
Means followed by the same letter in a column are not significantly different by Duncan's multiple range test (P = 0.05) (analysed separately for the different insect species).

The higher an ecosystem has been simplified, the higher the risk for the outbreak of an insect pest [3]. While detailed studies are rare, such general statements linking absence of pest outbreaks with high tree species diversity and occurrence of outbreaks with simplification or disturbance of the natural ecosystem are thus common in tropical forestry literature. It is believed that in mixed forests, other tree species associated with a host tree may mask or interfere with its attractiveness for a pest as well as provide nectar and pollen sources or shelter for the natural enemies of the pest. On the other hand, proximity of host trees in a host-dense stand, as in a plantation, is believed to favour the buildup of pests by reducing dispersal mortality and providing abundant food.

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