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ENTOMOLOGY

Evaluation of Certain New Insecticides for the Management of Tea Mosquito Bug, *Helopeltis theivora* Waterhouse (Hemiptera: Miridae) in Tea

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ABSTRACT

The tea mosquito bug is one of a major pest in tea. The promising and effective insecticides are limited for the control of TMB and repeated use of similar pesticides for a prolonged period leads to the development of resistance in TMB. In this view, a study was done on finding new and effective pesticides for the control of TMB. Overall fifteen synthetic insecticides were evaluated with 50 treatments against TMB under laboratory conditions. Based on the laboratory evaluation, the effective insecticides were selected for further field evaluation from 2020 to 2021 in Valparai, Coimbatore. TMB reduction percentage, yield analysis and phytotoxicity studies were undertaken during the study period. In the laboratory, seven treatments achieved 100% adult mortality on TMB after 24 hours of application. From the field evaluations, four treatments *Viz.*, Beta-cyfluthrin + Imidacloprid @ 625 mL/ha, Sulfoxaflor @ 250 g/ha, Tolfenpyrad @ 1000 ml/ha and Flupyradifurone 1000 ml/ha were showed 87, 84, 83 and 83% of TMB reduction respectively over the control. Similarly, the above-mentioned treatments also achieved 140, 201, 220 and 208% of increased yield, respectively over the control. From the study, new pesticides produced superior results in the reduction of TMB percentage as well as increase the crop yield.

HIGHLIGHTS

- Fifteen treatments were found to be effective on TMB under laboratory conditions.
- New insecticides *Viz.*, Beta-cyfluthrin + Imidacloprid @ 625 mL/ha, Sulfoxaflor @ 250 g/ha, Tolfenpyrad @ 1000 ml/ha and Flupyradifurone 1000 ml/ha produced excellent TMB reduction percentage as well as increase yield also.
- These new molecules might have a new hope of breaking the resistance chain in TMB.

Keywords: *Camellia sinensis*, TMB, bioassay, yield

Tea, *Camellia sinensis* (L.) is a perennial and monoculture crop which provides a superior habitat and continuous food to a wide range of arthropods (Muraleedharan 1992). Moreover, its estimated that more than 1000 arthropods and 80 nematodes were infested in every part of the tea plant (Sudarmani, 2004). Tea Mosquito Bug (TMB), *Helopeltis theivora* Waterhouse is one of the major threatening pest of tea in southern India. The occurrence of TMB was documented in tea in India more than a century ago (Peal 1873; Wood-Mason 1884) and its outbreak was started in the southern part of India around 1920 (Shaw 1928). Initially, the TMB incidence was restricted only to Vandiperiyar and Peermade (Kerala) area. But recently, the population spread and become alarming in Anamallais, Valparai

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(Tamil Nadu) (Radhakrishnan and Srikumar 2015). Now it's started to spread to the lower elevation of Munnar (Kerala).

At present, Qinalphos, Deltamethrin, Thiomethoxam, Thiocloprid and Bifenthrin are the effective chemicals for the management of TMB as per the recommendation of the Tea Board of India through the plant protection code (PPC) (Santhana *et al.* 2022). In recent days, the wide spreading of TMB is been noted in all the estates even after the application of recommended chemicals, which is possibly due to the development of resistance to these insecticides. Similarly, the extensive use of conventional insecticides for a prolonged period has resulted in the development of resistance to the respective insecticide, the outbreak of secondary pests, intolerable pesticide residues and adverse effects on the environment and non-target organisms (Kodandaram *et al.* 2010 & Mukhopadhyay and Roy 2009). Meanwhile, many previous studies also found that adult TMBs have developed a resistance against a different class of insecticides (Gurusubramanian and Bora 2008 & Roobakkumar *et al.* 2011). In addition, Srikumar *et al.* (2017) found that field-collected adult TMBs were highly capable of detecting the frequently or commonly used insecticides such as Quinalphos, Bifenthrin, Deltamethrin and Thiamethoxam. So now, the tea industry is keenly looking for more effective and promising new generation pesticides which might help in breaking resistance as well as efficient against TMB. In this view, the present study was focused to find some new molecules for the control of TMB.

MATERIALS AND METHODS

Laboratory culture of TMB: Adult TMBs were collected from UPASI experimental farm and brought to the laboratory for further mass multiplication. Sudhakaran (2000) protocol was adopted for mass multiplication. The culture was continuously reared for five generations without exposing them to any chemicals. Sixth generation adults were used for laboratory bioassay studies.

Selected pesticides for the study: Fifteen synthetic insecticides were selected and evaluated involving 50 treatments against TMB under laboratory conditions. The selected insecticides list is given in Table 1 and the same were directly purchased from Tamil Nadu Agrochemicals Pvt. Ltd., Pollachi, Tamil Nadu.

Laboratory evaluation: For the laboratory evaluation, twenty mixed TMB adults were randomly selected from the stock culture and introduced into a plastic container (30 cm height × 16 cm width). Five to seven tea shoots (three leaves and bud) were tightly placed using wet cotton in a glass vial (6cm height) which was filled with tap water. All insecticide formulations were prepared using tap water and spraying was done on the tea shoots using a fine atomizer. After spraying, the shoots were transferred to plastic bottles which contain adult TMBs. New shoots were provided on alternate days without removing the sprayed shoots. Each treatment replicates thrice and adult mortality was observed every 24 hours until 96 hours.

Field evaluation: Among the fifty treatments, twelve effective treatments were selected for further field evaluations from 2020 to 2021. The tea field was 4th year since the pruning and contains mixed tea clones with a planting space of 1.20 m × 1.20 m. The plot size was 100 m^2 (10 m × 10 m) and followed a randomized block design (RBD) with three replications. To know the TMB infestation percentage, a hundred numbers of tea shoots (three leaves and bud) were randomly collected from each plot and each shoot was thoroughly examined. The percentage of infestation was calculated using the following formula.

% of TMB infestation =

$$\frac{\text{Total number of freshly infested shoots}}{\text{Total number of collected shoots}} \times 100$$

A pretreatment assessment (PTA) was done before the application. After PTA, the first spray was commenced using a motorized sprayer with a type IV nozzle and a follow-up spray was done after 7 days. Thereafter, each plot was continuously monitored and consequence pesticide application was done on a requirement basis if the infestation crosses the economic threshold level (ETL) of 5%.

Yield analysis: During the study period, yield estimation was also carried out by maintaining standard plucking rounds. Yield (green leaves) was recorded for the first five plucking rounds. The per cent (%) increase in yield over control in various

Table 1: List of selected new pesticides for the evaluation against TMB

Sl. No.	Chemical Name	Brand Name	Manufacture	Short name used in this study
1	Beta cyfluthrin 8.49 % + Imidacloprid 19.81 % OD	Solomon	Bayer Crop Science Ltd, Mumbai	β-C + IMI
2	Flupyradifurone 17.09 SL	Sivanto prime	Bayer Crop Science Ltd, Mumbai	FLU
3	Spirotetramat 11.01% + Imidacloprid 11.01 SC	Movento Energy	Bayer Crop Science Ltd, Mumbai	SPI + IMI
4	Spirotetramat 15.31% OD	Movento	Bayer Crop Science Ltd, Mumbai	SPI
5	Sulfoxaflor 50% WG	—	Dhanuka Agritech Ltd.	SUL
6	Tolfenpyrad 15% EC	Keefun	PI Industries Ltd.	TOL
7	Afidopyropen 50 g/L DC	Sefina	BASF India Ltd., Mumbai	AFI
8	Lufenuron 5.4 EC	Modern Guard	Modern Insecticides Limited	LUF
9	Flonicamid 50% WG	Ulala	UPL Limited	FLO
10	Chlorantraniliprole 18.5% SC	Coragen	FMC India Ltd.	CHL
11	Cyantraniliprole 10.26 % OD	Benevia	FMC India Ltd.	CYA
12	Spinosad 45% SC	Taffin	Rallis India Limited (TATA)	SPI
13	Fenpyroximate 5% EC	Mitigate	Isagro (Asia) Agrochemical Pvt. Ltd.	FEN
14	Imidacloprid 30.5 SC	Premise	Bayer Crop Science Ltd, Mumbai	IMI
15	Dimethoate 30 EC	Tafgor	Rallis India Limited (TATA)	DIM

treatments was calculated using the following formula.

% Yield increases over control =

$$\frac{\text{Yield of treated plot} - \text{Yield of untreated plot}}{\text{Yield of untreated plot}} \times 100$$

Phytotoxicity evaluation: For the phytotoxicity evaluation, the required quantity of selected pesticides was sprayed using a hand-operated knapsack sprayer. Phytotoxicity observations on the leaf surface, leaf tips, wilting, necrosis, vein clearing, epinasty, hyponasty, etc., were recorded after the 1st, 3rd, 5th and 7th days of after spray. Phytotoxicity was denoted as a grade *Viz.*, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 based on the percentage of phytotoxicity such as 0, 1-10, 11-20, 21-30, 31-40, 41-50, 51-60, 61-70, 71-80, 81-90 and 91-100 respectively.

RESULTS AND DISCUSSION

Laboratory evaluations: In under laboratory evaluation, six new insecticides such as Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD @ 1.25 mL/L, Emamectin benzoate 5 SG + Deltamethrin 2.8 EC @ 0.4 g + 0.25 mL/L, Flupyradifurone 17.09 SL @ 2 mL/L, Sulfoxaflor 50% WG @ 0.50 g/L, Tolfenpyrad 15% EC @ 2 mL/L, Dimethoate @ 1.5 mL/L and Imidacloprid @ 1 mL/L were showed 100% adult mortality after 24 hours of the application. The other treatments such as Spiromesifen 22.9% SC @ 1 mL/L, Emamectin benzoate 5 SG @ 0.50 g/L, Tolfenpyrad 15% EC @ 1 mL/L, Spirotetramat 11.01% + Imidacloprid 11.01 SC @ 1.25 mL/ L and Spirotetramat 15.31% OD @ 1 mL/L were also produced notable mortality at about 87, 87, 83, 83 and 80% respectively, after 96 hours of the application.

The standards combinations *Viz.*, Thiacloprid 21.7 SC + Deltamethrin 2.8 EC @ 0.5 mL + 0.35 mL/L, Thiacloprid 21.7 SC + Deltamethrin 2.8 EC @ 0.6 mL + 0.3 mL/L and Quinalphos + Thiacloprid @ 1mL+ 0.5mL/L also produced 100% mortality after 24 hours of the application (Table 2). Ranjithkumar *et al.* (2022) found that application of Tolfenpyrad @ 2mL/L significantly reduce the TMB population and followed by Tolfenpyrad, Dinotefuran @ 0.5 mL/L, Sulfaxaflor @ 1.8 mL/L, Spirotetramate + Imidacopride @ 2 mL/L, Chlorantraniliprole @ 0.3 mL/L and Spinosad @ 0.5 mL/L also produced excellently control on TMB under laboratory conditions. In present study also reported that Tolfenpyrad, Sulfaxaflor and Spirotetramate + Imidacloprid are the effective pesticides against TMB. In addition, Beta-cyfluthrin + Imidacloprid, Flupyradifurone, Dimethoate and Imidacloprid

Table 2: List of promising treatments against TMB under laboratory conditions

Sl. No.	Treatments	Dosage/L	Mean mortality % of *H. theivora* after			
			24 hours	48 hours	72 hours	96 hours
1	Beta cyfluthrin 8.49 % + Imidacloprid 19.81 % OD	1.25 ml	100	—	—	—
2	Emamectin Benzoate 5 SG + Deltamethrin 2.8 EC	0.4 g + 0.25 ml	100	—	—	—
3	Flupyradifurone 17.09 SL	2.00 ml	100	—	—	—
4	Sulfoxaflor 50% WG	0.50 g	100	—	—	—
5	Thiacloprid 21.7 SC + Deltamethrin 2.8 EC	0.5 ml + 0.35 ml	100	—	—	—
6	Thiacloprid 21.7 SC + Deltamethrin 2.8 EC	0.6 ml + 0.3 ml	100	—	—	—
7	Quinalphos + Thiacloprid	1 ml + 0.5 ml	100	—	—	—
8	Tolfenpyrad 15% EC	2.00 ml	100	—	—	—
9	Dimethoate	1.50 ml	100	—	—	—
10	Imidacloprid	1 ml	100	—	—	—
11	Emamectin Benzoate 5 SG	0.5g	43.3	60	80	86.7
12	Spiromesifen 22.9% SC	1.00 ml	23.3	46.7	73.3	86.7
13	Tolfenpyrad 15% EC	1.00 ml	56.7	60	80	83.3
14	Spirotetramat 11.01% + Imidacloprid 11.01 SC	1.25 ml	36.7	46.7	76.7	83.3
15	Spirotetramat 15.31% OD	1.00 ml	20	23.3	60	80

were also elucidated due to the excellent control of TMB under laboratory conditions.

Field studies: Infield evaluations, the new pesticides such as Beta-cyfluthrin + Imidacloprid @ 625 ml/ha, Sulfoxaflor @ 250 g/ha, Tolfenpyrad @ 1000 ml/ha, Flupyradifurone @ 1000 ml/ha, Dimethoate @ 750 ml/ha and Spirotetramat + Imidacloprid @ 625 ml/ha were reduce the TMB infestation at about 87, 84, 84, 83, 83 and 80% respectively. Vaishali *et al.* (2018) found that Solomon 300 OD (Beta-cyfluthrin 8.49% + Imidacloprid 19.81%) @ 1.5 ml/10 lit was most effective against tea mosquito bug, *Helopeltis antonii* and thrips, *Scirtothrips dorsalis* in cashew plantation. They also reported that Solomon 300 OD has recorded the highest yield as well as no phytotoxic effect on cashew. On par, results were made in the present study also. Beta-Cyfluthrin is usually acting as a contact cum ingestion poison and blocks the sodium channels of the insects' nervous system. Imidacloprid is act as an antagonist to the nicotinic acetylcholine receptor in the central nervous system of insects and disturbs the signal transmission system which leads to the excitation of the nerve cell. Both Beta-cyfluthrin and Imidacloprid have a combination of systemic and contact properties which provides quick knockdown and anti-feeding effects on insects (https://www.cropscience.bayer.in/Products-H/Brands/Crop-Protection/Insecticide-Solomon). After Beta-cyfluthrin + Imidaclorpid, Sulfoxaflor was found as the second most effective pesticide which produced 84% of TMB reduction in this study. The previous studies also found that the application of Sulfoxaflor 50% WG @ 150 g/ha has achieved excellent control on TMB under field conditions (Das *et al.* 2019 & Radhakrishnan *et al.* 2018) and similarly, the application of Sulfoxaflor @ 170 ml/ha and Flupyradifurone @ 1022 ml/ha at a higher rate also showed significant control on *Lygus hesperus* in Strawberry (Shimat and Mark 2016).

Tolfenpyrad was found to be the third effective molecule to control TMB in field conditions. Echegaray *et al.* (2016) found that Tolfenpyrad was highly effective over the eggs, nymphs and adults of Potato Psyllid (Hemiptera: Triozidae). This may be due to Tolfenpyrad being a contact and ingestion poison which inhibits the electron transport chain in the mitochondria resulting in the death of the target pest (https://www.piindustries.com/our-business/

Our-Business/products-and-services/Keefun). Next to Tolfenpyrad, Flupyradifurone was an effective pesticide over TMB. Flupyradifurone @ 1000 ml/ha was reported as a third molecule which reduce the TMB infestation by 83.4%. A similar observation was made by Barrania *et al.* (2019) in cucumber plants that Flupyradifurone was most effective and produced the highest reduction percentage of 98 and 97% in *Aphis gossypii* and *Bemisia tabaci* respectively under field conditions in cucumber plants. Also found that Flupyradifurone was less toxic to the natural enemies such as *Chrysoperla carnea* and *Coccinella* spp. Flupyradifurone is also effective against a wide range of plant sap-feeding insect pests which are resistant to various classes of insecticides (Jeschke *et al.* 2015; Saeedi and Ziaee, 2020). The standards *Viz.,* Emamectin benzoate @ 250 g/ha, Emamectin benzoate + Deltamethrin @ 200 g + 125 mL/ha, Thiacloprid @ 500 mL and Quinalphos + Thiacloprid @ 500 mL+ 250 mL/ha also achieved notable TMB reduction percentage at about 77, 73, 68 and 67.5 respectively (Fig. 1). In the present study, Beta-cyfluthrin + Imidacloprid was recorded as a superior pesticide and all the new pesticides produced an excellent TMB reduction percentage than the available standards.

During the study period, a minimum of two rounds and a maximum of four rounds of spraying were undertaken to keep the TMB population down. Dimethoate @ 750 ml/ha and Spirotetramat + Imidacloprid @ 625 ml/ha were warranted to control TMB with a minimum of two rounds of application. In addition, Beta-cyfluthrin + Imidacloprid, Tolfenpyrad, Flupyradifurone and Sulfoxaflor were warranted to control TMB with a minimum of three rounds of application. The standards took four rounds of application to keep the TMB population under check.

Yield estimations: In yield analysis, a maximum of 220% yield was increased over the control in Tolfenpyrad @ 1000 mL/ha treatment and the lowest was noted with 22% in the treatment of Spinetoram @ 250 g/ha. The effective molecules such as Flupyradifurone, Sulfoxaflor and Beta-cyfluthrin + Imidacloprid were produced 208, 201 and 140% of increased yield over the control with three rounds of application. Dimethoate and Spirotetramat + Imidacloprid were achieved at about 97 and 140% of increased yield over control with two rounds of application (Fig. 2). Moreover, an excellent yield was recorded (140% - 220%) in the newer chemicals which were undergone three rounds of application except for the standards.

Phytotoxicity effect: During the phytotoxicity evaluation, the visible phytotoxicities such as leaf tips, wilting, necrosis, vein clearing, epinasty,

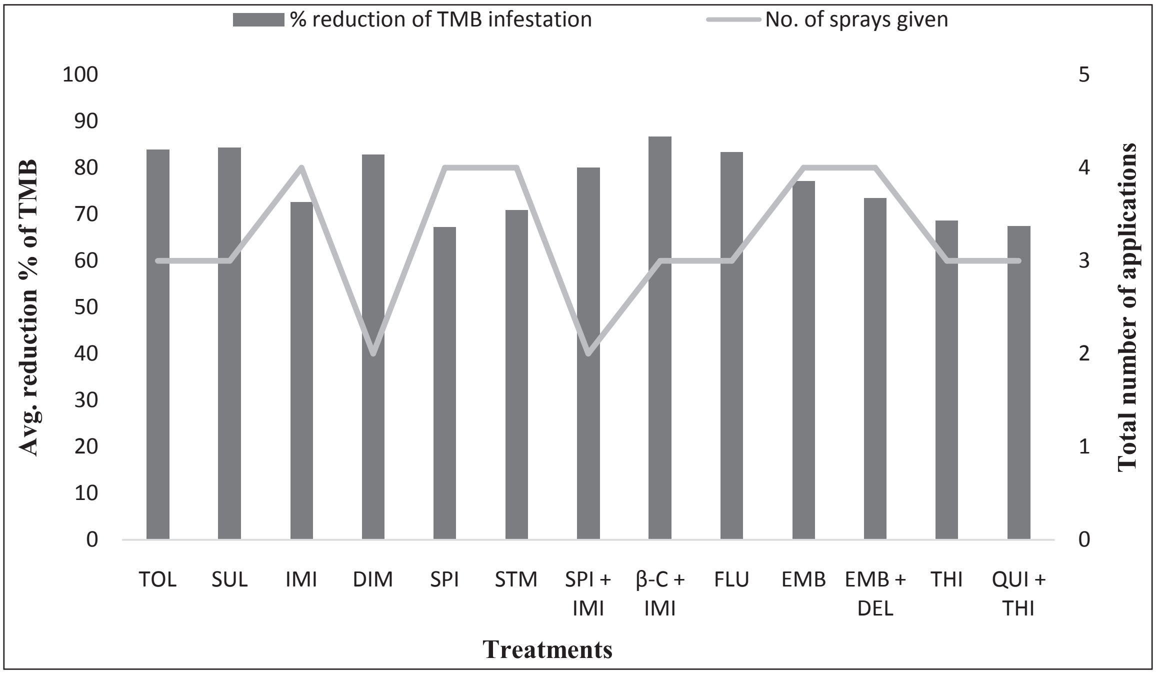

Fig. 1: Average reduction % of TMB

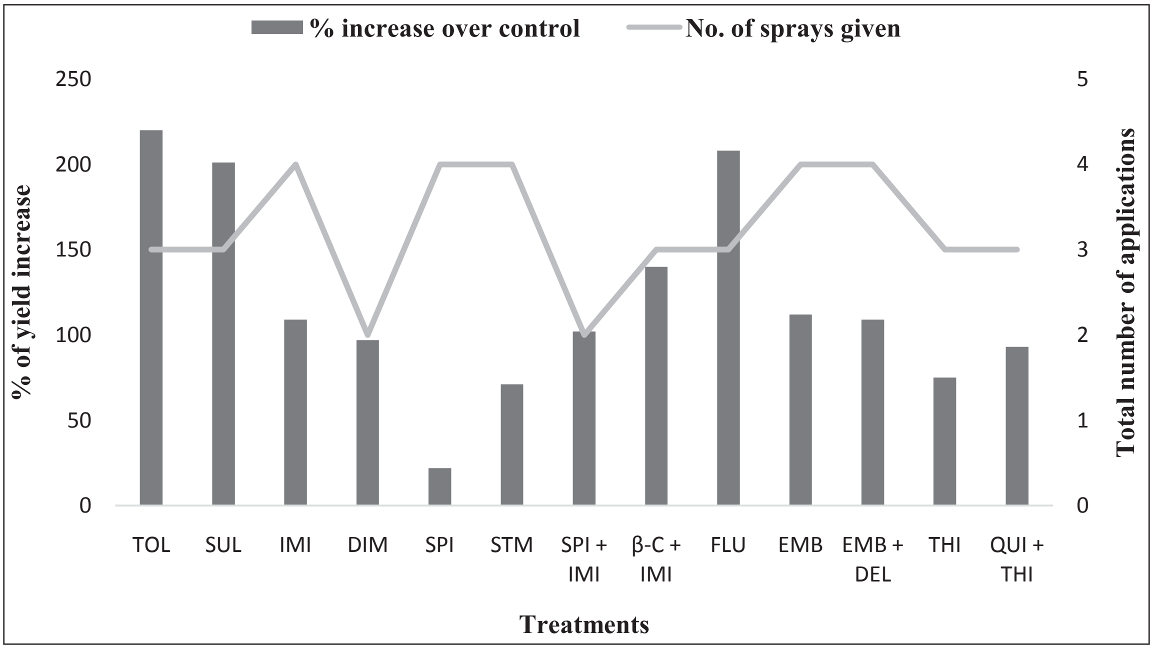

Fig. 2: % of yield increase over control

hyponasty, etc., were not recorded on tea leaves and harvestable shoots. All evaluated insecticides showed nil phytotoxicity (Grade-0).

CONCLUSION

The newer molecules such as Beta-cyfluthrin + Imidacloprid, Sulfoxaflor, Tolfenpyrad, Flupyradifurone, Dimethoate and Spirotetramat + Imidacloprid were got attention due to its excellent efficacy on TMB control in both, laboratory and field conditions; as well as increased yield also noted during the study period. These molecules might have a new hope of breaking the resistance chain in TMB. Further, an effort will be needed to add these new molecules under Plant Protection Code (PPC), Tea Board of India to recommend the same for the effective management of TMB.

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REFERENCES

Barrania, A.A., Mabrok, A.E. and Atef, T.E. 2019. Field Efficiency of some New Insecticides Against some Sucking Insects at Cucumber Plants. *Alexandria Science Exchange J.*, **40**(2): 327-332.

Das, P., Rana, P.B., Uddipana,S., Binita, B. and Bikash,J.G. 2019. Bio-efficacy and phytotoxicity of Sulfoxaflor 50% WG against tea mosquito bug (*Helopeltis theivora*) and green fly (*Empoasca flavescens*) and its effect against natural enemies in tea. *J. Entom. and Zool. Stud.*, **7**(4): 224-229.

Echegaray, E.R., Vinchesi, A.C., Rondon, S.I., Alvarez, J.M. and McKinley, N. 2016. Potato Psyllid (Hemiptera: Triozidae) Response to Insecticides Under Controlled Greenhouse Conditions. *J. Econ. Entomo.*, pp. 1-6.

Gurusubramanian, G. and Bora, S. 2008. Insecticidal resistance to tea mosquito bug, *Helopeltis theivora* Waterhouse (Miridae: Heteroptera) in North East India. *J. Environ. Res. Dev.*, **2**(4): 560-567.

Jeschke, P., Nauen, R., Gutbrod, O., Beck, M.E., Matthiesen, S., Haas, M. and Velten, R. 2015. Flupyradifurone (Sivanto™) and its novel butenolide pharmacophore: Structural considerations. *Pestic. Biochem. and Physiol.*, **121**: 31–38.

Kodandaram, M.H., Rai, A.B. and Jaydeep, H. 2010. Novel insecticides for management of insect pests in vegetable crops: A review. *Veg. Sci.*, **37**(2): 109-123.

Mukhopadhyay, A. and Roy, S. 2009. Changing dimensions of IPM in the tea plantations of the North Eastern sub-Himalayan region. *In:* Proceedings of National Symposium on IPM Strategies to Combat Emerging Pest in the Current Scenario of Climate change. January 28-30, Central Agricultural University Pasighat, Arunachal Pradesh, India, pp. 290-302.

Muraleedharan, N. 1992. Pest Control in Asia. In "Cultivation to Consumption". Wilson, K. C. and Clifford, M. N. (editors), Chapman and Hall, London.

Peal, S.E. 1873. The tea-bug of Assam. J*ournal of the Agricultural and Horticultural Society of India*, **4**: 126–132.

Radhakrishnan, B., Srikumar K.K., Smitha, S. and Sureshkumar, B. 2018. Evaluation of Sulfoxaflor 50% WG against tea mosquito bug, *Helopeltis theivora* Waterhouse (Hemiptera: Miridae). *Pestology*, **42**: 31-36.

Ranjithkumar, R.M., Kalaynasundaram, M., Kannan, J.S., Kennedy, C.R. and Chinnamuthu. P. 2022. Bioefficacy of Newer Molecules Insecticides against Tea Mosquito Bug, *Helopeltis theivora* Waterhouse under Laboratory Condition. *Int. J. Plant & Soil Sci.*, **34**(2): 73-80.

Roobakkumar, A., Shanmugapriyan, R., Babu, A., Sibi, Mathew., Sankara, Rama, Subramaniam, M. and Muraleedharan, N. 2011. Relatively susceptibility of Tea mosquito to commonly used pesticides. *Planters Chronicle*, pp. 5-7.

Saeedi, Z. and Ziaee, M. 2020: Biochemical responses of two sugarcane varieties to whitefly *Neomaskellia andropogonis* Infestation and its control by a new butenolide insecticide, flupyradifurone. *Agric. and Fores.*, **66**(1): 69-81.

Santhana Bharathi, N., Mahendran, P., Anju, A. and Rabeesh, T.P. 2022. Behavioural response and mass trapping of males of tea mosquito bug *Helopeltis theivora* Waterhouse. *Indian J. Entom.* **DOI**.: 10.5958/IJE.2022.165.

Shaw, W.S. 1928. Observations on *Helopeltis* (Tea mosquito blight) for south India Tea Planters. The Diocesan Press, Madras, pp. 56.

Shimat, V.J. and Mark, B. 2016. Efficacy of Insecticides against *Lygus hesperus* Knight (Hemiptera: Miridae) in the California's Central Coast Strawberry. *Int. J. Fruit Sci.*, **16**(S1): 178-187.

Srikumar, K.K., Smitha, S., Suresh, K. and Radhakrishnan, B. 2017. Electro-antennographic response of *Helopeltis theivora* to synthetic pesticides used in tea plantations. *Acta Biologica Hungarica*, **68**(4): 358–367.

Sudarmani, D.N.P. 2004. Studies on the res spider mite, *Oligonychus coffeae* (Nietner) (Tetranychidae: Acarina), infesting tea in southern India. Dissertation, Bharathiyar University, pp. 3.

Vaishali, K.Z., Gajbhyie, R.C., Salvi, S.P. amd Haldavnekar, P.C. 2018. Efficacy and evaluation of Solomon 300 OD (Betacyfluthrin 90% + Imidacloprid 210%) for management of insect pest in cashew. *J. Entom. and Zool. Stud.*, **6**(4): 81-83.

Wood-Mason, J. 1884. Report on the tea-mite and tea-bug of Assam. London, Taylor & Francis, pp. 20.