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Research Article

SEASONAL INCIDENCE OF MANGO RED BANDED CATERPILLAR, *AUTOCHARIS ALBIZONALIS* HAMPSON (PYRALIDAE: LEPIDOPTERA) IN CONSIDERATION OF AGRO-CLIMATIC FACTORS AT MALDA DISTRICT OF WEST BENGAL,INDIA

Ajoy Sarkar[1]*, Suman Sarkar[2] and Kaushik Chakraborty[3]

[1]Department of Zoology, Balurghat Mahila Mahavidhyalaya, Balurghat, West Bengal
[2]Department of Zoology, University of Gour Banga, Mokdumpur, Malda, West Bengal
[3]Raiganj University, Raiganj, Uttra Dinajpur, West Bengal, 733134

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A B S T R A C T

Mango red banded caterpillar, MRBC *Autocharis albizonalis* is one of the most notorious and destructive insect pests of growing mango fruits rendering considerable range of damage. Substantial varieties of mango that were produced in Malda, district of West Bengal were infested by this pest. Out of that *Lakhanbhog*, *Langra* were important from economical point of view. Three distantly located mango producing places, namely Sattari, Kazigram, Gokul Nagar Kamat of Malda district were considered to assess the incidence of mango red banded caterpillar for consecutive fruit growing season (2016-2018). Incidence of mango red banded caterpillars for *Lakhanbhog* and *Langra* variety was primarily reported during 8 SMW (Standard meteorological week) and then continued up to 14 SMW and ultimately subsumed at 19 SMW. Population of Mango red banded caterpillar showed significant negative correlation with agro-climatic factors such as maximum temperature, minimum temperature, average temperature, temperature gradient, unshine hour but maximum humidity, minimum humidity, average humidity expressed significant positive relation with the seasonal incidence of *Autocharis albizonalis.*

INTRODUCTION

Mango of variable texture is very important fruit with high nutritive and medicinal value (Abdelnaser *et al.,*2010; Litz,1997).Mango fruit possesses anti-cancer (Parvez and Mosaddik,2016), anti-oxidant (Shieber *et al.,*2000; Diplock *et al.,*1998), anti-diabetic(Lucas *et al.,*2011) and anti-allergenic property (Rivera *et al.,*2006). West Bengal within Indian subcontinent is regarded as one of good mango producing state. Congenial environment of West Bengal ensures good mango production (Singh, 2012). However, production of mango is restricted due to the presence different insect pests (Bhattacharya, 2014). Insect and non-insect pests are responsible for mango fruit defoliation (Tandon and Srivastava,1982; Tandon,1977)

Mango red banded caterpillar, MRBC *Autocharis albizonalis* Hampson is one of the destructive pest to growing mango fruits in Malda District of West Bengal rendering 10-52% damage (Bhattacharya ,2014).Considerable range of damage was observed in Murshidabad, Nadia and Hooghly District of West Bengal (Sahoo and Jha,2009;Jha and Sarkar,1991). Incidence of MRBC causes reduction in mango production at Andhra Pradesh and Karnataka state of India.

Corresponding author:* **Ajoy Sarkar
Department of Zoology, University of Gour Banga, Mokdumpur, Malda, West Bengal

MRBC from different orchards of Malda and Murshidabad district was also noted by Jha and Sarkar (1991). *Noorda albizonalis* Hampson ,*Ctenomeristis ebriola* Meyrick, *Dichocrosis punctiferalis* Guence. were recorded by Sengupta and Behura (1955). Eggs hatched into destructive larval stage. Golez (1991) reported, MRBC had five larval instars. First instar larva was recorded to feed on fruit pulp at the apex.

Eggs hatched into destructive larval stage. MRBC had five larval instars. 11 larval instar were recored but in some cases only one larval stage was observed (Leefmans and Van der Vecht ,1930).First instar larva was recorded to feed on fruit pulp at the apex (Butani, 1979; Waterhouse,1993) All the larval instars including mature caterpillar are observed to damage different growth stages of mango fruits. The developing larva makes a hole inside the mango to get in touch with the seed. Larval instars were also recorded from growing mango pulp (Golez, 1991). Krull (2004) had noted that mango of all sizes were generally attacked by gregarious caterpillar. Fruits that are fallen from tree are severely attacked by MRBC (Kalshoven,1981). MRBC are observed in the orchards of Southeast Asia and Papua New Guinea except Burma and north-east India where the mango probably evolved (Mukherjee,1997).The present experiment was aimed to study the seasonal incidence of MRBC and effect of weather parameters on pest population.

Figure I: incidence of MRBC in mango orchards (a) mature mango red banded caterpillar (b) larval form of mango red banded caterpillar observed in mango pulp,(c) mango red banded caterpillar causing necrosis of the mango. D) mango red banded caterpillar found in mango seed.

MATERIALS AND METHODS

The seasonal incidence of MRBC was observed during three consecutive mango fruit years (2016-2018) in pesticide untreated field of mango cultivar namely *Lakhanbhog* and *Langra*. About 25-years old mango trees were selected and data of pest population was taken from 8 standard meteorological weeks (SMW). Three places of Malda District recognized for the mango production namely Sattari, Kazigram, Gokul Nagar kamat were selected for survey.

Seasonal incidence of MRBC was recorded from 10 randomly selected mango trees. 100 mango fruits of developing stages were tagged for the study of *Autocharis albizonalis* population. MRBC was registered as individuals/mango fruit basis and extent of damage was also recorded. Three replications were made for each of the study years.

Weekly noted MRBC population was correlated with the prevailing climatic factors such as maximum temperature (Tmax), minimum temperature (Tmin), temperature gradient (Tgr), maximum humidity (RHmax), minimum humidity (RHmin), humidity gradient (RHgr), sunshine hour (Shr), rainfall (Rfall) and rainy days (Rdays).

The collected data of MRBC and agro-climatic factors were analysed by using Excel 2007.Correlation and regression were done to study the relation between weather parameters and seasonal incidence of *Autocharis albizonalis.*

RESULT

In present study,seasonal incidence of MRBC varied with the alteration of agroclimatic factors.Weather parameters play important role in the fluctuations of pest population.

Incidence of MRBC in Lakhanbhog variety during period of observation (2016-2018)

In 2016, very low population of *A. albizonalis* was recorded up to 8 SMW with 2.00±0.10% extent of damage. The population then gradually increased from 9 SMW to 12 SMW. The number then further improved gradually and comparatively pest incidence was recorded from 13 SMW to 19 SMW. The appearance of peak population was primarily restricted within 15 SMW with fruit damage of 10.76±0.25%. The population then subsumed at first slowly and then abruptly. Low incidence of MRBC population was recorded from 19 SMW up to crop harvesting.

In 2017, MRBC infestation was started from 8 SMW. The extent fruit injury was 0.70±0.26%. Degree of damage gradually increased up to 16 SMW attaining peak incidences during 16 SMW with 9.80.± 0.15% fruit damage.The pest population declined during 19 SMW with 2.26.± 0.64 % fruit loss.

In 2018, MRBC infestation started at about 08 SMW with 1.90±0.10% fruit infestation . The rate of infestation steadily increased up to 12 SMW. Incidence of this pest reached the peak appearance during 13 SMW with 6.60±0.36 % fruit loss and then slowly declined but remained active till the harvest of the crop.

Incidence of MRBC in Langra variety during period of observation (2016-2018)

During 2016, MRBC was first observed at 8 SMW with a value of 1.03±0.15 % fruit infestation . Its incidence was low up to 10 SMW. Then pest population increased gradually and reached the maximum level at 15 SMW with 8.13±0.15 % fruit infestation. Again incidence of the pest decreased at first slowly and then steadily. The population then caused 1.30 ±0.26 % fruit damage at about 19 SMW and remained very active throughout mango cultivation period.

During the study period of 2017, it was recorded that primary infestation of MRBC occurred at 8 SMW when extent of damage was 1.03±0.25% then pest population increased slowly from 9 to 11 SMW and then reached peak in 15 SMW with 9.66±0.30% fruit damage. The lowest pest count was observed at 19 SMW with the value of 2.33±0.30% fruit loss.

In 2018, the initial infestation took place at 8 SMW with 1.70±0.26% extent of damage, then number of pest increased upto 14 SMW attaining highest population with 7.2±0.26% fruit damage. Then the pest number decreased at 19 SMW.

Average data of mango red banded caterpillar population infestation with extent of damage during study period (2016-2018)

Grossly during the period of observation, *A. albizonalis* population was first initiated at about 8 SMW with a value of 1.66±0.57 % fruit infestation for *Lakhanbhog* mango where as this value was 1.33±0.33 % for *Langra* mango. Its incidence was moderate up to 11 SMW Fig. 1 (a-d). The pest population then increased gradually and attained the maximum level of abundance at about 14 SMW with 9.00 ±2.00 % fruit infestation for *Lakhanbhog* mango while peak population observed for *Langra* mango was at 14 SMW with 7.33±0.57% fruit loss. Again incidence of the *A. albizonalis* subsumed at first slowly and then steadily. The population decreased at about 19 SMW with 1.66 ±1.52 % fruit damage in *Lakhanbhog* mango and 1.00±1.00 % fruit loss for *Langra* mango .

Study on the impact of the agro-climatic parameters on the incidence of Autocharis albonozalis.

In 2016,the incidence of *Autocharis albonozalis* showed negative significant correlation with the maximum temperature (r = -0.8124, Y= - 0.37811x+57.12),minimum temperature (r= -0.8641, Y= - 0.39987x+29.61),temperature gradient (r= -0.5356, Y= - 0.07538x+19.57) where as maximum humidity(r= 0.7660, Y= 1.04189x-97.83) ,minimum humidity (r=0.5112, Y= 1.06879x-71.48),average humidity (r=0.6711, Y=1.16743x-81.16),rainfall (r=0.6789, Y=4.36856x-39.21),rainy day (r= 0.7523, Y=3.00115x+0.58) had expressed positive correlation with the seasonal incidence of MRBC.

During 2017, the MRBC had expressed significantly negative relation with minimum temperature (r= -0.7715, Y= -0.17487x+34.77) while significant positive relation was found with maximum humidity (r=0.6795, Y= 0.26763x-178.08), minimum humidity (r=0.5887, Y= 0.47814x-70.31), average humidity (r=0.7191, Y= 0.43492x-86.07), rainfall(0.7792, Y= 1.14150x-45.85).

In 2018,*Autocharis albozonalis* population showed significantly negative correlation with maximum temperature (r= -0.5728, Y=-5.91509x+249.97), minimum temperature (r= -0.8288, Y=-5.92238x+161.74), temperature gradient (r= -0.6118, Y= -6.98206x -27.17), average temperature (r= -0.6807, Y=-5.75478x+97.11), sunshine hour (r= -0.5483, Y=-3.13911x+ 37.02) where as significantly positive correlation was observed with maximum humidity (r= 0.6368, Y=4.35775x-280.02), minimum humidity (r= 0.5115, Y=1.8543x-45.39), average humidity (r= 0.668, Y=2.434516x-122.21).

Gross incidence of MRBC was recorded during 2016-2018 mango season. Maximum temperature (r= -0.6663, Y = -0.12176x+21.26),minimum temperature (r= -0.7987, Y = -5.41161x+117.93),average temperature (r= -0.5605, Y = -0.54706x +54.04),sunshine hour (r= -0.5740, Y = -3.27788x +29.46) showed significant and negative relation with the pest population. MRBC had expressed positive correlation with maximum humidity (r=0.6795, Y= 2.72901x -139.42), minimum humidity (r=0.5689, Y = 1.15446x -44.56), average humidity (r=0.8140, Y = 1.44225x -73.99).

Table III Average climatic parameters (2016-2018) and the incidence of MRBC population during the period of study for *lakhanbhog* mango and *langra* variety.

SMW	Temperature				Relative humidity				Average sunshine hour (hr/day)	Rainfall (mm)	Number of rainy days	Individuals /*Lakhanbhog* mango	Individuals /*Langra* mango
	Tmax	Tmin	Tgr	Tavg	RHmax	RHmin	RHgr	RHavg					
08	32.65	19.81	12.84	26.23	95.47	46.38	49.09	70.93	5.84	0.87	1	1.66±0.57	1.33±0.33
09	32.61	21.11	11.50	26.86	94.83	47.14	47.69	70.99	5.17	0	0	2.00±1.00	1.33±0.33
10	33.89	22.56	11.33	28.23	96.53	78.00	18.53	87.27	7.47	0	0	3.66±0.57	3.00±1.00
11	35.42	23.21	12.21	29.32	96.22	65.01	31.21	80.62	2.29	0	0	5.33±0.57	4.33±1.15
12	35.82	23.65	12.17	29.74	95.53	56.27	39.26	75.90	2.04	0	0	6.33±1.52	6.33±0.57
13	35.72	23.13	12.59	29.43	95.00	44.53	50.47	69.77	3.48	2.87	0	7.66± 1.15	6.66±0.57
14	36.72	24.35	12.37	30.54	95.84	46.12	49.72	70.98	6.47	0	0	9.00±2.00	7.33± 0.57
15	40.31	24.25	16.06	32.28	94.25	40.12	54.13	67.19	6.94	0	0	8.33±3.78	7.00±2.64
16	36.35	24.79	11.56	30.57	94.76	41.79	52.97	68.28	8.69	3.02	1	7.00±4.35	4.33±2.51
17	39.23	24.05	15.18	31.64	94.28	48.41	45.87	71.35	7.35	2.51	1	5.33±2.88	3.33±1.52
18	40.81	25.34	15.47	33.08	96.01	41.59	54.42	68.80	8.51	1.62	1	3.66±1.52	2.66±1.15
19	41.69	30.92	10.77	36.31	85.01	47.41	37.60	66.21	8.53	1.97	1	1.66±1.52	1.00±1.00

Table IV Linear regression on the incidence of Mrbc with the climatic factors in consideration of the three selected places namely (A) Sattari (B) Kazigram And (C) Gokul Nagar Kamat (2016-2018)

Climatic parameters	Years of observation			Collective impact
	2016	2017	2018	
Maximum temperature (Tmax)	Y= -0.37811x+57.12	Y= -0.07646x+78.09	Y=-5.91509x+249.97	Y = -0.12176x+21.26
Minimum temperature (Tmin)	Y= -0.39987x+29.61	Y= -0.17487x+34.77	Y=-5.92238x+161.74	Y = -5.41161x+117.93
Temperature gradient (Tgr)	Y= -0.07538x+19.57	Y= -0.04158x+21.42	Y= -6.98206x -27.17	Y =0.70169x+ 58.16
Average temperature (Tavg)	Y= -0.44733x+34.27	Y= -0.34522x+41.20	Y=-5.75478x+97.11	Y = -0.54706x +54.04
Maximum humidity(RHmax)	Y= 1.04189x-97.83	Y= 0.26763x-178.08	Y=4.35775x-280.02	Y= 2.72901x -139.42
Minimum humidity (RHmin)	Y= 1.06879x-71.48	Y= 0.47814x-70.31	Y=1.8543x-45.39	Y = 1.15446x -44.56
Humidity gradient (RHgr)	Y= -0.03790x+26.60	Y= -0.26650x+56.90	Y=-1.73811x+45.60	Y = -0.45700x +41.94
Average humidity (RHavg)	Y=1.16743x-81.16	Y= 0.43492x-86.07	Y=2.434516x-122.21	Y = 1.44225x -73.99
Rainfall (Rfall)	Y=4.36856x-39.21	Y= 1.14150x-45.85	Y=-0.02676x+31.27	Y= 0.15476x +31.58
Rainy day (Rdays)	Y=3.00115x+0.58	Y=1.55600x+38.46	Y = 1.52278x+28.67	Y = 3.8767x +5.12
Sunshine hour (Shr)	Y=-1.24539x+11.38	Y= -2.88480x+ 48.26	Y=-3.13911x+ 37.02	Y = -3.27788x +29.46

Table I Seasonal incidence and extent of damage of MRBC for *Lakhanbhog* variety at Malda, West Bengal (2016-18)

SMW	Incidence of *A. albizonalis* in Lakhanbhog mango orchards by fruit tagging					
	2016		2017		2018	
	Individual/fruit	Extent of damage (%)	Individual/fruit	Extent of damage (%)	Individual/fruit	Extent of damage (%)
08	2.00±0.50	2.00±0.10	1.00±0.43	0.70±0.26	2.00±0.36	1.90±0.10
09	3.00±0.30	2.66±0.30	1.00±0.75	0.83±0.15	2.00±0.43	1.70±0.51
10	4.00±0.43	3.70±0.20	3.00±0.52	2.43±0.49	4.00±0.10	3.53±0.45
11	6.00±0.36	5.66±0.30	5.00±0.17	4.53±0.40	5.00±0.40	4.73±0.25
12	8.00±0.36	7.86±0.15	5.00±0.79	4.83±0.15	6.00±0.40	5.50±0.37
13	9,00±0.80	8.70±0.25	7.00±0.30	6.20±0.75	7.00±1.01	6.60±0.36
14	11.00±0.26	10.83±0.08	9.00±0.55	8.53±0.45	7.00±0.30	6.50±0.43
15	11.00±0.60	10.76±0.25	10.00±0.30	8.90±0.98	4.00±0.45	3.50±0.45
16	9.00±0.30	8.56±6.23	10.00±0.36	9.80±0.15	2.00±0..52	1.60±0.45
17	7.00±0.10	6.56±0.58	7.00±0.26	6.60±0.45	2.00±0.36	1.36±0.55
18	4.00±0.45	3.43±0.60	5.00±0.10	4.13±0.77	2.00±0.43	1.66±0.49
19	2.00±0.17	1.60±0.40	3.00±0.43	2.26±0.64	0.00±0.00	0.00±0.00

Note: Data are expressed as mean ± SD of three replicates

Table II: Seasonal incidence and extent of damage of MRBC for Langra variety at Malda, West Bengal (2016-18) **.**

SMW	Incidence of *A. albizonalis* in Langra mango orchards by fruit tagging					
	2016		2017		2018	
	Individual/fruit	Extent of damage (%)	Individual/fruit	Extent of damage (%)	Individual/fruit	Extent of damage (%)
08	1.00±0.50	1.03±0.15	1.00±0.55	1.03±0.25	2.00±0.20	1.70±0.26
09	1.00±0.26	1.00±0.30	1.00±0.30	0.96±0.15	2.00±0.30	1.50±0.43
10	2.00±0.10	2.03±0.15	3.00±0.26	3.00±0.26	4.00±0.50	3.96±0.15
11	5.00±0.43	5.10±0.26	3.00±0.70	3.10±0.10	5.00±0.62	5.10±0.20
12	6.00±0.62	5.90±0.35	7.00±0.17	7.03±0.32	6.00±0.43	6.20±0.20
13	6.00±0.43	6.50±0.45	7.00±0.55	7.13±0.15	7.00±0.45	6.73±0.25
14	7.00±0.43	7.03±0.15	8.00±0.45	7.96±0.35	7.00±0.60	7.20±0.26
15	8.00±.36	8.13±0.15	9.00±0.26	9.66±0.30	4.00±0.87	4.33±0.35
16	4.00±1.27	4.10±0.36	7.00±0.55	7.06±0.20	2.00±0.30	2.16±0.20
17	3.00±0.30	3.40±0.40	5.00±0.17	4.93±0.20	2.00±0.30	2.26±0.25
18	2.00±0.79	2.33±0.35	4.00±0.36	3.93±0.15	2.00±0.75	2.10±0.10
19	1.00±0.43	1.30±0.26	2.00±0.17	2.33±0.30	0.00±0.00	0.00±0.00

Note: Data are expressed as mean ± SD of three replicates

Table V: Correlation coefficient of the incidence of MRBC with the climatic factors in the district of malda (2016-18) in consideration of the three selected places namely (A) Sattari (B) Kajigram And (C) Gokulnagar Kamat

Climatic parameters	Years of observation			Gross impact
	2016	2017	2018	
Maximum temperature (Tmax)	-0.8124***	-0.2359**	-0.5728***	-0.6663***
Minimum temperature (Tmin)	-0.8641***	-0.7715***	-0.8288***	-0.7987***
Temperature gradient (Tgr)	-0.5356***	-0.3227^{NS}	-0.6118**	-0.4123 *
Average temperature (Tavg)	-0.1167^{NS}	-0.2272 ^{NS}	-0.6807***	-0.5605 *
Maximum humidity(RHmax)	0.7660***	0.6795***	0.6368**	0.6795***
Minimum humidity (RHmin)	0.5112*	0.5887***	0.5115***	0.5689***
Humidity gradient (RHgr)	-0.0640^{NS}	-0.5877 ^{NS}	-0.3281^{NS}	-0.2137 ^{NS}
Average humidity (RHavg)	0.6711***	0.7191**	0.66842***	0.8140***
Rainfall (Rfall)	0.6789**	0.7792**	-0.0819^{NS}	0.4946^{NS}
Rainy day (RD)	0.7523***	0.1034^{NS}	0.2500 ^{NS}	0.3449 ^{NS}
Sun shine hour (SSH)	-0.4954	-0.4792	-0.5483**	-0.5740**

Note: * indicats significant at P<=0.05, **<=0.01, *<=0.001, NS= not significant**

DISCUSSION

Bhattacharya (2014) reported from observations during 2009 to 2010 that maximum populations of MRBC were recorded from last week of March and April but these population decreased in number in the last week of May. The caterpillars fed different stages of fruits increasing continuously from March to april and ultimately found in lowest in the month of may. Maximum temperature, minimum temperature, maximum and minimum relative humidity (%), rainfall were the main agroclimatic factors for the incidence of MRBC as reported by Bhattacharya (2014). Bhattacharya (2014) observed that peak pest population was found from march month in 2010 when temperature, relative humidity and rainfall were in the range of 16.9-36.6 ºC, 31.4-98% and 0-27.1 mm respectively but negligible pest populations were recorded in second week of May when temperature, relative humidity and rainfall varied from 22.8-38.4 ºC, 51.6-93% and 27.1 mm respectively. In present investigation, the incidence of MRBC was observed from last week of February to the month of May. Maximum temperature , minimum temperature, relative humidity and rainfall were the major responsible factors for the seasonal incidence of MRBC in Malda District West Bengal. Inspite of these agro-climatic factors average temperature, humidity gradient, average humidity, sunshine hours were the important factors which could influence the pest population.

Maximum pest population was seen in the month of march and April month and outcomes were almost analogous to the observation of Sahoo *et al.* (2004) which was corresponding to our results during study period.

Golez (1991) reported that that maximum number of MRBC was observed during summer and result was quite related to our study evaluation.

MRBC, *Deanolis sublimbalis* snellen was observed in cape York Peninsula, Australia (Royer, 2009). Royer (2009) reported that the caterpillar fed on the fruit flesh as well as the seed. Zaheruddeen and Sujatha (1993) recorded that these larvae damaged the fruit from marble to maturing stages. This findings were alike with our results during field survey. Gibb *et al*. (2007) reported that adult MRBC were observed in maximum number in the month of September and October in Australia which was also confirmed by Yarrow and Chandler (2006). This results differed from our observation because maximum infestation occurred during march to April month.

CONCLUSION

From the present experiment, it was very clear that seasonal incidence of MRBC was entirely depended on agro-climatic factors at Malda District. Number of pest population altered with the variation of weather parameters. MRBC infestation started from 8 SMW improving continually up to 14 SMW and finally less number of pest was recorded at 19 SMW. Peak population was found from March to April month and it was depend on the climatic factors. The present study helped the mango farmers to give a clear idea about the control management of the MRBC so that mango production of Malda District could improve.

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