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PREDICTION MODEL FOR TEA MOSQUITO BUG *HELOPELTIS ANTONII* ON EARLY CASHEW VARIETY IN KONKAN REGION OF MAHARASHTTRA

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ABSTRACT

Tea mosquito bug is an important pest of cashew all over the Konkan region of Maharashtra. It was observed that minimum temperature, afternoon humidity and wind speed had a significant negative correlation with tea mosquito bug (TMB) population, but it had a positive correlation with maximum temperature and sunshine hours. The TMB incidence was negligible below 18°C ± 1°C. The maximum incidence was observed in between 18 °C ± 1°C to 21°C ± 1°C. Whereas, regarding afternoon humidity, TMB incidence was found negligible below 53°C ± 1°C and maximum incidence was observed in between 53% ± 1% to 64% ± 1%. The prediction equations were derived through multiple regression analysis for early varieties based on pooled data for all the five years with respect to the pest population and the variety. Thus, this equation can be useful for the cashew growers, extension workers, scientists to take immediate effective control measure against Tea mosquito bug.

Key word : Cashew, Tea Mosquito Bug, regression, weather parameter

INTRODUCTION

Cashew is one of the dollar earning horticultural crop now a days commercially cultivated along the West coast of India particularly in Maharashtra, Kerala and Karnataka states. In Maharashtra, along the west coast, Ratnagiri and Sindhudurg are the major cashew growing districts where cashew is cultivated on commercial basis. Tea Mosquito Bug (TMB), *Helopeltis antonii* Sighoret (Hemiptera: Miridae) is one of the menacing pests of cashew across the west coast. TMB alone can cause a loss upto 50 per cent in yield of cashew. It was observed that minimum temperature in between 18^0C - 20^0C with 50 to 55 per cent afternoon relative humidity (relatively dry weather during majority of the days from December to February) might trigger the pest population and damage in cashew. The most favourable period for the rapid multiplication and population build up which is responsible for enhanced damage of the pest was between December to February synchronizing with the flowering and flushing of cashew (Pillai *et. al*., 1984). The population and damage of the pest were negatively correlated with the meteorological factors like minimum temperature, afternoon relative humidity and positively correlated with sunshine hours (Rai, 1981 and Prasada Rao *et al*., 2002). There is very scarce material available on the quantification of the effect of weather parameters (elements) on the population and damage of Tea Mosquito Bug. Hence, a field experiment was conducted at the cashew farm of Regional Fruit Research Station, Vengurle, Dist. Sindhudurg from 2002-2006 to study the effect of weather parameters on the damage of Tea Mosquito Bug on different early varieties of cashew so that the outbreak of Tea Mosquito Bug can be predicted in advance.

MATERIALS AND METHODS

A field experiment was started from the season of year 2001-2002 to study the seasonal incidence of tea mosquito bug (TMB) on cashew. Every year, randomly selected trees of early varieties of cashew *viz*., Vengurle-1, Vengurle-2 and Vengurle-3 were used for recording the observation on damage of Tea Mosquito Bug. Fresh 52 leader shoots were selected randomly on each tree under observation along with the 4 directions (E.W.N.S) and labeled individually. The observations regarding incidence of TMB was recorded on number of damaged shoots, panicles and nuts on each selected tree of each variety at weekly interval in 0 to 4 scale as given below.

0 – No lesions/Streaks

1 – 1 to 3 necrotic lesions/streaks

2 – 4 to 6 coalescing or non-coalescing lesions/ Streaks

3 – Above six (6) coalescing or non-coalescing lesions/Streaks

4 – Lesions/Streaks confluent or wilting or drying of affected shoots/panicle.

The data thus obtained were converted in to per cent incidence using following formula.

$$\text{Per cent incidence} = \frac{\text{Sum of all numerical ratings}}{\text{No. of shoots observed x maximum rating}} \times 100$$

Simultaneously, weather data pertaining to Rainfall, (Rain) Maximum (Tx) and Minimum (Tm) temperature, morning (RHx) and afternoon (RHm) relative humidity, wind speed (Ws) in km/hr and sunshine hours (Bright) (SSH) were also recorded during from 1976 to 2006 (30 yrs). Per cent damage of tea mosquito bug was worked out for every week and then for each fortnight. The data were subjected to multiple linear regression analysis so as to find out the linear regression equation of each variety separately to reveal the extent of direct and other factors responsible for triggering the TMB population, which is responsible for the enhanced damage. In Multiple linear regression analysis, weather parameters were taken as independent variables and TMB per cent damage was taken as the dependent variable for development of forecasting model.

RESULTS AND DISCUSSION

Reproductive phases of cashew. The details on the time of flushing initiation, the extent and progression in the phenological events such as flowering, nut formation, harvest and off season flushing were observed on all

Table 1. Per cent infestation of TMB on cashew variety Vengurla-1

Month	2004	2005	2006	Average	Predicted
Nov .I	0.24	0.72	1.45	0.578	1.279
Nov.II	1.2	2.16	5.29	1.922	2.899
Dec. I	1.68	2.41	6.25	2.984	3.442
Dec. II	2.65	1.92	9.86	3.992	14.553
Jan. I	7.21	6.01	8.41	7.886	12.967
Jan. II	15.86	10.58	14.75	14.842	11.545
Feb. I	16.35	15.15	8.42	13.658	10.245
Feb. II	9.62	8.17	4.57	7.792	8.772
Mar. I	10.58	11.54	2.16	7.644	6.560
Mar.II	8.42	8.66	0	5.34	4.928
Apri. I	6.49	6.01	0	3.894	3.034
Apri.II	3.37	4.33	0	2.118	1.859
May I	0	0	0	0	0.9169
May II	0	0	0	0	-0.111
Jun. I	0	0	0	0	-0.525
Jun. II	0	0	0	0	0.483
July. I	0	0	0	0	-0.605
July.II	0	0	0	0	-0.195
Aug. I	0	0	0	0	-0.316
Aug.II	0.48	0.24	0	0.144	0.502
Sep. I	1.68	0.72	0	0.48	1.303
Sep. II	2.65	0	0	0.626	1.519
Oct. I	2.65	0.48	0	0.866	0.194
Oct. II	0	0	0	0.384	0.194

varieties. An early variety, Vengurla – 1,2,3 flushing started during October IV week and 50 per cent flushing was observed during II week of November and completed by last (IV) week of November. Panicle initiation started during III week of November and 100 per cent flowering was observed in December III week. Nut formation started during January II week and harvesting was completed by Feb. IV week. The off season flushing was noticed in IV week of June.

Seasonal incidence of Tea Mosquito Bug. The mean per cent infestation of tea mosquito bug ranged from 0 per cent (May to August) to 14.25 per cent (Jan) in V1. The incidence was observed minimum (0.148 %) in IInd fortnight of August and its peak was noticed in IInd fortnight of January (14.84) per cent whereas, In Vengurla-2, it varied from 0.0 per cent (May to September) to 13.92 per cent (Feb.). The incidence was noticed minimum in 1st fortnight of October (0.054 %) and its peak activity was observed in Ist fortnight of Feb. (15.29 %). Similarly, in Vengurla-3, it varied from 0.0 per cent (May to November) to 13.85 per cent (February). The minimum incidence of TMB was observed in IInd fortnight of Nov. (0.48 %) and maximum incidence was noticed in Ist fortnight of January (13.99 %).

Weather parameter. Rainfall was maximum during IInd fortnight of June (142.81 mm) followed by IInd fortnight of July (135.58 mm). The maximum temperature was recorded in Ist fortnight of November (33.31^{0}C) and lowest in Ist fortnight of August (29.16^{0}C). The lowest temperature was observed in 1st fortnight of Feb. (18.59 ^{0}C) followed by that (27.06^{0}C) in IInd fortnight of May. (Table 2). Regarding

Table 2. Per cent infestation of TMB on cashew variety Vengurla-2

Month	2004	2005	2006	Average	Predicted
Nov .I	0	1.44	0	0.288	0.471
Nov.II	1.2	1.93	0.72	0.914	2.567
Dec. I	1.68	1.2	1.2	1.296	3.476
Dec. II	0.48	0.72	1.92	1.828	2.834
Jan. I	3.37	3.37	5.29	6.158	12.820
Jan. II	13.3	9.28	8.65	12.208	10.893
Feb. I	19.71	12.74	7.21	15.286	10.886
Feb. II	16.11	9.62	2.41	12.552	8.894
Mar. I	11.06	10.58	1.2	8.994	7.093
Mar.II	7.45	7.93	0.96	5.624	4.587
Apri. I	4.81	4.09	0	3.464	2.657
Apri.II	0	1.93	0	0.77	1.951
May I	0	0	0	0	1.727
May II	0	0	0	0	-0.668
Jun. I	0	0	0	0	-1.724
Jun. II	0	0	0	0	0.426
July. I	0	0	0	0	-0.823
July.II	0	0	0	0	0.024
Aug. I	0	0	0	0	-0.312
Aug.II	0	0	0	0	0.917
Sep. I	0	0	0	0	0.864
Sep. II	0	0	0	0	1.531
Oct. I	0.27	0	0	0.054	-0.645
Oct. II	0.72	0	0	0.144	-0.873

Table 3. Per cent infestation of TMB on cashew variety Vengurla-3

Month	2004	2005	2006	Average	Predicted
Nov .I	0	0	0	0	-0.012
Nov.II	0.24	0	0	0.048	2.204
Dec. I	12	0	0.24	0.576	3.576
Dec. II	2.17	0.48	0.96	1.49	2.669
Jan. I	3.37	2.17	3.37	3.952	10.637
Jan. II	8.17	6.97	8.03	8.64	8.995
Feb. I	16.35	15.15	4.81	13.994	9.686
Feb. II	18.27	12.02	2.65	13.706	8.343
Mar. I	13.22	13.23	0.96	10.202	6.836
Mar.II	6.73	7.45	0	5.92	4.369
Apri. I	3.37	5.79	0	3.708	2.667
Apri.II	0.96	1.93	0	0.962	2.555
May I	0	0	0	0	2.378
May II	0	0	0	0	-0.543
Jun. I	0	0	0	0	-2.198
Jun. II	0	0	0	0	0.276
July. I	0	0	0	0	-1.263
July.II	0	0	0	0	0.259
Aug. I	0	0	0	0	-0.109
Aug.II	0	0	0	0	1.324
Sep. I	0	0	0	0	1.083
Sep. II	0	0	0	0	1.842
Oct. I	0	0	0	0	-0.816
Oct. II	0	0	0	0	-1.569

morning relative humidity, the maximum value was observed in IInd fortnight of July (84.20 %), whereas the minimum was observed in Ist fortnight of January (53.84 %). Afternoon humidity was observed maximum in August IInd fortnight (89.18 %) and minimum was observed in Ist fortnight of May (70.61 %). In case of wind speed, it was maximum in IInd fortnight of July (5.8 Km/hr) and minimum in Ist fortnight of January (1.8Km / hr). (Table 2). The sunshine hrs were maximum (11.32) in IInd fortnight of December, whereas minimum (3.45) was observed in Ist fortnight of July, which coincides with flushing, flowering and fruiting stages of cashew in Konkan region (Table 2).

Correlation Analysis. The mean TMB infestation on early variety Vengurla-1 showed significant negative correlation with rainfall (-0.483 *), afternoon relative humidity (-0.710 **), min. temperature (-0.786**) and wind speed (-0.855**) and positive correlation with maximum temperature (0.235) and sunshine hrs. (0.360). Another early variety Vengurla-2 showed significant negative correlation with rainfall (-0.429*), afternoon relative humidity (-0.644**), minimum temperature (0.724 **), wind speed (0.798 **) and positive correlation with maximum temperature (0.185) and sunshine hrs (0.304). The variety, Vengurla 3 showed significant negative correlation with rainfall (-0.409 **), afternoon relative humidity (-0.594**), minimum temperature (-0.653**) and wind speed (-0.721**) whereas it had positive correlation with maximum temperature (0.165) and sunshine hours (0.293).

The pest population was high during flushing and

Table 4. Average and Predicted population of TMB on different varieties of cashew

Month	V-1(Av.)	V-1(Pred.)	V- 2(Av.)	V-2(Pred.)	V-3(Av.)	V-3(Pred.)
Nov .I	0.578	1.279	0.288	0.471	0	-0.012
Nov.II	1.922	2.899	0.914	2.567	0.048	2.204
Dec. I	2.984	3.442	1.296	3.476	0.576	3.576
Dec. II	3.992	14.553	1.828	2.834	1.49	2.669
Jan. I	7.886	12.967	6.158	12.820	3.952	10.637
Jan. II	14.842	11.545	12.208	10.893	8.64	8.995
Feb. I	13.658	10.245	15.286	10.886	13.994	9.686
Feb. II	7.792	8.772	12.552	8.894	13.706	8.343
Mar. I	7.644	6.560	8.994	7.093	10.202	6.836
Mar.II	5.34	4.928	5.624	4.587	5.92	4.369
Apri. I	3.894	3.034	3.464	2.657	3.708	2.667
Apri.II	2.118	1.859	0.77	1.951	0.962	2.555
May I	0	0.9169	0	1.727	0	2.378
May II	0	-0.111	0	-0.668	0	-0.543
Jun. I	0	-0.525	0	-1.724	0	-2.198
Jun. II	0	0.483	0	0.426	0	0.276
July. I	0	-0.605	0	-0.823	0	-1.263
July.II	0	-0.195	0	0.024	0	0.259
Aug. I	0	-0.316	0	-0.312	0	-0.109
Aug.II	0.144	0.502	0	0.917	0	1.324
Sep. I	0.48	1.303	0	0.864	0	1.083
Sep. II	0.626	1.519	0	1.531	0	1.842
Oct. I	0.866	0.194	0.054	-0.645	0	-0.816
Oct. II	0.384	0.194	0.144	-0.873	0	-1.569

flower initiation coinciding with winter season (January to March) during which the maximum and minimum temperatures were relatively low when compared to that of the other seasons.

Multiple regressions. The regression equation was developed following line technique. The dependent variables were treated as TMB infestation and remaining all weather parameters were independent variables to develop the equation. The equation predicts the TMB infestation throughout the year. From equation, the R^2 value indicates the level of association of predicted value with observed values for early Vengurla varieties.

Among the weather parameters, afternoon humidity, rainfall, sunshine hours and minimum temperature were found most influencing weather parameters for the TMB infestation on the basis probability value. Therefore, the step down method was used to remove other parameters, which were not congenial for the TMB infestation from predicted model. Weather parameters assumed significance toward infestation of TMB. Accordingly regression equation was developed for early Vengurla varieties. The equation was developed for the TMB infesting contributing factors only.

The prediction equation was derived through multiple regression of pooled data for the five years with respect to TMB infestation, prediction. The equation for pooled

data is as follows:

Sr. No.	Multiple Regression Equation	R^2 Value
1.	$Y_1 = 0.077255X_1 - 0.33449\ X_2 - 0.08425X_3 - 0.6648X_4 - 1.36063\ X_5 - 2.25732\ X_6 - 0.28381X_7 + 89.83422$	0.868
2.	$Y_2 = 0.088461X_1 - 0.01417X_2 - 0.57036X_3 - 0.66156\ X_4\ 2.10393X_5 - 3.18725\ X_6 + 0.072528X_7 + 144.0199$	0.789
3.	$Y_3 = 0.082049X_1 + 0.110797X_2 - 0.76649X_3 - 0.7401\ X_4 - 3.08002\ X_5 - 3.00479\ X_6 - 0.681934X_7 + 178.145$	0.684

Y_1 = Predicted infestation of TMB on cashew variety Vengurla-1

Y_2 = Predicted infestation of TMB on cashew variety Vengurla-2

Y_3 = Predicted infestation of TMB on cashew variety Vengurla-3

X_1 = Rainfall (mm) X_5 = Maximum temperature (^oC)

X_2 = Afternoon humidity (%) X_6 = Wind speed (km/hr.)

X_3 = Forenoon humidity (%) X_7 = Sunshine hours.

X_4 = Minimum temperature (^oC)

The TMB incidence was negligible below 18°C ±1°C. The maximum incidence was observed in between 18°C ± 1°C to 21°C ± 1°C and it got declined after minimum temperature whereas regarding afternoon humidity, TMB incidence was found negligible below 53°C ± 1°C and maximum incidence was observed in between 53°C ± 1°C to 64°C ± 1°C and it gets declined afterwards.

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