Introduction

Cashew is an important commercial tree nut crop grown in tropical and subtropical regions. More than 30 countries grow cashew and the major countries producing cashew are Vietnam, Brazil, India, Tanzania etc. Tea mosquito bug (TMB) is considered as a serious pest of cashew in most of the cashew growing regions. Tea mosquito bug comprises four species viz., Helopeltis antonii (TMB), H. bradyi, H. theivora and Pachypeltis maesarum. Among which, H. antonii is a major species infesting cashew. Tender shoots, inflorescence, immature nuts and apples at various stages of development are damaged by TMB. Feeding results in development of black necrotic lesions and drying (Fig. 1). A yield loss of 30-40 % can occur due to TMB (Devasahayam and Nair, 1986), during outbreak situations 100 % loss can also occur if management measures are not taken up. The co-existence of H. theivora and H. bradyi with H. antonii was found in the west coast of India (Sundararaju and Sundarababu, 1999) and in few other parts of India (Ambika and Abraham, 1984). As there is no resistant cashew variety for TMB, chemical management is presently followed for its management. Biological control efforts are also taken up to some extent.

Under field conditions, TMB population is regulated by several parasitoids, predators and also by pathogens. Brief details on natural enemies of TMB recorded in India and their status are presented here.
A. Parasitoids

i. Egg parasitoids

Though the eggs of Helopeltis spp. are laid deep and concealed, they are often attacked by a range of parasitoids. The five egg parasitoids recorded on TMB are Telenomus cuspis, Erythmeles helopeltidis, Chaetostricha sp., Ufens sp. and Gonatocerus sp. (Sundararaju, 1996, Sundararaju and Sundarababu, 2000). All these species are solitary parasitoids. The highest parasitism up to 70.8 % by Telenomus cuspis during certain months in some places of coastal Karnataka was recorded (Sundararaju, 1996). Though T. Cuspis is a dominant species in cashew ecosystem of west coast of India, it is not predominant in TMB eggs collected from neem trees in east coast especially in Tamil Nadu. While, Ufens sp., is the dominant egg parasitoid recorded in the neem ecosystem of Tamil Nadu.

Attempts made for mass rearing of any of the egg parasitoids was not successful in laboratory since they are host specific and requires freshness in the plant host having TMB eggs for emergence, hence they cannot be exploited for TMB control at present.
TMB eggs (inside plant tissue) with respiratory processes seen above

Chaetostricha sp. parasitizing TMB eggs

ii. **Nymphal-adult parasitoid**

A nymphal parasitoid of genus *Leiophron* (Hymenoptera: Braconidae) is also found to occur on TMB. Parasitism takes place during nymphal period, which death results in adults. But its occurrence is at very low intensity. A maximum parasitism of 1.3% was recorded at Puttur cashew plantations of Karnataka, of which 59.4% was observed during the month of June (Bhat and Srikumar, 2014).

iii. **Entopathogenic nematode**

Besides, an entomopathogenic nematode, namely *Agamermis paracaudata* Steiner (Mirmithida: Mirmithidae) has been reported from *H. theivora* on tea (Durgadas and Sambhunath, 1956) and subsequently also on *H. antonii* in cashew.

B. **Predators**

On the other hand, the predatory fauna reported in cashew plantations include a wide number of spiders, reduviid bugs, ants, praying mantids, mantispid flies, robber flies, pentatomid bugs etc which predate on several insect pests.

i. **Spiders**

Among these predators, spiders are the most abundant predators of arthropod-pest complex (Beevi and Mahapatro 2008) in cashew ecosystems and more than 120 species have been documented in Puttur region (Bhat *et al.*, 2013). Major spider species include *Telamonia dimidiate*, *Oxyopes shweta*, *Argiope pulchella*, *Cyclosa fissicuda*, *Eriovixia laglazei*,...
Neoscona mukerjeri, Nephila pilipes, Oxyopes sunandae, Bavia kairali, Carrhotus viduus, Epocilla aurantiaca, Hyllus semicupreus, Achaearanea mundula, Camariacus formosus and Thomisus lobosus.

ii. Reduviids

Reduviids are also commonly found in cashew plantations which serve as predators of pests including TMB. The common species include Euagorus plagiatus, Sycanus spp., Sphedanolestes signatus, Irantha armpes, Occamus typicus, Cydnocoris gilvus, Endochus spp., Epidaus spp., Panthous bimaculatus, Rhynocoris sp., Rihirbus trochantericus (Sundararaju, 1984; Vennison and Ambrose, 1990; Bhat et al., 2013).

A reduviid bud, Panthous bimaculatus predating Helopeltis theivora

iii. Praying mantids

Like reduviids, praying mantids also act as excellent predators of different pests including TMB. Predation of H. theivora by praying mantids has been reported (Mamun and Ahmed 2011). Among the 16 mantids recorded in cashew plantations of Puttur, Karnataka, Ephestiasula pictipes, Hestiasula brunneriana, Euantissa pulchra, Humbertiella similis and Elmantis lata are the common mantid species (Vanitha et al., 2017).

A nymph of a praying mantid Euantissa pulchra, predating Helopeltis antonii
iv. **Ants**

Three species of ant genera, *viz.* *Tetraponera*, *Crematogaster* and *Oecophylla* were noticed as predators of *Helopeltis* spp. (Beevi and Mahapatro, 2008). The aggressive predators namely, red ants (*Oecophylla smaragdina*) actively predate on TMB and other pests of cashew, thus providing service to farmers in reducing the pest attack. In a field experiment, Sreekumar et al. (2011) reported TMB population was significantly lower in plants colonized by red ants. Thus the cashew trees having good number of ant nests must be spared of insecticidal sprays so as to allow them to take care of pests in those trees besides conserving the ants.

v. **Chrysopids:**

*Chrysoperla carnea* (Neuroptera: Crysopidae) has been reported as predator of *H. theivora* by Das et al. (2010). Another green lacewing (*Mallada* sp.) consumed 10 to 11 nymphs/hr and the time taken to consume a single nymph varied from 3 to 10 minutes.

vi. **Predatory mites:**

Adults of *H. antonii* and *H. theivora* were found to be infested by predatory mite, *Leptus* sp. attached by mouth parts to the ecdysial lines on the bugs head and thorax.

C. **Pathogens**

*Aspergillus flavus* Johann and *A. tamarii* (Eurotiales: Trichocomaceae) can cause infection to *H. antonii* (Sathiamma and Saraswathy, 1990, Satapathy, 1993). An entomopathogen, Beauveria bassiana Bals. (Hypocreales: Clavicipitaceae) was isolated from *H. antonii* infesting guava (Visalakshy and Mani, 2011) and was found effective to little extent against TMB in cashew during certain months. Field application of *Baeauveria bassiana* isolate during flushing and flowering period with concentration of 107 spores/ml is a potential approach for the management of TMB (Makawana et al., 2017).

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To conclude, natural enemies especially egg parasitoids and spiders play a key role in reducing the population of tea mosquito bug under field conditions. However, much research is needed to mass multiply these potential natural enemies and to develop suitable augmentation measures as biological control of tea mosquito bug in cashew remains as a challenge still now.

References


