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NEWS

A report on the seminar on 'Biological control of social forestry and plantation crop insects'

A national seminar on 'Biological control of social forestry and plantation crop insects' was held at the Entomology Research Institute, Loyola College, Madras on 25 and 26 February 1994 Inaugurating the seminar, M. S. Swaminathan, FRS indicated that the subject was appropriate in the present-day context when there is greater awareness on environmental problems associated with the use of chemical insecticides; social forestry has been established all over the country to fulfil the twin objectives of reclamation of waste lands and meeting the needs of local communities. To sustain natural growth of these social forestry stands, effective steps need to be taken to control insect pests and biological control should give the desirable effects; biocontrol will be particularly effective against insect pests, and therefore entomologists should identify natural enemies of tree pests.

Introducing the theme of the seminar, T. N. Ananthakrishnan (Entomology Research Institute) indicated that more than 100 species of pests of social forestry plantations and nurseries were identified along with 27 species of biological control agents, with plans for augmentation of some of the natural enemies for effective biocontrol in the field He also cited recent researches to show that green leaf volatiles serve a tritrophic communication role in plant–herbivore–parasite system which may reserve the use of chemical communication substances till they are needed and enzymatic reactions are hastened with damage.

Delivering the Fourteenth Dr. T. V. Ramakrishna centenary memorial lecture on biological control of forest pests and weeds in India, T. Sankaran (former Director, Commonwealth Institute of Biological Control, Bangalore) indicated that the teak defoliators *Hyblaea puera* and *Pyrausta machaeralis* are two of the major pests against which native parasites have been employed as biological control agents. These efforts have emphasized that native natural enemies used in periodical and inundative releases at best bring about only temporary relief and fail to provide sustained control *Apanteles balteata* and *Cedria paradoxa* are valuable parasites that help to check the defoliator *Arthroschista hilaralis*, a pyralid pest of *Anthocephalus chinensis* *Lymantria obfuscata* attacking *Populus* spp., *Salix* spp and other forest trees have a rich endowment of parasites and several of them have been studied in some detail. *Atteva febriciella* and *Eligma narcissus* which defoliate *Ailanthus excelsa* have shown 50–80% natural parasitism.

Exploratory surveys have been carried out for natural enemies of *Adelges* spp. on fir, pine shoot borers *Dioryctria* spp., toon shoot borer *Hypsipyla robusta*, and many key parasites of these pests have been identified, with biological and ecological data collected for some of them.

Highlights of the presentation by specialists from different institutes related to such aspects as biocontrol of bagworms, and other pests of social forest trees like *Acacia nilotica*, *Tamarindus indica*, *Pongamia glabra*, *Albizzia lebbeck*, *Azadirachta indica*, *Leucaena leucocephala*, besides the pests of tea, teak, and cardamom. Augmentation of some of the generalist predators and parasites which are potential biocontrol agents, the genetics of *Trichogramma*, and the bioenergetics of the parasitoids and predatory insects, were discussed.

Social forestry

Parasitoid and predator complexes in social forest stands are important components to reduce the pest attack in nurseries and plantations. These natural enemy complexes play a major role in bringing down the pest population outbreaks of insect pests such as *Eumeta crameri*, *Pteroma plagiophleps*, *Tephrina pulinda*, *Dasychira mendosa*, on *Acacia nilotica*; *Pteroma plagiophleps* and *Manatha assamica* on *T. indica* and *Parnara mathias* on *P glabra*. Information presented by the Institute of Forest Genetics and Tree Breeding, Coimbatore and Entomology Research Institute highlighted the outbreaks of bagworms such as *Eumeta crameri*, *P plagiophleps*, *M assamica*, and *Chaliodes ferevitrea* associated with nurseries and plantations of *A nilotica* and *T. indica* that result in considerable defoliation leading to mortality in trees and growth retardation in saplings. Field observations on the parasitization rate of different parasitoids like the tachinids (Diptera), *Sinophorus psycheae* (Ichneumonidae), *Brachymeria carinata* and *Brachymeria marmonti* (Chalcidae), revealed 65–70% parasitism on bagworms.

Among these parasitoids, tachinids showed a higher percentage of parasitism on *E crameri* followed by

S psycheae Comparative field parasitization rate of the parasitoids viz., *Apanteles cirphicola* (Braconidae), *Phanerotoma* (Braconidae), tachinid and *Charops* sp (Ichneumonidae) on *E lunata* and *T pulinda*, revealed that *A cirphicola* is an efficient biocontrol agent as compared to other parasitoids. Among the predatory resources, the reduviid *Rhinocoris fuscipes*, a polyphagous predator of *T pulinda* and *Parnara mathias*, and the polyphagous predatory stink bug *Eocanthecona furcellata*, were identified as potential biological control agents.

Discussing the problems of biological control of the subabul psyllid, *Heteropsylla cubana*, S. Uthamasamy (Tamil Nadu Agricultural University, Coimbatore) highlighted the relationship between *H. cubana* and its natural enemies. The parasitoids, *Syrpophagous aphidivorus*, *Syrpophagus* sp. and *Sectiliclava* sp. cause mummification of the psyllid. Several insect and non-insectan indigenous predators prey on *H cubana*. The spiders are the most important non-insect predators that feed on psyllids. Both young and adult spiders prey mostly on adults of psyllids. *Cyclosa* sp., *Scinipia horrida*, *Oxyopes javanus* are some of the spiders which prey on *H. cubana*. A web spider consumes nine adults per day while up to 300 adults are trapped in a web.

Among insect predators, the lady bird beetles are the dominant and effective group. Several species of coccinellids hover around partially defoliated subabul trees. Obviously, these feed on nymphs and adults of *H. cubana* which aggregate on the terminal shoots and folded leaves. The two coccinellid beetles *Olla abdominalis* and *Curinus coerulus* were found to be the dominant predators of the predatory complex which include the grubs and adults of *Menochilus sexmaculatus*, *Coccinella rependa*, *C. septempunctata*, *Brumus suturalis* and *Scymnus gracilis*.

Plantation crops

(a) *Tea*: Discussing the role of several biocontrol agents in the tea ecosystem, N. Muraleedharan (Tea Research Institute UPASI) indicated that the predatory mites *Amblyseius herbicolus*, *Agistemus* sp.; and *Cunaxa* sp., are useful natural enemies of the eriophyid mites *Acapatylla theae* and *Calacarus carinatus* The larvae of *Lestodiplosis* sp. and *Scolothrips rhagebianus* are the other two important natural enemies of the eriophyid mites *Agistemus fleschneri* and *Exothorhis caudata* feed on the eggs of *Brevipalpus phoenicis* and *D. coffeae*. *Cryptogonus bimaculatus*, *Menochilus sexmaculatus*, *Jauravia soror*, *J. opaca* and *Stethorus gilvifrons* are the principal coccinellid predators of the red spider mite. Syrphids play a major role in suppressing *Toxoptera aurantii* populations. *Episyrphus balteatus*, *Paragus tibialis*, *Ischiodon scutellaris*, *Allobaccha nubilipennis*, and *Betasyrphus serarius* are the common aphidophagous syrphids. Several species of coccinellids and a few of Neuroptera also attack the tea aphids. *Coccophagus cowperi* and *Encyrtus infelix* inflict heavy mortality on *Saissetia coffeae* populations. *Fiorinia theae* is another scale insect that is under excellent natural control in north east India. The tea shoot mealy bug, *Nipaecoccus viridis* is heavily parasitized by *Aprostocetus purpureus*, while the drosophilid, *Cacoxenus perspicax* is a major predator. *Erythmelus helopeltidis* is a well-known egg parasitoid of *Helopeltis theivora*. Anthocorids belonging to the genus *Orius* and certain aelothripids feed on tea thrips.

Leaf folding caterpillars such as flushworms, leaf rollers, and tortrix are well regulated by an array of parasitoids. The braconid, *Apanteles aristaeus* is the major parasitoid of flushworms, while the eulophid, *Sympiesis dolichogaster* exerts tremendous pressure on the populations of the leaf roller. In the field, parasitism by this insect is as high as 60%. The tea tortrix, *Homona coffearia* is attacked by eight species of larval parasitoids, among which *Phytodietus spinipes* and *Palexorista solennis* are the most important. The looper caterpillar *Buzura suppressaria* is parasitized by *Apanteles fabiae* and *A. taprobanae*.

(b) *Cardamom*: Introducing the pest complex and release of biocontrol agents in the cardamom plants, S. Varadarasan (Indian Cardamom Research Institute) stated that nearly 60 species of insect pests are known from cardamom, of which the major pests are thrips (*Sciothrips cardamomi*), shoot/capsule/panicle borer (*Conogethes punctiferalis*), hairy caterpillar (*Eupterote* sp.), whitefly (*Dialerurodes cardamomi*) and the root grub (*Basilepta fulvicorn*).

Natural enemies of these major pests are *Chrysopa* sp., feeding on the larvae and the adults of *S. cardamomi* under laboratory conditions. An undetermined fungus attacks the larvae of thrips and an anthocorid bug feeds on both adults and larvae. Ten larval, two larval-pupal and eight pupal parasitoids are known on the shoot borer, *C. punctiferalis*. The larval parasitoid, *Friona* sp. could effectively locate the host larvae which lie concealed in the pseudostem and parasitize them with the long ovipositor, piercing through the pseudostem. The larval-pupal parasitoid *Agripon* sp. has been recorded on cardamom shoot borer *C. punctiferalis* throughout the year.

(c) *Teak*: Biocontrol measures relating to the teak defoliator, *Hyblaea puera*, a serious pest of teak in India, was dealt with by K. S. S. Nair (Kerala Forest Research Institute). One or more population outbreaks per year are common in plantations. Nearly 34 species of insect parasitoids have been recorded on *H. puera* in India.

The problem is occurrence of displacement of moth populations leading to sudden build-up of large populations of larvae in places where no sizable population existed previously. Endemic parasite populations will be too small to make any significant impact on these incoming large host population; and by the time the endemic parasite population multiplies in the present host generation, the emerging moth population of host moves away to another area, thus evading the parasite population.

Besides *Trichogramma* sp. and tachinids which have restricted potential, an unidentified species of *Symbieseis* attacking the early larval stages of the host appears to hold some promise. But success will depend on our ability to predict the occurrence of outbreaks and inundative release of large numbers of the parasites with high speed and efficiency.

Augmentation of natural enemies: The need for augmentation of natural enemies, prior to large scale production of BT, was emphasized by T. M. Manjunath (Pest Control India, Bangalore) who indicated that augmentation has now gained greater importance than ever before. Augmentation refers to qualitative and quantitative improvement in biological control agents with a view to enhancing their effectiveness in suppressing pest populations. Quantitative approach involves mass-production or, as in a few cases, mass-collection of selected natural enemies and their programmed releases – inoculative inundative – in desired areas, whereas qualitative measures include selection or development of superior strains, provision of supplementary food, manipulated use of alternative host plants or hosts, modification of the habitat, and use of kairomones to influence searching ability of natural enemies. Importance of these is discussed with examples.

Although there is great potential to control forest pests by augmentation, it has not been adequately explored. A few attempts made include the release of *Apanteles melanoscelus* (Hymenoptera: Braconidae) against the gypsy moth larvae, *Lymantria dispar* (Lepidoptera: Lymantridae) in USA, and *Cedria paradoxa* (Hymenoptera: Braconidae) and *Trichogrammatoidea nana* (Hymenoptera: Trichogrammatidae) against the teak defoliators, *Pyrausta mecharalis* (Lepidoptera: Hyblaeidae) in India and Myanmar.

Genetic diversity of *Trichogramma*

The occurrence of several instances of diversity between intraspecific populations in Chalcidoidea, notably among trichogrammatids, was reported by H. Nagaraja (Biotech International Limited, New Delhi) emphasizing that this should be considered more seriously before selecting these parasitoids for biological control purposes.

Considerable studies on the genetic diversity of *Trichogrammatoidea* have been carried out in the past 25 years. In *Trichogramma* over 130 species are known to date, many of which are sibling species. Many species have discrete biogeographical populations, each having developed varying degrees of reproductive isolation and habitat preferences.

Bioenergetics

Bioenergetics and life table studies of parasitoids and predators provide information on the extent of control they can exercise on pest population as well as the rate at which they can build up their population. According to J. Muthukrishnan (Madurai Kamaraj University) such information may find application in designing pest management programmes. His observations were based on the work with predatory wasp, *Delta conoideus* and the endoparasitoids *Apanteles flavipes*, *Microplitis ensirus*, and *Bracon brevicornis*, the latter playing an important role in the control of pests of teak, coffee and tea.

Potential biological control agents

Of the hundred species of reduviids recorded, *Rhinocoris marginatus*, *R fuscipes*, *R. kumarii* (Harpactcorinae), *Acanthaspis pedestris*, *Ectomocoris tibialis*, and *Catamiarus brevipennis*, appear to be potential biological control agents, according to Dunston Ambrose.

These reduviids multiply faster with short life cycles and female biased sex ratio. Among these, harpactorine and reduviine reduviids are multivoltine with higher fecundity and hatchability than piratine reduviids which are univoltine with comparatively lesser fecundity and hatchability.

Speaking of ants as useful predators, G. K. Veeresh (University of Agricultural Sciences, Bangalore) emphasized the fact that they are among the most ubiquitous animal groups in both natural and man-made terrestrial ecosystems. They are particularly dominant in number and biomass in tropical ecosystems. They exhibit wide range of food preference and occupy all trophic levels. All ponerine ants and most species of Dorylinae are exclusive predators. While doryline ants are generalists, ponerines exhibit varying levels of specialization. *Leptogenys processionalis*, for example, selectively forages on termites and can restrict their potential damage to trees.

The potential of spiders as biocontrol agents was briefed by K. Vijayalakshmi (Centre for Indian Knowledge Systems, Madras) who stated that it has not been fully utilized in India and interestingly enough, they play an essential role in the control of social forest insects. A preliminary survey of the spider population in the social forests and plantation crops has shown that the most common species in these ecosystems belong to the families Salticidae (jumping spiders), Oxyopidae (Lynx spiders), Lycosidae (wolf spiders), Thomisidae (crab spiders), Araenidae (Orb weavers) and Eresidae (social spiders). *Peucetia* belonging to the family Oxyopidae has been observed to be a predator of the semilooper *Tephrina pulinda* and the bagworm *Eumeta cramerii*. Species of *Peucetia* are active hunters, and they do not spin webs, but ambush their prey.

Intensity of pest infestations in Social Forestry and plantation crops naturally calls for sustained efforts to utilize natural enemies which abound in large numbers, to achieve increased productivity. With increasing disruption of agroecosystem biological control agents tend to operate below their potential effectiveness, making augmentative release of many of these species increasingly obligatory.

T. N. Ananthakrishnan, Entomology Research Institute, Madras

Forestry for food: Challenges for 2000 AD and beyond

The extent and the growing stock of the worlds' forest has been subject of continuous interest because of their significance for potential raw material and stabilizing role in the biosphere. During recent times *forestry for food security* is being emphasized as the world population growth would be up by 3.7 billion in the next forty years and the food production will need to be doubled (Figure 1). About 19% of the world population (950 million people) in lower income countries are not getting enough food[1]. Expansion of cropland projected at 25% and of