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Insect natural enemy complex in some agroforestry systems of Mizoram, India

D. Paul[1] and Lalnunsangi[2]*

[1] *Centre for Environmental Studies, North Eastern Hill University, Shillong 793022, India*
[2] *Department of Zoology, Mizoram University, Aizawl 796009, India*

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ABSTRACT

Small scale agroforestry systems in north-east India are unique in terms of the complex biodiversity of both the agricultural produce and the adjoining biotic components, and thus, are excellent models for sustainable production system. The structure and biotic composition of the systems offer inbuilt sustainability and potential for reduced dependence on chemical fertilizers and pesticides. Maintenance and potential role of natural enemy complex in various compartments of such systems are discussed in the light of land use practices and holding size.

Key words: Agroforestry; insect pest; insect natural enemy complex; sustainability.

INTRODUCTION

In Mizoram, India, farmers normally practice tree-based cropping systems on the basis of knowledge inherited from earlier generations. Although in the past, such practices were directed at retaining the trees for use as timber, at present, realizing the value of economically important species, teak is introduced as the preferred tree component. Jha[1] and Jha and Lalnunmawia[2] presented research findings of agroforestry system named as tree-greenhedge-crop farming system and Bamboo based agroforestry system, respectively. Lalramnghinglova and Jha[3] have reported various multipurpose tree species and predominant agroforestry system prevalent in Mizoram. The most common and successful agroforestry practice is intercropping of *Oryza sativa* L. (Poaceae) and *Zea mays* L. (Poaceae) along with *Tectona grandis* L (Verbenaceae).

The agroforestry or farm forestry practices has exposed plantations to risk of insect pests epidemics because of failure of natural regulatory factors. It has been experienced and recorded since the introduction of plantation forestry that insect pests are one of the serious

Corresponding author: Lalnunsangi
Phone. +91-9436153083
E-mail: rose_khiangte@yahoo.com

biological determinants in productivity, especially in man-made plantations. On account of high reproductive potential and short life cycle, most insect pests of plantation forestry are capable of multiplying to an amazing numbers, within short period affecting success of plantation. Agroforestry has introduced another dimension to tree plantation entomology.

Species diversity frequently causes significant reduction of insect pest.[4] Manipulation of plant elements in an ecosystem also encourages built-up of the natural enemies of the pest, simultaneously creating ecological conditions that will suppress population build -up of the pest. This is mainly done through encouraging beneficial plant species (perennial/annual) that support 10-12 polyphagous parasitic species and discouraging the plant species (perennial/annual) that act as alternate hosts of pests.

It is also well known that mixed culture of plant species faces much lesser problem from insect pests than in monoculture comprising of even aged genetically similar population of crop. Agroforestry which is another type of polyculture can be designed to control or reduce damage by insect pests.[5,6] It is desirable to gain insight in to the evolving plant-insect interactions particularly pest problems of agroforestry system.

Materials and Methods

Study area

The study was conducted in Aizawl district of Mizoram (Fig. 1). In each case, a plot was selected. The tree component was teak and the crop component in both the sites was maize (*Zea mays*), *Phaseolus vulgaris* L. (Fabaceae) and/ or *Vigna sinensis* L. (Fabaceae). Besides, the site at Aizawl also had *Clerodendrum colebrookianum* Walp. (Lamiaceae) and *Solanum indicum* L. (Solanaceae) as other components.

Weed species such as *Imperata cylindrica* L. (Poaceae), *Drymaria chordata* L. (Caryophyllaceae), *Cyperus rotundus* L. (Cyperaceae), *Eupatorium sp*, *Ageratum conyzoides* L. (Asteraceae), etc. were common in the sites.

Each experimental plot was subdivided into three components, *viz.* tree component, crop component, and fringe area. The fringe area consisted of the natural vegetation imme-

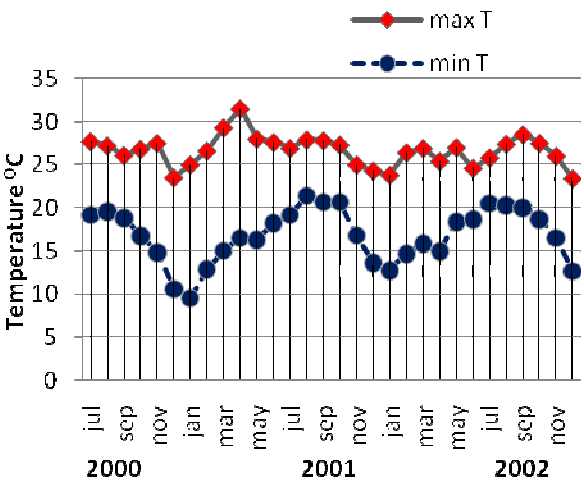

Figure 1. Graph showing monthly minimum and maximum temperatures in Aizawl.

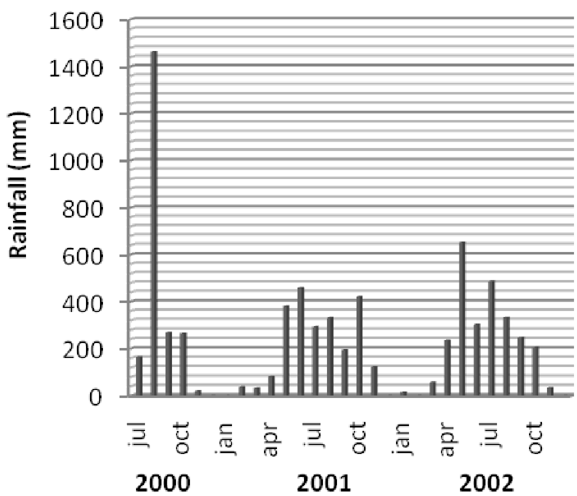

Figure 2. Graph showing mean monthly rainfall in Aizawl.

diately outside the cropping plots. Three tree components were chosen. These were teak, tung, and *Leucaena*.

Sampling and data collection

Monthly records for maximum and minimum temperature, and rainfall were collected from Aizawl Metorological office.

A random sampling program,[7] replicated five times, was undertaken for 28 months (August 2000 to December 2002) in each component of each site to account for the following:

Total arthropod fauna: The arthropod fauna of the different components of each site was monitored through a replicated monthly sampling program. Sweep net sampling was used for this purpose.

Seasonal dynamic study: The monthly sampling detailed above was analysed for the seasonal dynamics of various orders of arthropods encountered during the study

Pest of crop and tree components: The pests collected through the random sampling program detailed above, and also through handpicking were identified from FRI Dehra Dun, ZSI, Shillong and ICAR, Shillong

Natural enemy complex: The natural enemies were also segregated as a group from the monthly sampling data

RESULTS

The minimum temperatures in Aizawl hovered around 10°C recorded during the winter in January, and the maximum temperatures occurred during March in all the years (Fig. 1). The rainfall was distributed during the period May-October, with occasional mild showers during the dry and cold period (Fig. 2).

Figure 3 depicts the seasonal fluctuation of

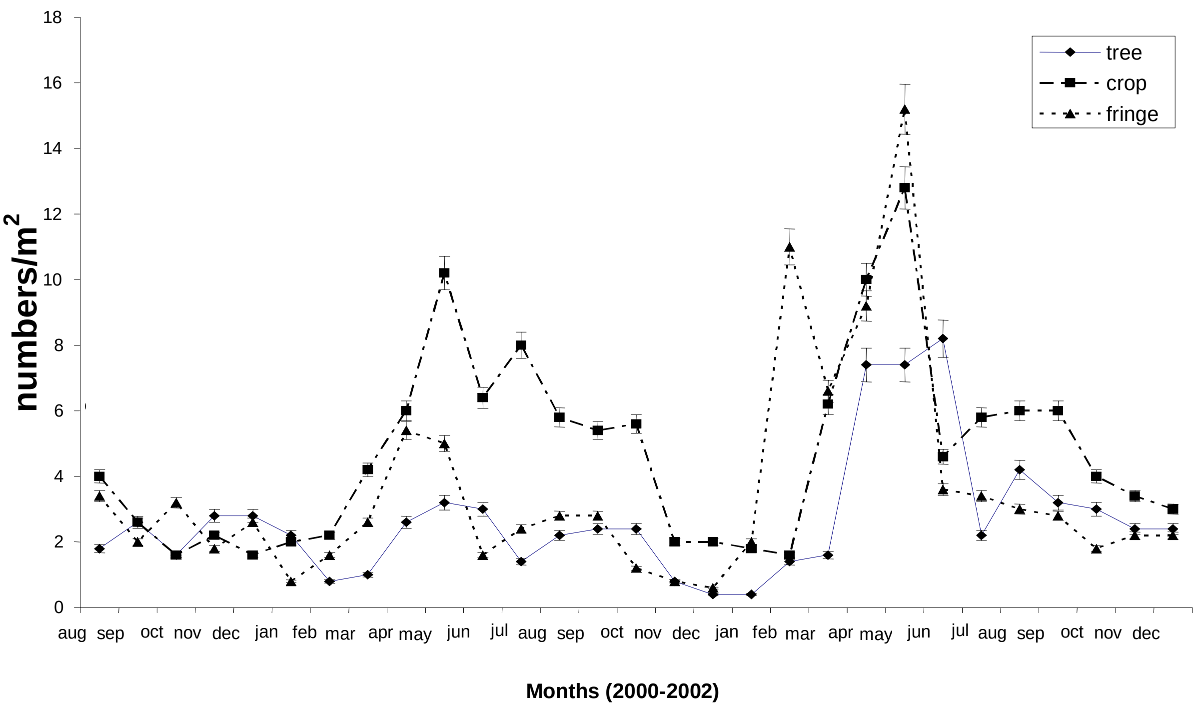

Figure 3. Total fauna in the different components of the Teak agroforestry site , Aizawl.

the total arthropod fauna in the different components of the teak agroforestry site. The overall population densities were low during the cold and dry months, and started to increase with the onset of the rainy season, coinciding with the growing season of the flora, and had the highest records during the monsoons, possibly with the addition of the new individuals recruited from the overwintering population of dormant eggs and pupae.

Analysis of the percentage contribution of the fauna in the different components (Fig. 4) revealed that the natural enemy complex was constituted of the orders Hymenoptera, Dermaptera, Chilopoda, Hemiptera, Mantoidae, and Araneida. Besides, some predatory coleopteran species were also present. Among the three components, the fringe area had representatives of the maximum number of groups (Fig. 4).

The overall trend of low population records of the tung agroforestry site during the dry and cold periods, followed by peaks during the warm and wet seasons was similar to the teak site. However, the population table of the fringe area component was markedly higher that the other components (Fig. 5).

The percentage composition of the natural

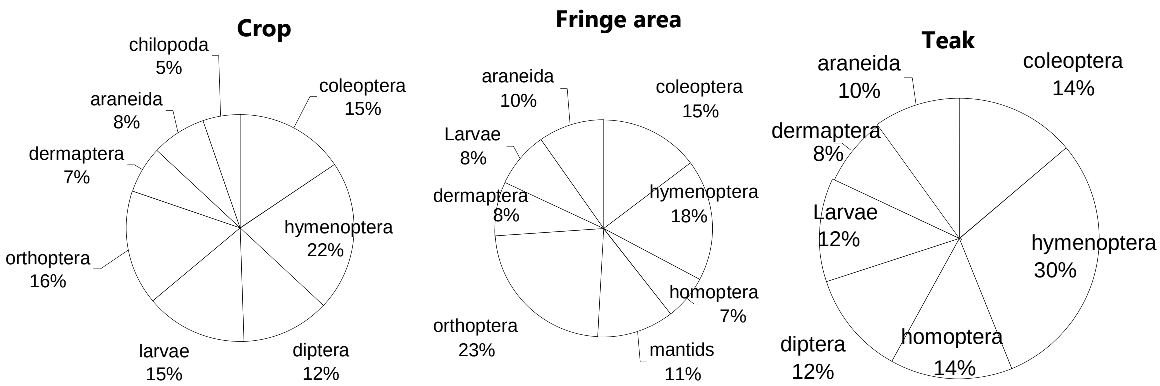

Figure 4. Contribution of the fauna in the different components of the teak site.

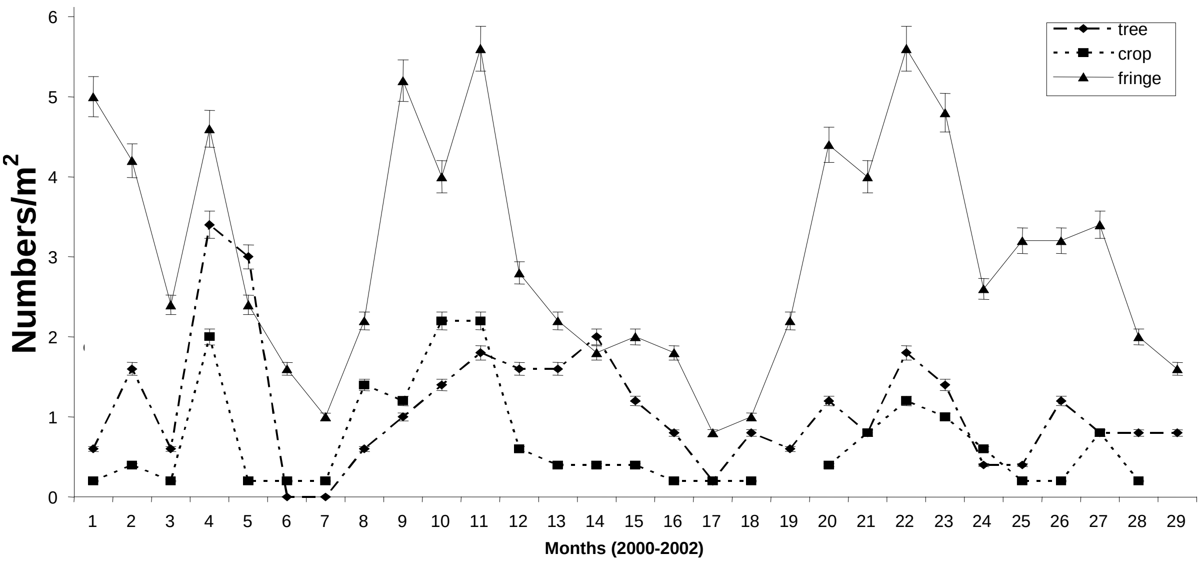

Figure 5. Seasonal fluctuation of arthropods in the different components of the Aleurites sites, Aizawl.

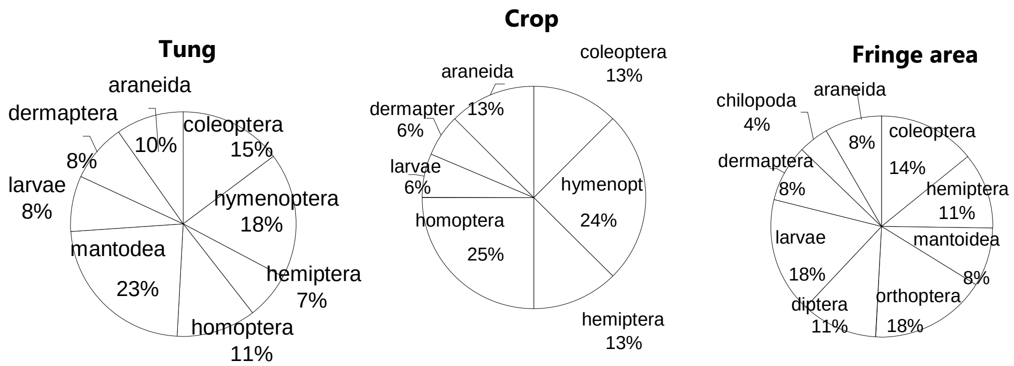

Figure 6. Contribution of the fauna in the different components of the tung site.

enemy complex of the tung agroforestry site (Fig. 6) revealed the presence of highest diversity in the fringe area component, followed by the tree component. The Hymenoptera, particularly the ants were predominant in the crop component.

At the *Leucaena* agroforestry site, the overall trend of low population records during the dry and cold periods, followed by peaks during the warm and wet seasons was similar to the other sites. The population table of the crop component was markedly higher during the first cropping cycle, and this was due to the high numbers of Isoptera and Hymenoptera. Barring this, the fringe area component had markedly higher population tables than that of the other components (Fig. 7).

The percentage contribution too followed a similar trend as that of the other sites, with the representative groups being higher in the fringe area.

Discussion

The results of the present study indicate the potential of the natural enemy complex as pest management options without the use of harmful chemical insecticides. The tree component in this context may be visualized as a secure habitat for many of the predatory components, and the presence of food in the crop component in the form of pests in the near vicinity may act as an attractant for habitation of the tree component. The fringe area too is a suitable habitat, and this is substantiated by the large numbers of the predators recovered from the area. Further, many of the actively flying predators and parasitoids like mantids and wasps can use the natural vegetation as camouflage while predating in the cropping area. A further benefit arising out of the tree component is an undisturbed ground litter and vegetal cover around the tree component, which often form suitable habitat for predatory chilopods and beetles.

Combining trees with crops and the presence of natural buffer of vegetation surrounding the crop plot thus seem to provide ambient conditions for the suppression of pest populations and at the same time enhancing the faunal comlex,[8] consisting of natural enemies.[9-12] Further, the tree component provides habitation to fauna beyond the cropping season, and moderates the climatic conditions.

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