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In vitro Bio Efficacy of Botanicals against Tea Mosquito bug, *Helopeltis theivora* Waterhouse in Tea

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ABSTRACT: Bio-efficacy of botanicals against the Tea mosquito bug (TMB) in Tea was evaluated at the R&D center, Parry Agro Industries Limited, Valparai, Coimbatore, Tamil Nadu. In laboratory condition, using cold extraction method some botanicals were extract and using for bioassay. Among all the treatments tested, *Calophyllum inophyllum* seed oil after 72 hours after treatment treated tea shoots had less number of feeding punctures (304.67 Nos) and a maximum of 98.25% adult mortality followed by *Pongamia pinnata* seed oil showed 272.00 Nos feeding puncture and 94.74% mortality, Azadirachtin 10000 ppm, 283.00 feeding puncture and 84.21% mortality, *Madhuca longifolia* seed oil 2% showed 289.00 feeding puncture and 80.70% mortality, extracts of *Vitex negundo* leaf extract 5%, 301.67 feeding puncture and 70.18% mortality and extracts of *Clerodendrum viscosum* leaf extract 2%, 304.67 feeding puncture and 70.18% mortality, Fish Oil Rosin Soap showed 382.33 feeding puncture and 24.56% mortality. The feeding punctures were maximum in the untreated control (421.00 Nos).

Keywords: Bioefficacy, Botanicals, Tea, Tea mosquito bug and sucking pests.

INTRODUCTION

Tea (*Camellia sinensis)* is the world's second most widely consumed beverage belong to the family Theaceae (Arancon *et al.*, 2007). Tea is an intensively managed perennial monoculture crop cultivated on large-scale and small-scale plantations (Ahmad and Hossain, 2013). Asia-Pacific dominates the global market and accounts for 40% of the total demand in the tea market (Srikumar and Bhat, 2013). India, the second-largest consumer of tea, accounts for nearly 25-27% of world tea production; and accounts for 10-12% of world tea exports having an agricultural output estimated to be more than $300 billion. Tea crop production in India is significantly impacted by the attack from a wide variety of pests. Climatic conditions of the tea growing regions of India are conducive for a large number of insects and mite pests, diseases, and weeds that need to be managed to protect yields (Pathak *et al.*, 2003). Tea mosquito bug (TMB), *Helopeltis theivora* Waterhouse (Hemiptera : Miridae) is the major insect pest of tea that causes heavy loss to the tea crop every year since it attacks the young shoots consisting of two leaves and a bud which constitute the productive region tea (Somnath *et al.*, 2009; Gurusubramanian *et al.*, 2008). In North-East India, major parts of tea plantations are infested by TMB causing each year a loss of around 15-20 lakhs of made tea while in South India, around 40,000 acres annually are under the attack of this notorious pest. Depending on the severity, yield loss ranges from around 10-50 % (Basu Majumder *et al.*, 2010). This pest sucks the sap from young leaves by injecting their labial stylet containing saliva into soft plant tissue. The water soak lesion around the site of puncture turns into a brown spot and in severe damage leaves curl up, ultimately drooping and withering, thereby reducing the yield of the bushes. In some cases of severe infestation, the affected young bushes may not flush for several weeks, leading to delayed or absence of shoot formation (Hazarika *et al.*, 2009). There has been heavy use of organo-synthetic pesticides since the 1950s to defend the plant against TMB and other sucking insects, leading to rapid conversion of innocuous species into pests, development of resistance, and undesirable pesticide residues was present in processed tea (Rahman *et al.,* 2007). Crude plant extracts often consist of complex mixtures of active compounds. Plant crude extracts were advantages of using complex mixtures as pest control agents are that natural mixtures may act synergistically (Berenbaum 1985), they may show greater overall bioactivity compared to the individual constituents (Berenbaum *et al*., 1991), and insect resistance is much less likely to develop with mixtures (Feng and Isman, 1995). These reasons support the use of crude, chemically unrefined plant extracts, containing mixtures of bioactive plant compounds rather than the use of the pure individual compounds. Also, the former will be simpler and cheaper to prepare if the plant materials are locally available (Chen *et al*., 1995). A major problem in the control of *H. theivora* is its capability to develop resistance quickly to frequently used insecticides (Mukhopadhyay and Roy, 2013). The present study is focused on the effect of certain botanicals against tea mosquito bug for effective management in tea.

MATERIALS AND METHODS

A. Cold extraction method

Leaf samples of *Vitex negundo* and *Clerodendrum viscosum* were collected from Murugali estate (10.3062° N, 76.8519° E), Valparai, Coimbatore, Tamil Nadu. That leaf samples kept 3–4 days for shade dry. After that leaf samples were cut into small pieces in a grinder and were made to coarse powder, 100g of powder was mixed with 300 ml of 100% methanol in a conical flask and thoroughly mixture. The conical flask was kept with intermittent shaking for 72 h. The mixture was filtered using muslin cloth and through Whatman No. 1 filter paper (Hu *et al.*, 2013).

B. Mass culturing of Tea mosquito bug (H. theivora)

Field populations of *H. theivora* were collected from Parry Agro Industries Limited, Murugali Tea Estate in Valparai area (10°19'36.88" N 76°57'4.18" E), Coimbatore district, Tamil Nadu from September 2019 to December 2022. The collected insects were maintained as a mother culture and sub-cultured in separate cages (47.5 × 47.5 × 47.5 cm) on young tea foliage (variety – UPASAI - 9) in a BOD at 27 ± 2°C, 80 % RH and a photoperiod of 16 h light: 8 h dark. These insects were taken for conducting bioassay studies under laboratory conditions.

C. Bioassay

Adult of *H. theivora* was collected and the bouquet bioassay method was used to test the efficacy. Eight botanicals with three replications (5 shoots/ replication) and Completely Randomized Design (CRD) were followed. The treatments include: T1- *Pongamia pinnata* seed oil @ 20ml/lit., T2- Fish Oil Rosin Soap @ 25ml/lit., T3 - *Vitex negundo* Leaf extract 5% @ 50ml/lit., T4 - *Madhuca longifolia* seed oil @ 20ml/lit., T5- Azadirachtin 10000 ppm @ 2ml/lit., T6- *Calophyllum inophyllum* seed oil @ 20ml/lit., T7- *Clerodendrum viscosum* leaf extract 2% @ 20ml/lit., T8- Control (Water). *Triton X-100* @ 0.01 % was used as an adjuvant in all the treatments. Ten bugs were introduced in each treatment. The shoots were sprayed with a hand atomizer. The observations on percent adult mortality and feeding puncture/shoots were recorded at 24, 48, and 72 hours after treatment (HAT). Moribund insects were considered dead and taken for the count, and collected data were analyzed using statistical software OPSTAT.

RESULTS AND DISCUSSION

The results on the efficacy of botanicals against TMB revealed that *Calophyllum inophyllum* seed oil 2% treated tea shoots has 98.23 percent adult mortality followed by *Pongamia pinnata* seed oil 2% (94.74%), Azadirachtin 10000 ppm (84.21%), *Madhuca longifolia* seed oil 2% (80.70%), Extracts of *Vitex negundo* leaf extract 5% (70.18%) and extracts of *Clerodendrum viscosum* leaf extract 2% (70.18%), Fish Oil Rosin Soap (24.56%) and control (feeding punctures was more 421.00 Nos) (Table 1)**.**

Table 1: Adult mortality % of botanicals against Tea mosquito bug under laboratory condition.

Treatment	Dose (ml or g/Lit.)	Adult mortality %			% reduction over control
		24 HAT	48 HAT	72 HAT	
T1- *Pongamia pinnata* seed oil	20	41.67±0.20^{a}	65.00±0.21^{ab}	95.00±0.09^{a}	94.74
T2- Fish Oil Rosin Soap	25	15.00±0.00^{b}	18.33±0.10^{d}	28.33±0.08^{c}	24.56
T3 –*Vitex negundo* Leaf extract 5%	50	31.67±0.16^{a}	48.33±0.07^{bc}	71.67±0.16^{b}	70.18
T4 - *Madhuca longifolia* seed oil	20	38.33±0.20^{a}	55.00±0.07^{abc}	81.67±0.06^{ab}	80.70
T5- Azadirachtin 10000 ppm	2	38.33±0.08^{a}	61.67±0.06^{abc}	85.00±0.09^{ab}	84.21
T6- *Calophyllum inophyllum* seed oil	20	45.00±0.12^{a}	68.33±0.16^{a}	98.33±0.10^{a}	98.25
T7- *Clerodendrum viscosum* leaf extract 2%	20	28.33±0.08^{a}	45.00±0.12^{c}	71.67±0.16^{b}	70.18
T8- Control	-	5.00±0.00c	5.00±0.00^{e}	5.00±0.00^{d}	-
CD (P=0.05)	-	0.39	0.36	0.32	-
SE(d)	-	0.18	0.17	0.15	-

HAT- Hours After Treatment

Means ± SE within a column followed by the same letter are not significantly different from each other at 5% level of significance (LSD test)

The results showed that the efficacy of botanicals against TMB revealed that *Calophyllum inophyllum* seed oil 2% treated tea shoots has less no of feeding punctures (269.00 Nos) followed by *Pongamia pinnata* seed oil 2% (272.00 Nos), Azadirachtin 10000 ppm (283.33 Nos), *Madhuca longifolia* seed oil 2% (289.00 Nos), extracts of *Vitex negundo* leaf extract 5% (301.67 Nos) and extracts of *Clerodendrum viscosum* leaf extract 2% (304.67 Nos), Fish Oil Rosin Soap (382.33 Nos%) and control (feeding punctures was more 421.00 Nos) (Table 2)**.**

Table 2: Number of Feeding punctures/shoot of botanicals against Tea mosquito bug under laboratory condition.

Treatment	Dose (ml or g/Lit.)	No. of Feeding punctures/shoot			% reduction over control
		24 HAT	48 HAT	72 HAT	
T1- *Pongamia pinnata* seed oil	20	135.00 ± 0.24^{cd}	205.00 ± 0.17^{c}	272.00 ± 0.37^{d}	40.67
T2- Fish Oil Rosin Soap	25	197.00 ± 0.66^{b}	320.00 ± 1.04^{b}	382.33 ± 0.32^{b}	12.65
T3 –*Vitex negundo* Leaf extract 5%	50	156.00 ± 0.24^{c}	229.00 ± 0.37^{c}	301.67 ± 0.24^{c}	34.00
T4 - *Madhuca longifolia* seed oil	20	146.67 ± 0.37^{cd}	220.00 ± 0.42^{c}	289.00 ± 0.21^{cd}	36.69
T5- Azadirachtin 10000 ppm	2	136.00 ± 0.38^{cd}	212.67 ± 0.40^{c}	283.33 ± 0.29^{cd}	38.31
T6- *Calophyllum inophyllum* seed oil	20	125.33 ± 0.52^{d}	200.00 ± 0.09^{c}	269.00 ± 0.33^{d}	41.67
T7- *Clerodendrum viscosum* leaf extract 2%	20	151.00 ± 0.06^{cd}	223.67 ± 0.52^{c}	304.67 ± 0.12^{c}	34.29
T8- Control	-	236.67 ± 0.56^{a}	383.00 ± 0.30^{a}	421.00 ± 0.31^{a}	-
CD (P=0.05)	-	1.27	1.41	0.86	-
SE(d)	-	0.59	0.65	0.40	-

HAT- Hours After Treatment

Means ± SE within a column followed by the same letter are not significantly different from each other at 5% level of significance (LSD test).

Manimaran *et al*. (2019) also reported that azadirachtin 10,000 ppm was more efficient against the Tea mosquito bug in *Ailanthus excelsa* than other bio-pesticides. Kumar (2017) reported that Petroleum spray oil was evaluated against turnip aphid, *Lipaphiserysimi* (Kaltenbach) on *Brassica juncea* in Punjab region. Different concentration of of petroleum spray oil spray along with dimethoate 30 EC. Among all the tratments 1.5% concentration showed 82% mortality. Similarly, Dutta *et al*. (2013) investigated the antifeedant efficacy of different doses of aqueous extracts of NSKE against TMB populations. They also resulted in a low hatching percentage as well as shorter oviposition and nymphal periods. Roy *et al*. (2010) found that different azadirachtin content Neem formulations were tested against TMB in tea and that different concentrations (12000 ppm) effectively controlled the TMB. Roy *et al*. (2010) reported that the water extract of *Clerodendrum viscosum* (Verbenaceae) showed effectively control TMB populations in the field condition. The four different concentrations of *C. viscosum* extracts was caused effective control of *H. theivora* and *O. coffeae*, compared to the unsprayed control plots and sprayed plots with neem formulation and chemical pesticides. According to Somnath *et al*., (2009), azadirachtin 10,000 ppm proved effective against the tea mosquito bug. Reduction in the populations of the two pests in the field may be due to collective insecticidal, acaricidal, ovicidal, growth regulatory, and antifeedant effects of *C. viscosum* (Gurusubramanian *et al*., 2008; Roy *et al*., 2009).

The extract of the same plant species should not be repeatedly used for long periods because prolonged exposure decreases the response of target herbivores (Hazarika *et al.*, 2009; Liu *et al*., 2005). The present finding was supported by the field studies of Roy *et al*. (2010); Hazarika *et al*., (2009).

CONCLUSION

The present studies conclude that the application of *Calophyllum inophyllum* seed oil @ 20ml/lit. followed by *Pongamia pinnata* seed oil @ 20ml/lit, in rotation effectively control *H. theivora* in tea. Thus *Pongamia pinnata* seed oil @ 20ml/lit was recommended for widespread application to successfully manage the tea mosquito bug in different tea plantations.

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Conflict of Interest. None.

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