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Seasonal occurrence and record of alternative host plant of mango mealy bug, *Drosicha mangiferae* in relative to climatic parameters at Malda, West Bengal

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Abstract

The mango mealy bug, *Drosicha mangiferae* population was studied during 2017-2018 at Malda District, West Bengal. The climatic parameters play a decisive role in determining the abundance and distribution of pest population. The observation on natural higher infestation of mealy bug was showed mango tree, besides this also on alternative host plants of guava and custard apple. The mango mealy bug first appeared on 7 SMW. Its population increased gradually and maximum population was noted at about 15 to 17 SMW in relation to the development of mango fruits in the orchard, afterwards its number decreases mostly from 18 SMW to 20 SMW. The present work was found correlation between mealy bug populations with climatic parameters. The mealy bug population was showed significantly positive correlation with minimum temperature and relative humidity gradient whereas, significant negative correlation with minimum relative humidity. The present works in near future will further developed an insect pest forecast model based on meteorological variables that help in the pest management programs.

Keywords: Mango mealy bug, *Drosicha mangiferae*, population dynamics, correlation

Introduction

India is predominantly an agriculture based country with more than two thirds of its population living in rural areas. Agriculture contributes 29.4 % of Indian gross domestic product and also provides working for 64 % of the country's workforce (Rao, 2004) [19]. Mango (*Mangifera indica* L.) is one of the world`s most important cultivated tropical fruits that are grown in India. World production of mango was about 28.5 million tonnes accounting for nearly 50% of the world tropical fruit production (Ambele *et al.*, 2012) [1]. Bengal concerns 70-80 thousand hectares of mango cultivation field sharing 44% of the total area occupied for food crop cultivation of the state (Bhattacharyya, 2014) [6] and Malda tops the list within the state with an annual net production of about 270 thousand tons (Anonymous, 2017) [2]. Insect pests are the major threat to underscore the mango production (Ishaq *et al.*, 2004) [13]. Grossly 400 insects and non-insect mango pests with economic importance are recorded from Indian subcontinents (Sengupta *et al*., 1957) [21]. The mealy bug species cause considerable economic damage to agricultural and horticultural plants (Arif *et al.,* 2002) [3]. Mango mealy bug, *Drosicha mangiferae*, is the serious, dilapidating, polyphagous, dimorphic and notorious insect pest of mango orchards in Indian sub-continent (Rao *et al*., 2006) [18]. Mealy bugs are so named because many of the known species are covered in a whitish 'mealy' wax, which helps to retard the loss of water from their soft bodies. Damage to mango plants is due to the sucking of 'cell sap' from tender leaves, stem, inflorescence and even from the growing mango fruits and make it unfit for human consumption (Bhagat, 2004) [5]. Moore (2004) [16] reported that in West Africa, infestation of mealy bug rendered 50-90% mango fruit loss (Karar *et al*., 2013) [14] had observed that mealy bug ranked second pests in consideration to damage to mango after leafhopper and causes damage up to 50%.

The climate as an extrinsic integrative factor plays a crucial role in determining the abundance and distribution of insect pest population. Singh *et al*. (2009) [23] had observed that abiotic factors are believed to be responsible for pest population dynamics. Hatching and transformation of different stages of life cycle depend on certain environmental condition. The mealy bug female deposits eggs in the cracks in the soil in the month of April-May (Chowdhury, 2015) [8] that remain in diapauses from May to middle of December (Sen and Prasad, 1956) [20] and hatched in the last of December sometimes extending up to January (Srivastava *et al*., 1973) [24] depending upon the climatic factors (Ashfaq *et al*., 2005) [4].

First instars nymphs were noted during December to February, second and third instar during February to mid-March and from March to April and then became adults. Alteration of environmental factors may effect on their life cycle thereby effecting time of infestation. The present study was investigating the alternative host plant of *D. mangiferae*, incidence of mango mealy bug with standard meteorological weeks (SMWs) and relation of mealy bug with climatic factors. This study may be used as an effective tool to forewarn the mango mealy population and prevent fruit loss by efficiently planning control measures well in time.

Materials and Methods

Place of observation: Incidence of *D. mangiferae* was recorded from three sites that are separated from nearby site by about few kilometres apart and have mostly same mango cultivar. Villages are located within Malda district of West Bengal. The villages are Tripajani (Kotwali) (latitude 25.04, longitude-88.10) (ii) Manikpur, Lakshmipur (Kazigram) (Latitude 25.01, Longitude 88.07) (ii) Sonatala (Amriti) (Latitude 25.03, Longitude 88.06) was studied (Fig. 1).

Agro-climatic conditions of the experimental area: The climate was warm and temperate. The annual rain fall during the period of study was varies, the maximum rainfall occurs during the rainy months of June to September about more than 80% of the total rain fall. The annual average day night temperature ranges from 21.5 to 31.2ºC, even as high in April-May and lesser in January. The relative humidity was high in the air throughout the year.

Period of observation: Different orchards from each experimental village were considered for survey of *D. mangiferae* population which was carried out for two consecutive fruit season i.e. 2017-2018. Orchards are inspected on every Standard Meteorological Week (SMW) during mango growing season in the basis of pests.

Experimental parameters: Climatic parameters like maximum temperature (Tmax), minimum temperature (Tmin), average temperature (Tavg), temperature gradient (Tgr), maximum relative humidity (RHmax), minimum relative humidity (RHmin), average relative humidity (RHavg), relative humidity gradient (RHgr), rain fall (Rfall), rainy days (Rdays) was recorded by conventional agro-ecological techniques. Maximum (Tmax) and minimum temperature (Tmin) was recorded by thermometer (Lutron TM-947SD. While relative humidity (RHmax and RHmin) was registered by humidity meter (Lutron HT-3007SD). Duration of rainfall (Rfall) and rainy days (Rdays) was estimated by rain gauze.

Record of alternative host plant: Survey was made in the selected study area and some alternative host plant was also identified in consideration with principal host plant of the mango mealy bug. Observations were recorded by weekly visited the plants. The host plants are identified by visually with their vegetative property (Fig. 2).

Observation on mealy bug incidence: Surveillance on pest occurrence in the field is commenced soon after the appearance of the flower spikelet. Counting was done at weekly intervals thereafter by walking across the field and after selection of 20 trees/acres randomly that are chosen diagonally in the field. To study mealy bug incidence, count and record the number of both nymphs and adults on five randomly selected fruits/leaves/twigs per plant. In orchard, trees, from each corner of the field and from the centre of the orchard are randomly observed. Number of mealy bug infested panicles or shoots are visually counted during fruit season.
The mango trees of about 5-15 years old are inspected starting from the fruiting season. All the parts of the tree (i) bark (ii) leaf (iv) twig (iv) stem and (iv) fruits are periodically inspected. Averages of all the observations are considered. Special attention was given to record mealy bugs on the inflorescence or flower panicle where these pests infest most.

Mean number of *D. mangiferae* population

$$\frac{N1 + N2 + N3 + \cdots \ldots \ldots \ldots . + Nn}{\text{Total number observation } / \text{Number of panicle observed}}$$

Where, N is the number of mealy bug in each observation

Statistical analysis: The data are analyzed using KyPlot version 2.0 beta 15 (32 bit) and Microsoft Office Excel 2007 statistical analysis.

Result

Record of alternative host plant: Field survey and observations conducted during 2017 and 2018 showed that the mango mealy bug invariably found on cultivated fruits. Two host plants of mealy bug have been observed and identified belonging to different botanical family. These alternative host plants are represented by their systematic position in Table 1.

Observation on gross dynamics of mealy bug incidence: Descriptive explanation of the climatic parameters during the experimentation period 2017-18 had evicted in Table 2 and Fig. 3. During winter season, the overall dynamics showed that mealy bug first appeared at about 7 SMW and the population was very low. Then Population was increased gradually and up to 11 SMW nearly remained free from *D. mangiferae* infestation. The extent of infestation was moderate at about 12 SMW. The dynamics pattern showed three peaks at 12 SMW, 15 SMW and 17 SMW respectively. High number of adult population was noted from 14 SMW maintained nearly up to 16 SMW, but maximum peak population was attained during 15 SMW in relation to the development and maturation of mango fruits. Afterwards the population decreases mostly from 18 SMW to 20 SMW (Fig.4). In regression, the R^2 coefficient of determination is a statistical measure of how well the regression predictions approximate the real data points. A value of R^2 of 1 indicates that the regression predictions perfectly fit the data.

Characterization of the incidence of mango mealy bug in different SMW: In 2017, the mango mealy bug population increased gradually after 10 SMW and maximum population reached on 15 SMW under different dates in relation to the appearance of mango fruit in the orchards. Here the regression value $y = -0.281x^2 + 4.261x - 3.259$ and R^2 is 0.684 signifying a very definite significant and positive level of population growth. The regression equation indicated that the variability of incidence of mealy bug infestation could be explained up to 68.4 percent ($R^2 = 0.684$) (Fig. 5).
In 2018, the mango mealy bug population and maximum

population were noted at about 16 SMW in relation to the development of mango fruit in the orchards. The regression equation indicated the variability of mealy bug infestation was up to 65.4 percent (R2 = 0.654) (Fig. 6).

In average of both the years of study, it was observed that the mealy bug activity followed somewhat similar trend in both the crop seasons of 2016-17 and 2017-18. On average of the subsequent two years data maximum number of mealy bug population was recorded in 15 SMW. The regression equation indicated the influence of weather variables on mealy bug incidence was 70.2 percent (R2 = 0.702) (Fig. 7).

Correlation study: Correlation coefficient of incidence of *D. mangiferae* population with the climatic factors indicating the level of significance**.** Overall for the years 2017 to 2018, correlation studies revealed that the mealy bug population showed significantly positive correlation with Tmin (0.537) and RHgr (0.732). Whereas, mealy bug population had significantly negative correlated with RHmin (-0.515). In addition to this, *D. mangiferae* population has moderately positive correlations with Tmax (0.461), Tavg (0.455), RHmax (0.392) and RHavg (0.334). On the other side, mealy bug population moderately negative correlations with Tgr (-0.429); very non-significantly negative correlated with Rfall (-0.097) and Rdays (-0.159) respectively (Table 3).

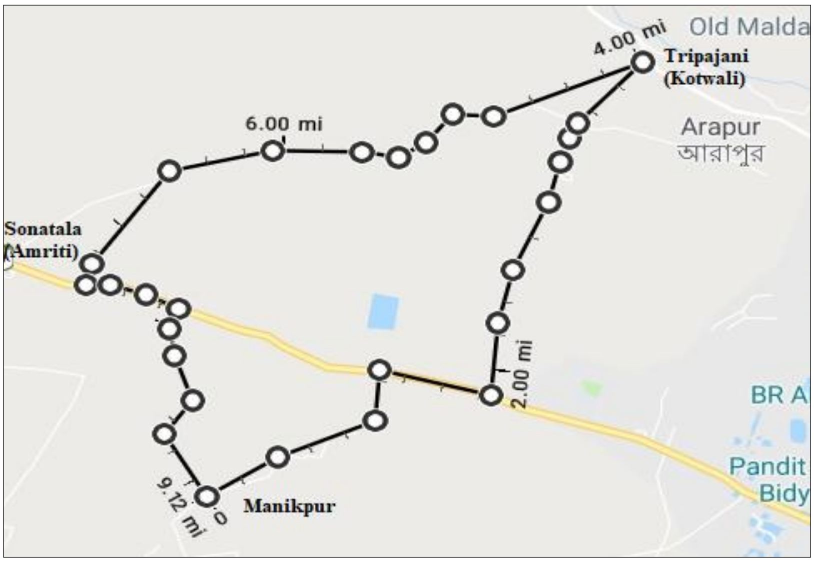

Fig 1: Map showing the location of the study area at Malda District of West Bengal

Fig 2: Host plants of mealy bug (a) on custard apple (b) on guava plant (c) on bark of mango tree (d) on internodes of stem (e) mealy bug on dried mango twig (e) on peduncle and growing mango fruit

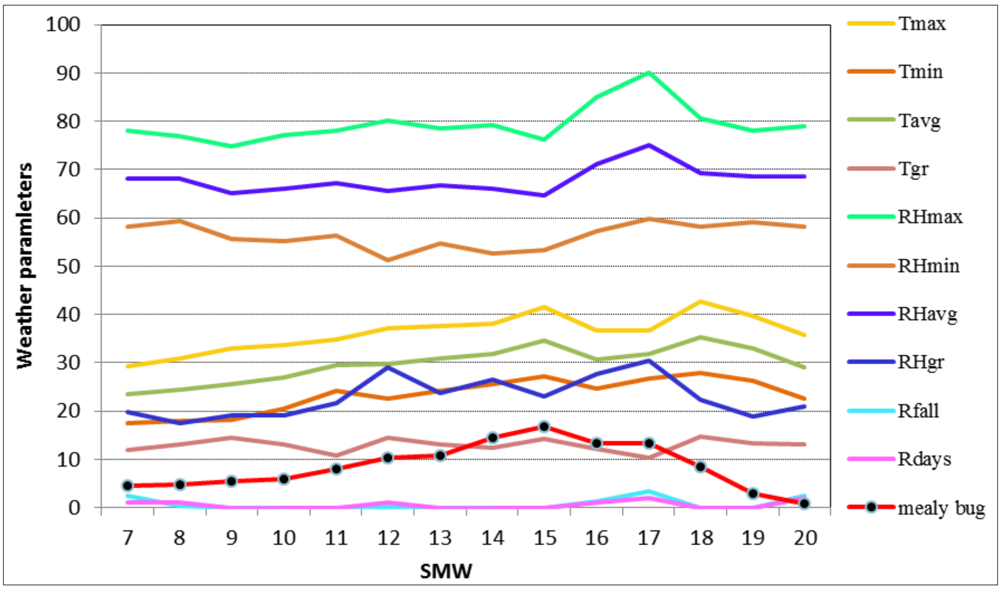

Fig 3: Descriptive explanation of climatic parameters and mealy bug dynamics

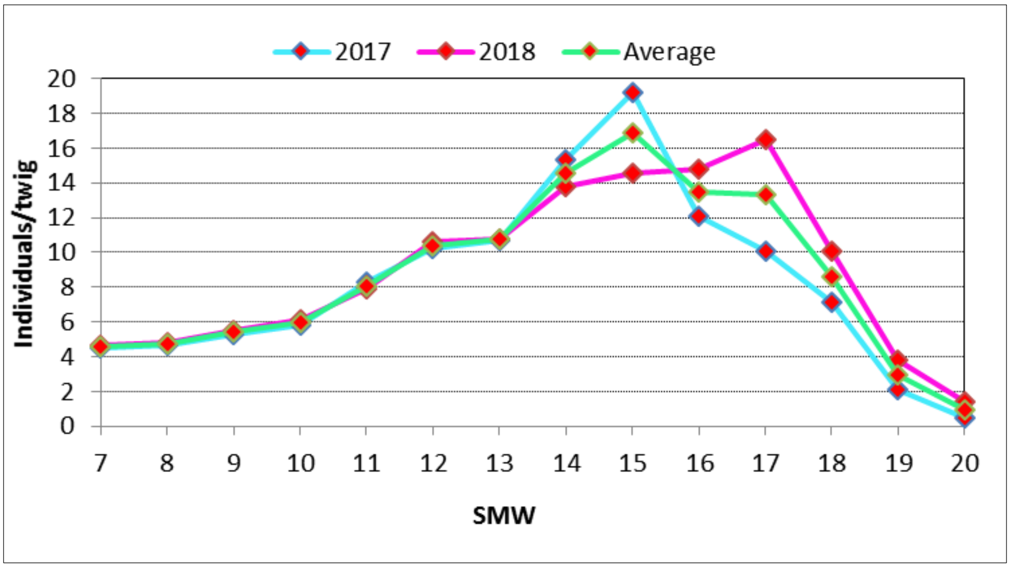

Fig 4: Mean seasonal incidence of mealy bug during the period of observation in relation to standard meteorological week

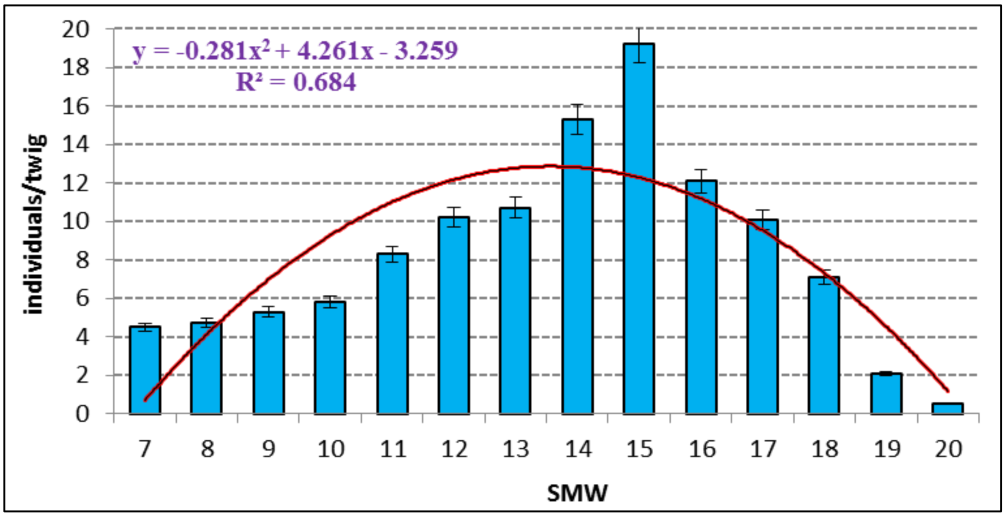

Fig 5: Mango mealy bug incidence with different SMW in 2017

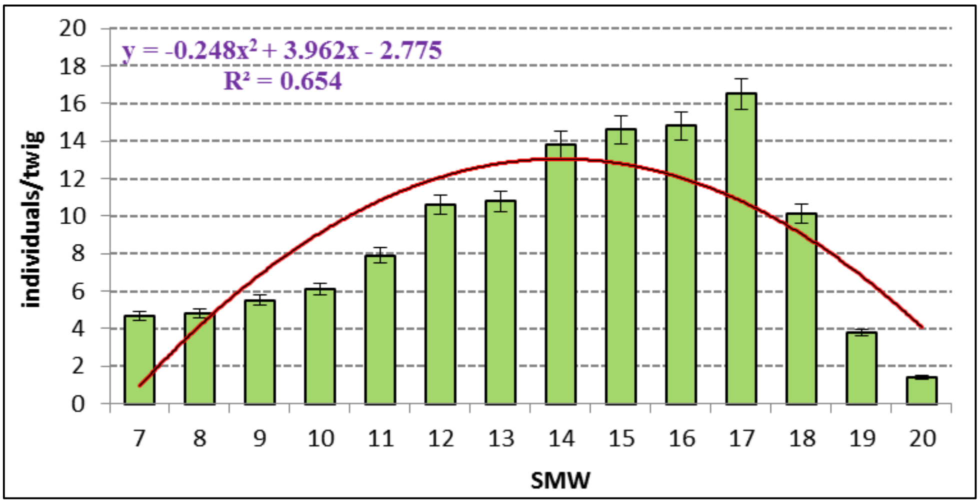

Fig 6: Mango mealy bug incidence during different SMW in 2018

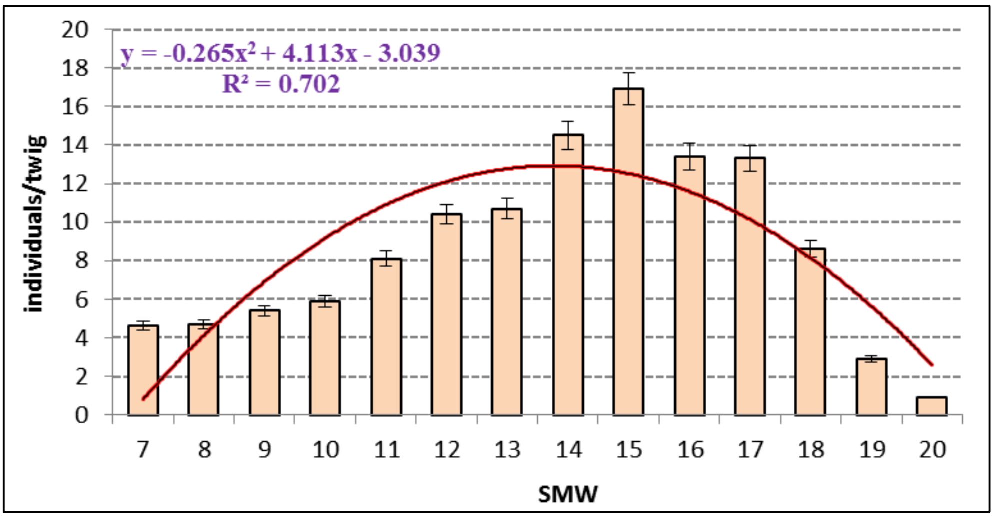

Fig 7: Mango mealy bug incidence during different SMW in average of 2017 and

Table 1: Relative incidence of the alternative host plants of mealy bug

Common name	Order	Family	Genus	Scientific name
Guava	Myrtales	Myrtaceae	Psidium	P. guajava
Custard apple	Magnoliales	Annonaceae	Annona	A. reticulate

Table 2: Mango mealy bug population with respect to climatic parameters

SMW	Climatic parameters										Mealy bug individuals /twig
	Tmax	Tmin	Tavg	Tgr	RHmax	RHmin	RHavg	RHgr	Rfall	Rdays	
7	29.4	17.4	23.4	12.0	78.1	58.2	68.15	19.9	2.5	1	4.5
8	30.9	17.9	24.4	13.0	77.0	59.4	68.2	17.6	0.4	1	4.7
9	32.9	18.3	25.6	14.6	74.74	55.7	65.22	19.04	0.0	0	5.4
10	33.6	20.4	27.0	13.2	77.2	55.1	66.15	19.1	0.0	0	5.9
11	34.9	24.2	29.6	10.7	78.0	56.3	67.15	21.7	0.0	0	8.1
12	37.1	22.5	29.8	14.6	80.2	51.2	65.7	29.0	0.2	1	10.4
13	37.5	24.3	30.9	13.2	78.5	54.8	66.65	23.7	0.0	0	10.7
14	38.1	25.7	31.9	12.4	79.2	52.75	65.97	26.45	0.0	0	14.5
15	38.6	27.3	32.9	11.3	76.2	53.25	64.72	22.95	0.0	0	16.9
16	36.7	24.6	30.7	12.1	84.9	57.2	71.05	27.7	1.4	1	13.4
17	37.4	26.8	32.1	10.6	90.2	59.7	74.95	30.5	3.5	2	13.3
18	39.7	27.8	33.7	11.9	80.6	58.2	69.4	22.4	0.0	0	8.4
19	39.5	26.4	33.0	13.1	78.0	59.1	68.55	18.9	0.0	0	2.9
20	36.8	23.5	30.2	13.3	79.1	58.2	68.65	20.9	2.5	2	0.9

Table 3: Correlation matrix showing correlation coefficient of incidence of *D. mangiferae* population with climatic factors indicating the level of significance

	Tmax	Tmin	Tavg	Tgr	RHmax	RHmin	RHavg	RHgr	Rfall	Rdays	Mealy bug
Tmax	1										
Tmin	0.923*	1									
Tavg	0.981*	0.981*	1								
Tgr	0.335	-0.052	0.145	1							
RHmax	0.319	0.445	0.326	-0.551*	1						
RHmin	-0.236	-0.089	-0.167	-0.391	0.315	1					
RHavg	0.125	0.278	0.153	-0.594*	0.882*	0.725*	1				
RHgr	0.481	0.526*	0.462	-0.279	0.777*	-0.323	0.403	1			
Rfall	-0.098	0.186	0.047	-0.576*	0.528*	0.532*	0.641*	0.297	1		
Rdays	-0.039	0.015	-0.028	-0.151	0.614*	0.508*	0.696*	0.302	0.861*	1	
Mealy bug	0.461	0.537*	0.455	-0.429	0.392	-0.515*	0.334	0.732*	-0.097	-0.159	1

(*) Significant at 5% level

Discussion

These wide ranges of host plants offer shelter for mealy bugs and maintain their population. Bhau *et al.* (2017) [7] had enlisted a number of host plants like Tomato, Mulberry, Mango, Guava, Lemon, Grape, Papaya, Custard Apple etc. as the host plant for mealy bug. The present findings are in conformity with the results obtained by the Wih and Billah (2012) [26] mango mealy bug attack on a variety of crops.

Dhawan *et al.* (2009) [9] and Nagrare *et al.* (2009) [17] were recorded and stated that mango mealy bug, *D. mangiferae* attacks on a dangerous level for mango crop. Present finding related to the impact of the agro-ecological parameters such as temperature, rainfall, and relative humidity greatly influence the outbreak of the insect population as observed by Heong *et al*. (2007), [12] Yadav *et al. (*2004) [27] and Tanwar *et al.* (2007) [25]. In the present study, the high nymphal population during month of April could be mainly due to high temperature and relative humidity that reflects dry climatic conditions conformity with Kumar *et al*. (2009) [15] and Singh *et al.* (2010) [22]. Present observation is also in agreement with Dwivedi *et al*, (2003) [10] who had also recorded the seasonal incidence of mango mealy bug in relation to mean temperature and humidity. Yadav *et al.* (2004) [27] had noted that the highest population of mango mealy bug was recorded on April when average temperature and relative humidity was 27.43°C and 46.57%, respectively. In present observation average temperature and relative humidity was 31.6°C and 67% partly supported by Yadav *et al.* (2004) [27]. Hala *et al.* (2011) [11] had observed that the mango mealy bug populations were affected mainly temperature variations and to a lesser extent by humidity. The present study explained that incidence of mealy bugs has a highly significant positive correlation with minimum temperature and relative humidity gradient. On the other side mealy bug incidence has significant negative correlation with minimum relative humidity but moderate negative correlation with gradient temperature.

Seasonal dynamics of incidence of mealy bug was highly significant in all the cases. Mealy bug incidence significant (R^2 = 0.684) with climatic factors with observed SMW during 2017, (R^2 = 0.654) in 2018 and (R^2 = 0.702) in average of the two years. So, average year data of 2017 and 2018 best signify the effect of climatic factor on seasonal incidence and abundance of mango mealy bug population. In consideration to climatic variables, mealy bug incidence was peaked during 15 SMW as because the climatic condition favoured the crest population of mealy bug. As the temperature increased the mealy bug population was found to increase but in extreme condition mealy bug population was fallen down. Matrix analysis of important climatic factors leads to determine the relative dynamic of the mealy bug population. As most of the climatic factors are interdependent, any change of single climatic factor will lead to multiple effects on pest structure.

The present study on mango mealy bug was undertaken to develop some suitable models to know the dynamics of insect pests in relation with meteorological variables namely temperature products, relative humidity products, rainfall, and rainy days of the precedent insect pests so that active period may be ascertained for forewarning to avoid the mango fruit loss caused by the infestation of the insect pests.

Conclusion

The present study on biology of mealy bug, *Drosicha mangiferae* give the understanding of mode and degree of its population growth. The presence of large alternative host range of mealy bug causes its persistence throughout the year, makes them a great threat in agricultural fields. Mango crop of Malda District is attacked by wide variety of insect pest. Mango mealy bug is one of the major threats to the mango production of Malda District, some extent which is related to climatic factors. Present study revealed that climatic factors have relation to the mealy bug population. Present work can be considered as the bench mark for the construction of pest calendar for future warning and will be helpful to prevent mango crop loss.

References

1. Ambele FC, Billah MK, Afreh-Nuamah K. Obeng-Ofori D. Susceptibility of four mango varieties to the Africa Invader Fly, *Bactrocera invadens* Drew, Tsuruta and White (Diptera: Tephritidae) in Ghana. Journal of Applied Bioscience. 2012; 49:3425-3434.
2. Anonymous. Report of joint inspection team, Major Horticultural Crops in Malda District, West Bengal, 2017.
3. Arif MI, Rafiq M, Ghaffar A. Host plants of cotton mealy bug (Phenacoccus solenopsis): a new menace to cotton agro-ecosystem of Punjab, Pakistan. International Journal Agriculture and Biology. 2002; 11(2):163-67.
4. Ashfaq M, Khan RA, Khan MA, Rasheed F, Hafeez S. Complete control of mango mealy bug using funnel type slippery trap. Pakistan Entomology. 2005; 27(1):45-48.
5. Bhagat KC. Mango mealy bug, *Drosicha mangiferae* (Green) (Margarodidae: Hemiptera) on Ashwagandha - a medicinal plant. Insect Environment. 2004; 10(1):14.
6. Bhattacharyya M. Impact of ecological factors on the

infestation of mango red banded caterpillar. Journal of Entomology and Zoology Studies. 2014; 2(4):68-71.
7. Bhau B, Ushankar U, Abrol U. Studies on Host Range and Biology of Mango Mealy Bug (*Drosicha mangiferae*) in Jammu Region. International Journal of Current Microbiology and Applied Sciences. 2017; 6(9):230-240.
8. Chowdhury SK. Diversity and nature of damage of mango insect pests at Kaliachak-II Block of Malda, West Bengal, India. Journal of Entomology and Zoology Studies. 2015; 3(4):307-311.
9. Dhawan AK, Singh K, Aneja A, Saini S. Distribution of mealy bug, *Phenacoccus solenopsis* Tinsley in cotton with relation to weather factors in South-Western districts of Punjab. Journal of Entomological Research. 2009; 33(1):1.
10. Dwivedi SC, Singh SMR. Katiyar RR. Seasonal incidence of insect pest associated with mango crop. Annals of Plant Protection Sciences. 2003; 11(1):159-162.
11. Hala N, Dembele B, N'da AA, Coulibaly F, Kehe M, N'goran YA, Doumbia M. Population dynamics of the mango mealy bug, *Rastrococcus invadens* Williams (Homoptera: Pseudococcidae) in northern Cote d'lvoire. Journal of Animal and Plant Sciences. 2011; 12(1):1481-1492.
12. Heong KL, Manza A, Catindig J, Villareal S, Jacobsen T. Changes in pesticide use and arthropod biodiversity in the IRRI research farm. Outlooks on Pest Management. 2007; 18:229-233.
13. Ishaq M, Usman M, Asif M, Khan LA. Integrated pest management of mango against mealy bug and fruit fly. Journal of Agriculture and Biological Science. 2004; 6:452-454.
14. Karar H, Arif J. Hameed A, Ali A, Hussain M, Shah FH, Ahmad S. Effect of cardinal directions and weather factors on population dynamics of mango mealy bug, *Drosicha mangiferae* (Green) (Margarodidae: Homoptera) on Chaunsa cultivar of mango, Pakistan Journal of Zoology. 2013; 45(6):1541-1547
15. Kumar A, Pandey SK, Kumar R. Population dynamics of mango mealy bug, *Drosicha mangiferae* Green from Jhansi, Uttar Pradesh. Biological Forum. 2009; 1(2):66-68.
16. Moore D. Biological control of *Rastrococcus invadens.* Review article. Biocontrol News and Information. 2004; 25:17-27.
17. Nagrare VS, Kranthi S, Biradar VK, Zadi NN, Sangode V, Kakde G, *et al*. Widespread infestation of the exotic Mealy bug species, *Phenacoccus solenopsis* (Tinsely), (Hemiptera; *Pseudococcidae*) on cotton in India. Bulletin of Entomological Research. 2009; 99:537-541.
18. Rao CN, Shivankarand VJ, Shyam S. Citrus mealy bug (*Planococcus citri* Risso) management- a review. Agricultural Review. 2006; 27(2):142-146.
19. Rao DP. Marketing Strategies for Horticultural Products- A Case Study in Varanasi District, Uttar Pradesh. Economic Affairs. 2004, 181.
20. Sen AC, Prasad D. Biology and control of the mango mealy bug *Drosicha mangiferae* Green. Indian Journal of Entomology. 1956; 18(2):127-140.
21. Sengupta GC, Behura BK. Annotated list of crop pests in the state of Orissa. Memoirs of the Entomological Society of India. 1957; 5:1-44.
22. Singh D, Bhatnagar P, Niwas HOR. Impact of weather variations on the incidence of mealy bug *Drosicha mangiferae* (Green) and leaf hopper *Amritodes atkinsoni* (Lethier) in mango. Environment and Ecology. 2010; 28(4):2482-2484.
23. Singh R, Joshi G, Ram L. Population dynamics of paddy stem borers in relation to biotic and abiotic factors. Annals of Biology. 2009; 25:47–51.
24. Srivastava AS, Singh YP, Pandey RC, Awasthi BK. Bionomics and Control of mango mealy bug. World Crops. 1973; 25(2):87-88.
25. Tanwar RK, Jeyakumar P, Monga D. Mealy bugs and their management**.** Technical Bulletin 19, National Centre for Integrated Pest Management. New Delhi, India. 2007, 12.
26. Wih K, Billah MK. Diversity of Fruit Flies and Mango mealy bug in the upper west Region of Ghana. Journal of Development in Sustainable Agriculture, 2012; 7:39-45.
27. Yadav JL, Singh SP, Kumar R. The population density of the mango mealy bug (*Drosicha mangiferae* G.) in mango. Progressive Agriculture. 2004; 4(1):35-37.