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Seasonal incidence, damage and impact of abiotic factors on tea mosquito bug, *Helopeltis antonii* Signoret (Hemiptera: Miridae) infesting tamarind

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Abstract
Seasonal incidence of tea mosquito bug, *Helopeltis antonii* Sign. infesting tamarind was studied at fortnightly intervals during June 2020-May 2021 by sweep method at KVK, Chintamani. The population of tea mosquito bug started infesting tamarind during August 2020. The bugs were active on tamarind until January 2021 at varied levels of intensity and the pest population reached its peak during October 2020. The highest number of tea mosquito bug was recorded 15.84 per five sweeps during first fortnight of October 2020 with per cent damage of 31.55 and the lowest numbers were recorded during second fortnight of January 2021 with an average population of 0.4 bugs per five sweeps and per cent damage of 2.20. Correlation analysis between incidence of tea mosquito bug *Helopeltis antonii* and weather parameters revealed that incidence of tea mosquito bug, *H. antonii* showed positive relationship with total rainfall and number of rainy days with the r values of 0.579 and 0.458 and were found to be significant at 5 % level. Similarly, minimum temperature (T_{min}), morning relative humidity and evening relative humidity were found to be positively correlated with the population of tea mosquito bugs with the r values of 0.107, 0.446, and 0.602, respectively. While the maximum temperature (T_{max}) and sunshine hours were negatively correlated with the incidence of tea mosquito bug population with the r values of -0.597 and -0.489. Multiple linear regression analysis between weather parameters and incidence of tea mosquito bug showed a R^2 value of 0.928 indicated that 92.80 per cent influence of weather parameters on tea mosquito bug incidence.

Keywords: Seasonal incidence, per cent damage, tea mosquito bug, tamarind

Introduction
Tamarind (*Tamarindus indica* L.) is a multipurpose tropical fruit tree belongs to the family Leguminosae, which is the third largest family of flowering plants with 727 genera and 19,327 species (Lewis *et al.*, 2005) [6]. It is mostly grown for its fruits, which are consumed fresh or processed, used as a seasoning or spice or processed for non-food purposes. It is widely distributed in the semi-arid and subtropics. The origin of tamarind has been traced to a number of locations like Africa, as well as India or the Far East (Morton, 1987) [7]. Tamarind is a versatile tree because almost every part of the tree has industrial and economic value in addition.to being rich in nutraceutical and pharmaceutical characteristics. It is used for food, fodder, apiculture, medicine, timber, fuel, tannin/dyes, varnishes and paints, shelter, live fencing and as an ornamental (Kuru, 2014) [5].A change in climatic conditions resulted in exceptional weather events such as unusual rainfall, extremely hot and low temperatures which leads to pest and disease outbreaks. Just like other tropical fruit trees tamarind is attacked by various kinds of insect pests feeding on foliage, flower and fruits in both field and storage conditions. Currently tea mosquito bug has been reported on tamarind by damaging the fruits. It has been known to feed on more than 100 different plant species. The sites of feeding on plant hosts are not localized. Rather, both adult and nymphs feed on various sites ranging from tender shoots, buds, stems, and even their fruiting bodies to obtain sap. It is considered to be the most serious pest of the many agricultural cash crops such as cocoa, cashew, and tea etc. An extensive review has been made on tea mosquito bugs involving different species and different host plants which have been reported by various workers. But the literature pertaining to the tea mosquito bug on tamarind was scanty, so literature related to tea mosquito bug on different hosts like cashew, guava, tea, etc. are reviewed for study. Climatic factors are greatly influence the abundance of *Helopeltis* sp. (Swaine, 1959) [10]. Understanding weather characteristics as a requirement for insect pest population dynamics and formulating

successful management methods requires a weather-based forecasting system and its expertise. Considering the above facts the current study was conducted to investigate the seasonal incidence of the tea mosquito bug, *Helopeltis antonii* Sign. Infesting tamarind and to connect population abundance with meteorological parameters.

Materials and Methods

The seasonal incidence of tea mosquito bug, *Helopeltis antonii* Signoret was recorded by sweep method (population of bugs per five sweeps) from June 2020-May 2021 on tamarind plantation at KVK, Chintamani. Fortnightly observations were made on the population of tea mosquito bug on 25 randomly selected trees. In each tree the populations of bugs were assessed on five randomly selected branches in different directions viz., North, South, East and West of the tree. The percentage of damage caused by tea mosquito bugs on fruits of tamarind was calculated. Observations were recorded on total number of both affected and healthy fruits on selected trees from June 2020 to May 2021. The fortnight counts of tea mosquito bug population were correlated with weather parameters such as total rainfall (mm), number of rainy days, maximum temperature (T_{max}), minimum temperature (T_{min}), morning relative humidity (%) and sunshine hours obtained from ARS, weather station, Chintamani.

Percent damage caused by tea mosquito bugs on fruits of tamarind was calculated by using formula given below,

$$\text{Percent damage on fruits} = \frac{\text{Total number of fruits damaged}}{\text{Total number of fruits observed}} \text{x } 100$$

Table1: Seasonal incidence of tea mosquito bug, *Helopeltis antonii* Sign on tamarind during June 2020-May 2021

Period	Population of *Helopeltis antonii* Sign. per five sweeps
I FN June 2020	0.00
IIFN June 2020	0.00
I FN July 2020	0.00
IIFN July 2020	0.00
I FN August 2020	0.80
IIFN August 2020	5.04
I FN September 2020	8.36
IIFN September 2020	13.68
I FN October 2020	15.84
IIFN October 2020	15.08
I FN November 2020	13.72
IIFN November 2020	11.76
I FN December 2020	9.40
IIFN December 2020	5.96
I FN January 2021	1.16
IIFN January 2021	0.40
I FN February 2021	0.00
II FN February 2021	0.00
I FN March 2021	0.00
IIFN March 2021	0.00
I FN April 2021	0.00
IIFN April 2021	0.00
I FN May 2021	0.00
IIFN May 2021	0.00
Grand mean	4.21

FN – fortnight

Fig 1: Adult and nymph of tea mosquito bug, *Helopeltis antonii* Sign on tamarind fruit

Fig 2: Damage of tea mosquito bug on fruits of tamarind

Results and Discussion

The results of seasonal incidence of tea mosquito bug population at KVK, Chintamani revealed that the highest numbers of bugs were reported during first fortnight of October 2020 (15.84 bugs per five sweeps) with per cent damage of 31.55 and the lowest numbers were recorded during second fortnight of January 2021 with an average population of 0.4 bugs per five sweeps and per cent damage of 2.20. Maximum number of tea mosquito bug was recorded during October and November, 2020. No incidence of bugs was observed during first fortnight of February to last fortnight of May 2021. (Table1, 2 and Figure 1, 2).These findings are in accordance with the investigations of Onkarappa (1993) [8] on neem who reported the peak incidence of tea mosquito bug *Helopeltis antonii* Sign. Was noticed during July to January at GKVK, Bengaluru. The maximum infestation was noticed during October and the minimum during January. There was no incidence from February to June.

Table 2: Per cent damage of tea mosquito bug, *Helopeltis antonii* Sign on tamarind during June 2020-May 2021

Period	Per cent damage on fruits*		
	No Observed	No Affected	% Damage
I FN June 2020	230.00	0.00	0.00
IIFN June 2020	270.4	0.00	0.00
I FN July 2020	256.53	0.00	0.00
IIFN July 2020	278.53	0.00	0.00
I FN August 2020	272.53	1.20	0.44
IIFN August 2020	302.53	8.70	2.87
I FN September 2020	281.15	35.92	12.77
IIFN September 2020	321.15	76.92	23.95
I FN October 2020	280.90	88.65	31.55
IIFN October 2020	316.90	78.15	24.66
I FN November 2020	302.75	54.27	17.92
IIFN November 2020	270.75	40.77	15.05
I FN December 2020	280.5	31.53	11.24
IIFN December 2020	301.50	25.03	8.30
I FN January 2021	284.88	10.20	3.58
IIFN January 2021	303.38	6.70	2.20
I FN February 2021	270.80	0.00	0.00
II FN February 2021	302.30	0.00	0.00
I FN March 2021	270.43	0.00	0.00
IIFN March 2021	287.43	0.00	0.00
I FN April 2021	269.55	0.00	0.00
IIFN April 2021	280.55	0.00	0.00
I FN May 2021	0.00	0.00	0.00
IIFN May 2021	0.00	0.00	0.00

*Average of 10 plants

Correlation between weather parameters and incidence of tea mosquito bug infesting tamarind

Results of the correlation analysis between weather parameters and the incidence of tea mosquito bug revealed significant positive relationship with total rainfall and number of rainy days with the r values of 0.579* and 0.458* respectively. Similarly, minimum temperature (T_{min}), morning relative humidity and evening relative humidity were found to be positively correlated with the population of tea mosquito bugs with the r values of 0.107, 0.446, and 0.602, respectively. While the maximum temperature (T_{max}) and sunshine hours were negatively correlated with the incidence of tea mosquito bug population with the r values of -0.597 and -0.489 (Table 3). These results are in accordance with the

findings of Chakraborthy and Chakraborthy (2005) [1] who stated that the attack of tea leaves by tea mosquito bug *Helopeltis theivora* Waterhouse was positively correlated to temperature, rainfall and partially to relative humidity in North Bengal. Kumar and Krishna Naik (2002) [4] reported that the population of *Helopeltis antonii* Sign. Was negatively correlated with maximum temperature in guava. Kalloor *et al.* (2020) [3] reported that sunshine hours are negatively correlated with the abundance of tea mosquito bug on neem at Mettupalayam region of Tamil Nadu.

Table 3: Correlation between weather parameters and incidence of tea mosquito bug infesting tamarind during June 2020-May 2021

Weather parameters	Correlation coefficient
Total rainfall (mm)	0.579*
Number of rainy days	0.458*
Maximum temperature (^{0}C)	-0.597
Minimum temperature (^{0}C)	0.107
Morning relative humidity (%)	0.446
Evening relative humidity (%)	0.602
Sunshine hours	-0.489

* Correlation coefficient is significant at 5% level

Multiple linear regression analysis between weather parameters and incidence of tea mosquito bug infesting tamarind

Multiple linear regression analysis between weather parameters and incidence of tea mosquito bug population on tamarind plantations at KVK, Chintamani showed a R^2 value of 0.928 indicated that 92.80 per cent influence of weather parameters on tea mosquito bug incidence.

The multiple linear regression equation was:

$$Y= 146.572 + 0.034X_1 – 0.752X_2– 4.56X_3 + 3.96X_4 – 2.54X_5 + 1.56X_6 + 1.28X_7$$

Thus for every unit increase of total rainfall, the tea mosquito bug population increased by 0.03 per five sweeps. Whereas, when the evening relative humidity increases by 1 per cent, the population of bugs increases by 1.56 bugs per five sweeps. Similarly, increase in sunshine hours by 1h/day, increased the population of tea mosquito bug by 1.28 bugs per five sweeps. Whereas, for every one degree Celsius increase in maximum temperature, the number of tea mosquito bug decreased by 4.56 bugs per five sweeps. The results are in accordance with the investigations of Zeiss and Braber (2001) [11] and Damiri (2002) [2] who reported that tea mosquito bug causes severe damage in the humid months of rainy season in Indonesia and Vietnam on cashew. Whereas, Roy *et al.* (2015) [9] reported that population of tea mosquito bugs on tea increase with prolonged wet or humid weather or intermittent rains with warm conditions.

Table 4: Multiple linear regression analysis between weather parameters and incidence of tea mosquito bug infesting tamarind during June 2020-May 2021

Variables	Regression coefficient (Y)
Intercept	146.572
Total rainfall (mm) (X_1)	0.034
Number of rainy days (X_2)	-0.752
Maximum temperature (^{0}C) (X_3)	-4.56
Minimum temperature (^{0}C) (X_4)	3.96
Morning relative humidity (%) (X_5)	-2.54
Evening relative humidity (%) (X_6)	1.56
Sunshine hours (X_7)	1.28
R^2 value	0.928

Conclusion

Correlation analysis studies revealed that incidence of tea mosquito bug, *H. antonii* showed positive relationship with total rainfall and number of rainy days with the r values of 0.579 and 0.458 and were found to be significant at 5 % level. Similarly, minimum temperature (T_{min}), morning relative humidity and evening relative humidity were found to be positively correlated with the population of tea mosquito bugs with the r values of 0.107, 0.446, and 0.602, respectively. While the maximum temperature (T_{max}) and sunshine hours were negatively correlated with the incidence of tea mosquito bug population with the r values of -0.597 and -0.489. Multiple linear regression analysis between weather parameters and incidence of tea mosquito bug showed a R^2 value of 0.928 indicated that 92.80 per cent influence of weather parameters on tea mosquito bug incidence.

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