



## Review on destructive pest tea mosquito bug, *Helopeltis theivora* of tea (*Camellia sinensis*)

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### Abstract

Tea (*Camellia sinensis*) is one of the most important plantation crop in India. Tea crop is mostly growing in the state of Assam followed by the state west Bengal. Second only to water, tea is the most popular and widely consumed beverage in the world today. Tea crop is attacked by about 25 insect pests among them tea mosquito bug is most destructive pest. It is a sucking pest, and mainly attacks on tender stems, young leaves and buds. The adult of tea mosquito bug is identified by its body length of 6-8 mm and the body is slender and elongated with yellowish brown or olive green head, dark red thorax and yellow and greenish-black abdomen. By spraying DDT (0.1%) and Malathion (0.1%) the insect population can be controlled. Biologically we can control this pest by introducing the solitary egg parasitoids, *Telenomus cuspis*, *chaetostricha sp* and the predators like ant, crematogaster wrougtoni forel.

**Keywords:** *camellia sinensis*, life history, predators, natural enemies, ipm, chemical control

### Introduction

Tea is an evergreen and a perennial (over 100 years) crop that is grown as plantations with genetically diverse cultivars and interplanting of shade trees, particularly in south East Asia. At present tea is grown in more than 50 countries around the world and is distributed from Georgia at 43° north latitude. Tea is found from sea level to 2300m. The prime producer of tea are china, India, Sri Lanka, and Kenya. Vietnam, turkey, Indonesia, Argentina, japan, Bangladesh, Malawi, Uganda and Tanzania produce the rest of the world tea crop (Somnath Roya, 2010)

The tea mosquito bug, *helopeltis theivora* is an important pest of various plantations and cash crops in India, including black pepper (*piper nigrum*), cashew nut (*anacardium occidentale*), annatto (*Bixa Orellana*), tea (*Camellia sinensis*), kapok (*Ceiba pentandra*), cinchona tree (*cinchona officinalis*), camphor laurel (*Cinnamomum camphora*), cocoa (*Theobroma*) (Somnath Roy, 2015)

The eggs are white, Ovo elongate (slightly narrower apically) and laterally compressed apically, 1.0 to 1.31mm long (miller 1941, tan 1947, Satapathy 1993, Ambika and Abraham 1979). Initially, after the deposit of egg in the plant tissue, the shape of egg is almost cylindrical. After two days, expansion of egg to a tune of 0.04 to 0.88 mm both longitudinally and laterally. Particularly at the distal region is seen. The eggs are whitish for first two days and subsequently turn to orange color with a distinct dark orange band at the coastal region. Typical feeding damage by *Helopeltis spp.* Appears as a discolored necrotic area or a lesion around the point of entry of labial stylets inside the plant tissue. The infestation of inflorescence results in to "blossom blight" (Devasthanam and Nair 1986). Sometimes, complete scorching of cashew foliage is seen as depicted. (Saroj, 2016)

Use of biocontrol agents is an alternative or supplement to synthetic insecticide applications. Conscious deployment of beneficial organism, called natural enemies, for the management of pests is the method of biocontrol in a classical sense. Spiders are the major components of

predatory arthropods in natural agroecosystem and can be effective biocontrol agents. Spiders are generalist predators and are often more efficient at pest control than other specialist predators. Synthetic insecticides such as cyclodienes, organophosphates, pyrethroids and imidacloprid are mostly used to control this bug

Nymphs and adults of *Helopeltis theivora* suck cell sap from tender stems, young leaves and buds, forming reddish brown circular feeding punctures. In severe infestations, damaged leaves with 76-210 feeding punctures curl upward and desiccate initiation of new shoots is prevented due to the death of the stem and may result in total loss of the crop: *Helopeltis theivora* causes dieback and stem canker (Mukhopadhyay, 2010)<sup>[62]</sup>

Bio efficacy in controlling *Helopeltis theivora* using Nemoral F 5EC alone and in combination with endosulfan and deltamethrin at different dilutions was evaluated using similar randomized block design methods as mentioned earlier. The control plot was treated with water spray. The treatments were applied at fortnightly interval with knapsack sprayer at 400 l/ha. Pre and post treatment observations were made at weekly interval for 4 weeks. Infestation of *Helopeltis theivora* was assessed on the basis of collection of infested and uninfested shoots from each replicate of the treatment. After that present infestation and percent reduction were calculated. Analysis of variance (ANNOVA) and critical differences of mean ( $p=0.05$ ) were used for taking statistical decisions

### Distribution

Geographical distribution the genus *Helopeltis* has a distribution in both northern and southern hemispheres that include Southeast Asia, Africa and northern Australia (Stonedahl 1991; CAB 1992). The TMB was first recorded on tea in Java in 1847 (Rao 1970)<sup>[60]</sup> and on tea in India in 1968 in the Cacharregion (Watt and Mann 1903). In addition to occurring in India (Sudhakaran and Muraleedharan 2006; Hazarika *et al.* 2009; Saha and Mukhopadhyay 2013), the TMB is known to occur in most

of the tea-producing countries, i.e., Bangladesh (Ahmed *et al.* 1992, 2005, 2013) [3, 4], Sri Lanka (Cranham 1966a, 1966b) [20, 21], Java and Sumatra (Koningsberger 1908; Leefmans 1916) [44], Laos (Du Pasquier 1932) [26], Vietnam (Du Pasquier 1932) [26], West Malaysia (Lever 1949; Corbett 1930) [46, 19], Taiwan (Hsiao 1983), Papua New Guinea (Smith *et al.* 1985), Uganda (Hargreaves 1936) [35], Kenya (Rattan 1992) [61] and China (Schuh 1995). On Hainan island of China, the TMB is recorded as a serious pest of tea and cashew plantations (Yong-ming and Qi-An 1985) The Tea Mosquito Bug was first recorded on tea in Java in 1847 [9] (Rao 1970) [60] whereas on the tea in India it was first recorded in 1968 in the Cachar region [10] (Watt and Mann 1903). Along with India [11] (Sudhakaran and Muraleedharan 2006; Hazarika *et al.* 2009; Saha and Mukhopadhyay 2013), the Tea mosquito bug is known to occur in most of the tea-producing countries, i.e., Bangladesh [12] (Ahmed *et al.* 1992, 2005, 2013) [3, 4], Sri Lanka [13] (Cranham 1966a, 1966b) [20, 21], Java and Sumatra [14] (Koningsberger 1908; Leefmans 1916) [44], Laos [15] (Du Pasquier 1932) [26], Vietnam [15] (Du Pasquier 1932) [26], West Malaysia [16] (Lever 1949; Corbett 1930) [46, 19], Taiwan [17] (Hsiao 1983), Papua New Guinea (Smith *et al.* 1985) [18], Uganda (Hargreaves 1936) [35], Kenya (Rattan 1992) [61] and China (Schuh 1995) [21]. On Hainan island of China, the TMB is recorded as a serious pest of tea and cashew plantations (Yong-ming and Qi-An 1985) [22].

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pest of tea and cashew plantations (Yong-ming and Qi-An 1985). This is the most important among the tea pests in India. *Helopeltis theivora* have been reported from Sri Lanka, Indonesia, Indochina and India. In India they are more commonly found in North-Eastern part. [23]

### Hosts

Tea mosquito bug, *Helopeltis theivora* Waterhouse (Heteroptera: Miridae) is believed to be one of the severe pests causing an economic loss from 25 to 50 % [1] (Prasad, 1992; Barbora and Singh, 1994; Subramaniam, 1995) [57]. A laboratory experiment was conducted to determine the hosts of *Helopeltis theivora* (Hemiptera: Miridae) other than tea. Amongst the collected plants, 19 were preferred by the bug for feeding. Oviposition was seen on seven plants, but the bug completed its life cycle only on the following: *Gardenia jasminoides* (jasmine), *Psidium guajava* (guava), *Eugenia jambolana* (java plum), *Melastoma malabathricum* (Indian rhododendron) and *Annona reticulata* (wild sweetsop). These can be considered as alternate hosts. [2] Crop Research (Hisar) 2000 Vol.19 No.1 pp.122-124 ref.3). Some other hosts are cashew (*Anacardium occidentale*), tea (*Camellia sinensis*), Eggplant (*Solanum melongena*).

**Table 1**

Host plant species	family	references
<i>Acalypha mangium willd</i>	Febaceae	Thu <i>et al.</i> (2010)
<i>Annona reticulata L.</i>	Annonaceae	Kalita <i>et al.</i> (2000)
<i>Bidens Pilosa L.</i>	Bixaceae	Das (1984)
<i>Capsicum spp.</i>	solanaceae	Anonymous (2007)
<i>Cinchona spp.</i>	Rubiaceae	Das (1984)
<i>Durganta repens L.</i>	Verbenaceae	Gogoi <i>et al.</i> (2012)
<i>Ficus hispida lf</i>	Moraceae	Saha and Mukhopadhyay (2013)
<i>Morus alba L.</i>	Moraceae	Barbora and singh (1994)
<i>Pipper hamiltoni C.DC</i>	Pipperceae	Gogot et (2012)
<i>Theabrama cacao L.</i>	Malvaceae	Anonymous (2007)

### Mark of identification

*Helopeltis theivora*'s nymphal stages are classified into five instars with different characteristics and developmental stages. Average 1<sup>st</sup> nymphal instar body length is 1.5 mm with brownish color on legs and abdomen. The antennae are longer than the body of insect. The 2<sup>nd</sup> nymph has a bigger body which has average body length of 2.2mm with brighter color than the 1<sup>st</sup> instar. The third instar body is 3.4mm with reddish-green in color and 1<sup>st</sup> development of wings is seen. 4<sup>th</sup> instar has 4.4mm body length and wings are developed better than the 3<sup>rd</sup> instar. It slightly turns into light green color. 5<sup>th</sup> instar has darker green abdomen and average body length of 5.2mm. The spine on the scelletum and the wings are well developed in this stage. [24] Male and female bugs can be classified clearly. Male has a sharper abdomen and the color tended to be black on the top abdomen. Whereas female has black ovipositor hidden under the abdomen. The adult of *Helopeltis theivora* is green and bigger than the 5<sup>th</sup> instar. The male bodies are smaller than females. Approximately a male adult insect body is 5.8mm in length and female is 6.2mm in length. It has been observed that adults had longer life span compared to other developmental stages. Adult insects have life span of about 9-19 days. The egg incubation period is 5.87 days.

While the developmental stages from one instar to the next

instar is about 2-5 days. Researches show that 209 of 314 eggs survived and grew into adult bugs. The highest mortality rate occurs in the 1<sup>st</sup> and the 2<sup>nd</sup> instar with 44 individuals but 34 eggs were enabled to hatch. The female has maximum life span of 15 days. [24] The nymph of *Helopeltis theivora* has dark yellow color. This color changes into greenish yellow after the 2<sup>nd</sup> and the 3<sup>rd</sup> instar and finally become green. Study has showed that there are many variations in color between the species of *Helopeltis theivora* on the tea plant. The color variation that is considered as the same species is known as biotype. The variation of color can also occur due to difference in describing the color of insect. There is very crucial to standardize the color description. [24]

### Biology of pest

Adults mate right after they emerge. Female start laying eggs within two days later copulation- A female is capable of laying about 500 eggs. The eggs laid on the surface tissues of the host plants, like leaves, tender shoots mid rib petioles of the leaves and buds. Shape of the eggs are elongated, and sausage shaped. Hatching occurs within 5 to 7 days in summer and 20 to 27 days in the winter. The nymph might look like spider because it bears delicate, elongated legs. The nymphs suck the sap of the host plant and undergo five moults to attain maturity. The larval periods lasts for 9-10 days in summer and 25-29 days in winter. Life cycle is completed in about 15-20 day in summer and 45-60 days in winter in North-East Indian conditions. There may be several generations in a year. In extreme winter the adults undergoes hibernation. An individual usually completes its life cycle on a single bush. The duration of the life cycle varied with season depending on climatic conditions [3] (Das 1984). Details on the biology of the TMB were reported by [4] Gope and Handique (1991) [32] on tea from Assam and by [5] Roy *et al.* (2009e) on tea from the Dooars of India.

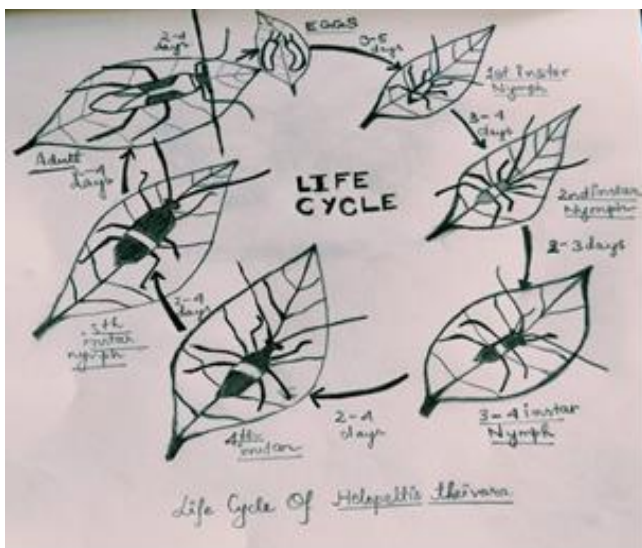


Fig 1: Life cycle of tea mosquito bugs

**Eggs:** The females deposit an egg separately, which remains completely embedded in the plant tissue. The dull, white egg is oblong-shaped, approximately 0.8-1.0 mm long. Following are the sites for oviposition commonly used, the succulent stems of growing shoots and buds at the leaf axils, and occasionally, the midrib of the leaf, petioles, broken

ends of the plucked shoots or other soft parts of the bush [6] (Das 1965). [7] Roy *et al.* (2011) reported that the most common and preferred site of oviposition for the TMB was the internode between the first leaf and second leaf of the shoots. Nearly 28.5% of the total numbers of eggs laid were laid there.

**Nymphs:** During the first instar, the labium extends to half the abdomen, the eyes are pink and the antennae are longer than the body. Whereas during the second instar, the drumstick-like process appears. Third instar is when the nymph approximately becomes 3 mm long and has a reddish green body with newly formed wing buds. In fourth instar the body is 4 mm long with a greenish yellow color of the body, and the wing pads become bigger and darker now. The fifth instar is reddish green with a green abdomen and is approximately 5 mm long [6] (Das 1965). Now the scutellar process and the wing pads are well developed, and the sexes can be identified. The males are observed to have blunt abdominal tips, whereas the females have a groove for a future ovipositor. During May to October, nymphal development is completed within a short time, whereas it is longer in the month of January [5] (Roy *et al.* 2009e).

**Adults:** Das (1957) had observed sexual dimorphism in the TMB. The male was smaller than the female and was slim with a black pronotal area and a bluish abdomen. The female was bigger and had a distinct orange pronotum in the thoracic region.

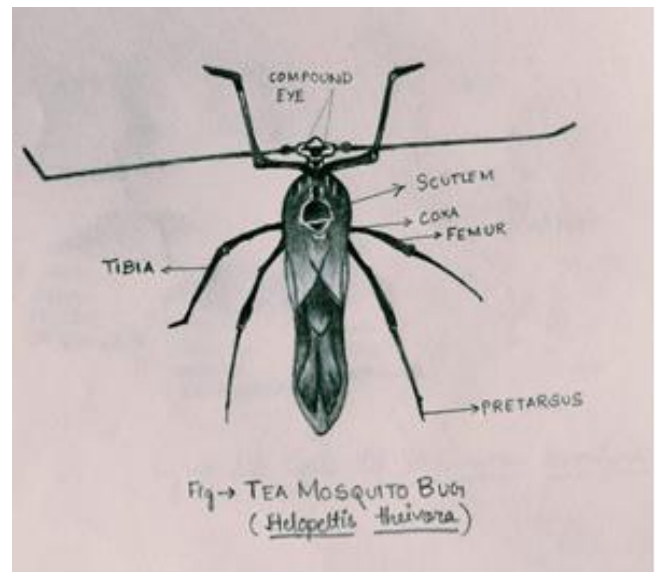


Fig 2: Adult of Tea mosquito bug

### Damaging symptoms

*Helopeltis theivora* or the tea mosquito bug is a major sucking pest of tea (*Camellia sinensis* L.). Mostly this pest attacks tender leaves, buds and young shoots. It's done by nymphs and the adults by sucking the sap. It causes heavy crop loss. Damage is also caused by insertion of eggs into plant tissues into oviposition. Many alternate host plants and only few natural enemies of tea mosquito bug has been recorded. For the control of this pest synthetic pesticides are mostly used.

Excessive application of insecticide has also resulted in development of high tolerance and even resistance in this pest. [25] Typical feeding damage appears as a discolored,

necrotic area or lesion around the point of entry of the labial stylets into the plant tissue that becomes darker with age as the tissue around the puncture dies. It results in the formation of reddish brown circular feedings punctures. Feeding occurs primarily on the leaves of new flushes and to a lesser degree on the stems. Leaves affected often curl and become de-formed. Sometimes dying from tip or edges inward. Dieback of young shoots is common under this condition of heavy infestation.

The damaged buds cannot be plucked (harvested) which will eventually affect the next flush of shoots. Dark green color is the sign of seriously affected tea plant. Mostly they are stunt. <sup>[6, 11]</sup>(Das 1965; Hazarika 2009). Over-callusing is caused due to oviposition which eventually causes the stems to develop cracks and it results in stunted growth <sup>[6, 27, 28]</sup> (Das 1965; Roy 2008; Sudhakaran 2000) <sup>[33]</sup>. Mostly infestation by tea mosquito bug starts from a small area in the tea field and it largely spreads to patches of neighboring plants. Due to this tea field's appearance becomes uneven <sup>[6]</sup> (Das 1965). Mostly this pest causes two types of damage that is direct loss of the harvestable shoots and acute debilitation of the bushes leading to dieback which results in delays flushing and results in poor yield <sup>[9]</sup> (Rao 1970) <sup>[60]</sup>.

#### Economic threshold level

The economic threshold level (ETL) for the TMB in tea was reported to be a 5% infestation in south Indian tea plantations <sup>[29]</sup> (Muraleedharan and Selvasundaram 2002). In a North Bengal Dooars plantation, <sup>[30]</sup> Somchoudhury *et al.* (1993) reported that the presence of one pair of TMBs in a group of 10 bushes might cause economic damage to the crop within 14 days. <sup>[31]</sup> Sarmah *et al.* (2011) estimated the EIL and ETL for a TMB infestation on tea in Assam to be 3.75% and 2.81% shoot infestation, respectively. The ETL of the TMB in Bangladesh was a 5% infestation <sup>[32]</sup> (Mamun and Ahmed 2011) <sup>[47]</sup>. The ETLs are, however, subject to change with crop phenology, weather conditions, cost of control, and market prices of tea, which vary from region to region. TMB uses their mouth parts for piercing the young shoot and sucking the young sap from young leaves, buds and tender stem. When TMB feeds, toxic saliva is injected which causes the breakdown of tissues surrounding the punctures. According to studies conducted on the nocturnal and diurnal feeding activities of TMB, it was revealed that the no. of feeding punctures is much greater during nights than during the day <sup>[37]</sup> (Sana and Haq 1974). A single fully grown 5<sup>th</sup> instar nymph is the most voracious feeder among the life stages and produce largest feeding lesions <sup>[38]</sup> (Bhuyan and Bhattacharyya 2006) <sup>[12]</sup>. An adult can make 150 feeding spots in a day <sup>[39]</sup> (Hainsworth 1952) <sup>[34]</sup>. TMB attack can severely cause loss in the quality of leaf appearance, briskness and flavor. The feeding mechanism of TMB was studied by <sup>[40]</sup> Cohen-Stuart (1922) which shows that proboscis penetrates the epidermal tissue and causes collapse of parenchymal tissue. The infestation by TMB induces morphological changes in the tea plant which is affected by both mechanical act of infestation and the resulting hypersensitive reaction which are induced as a part of direct defense strategy of plant <sup>[41]</sup> (Bandyopadhyay 2012) <sup>[9]</sup>. Mostly manifestation in plants appears after 30 minutes of feeding. In the affected cells ultra-structural changes starts which eventually collapse. The vacuole and progress to degenerative changes in chloroplast and causes major damage in cell membrane and cell wall. <sup>[12]</sup> (Ahmed

*et al.* 2013) <sup>[4]</sup>. Study says that activity of phenylalanine ammonia-lyase generally decreases because of this pest attack. <sup>[35]</sup> (Chakraborty and Chakraborty (2001) <sup>[15]</sup>. Rate of feeding by female TMB is much higher compared to the male. <sup>[42]</sup> Kalita *et al.* (1995) <sup>[42]</sup> and Rahman *et al.* (2007) <sup>[58]</sup>. Recent studies found a number of lesions in the form of fluid-soaked feeding spot produced by nymph and adult of the upper surface of tea leaves. The 2<sup>nd</sup> leaf is most preferred site for 3<sup>rd</sup> and 4<sup>th</sup> in star and the adults. Whereas 1<sup>st</sup> leaf is most preferred by 1<sup>st</sup> and 2<sup>nd</sup> instars. <sup>[43]</sup> Roy *et al.* (2009d)

**Management:** Management of Tea mosquito bug is possible only if we detect TMB in early stages and immediate implementation of varietal management practices. There are multiple ways for controlling this pest.

**Cultural Control:** These are the 1<sup>st</sup> phase practices and are the oldest method used for pest population management. Pruning is an essential agronomic practice. By adjusting the pruning cycle every 2-6 years, the effect of pest that attacks stems, branches and leaves can be minimized or eliminated. Most frequent plucking schedule helps to remove inserted eggs <sup>[6]</sup> (Das 1965). Hard plucking, black plucking is more effective in the case where severe attack of TMB occurs. In the TMB infested sections pruning and skiffing should be conducted for the removal of adult TMB <sup>[6]</sup> (Das 1965). TMB mostly requires moist condition and mild temperature. That is why this pest is mostly observed in heavy shaded regions. However in un shaded condition, receiving full sunlight is equally important because it enhances the attack of other pest such as leaf hoppers, thrips and red spider mites. Study prove that tea plantation with moderate shade of 60% gives optimum yield. <sup>[55]</sup> (Rahman *et al.* 2006). Inter-cropping with shade giving trees and cover cropping vacant land constitutes a plant diversification program in tea plantations, which can contribute to the process of CBC (Conservation Biological Control) of natural enemies by providing shelter, nectar and pollens <sup>[49]</sup>, an alternative host/prey <sup>[50]</sup>. Protection, maintenance and enhancing efficacy of the existing population of natural enemy through the use of eco-friendly operation and keeping in mind the main objectives of conservation biological control (CBC) <sup>[51]</sup>. Botanical pesticides are biodegradable, systemic, eco-friendly and non-toxic to mammals and are considered safe <sup>[52]</sup> (Isman 2006). Mostly concentration of aqueous extracts of neem seed kernels (NKAE) were given against TMB population. This causes low hatching % and shortened oviposition and nymphal period <sup>[53]</sup> (Dutta *et al.* 2013). Neem formulation with different azadirachtin contents were tried against the TMB by <sup>[54]</sup> Roy, Gurusubramanian, and Mukhopadhyay (2010a) <sup>[62]</sup>. Different concentration of azadirachtin were tested but only 50000 ppm concentration resulted in maximum (65%) control of TMB. <sup>[54]</sup> Roy *et al.* (2010a) reported that the water extract of *Clerodendrum viscosum* (Verbenaceae), a common weed in India, showed promise in controlling TMB populations in the field.

**Mechanical and physical control:** Hand collection of adult and nymphs during minor attacks when signs of damage have been noticed. Best time for hand collection is morning and afternoon because TMB pest move on the tea bushes actively during this time. Specialized type of spraying technique known as barrier spraying is sprayed about 8-10

rows of tea bushes at the outer periphery first and then the operators should start spraying the remaining parts from opp. direction to prevent migration of TMB adults <sup>[6]</sup> (Das 1965). TV1 is a susceptible tea clone which may be used as a trap crop for the TMB <sup>[11]</sup> (Hazarika *et al.* 2009) <sup>[37]</sup>. High potash content in the soil can decrease the population of TMB <sup>[56]</sup> Andrews (1914, 1919, 1923) <sup>[6, 7, 8]</sup>. Fields having a low ratio of available potash to available phosphorous were more prone to TMB attack. Ultrasound-based control is also a potential component of IPM for the TMB, which suffered early mortality when exposed to a 20 KHz frequency for 15, 30 and 45 minute per day from the first instar onward <sup>[46]</sup> (Borthakur *et al.* 2011).

**Biological Control:** Different bio control programmes might have been attempted for controlling TMB. Different exotic natural enemy, predator and parasitoids are used for controlling TMB. But no attempts have been yet recorded. A few natural control agents of the TMB have been reported <sup>[44]</sup> (Simmonds 1970; CIBC 1983; Cadou 1994). <sup>[45]</sup> Watt and Mann (1903) and <sup>[46]</sup> Barthakur (2011) reported that a reduviid bug fed on TMBs. The ant, *Crematogaster wroughtoni* Forel (Hymenoptera: Formicidae), was reported to be a predator of eggs and early instars of the TMB <sup>[47]</sup> (Ambika *et al.* 1979). A survey for egg parasitoids of the TMB from cocoa plants revealed the prevalence of two parasitoids, *Telenomus* sp. and *Chaetostricha* sp. <sup>[48]</sup> (Bhat and Srikumar 2013). The reduviids *Panthous bimaculatus* Dist, *Sycanus collaris* Fab and *Rihirbus trochantericus luteous* Stal were recorded as effective predators of nymphs and adults of the TMB on cashew by <sup>[48]</sup> Bhat *et al.* (2013).

**Chemical Control:** Therapeutic, botanical, insect growth regulators, insecticide, pesticide is used for pest management in Tea.

**Botanical:** Neem in various formulation is recommended against insects and pests of tea <sup>[57]</sup>. Other than neem the majority of information on botanical is restricted to the lab studies <sup>[58]</sup>. For organic tea production, botanical plays an important role in crop-protectants rotations to manage resistance development <sup>[59]</sup>.

**Insect Growth Regulator (IGRs):** IGRs mimic insect hormones such as juvenile hormones and ecdysone, thus interfere with normal growth and development. Azadirachtin is used for controlling TMB in the tea. Dislubenuron, tesflufenoxuron and buprofezin shows some promising result against tea pest. Many more groups of IGRs may show promise in laboratory trials, but their field efficacy and economics are yet to be evaluated against tea pests <sup>[60]</sup>.

**Attractants and Repellants:** many traps using sex pheromones are used as one of the recent tools employed in tea pest management <sup>[30, 28]</sup> Somchoudhury *et al.* (1993) and Sudhakaran (2000) have experimented and suggested that sex pheromone activities can be existed in TMB. The males and the females pheromone attraction was demonstrated using wind tunnel experiment in laboratory. Bio-active compound from the thoracic region of virgin female involved in pheromonal attraction of males of the TMB. Behavioral responses of adult male were mediated by a blend of volatile female sex pheromones components (Z)-3

hexenyl acetate and (E)-2-hexenol, at a ratio of 1:5.

**Synthetic chemical insecticides:** DDT was used during 1940 to combat the problem of TMB. Different pesticides such as chlordane 10% dust, 50% DDT WP, Endrex 20 EC, Gammexane 50% W.P., 5% BHC dust, lindane 20% EC, aldrin, dieldrin, and endrin have been recommended for controlling tea pests <sup>[61]</sup> (Glover 1955; Mukerjee 1962). After Endosulfane was introduced in tea in the north-eastern region of India, the DDT application is restricted. During the 1970s, eight different types of chemical insecticides, viz., endosulfan, monocrotophos, phosalone, Shalimar Tar oil, dimethoate, fenitrothion, chlorpyrifos and quinalphos, were approved for TMB management (Banerjee 1973). Relatively safe insecticide such as abamectin, cartap HCl, thiamethoxam and imidacloprid, were suggested for use by <sup>[62]</sup> Gurusubramanian *et al.* (2008a, 2008b, 2009a) <sup>[33, 51, 52]</sup>.

### Conclusion

*Helopeltis theivora* is a serious pest in tea. The nymphs and adults of tea mosquito bug suck the sap from tender leaves, buds and young shoots. This mainly causes loss of yield and also quality deterioration. Damage in tea plant by tea mosquito bug is also done by insertion of eggs into plant tissue during oviposition. Many alternate hosts for tea mosquito bug is also there like cashew etc. Synthetic pesticides are widely used for controlling the pest attack. But serious studies have found out that due to application of many or excessive insecticide the pest has gained lot of tolerances towards the insecticides or pesticides. IPM practices with ecofriendly manner or growing different varieties with low pest attack can be used also growing the plant in correct time before the pest attack is more is to be considered.

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