Journal of Advances in Biology & Biotechnology

Volume 27, Issue 6, Page 563-573, 2024; Article no.JABB.116968
ISSN: 2394-1081

Seasonal Incidence and Effect of Abiotic Factors on Mango Leaf Hopper (*Amritodus atkinsoni* L.) Population on Different Cultivars of Mango in Eastern Uttar Pradesh, India

Aryan Arya [a++], Ritesh Kumar [a#*], Saroj Chauhan [a#], Naveen Kumar [b#] and Ishtiyaq Ahad [c†]

[a] Department of Entomology, Institute of Agriculture and Natural Sciences, Deen Dayal Upadhyaya, Gorakhpur University, Gorakhpur-273009, India.
[b] Department of Entomology, National P. G. College Barhalganj, Gorakhpur-273402, Uttar Pradesh, India.
[c] Department of Entomology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir, Srinagar -193201, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jabb/2024/v27i6916

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here:
https://www.sdiarticle5.com/review-history/116968

Original Research Article

Received: 12/03/2024
Accepted: 17/05/2024
Published: 19/05/2024

[++] *M.Sc Student;*
[#] *Assistant Professor;*
[†] *Associate Professor;*
**Corresponding author: E-mail: riteshskuast@gmail.com;*

Cite as: *Arya, A., Kumar, R., Kumar, N., & Ahad, I. (2024). Seasonal Incidence and Effect of Abiotic Factors on Mango Leaf Hopper (Amritodus atkinsoni L.) Population on Different Cultivars of Mango in Eastern Uttar Pradesh, India. Journal of Advances in Biology & Biotechnology, 27(6), 563–573. https://doi.org/10.9734/jabb/2024/v27i6916*

ABSTRACT

The mango hopper, scientifically known as Amritodus atkinsoni L., is a very destructive insect that poses a significant threat to mango trees in Eastern Uttar Pradesh. Experiments were done to study the seasonal abundance and the impact of abiotic variables on the occurrence of A. atkinsoni on various mango cultivars, including Dasheri, Sindhu, Amarpali, and Langra, at Vindhyavasini Park (Mango orchard) in DDU, Gorakhpur University Gorakhpur. The adult mango hoppers began to appear when the panicles emerged between the 40th and 20th weeks of the Southwest monsoon in 2022-2023. The highest population of mango hoppers was observed on the Dasheri variety during the 14th week of the season, while the lowest population was observed during the 42nd week. The Amrapali variety had a somewhat lower incidence of mango hoppers, with the highest population observed during the 4th, 7th, and 8th weeks, and the lowest population observed during the 40th week. Abiotic conditions, including maximum temperature (X1), minimum temperature (X2), morning relative humidity (X3), evening relative humidity (X4), and rainfall (X5), significantly influenced the hopper population's impact. The population of hoppers had a negative and significant relationship with morning relative humidity (r = -0.65** to 0.34*) and evening relative humidity (r = -0.40* to -0.21). On the other hand, there was a significant positive correlation between the hopper population and mean maximum temperature (r = 0.28 to 0.09) and minimum temperature (r = 0.17 to – 0.02). Rainfall varied throughout the study period and did not have a significant impact, except for the Dasheri variety.

Keywords: Mango hopper; seasonal incidence; abiotic factor; multiple correlation coefficients.

1. INTRODUCTION

Mango, scientifically known as *Mangifera indica* Linn. and belonging to the family Anacardiaceae, is a highly significant fruit in terms of commercial value. It is also recognized as the national fruit of India. It is called the "king of fruits" because of its ability to grow in many conditions, its sweetness, exceptional flavor, and delightful taste, as well as its high nutritional value, mineral content, and abundance of vitamin A, C, and pro-vitamins [1]. India is a major global grower of mangoes. In India, mango cultivation accounts for fifty percent of the global total, making it the third largest exporter of mangoes. India possesses the largest land area compared to the other nations [2]. India, with a land size of 2,339 million hectares and a crop yield of 2,036,600 metric tons, holds the position of being the leading agricultural producer in the world. India cultivates this crop in Uttar Pradesh, Karnataka, Bihar, Gujarat, Tamil Nadu, and Maharashtra. Uttar Pradesh is the top production state, with a total output of 4,807,83 MT [3]. There have been 26 species of nematodes and 462 species of insects reported worldwide that attack mangoes. Girish et al. [4] have documented several insect predators that impact mango trees, including hoppers such as *Idioscopus clypealis* (Lethierry) and *Amritodus atkinsoni* (Lethierry); mealybugs like *Drosicha mangiferae* (Green); fruit flies such as *Bactrocera dorsalis* (Hendel); fruit sucking moths like *Eudocima aurantia* (Moore); thrips like *Aeolothrips itermedius* Bagnall; ants like *Oecophylla smaragdina* (Fabricius); termites belonging to the Odontotermes spp. species; and grey weevils known as *Myllocerus discolour* (Boheman). Climate change and improved environmental circumstances have led to an increased threat from mango hoppers such as *A. atkinsoni, I. clypealis, and Idioscopus nitidulus* (Walker) during the mango's flowering season [5]. Noted that the prevalence of the mango hopper, Idioscopus spp., was highest during the 49th standard weeks and ceased on the 13th SW [6]. Observed that adult mango hoppers emerge during the period of panicle growth, often occurring between February and March. The population of adult mango hoppers in both natural habitats and cultivated varieties typically falls between the range of 9.6 to 14.2 throughout the months of May and June. The quantity of hoppers gradually decreased over time, however, there was a further surge (from 6.6 to 9.8) in August and September [7] documented a progressive increase in the population of mango hoppers from the second week of September to the fourth week of September. The average number of hoppers per 5 panicles during this period was 18.22, occurring between the 37th and 39th meteorological weeks. The highest concentration of mango hoppers was seen during the 44th meteorological week, with an average of 45.76 hoppers per 5 panicles. The study [8,9] found that there was a positive association (r = 0.093) between the greatest temperature and the number of hoppers, while there was a negative correlation (r = -0.217) between the minimum temperature and the number of hoppers. The study conducted by [20] revealed that there was a positive correlation (r = 0.302) between temperature and the abundance of mango hoppers. On the other hand, rain (r = -0.062) and relative humidity (r = -0.383) showed a negative correlation with the quantity of mango hoppers. [10] It was noted that high levels of relative humidity have a negative impact on hopper populations. Debnath et al. [11] conducted an experiment to investigate the temporal fluctuations in the population of the mango hopper, *A. atkinsoni*, in relation to the annual abundance and human activity in the Langra mango cultivar during the Rabi season. The predominant mango hoppers are typically observed on the primary stem during the month of May, thereafter moving on to the leaves and flowers. The mango hoppers exhibit a significant and positive correlation with temperature, as well as a significant and negative correlation with both morning relative humidity (r = -0.445) and evening relative humidity (r = -0.118). Inclement weather and precipitation do not significantly impact the population of mango hoppers [12].

2. MATERIALS AND METHODS

The current study investigated the seasonal occurrence and impact of non-living elements on the population of the mango hopper (*Amritodus atkinsoni* L.) on various mango cultivars in Eastern Uttar Pradesh. The experiment was place at Vindhyavasini Park (Mango Orchard) in DDU, Gorakhpur University, Gorakhpur, from 2022 to 2023. Gorakhpur is located at a latitude of 26.766^o, a longitude of 83.369^o, and an elevation of 272 feet. A study was undertaken to determine the seasonal occurrence of *A. atkinsoni* population in connection to abiotic parameters including temperature (X1), minimum temperature (X2), morning relative humidity (X3), evening relative humidity (X4), and rainfall (X5). The meteorological data on weekly basis was collected from Indian meteorological department, Kuragahat, Gorakhpur. The study included four cultivars: Dasheri, Amarpali, Sindhu, and Langra. Total twenty four mango plants were selected out of four cultivar, and each cultivar had eight plant was selected on each treatment had three replication. An experiment was done to investigate the seasonal occurrence of mango hopper, *A. atkinsoni* (adults), on a weekly basis. The study focused on three randomly chosen trees, with one tree each replication. Throughout this experiment, all agronomic techniques were consistently implemented, with the exception of plant protection measures. The hopper population was observed and recorded throughout the year throughout different stages of growth, including panicle emergence or pre-bloom, bloom, fruit stage, and non-flowering seasons from July to December. The Hopper population was gathered from panicles, leaves, stem, and trunk using the bagging traps method, as recommended by [13]. This technique involved enclosing the terminal portion of the inflorescence with a polythene bag of 60 × 30 cm^2. Inside the bag, a cotton swab saturated in ethyl acetate was placed [14]. Following the capture of the mango hoppers, the bags were taken to the laboratory where the nymphs and adults were then sorted and counted. The same technique was employed to gather hopper specimens from the fresh flush, branches, and stems of mango trees. Measurements of the mango hopper were taken from the trunk of the tree in four different directions (North, South, East, and West), with each measurement covering an area of 10 cm^2. Concurrently, daily records were made of climatic variables such as maximum and minimum temperature, relative humidity (both in the morning and evening), and rainfall. Prior to calculating Pearson's correlation coefficient and multiple correlation coefficients, the fortnightly average was computed for all of these components [15].

3. RESULTS AND DISCUSSION

The weekly data on the seasonal occurrence of mango hoppers, as observed on mango panicles/inflorescences, were also analyzed in connection to several abiotic conditions to establish the correlation with the pest. The occurrence of mango hoppers was documented on the mango crop from the 40th to the 20th Southwest monsoon, at regular weekly intervals.

Seasonal incidence of mango hopper *A. atkinsoni* in variety Dashehri (mango): Table 1 shows that during the observed period, there were 10.33 hoppers/panicles on the Dasheri variety mango tree in the 40th SW. The mean maximum temperature was 31.20^{o}C and the mean minimum temperature was 20.10^{o}C. The relative humidity was 88.25% in the morning and 46.52% in the evening. During the 2022-2023 seasons, there was an observed increase in hopper population in the south-western region between the 40th and 20th latitudes. The highest population of mango hopper was recorded during the 14th Southwest monsoon (27.00 hoppers per panicle) when the maximum temperature was 33.12ºC and the minimum temperature was 17.23ºC. The relative humidity in the morning was 72% and in the evening was 28%. This was followed by the 16th Southwest monsoon (25.67 hoppers per panicle) and the 12th Southwest monsoon (25.00 hoppers per panicle). The lowest population of mango hopper was recorded in the 42nd sampling week, with an average of 7.00 hoppers per panicle. This was followed by the 49th sampling week, with an average of 9.00 hoppers per panicle, and the 44th sampling week, with an average of 9.67 hoppers per panicle, on the mango tree. The analysis of the correlation coefficient between weather parameters and hopper population indicated a positive association (r = 0.28 and r = 0.17) between the highest and minimum temperature. This link was also shown to be statistically significant throughout the year. The population exhibited a strong negative correlation with morning relative humidity (r = -0.65**) and a significant negative correlation with evening relative humidity (r = -0.40*). On the other hand, rainfall showed a significant positive correlation (r = 0.147*) (Table 2).

Following regression equation was developed to predict the incidence of hopper

$$Y=101.39 - 0.367X1+0.074X2-0.875X3-0.066X4-2.824X5$$

The regression analysis indicated that the abiotic factors were the primary influencing factor, accounting for 54% of the variation in hopper population (R^2= 0.549). Anant [16], who observed a significant decline in the population of hoppers in Jhansi (U.P.) between April and May, concurred with the findings of our study. The observation made by [17] and [18] indicates that adult *A. atkinsoni* began appearing in February and March. Furthermore, the analysis revealed that there was no significant link between abiotic conditions and the presence of mango hopper. A positive association (r = 0.3406) was seen with the maximum temperature, whereas a negative correlation (r = -0.2038) was identified with the lowest temperature. Additionally, a mild positive association was observed between the quantity of hoppers and the relative humidity (RH) in the morning, while a robust negative correlation was established between the RH in the evening at Tirupati. Both studies discovered a negative correlation between the number of hoppers and the increase in relative humidity and minimum temperature. Hoppers primarily appear during the period of flower blossoming and new shoot emergence, when the crop's phenology and abiotic variables coincide. The absence of hoppers throughout the other months of the static crop season may have resulted in a limited correlation between abiotic factors. Typically, the quantity of hoppers varies in accordance with the expansion of crops in various regions, and the climatic conditions exhibit annual variations, hence influencing their significance. Collecting extensive weather data and monitoring hopper populations in a controlled canopy over several years will lead to more accurate projections.

Seasonal incidence of mango hopper *A. atkinsoni* in variety of Amrapali (mango): Table 1 show that the highest population of mango hoppers on mango trees (Amrapali) was recorded in the 7th, 4th, and 8th SW, with a density of 31.33 hoppers per panicle. This was followed by the 20th and 11th SW, with a density of 30.67 hoppers per panicle. The minimal population of mango hopper was 40th, 42th, and 41th SW, with densities of 13.33 hopper/panicle, 14.67 hopper/panicle, and 16.33 hopper/panicle, respectively. The average maximum temperature on the 7th and 8th of SW was 25.77ºC and 27.47ºC respectively. The average minimum temperature on both days was 12.00ºC and 12.08ºC respectively. The relative humidity in the morning on the 7th and 8th of SW was measured at 77.42% and 86.00% respectively, while in the evening it was recorded at 39.14% and 42.42% respectively. In the first, second, and third observations of SW 1st, 2nd, and 3rd, the number of hoppers per panicle was recorded as 20.33, 23.33, and 26.33 respectively. Additionally, the maximum temperature recorded for SW 1st, 2nd, and 3rd was 18.57°C, 12.27°C, and 16.80°C respectively. The analysis of the correlation coefficient between meteorological parameters and hopper population indicated that there was a positive correlation between maximum temperature and hopper population (r = 0.10), while there was a negative correlation between minimum temperature and hopper population (r = -0.11). However, these correlations were not statistically significant in the given year. The association between morning and evening relative humidity exhibited a negative relationship, with correlation coefficients of -0.50** and -0.34*, respectively, which were statistically significant throughout the year. The link between rainfall and hopper population exhibited a positive relationship (r = 0.30*) and was statistically significant across the year (Table 2).

Following regression equation was developed to predict the incidence of hopper

Y=82.32-0.354X1-0.558X2-0.332X3-0.279X4+0.839X5

The regression equation revealed that the various abiotic factors were to be most influencing factor, which contributed (R^2= 0.529) 52 per cent variation in hopper population.

As stated in reference [19], the number of mango hoppers experienced a gradual rise starting in January and reached its highest point in May. Based on the development of flowering and fruiting stages, [20] observed two periods of significant mango hopper activity in South Gujarat. The first peak occurs between the final week of March and the last week of May. During the period from the second week of September to the fourth week of September, there was a gradual increase in the population of mango hoppers, which coincided with the 37th and 39th weeks of the Southwest monsoon. Furthermore, according to Raut et al. [21], hopper activity showed a decline starting from April and reached its minimum level (0.20 and 0.33 hopper/panicle) during the 34th SW of 2016-17 and 2017-18, before thereafter increasing. The study by Raut et al. [21] found that during the periods of September 2013 to August 2014 and September 2014 to August 2015, there was a positive correlation between evapotranspiration (r = 0.443** and 0.368**), bright sunshine hours per day (r = 0.398** and 0.325*), and maximum temperature (r = 0.467** and 0.316*) with the population of hoppers. On the other hand, there was a negative correlation between morning relative humidity (r = -0.469** and -0.275*) and evening relative humidity (r = -0.430** and -0.289*) with the population of hoppers. As reported in [20], there was a strong positive association (r = 0.323*) between the population of mango hoppers and maximum temperature. Additionally, there were substantial negative correlations between the population of mango hoppers and morning (r = -0.496**) and evening (r = -0.824**) relative humidity (RH) as well as precipitation (r = -0.566**). The study conducted by [7] revealed that there was a positive correlation between temperature (r = 0.302), rainfall (r = -0.062), and relative humidity (r = -0.383) with the occurrence of mango hoppers. Based on the findings of Debnath et al. [11], there is a strong positive correlation between evaporation (r = 0.890**), bright sunshine hours per day (r = 0.370*), and maximum temperature (r = 0.880**) with hopper population. On the other hand, there is a significant negative association between morning relative humidity (r = -0.880**) and evening relative humidity (r = -0.720**) with hopper population. The population of mango hoppers showed a positive correlation with maximum temperature (r = 0.532** and 0.426**), sunshine hours per day (r = 0.521** and 0.371**), and evaporation (r = 0.379** and 0.375) from 2009-2010 to 2010-2011. However, evening relative humidity (r = -0.304*) and precipitation (r = -0.281*) exhibited a negative correlation in 2009-10. Furthermore, [22] found a significant correlation between evaporation (r = 0.743** and 0.527**), maximum temperature (r = 0.679** and 0.702**), and mango hopper population throughout the periods of 2007-08 and 2008-09. Additionally, there was a positive correlation between bright sunlight hours per day (r = 0.435*) and mango hopper population during 2008-09. Therefore, these researches closely correspond to the conclusions of the current investigation.

Seasonal incidence of mango hopper *A. atkinsoni* in variety of Sindhu (mango): Table 1 show that the highest population of hoppers per panicle was observed in the 11th and 20th weeks, with a maximum population on the mango tree variety Sindhu. The 4th, 6th, and 16th weeks had a slightly lower population of hoppers per panicle. The lowest population was observed in the 41st and 40th weeks, with 13.33 and 15.33 hoppers per panicle, respectively. The mean maximum temperatures in the 11th and 20th weeks were 31.80ºC and 36.25ºC, while the mean minimum temperatures were 16.91ºC and 24.52ºC. The relative humidity in the morning of the 7th and 8th weeks was recorded at 75.57% and 71.25%, respectively, while in the evening it was recorded at 31.42% and 26.50%. During the 18th, 19th, and 20th Southwest monsoons, the number of mango hoppers observed was 27.67 hoppers per panicle, 25.67 hoppers per panicle, and 31.33 hoppers per panicle, respectively. The maximum temperatures recorded during these monsoons were 37.27ºC, 38.51ºC, and 36.25ºC, respectively. The analysis of the correlation coefficient between meteorological parameters and hopper population showed that there was a positive link between maximum temperature and minimum temperature, with correlation coefficients of 0.19 and 0.02, respectively. However, this association was not statistically significant in the given year. The association between morning and evening relative humidity exhibited a negative relationship, with correlation coefficients of -0.48** and -0.34* respectively, both of which were statistically significant in the year (Table 2). The link between rainfall and hopper population exhibited a positive relationship (r = 0.23*) and was statistically significant.

Following regression equation was developed to predict the incidence of hopper

Y= 82.17-0.56X1-0.177X2-0.301X3-0.341X4-0.18X5

The regression equation revealed that the various abiotic factors were to be most influencing factor, which contributed (R^2= 0.376) 37 per cent variation in hopper population.

Based on the research conducted in reference [5], the highest occurrence of the mango hopper Idioscopus spp. was seen during the 49th standard week, and the insect pest ceased to exist by the 13th SW. around the months of February and March, it was noted that mango hoppers (adults) started to appear when the panicle emergence stage occurred. The number of mango hoppers reached a peak of 9.6 to 14.2 in both wild and cultivated varieties around May and June. During periods of plant dormancy, adult hoppers were able to survive without feeding by taking shelter in the cracks and crevices of the trunk. Additionally, severe monsoon showers with rainfall exceeding 100 mm in a straight line had a cleansing impact on the hopper population. The current research confirms the findings of [23], which indicated a strong positive relationship between atmospheric temperature (r = 0.69), maximum temperature (r = 0.32), and minimum temperature (r = 0.40). Additionally, there was a notable negative correlation between morning relative humidity (r = -0.75) and evening relative humidity (r = -0.40). The association between total rainfall and hopper population was negative, although not statistically significant. According to [24] and [25], temperature was found to have a positive and substantial influence on the population of mango hoppers. Conversely, relative humidity was found to have a negative and significant impact.

Seasonal incidence of mango hopper *A. atkinsoni* in variety of Langra (mango): (Table 1) show that the highest population of hopper/panicle hoppers was observed in the 6th SW of 32.33, specifically on the mango tree variety Amrapali. This was followed by the 16th and 4th SW, with populations of 31.67 hopper/panicle and 31.33 hopper/panicle respectively. The lowest population was observed in the 40th and 4th SW, with populations of 11.67 hopper/panicle and 12.33 hopper/panicle respectively. The mean maximum temperature on SW 6th was 23.01^{o}C, while the mean minimum temperature was 12.21^{o}C. The relative humidity was recorded at 86.57 in the morning and 54.58 in the evening for the entire week. The population of mango hoppers in the 40th, 41st, and 42nd Southwest (SW) was recorded as 11.67 hoppers per panicle, 12.33 hoppers per panicle, and 15.67 hoppers per panicle, respectively. The correlation coefficients between the highest temperature and hopper population were positive (r = 0.09), while the correlation coefficients between the minimum temperature and hopper population were negative (r = -0.02). However, these correlations were not statistically significant in the given year. The association between morning and evening relative humidity exhibited a negative relationship, with correlation coefficients of -0.34** and -0.21 respectively. This relationship was found to be very significant throughout the year, as indicated in (Table 2). The link between rainfall and hopper population exhibited a positive relationship (r = 0.11*) that was statistically significant.

Following regression equation was developed to predict the incidence of hopper

Y=67.54-0.162X1-0.268X2-0.368X3-0.099X4-0.0583X5

The regression analysis indicated that the abiotic factors had the greatest influence on the hopper population, accounting for 43% of the observed variation (R^2= 0.432).

Patel [26] examined the levels of insect population in agroforestry systems in Mizoram, India, between 2000 and 2002 [18]. The study revealed that the quantity of insects was much higher during the summer season and reduced during the winter season [4]. Carried out field trials in Andhra Pradesh, India, and found that the population dynamics and abundance of the mango hopper, *A. atkinsoni*, were impacted by the host plants and meteorological conditions. Additionally, they noted that there were negative associations between hopper infestation and minimum temperature, relative humidity, and night-time precipitation. Conversely, there were positive associations between hopper infestation and maximum temperature and morning relative humidity.

Table 1. Seasonal incidence of mango hopper *A. atkinsoni* during the year 2022-2023

SW	Hopper Population /Panicle/Week				Temperature (ºC)		Relative Humidity (%)		Rainfall (mm)
	Dasheri	Amrapali	Sindhu	Langra	Max.	Min.	Morning	Evening	
40	10.33	13.33	15.33	11.67	31.20	20.10	88.25	46.52	0
41	11.33	16.33	13.33	12.33	31.35	19.10	86.21	45.22	0
42	7.00	14.67	18.33	15.67	29.00	17.00	87.25	46.21	0
43	12.67	22.67	19.33	23.67	31.50	18.60	85.23	44.35	0
44	9.67	20.67	20.67	27.67	28.40	17.50	86.74	43.21	0
45	14.00	21.33	26.33	24.33	30.51	18.30	86.28	44.28	0
46	11.33	22.33	22.67	25.00	28.75	16.90	84.71	44.30	0
47	15.00	24.67	26.33	18.67	27.87	13.47	84.71	35.85	0
48	11.33	25.33	23.67	17.67	27.80	12.38	83.71	38.85	0
49	9.00	23.33	23.67	26.33	26.85	11.70	88.14	40.14	0
50	15.00	25.33	16.67	24.33	25.70	11.10	84.57	46.71	0
51	16.00	23.33	27.33	27.67	24.38	10.37	82.56	52.14	0
52	12.67	26.67	27.33	26.33	23.87	11.32	87.14	46.85	0
1	22.67	20.33	17.67	18.33	18.57	9.17	85.14	59.57	0
2	15.00	23.33	22.67	26.67	12.27	8.48	83.57	73.14	0
3	16.33	26.33	20.67	18.33	16.80	7.52	85.14	64.71	0
4	12.67	31.33	30.33	31.33	22.52	8.08	83.85	45.85	0
5	18.00	29.33	29.33	29.67	23.97	12.44	85.28	55.57	0
6	22.00	28.33	30.33	32.33	23.01	12.21	86.57	54.58	0
7	22.00	31.33	27.33	22.33	25.77	12.00	77.42	39.14	0
8	21.67	31.33	29.67	28.33	27.47	12.08	86.00	42.42	0
9	24.33	27.33	29.67	26.67	29.65	14.80	80.42	36.71	0
10	20.67	24.33	28.33	27.33	31.10	16.42	76.42	34.00	0
11	24.67	30.67	31.33	27.33	31.80	16.91	75.57	31.42	0
12	25.00	28.33	24.67	28.67	29.72	18.05	81.00	44.14	1.24
13	24.67	30.33	24.33	27.33	31.11	16.84	77.14	30.57	1.48
14	27.00	27.33	27.67	27.67	33.12	17.23	72.00	28.00	0
15	22.67	29.33	23.33	27.67	35.31	17.54	74.00	27.25	0
16	25.67	29.67	30.33	31.67	36.25	19.11	72.00	24.15	2.5
17	24.67	25.67	29.67	25.67	35.24	18.25	68.50	26.34	0
18	16.33	29.67	27.67	24.33	37.27	19.52	66.02	27.50	3
19	24.67	25.67	25.67	28.33	38.51	23.25	70.05	25.25	0
20	19.33	30.67	31.33	27.33	36.25	24.52	71.25	26.50	0

Table 2. Correlation coefficient and regression value of hopper population and weather parameters

Sr. No	Weathers Parameters	Varieties			
		Dasheri	Amrapali	Sindhu	Langra
1.	Maximum Temp (Tmax)	0.28	0.10	0.19	0.09
2.	Minimum Temp (Tmin)	0.17	-0.11	0.02	-0.02
3	Morning RH (RHmor)	-0.65**	-0.50**	-0.48**	0.34*
4.	Evening RH (RHeve)	-0 .40*	-0.34*	-0.39*	-0.21
5.	Rainfall (mm)	0.147*	0.30	0.23	0.11

Table 3. Multiple regressions between weather parameters and seasonal incidence of mango hopper during 2022-2023

Sr. No	Varities	Regression Equation	R^2 Value	Predicted Value (%)
1.	Dasheri	Y= 101.39 -0.367X1+0.074X2-0.875X3-0.066X4-2.824X5	0.549	54%
2.	Amrapali	Y=82.32-0.354X1-0.558X2-0.332X3-0.279X4+0.839X5	0.529	52%
3.	Sindhu	Y=82.17-0.56X1-0.177X2-0.301X3-0.341X4-0.18X5	0.376	37%
4.	Langra	Y=67.54-0.162X1-0.268X2-0.368X3-0.099X4-0.0583X5	0.432	43%

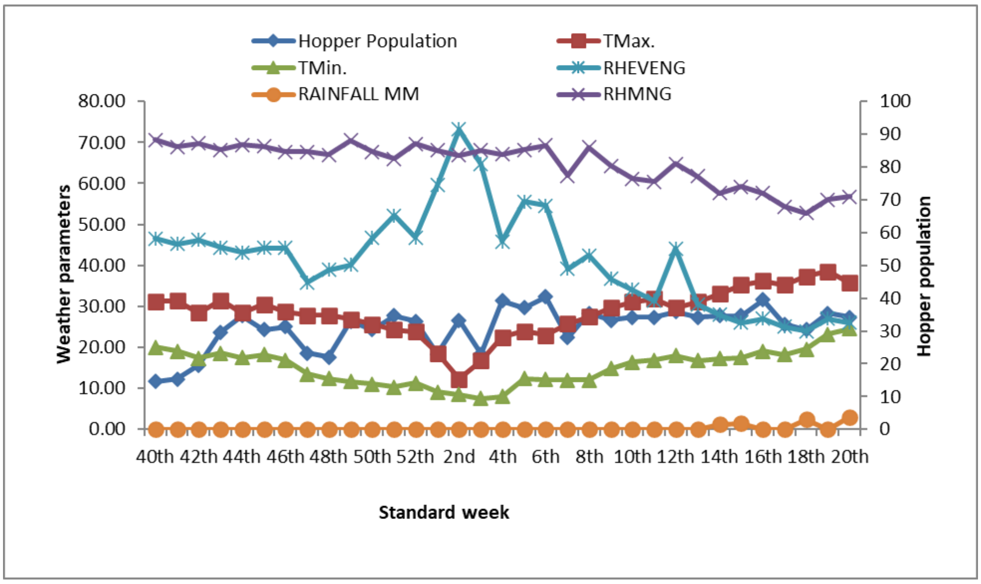

Fig. 1. Effect of abiotic factors on seasonal abundance of *Amritodus atkinsoni* (adults) on Dashehari

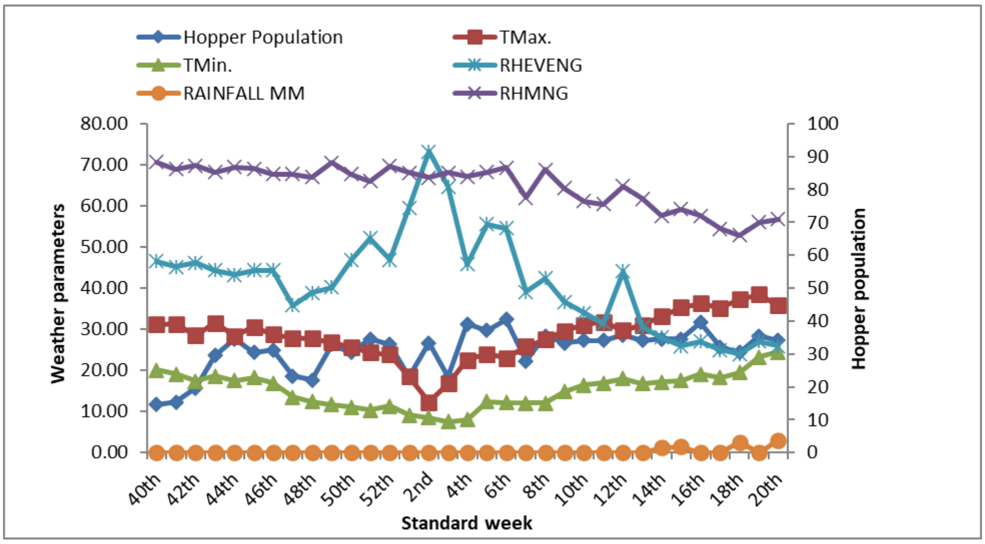

Fig. 2. Effect of abiotic factors on seasonal abundance of *Amritodus atkinsoni* (adults) on Amrapali

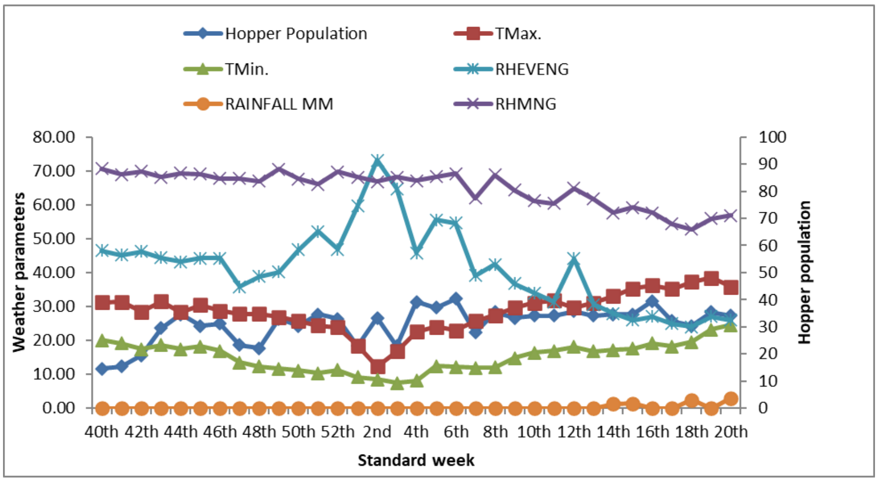

Fig. 3. Effect of abiotic factors on seasonal abundance of *Amritodus atkinsoni* (adults) on Sindhu

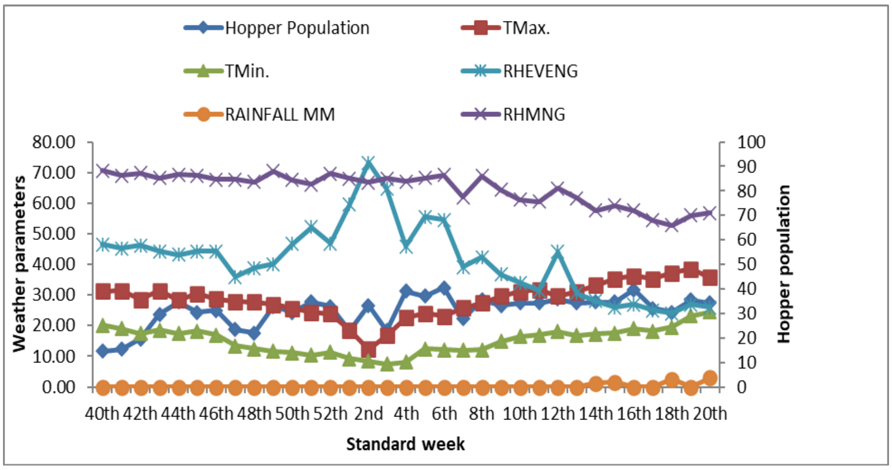

Fig. 4. Effect of abiotic factors on seasonal abundance of *Amritodus atkinsoni* (adults) on Langra

4. CONCLUSIONS

The adult *A. atkinsoni* L. individuals emerged when the panicle developed, and the peak population was seen in February and March, coinciding with the mango tree's maximum bloom. August-September exhibited the second greatest population among the four cultivars under investigation. Afterwards, the insect moved to the cracks and crevices of the tree trunk to enter a state of hibernation. This indicates that the organism has two distinct reproductive cycles, leading to the formation of two distinct generations: one during the spring and another during the summer. The spring cohort is more detrimental or deleterious in comparison to the summer cohort. The mean maximum and minimum temperatures showed a significant positive correlation with the increase in the hopper population; however the relative humidity (both in the morning and evening) had a noticeable negative effect. The varied nature of rainfall had little effect on the expansion of the hopper population.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kannan M, Rao NV. Incidence of homopteran pests in relation to weather conditions in mango. Indian J Ecol. 2006; 33:146-9.
2. Galán Saúco V. Worldwide mango production and market: current situation

and future prospects. InIX International Mango Symposium 992. 2010, Apr 8;37-48.

3. Anonymous. Ministry of Agriculture and Farmer welfare, http://agricoop.nic.in 2021-22 (First Advance Estimate) of area and production of horticulture crops. 2022;1- 2
4. Girish BR, Swamy CM, Adivappar N. Population dynamics and dominance of leafhopper species on mango. Pest Management in Horticultural Ecosystems. 2019;25(1):20-5.
5. Kumar A, Swami VP, Amrita Singh A. To Study on the population dynamics of mango hopper *Amritodus atkinsoni* leth. Research Journal of Chemistry and Environmental Sciences. 2014;2(3):48-51.
6. Sarode BR, Mohite PB. Seasonal incidence and biorational management of mango hopper, *Amritodus atkinsoni* Leth. Journal of Agriculture and Veterinary Science. 2016;9:29-31.
7. Gundappa AT, Shukla PK. Seasonal dynamics of mango hoppers and their management under subtropics. GERF Bull. Biosci. 2016; 7(1):6-9.
8. Namni S, Amin MR, Miah MR, Rahman MF, Suh SJ. Role of weather parameters on seasonal abundance of insects in a mango-based agroforestry in Bangladesh, with particular reference to mango hopper; 2017.
9. Bana JK, Saxena S, Ghoghari P, Sharma H, Sharma D. Prediction of mango hopper, Idioscopus nitidulus (Walker) based on diurnal variations under south Gujarat climatic conditions. J Entomol Zool Stud. 2018;6(5):1042-104.
10. Anithakumari D, Lakshmi BK, Sathyanarayana Reddy G, Lakshmi Narayana, Reddy M. Influence of abiotic factors on the incidence of hopper and chemical control strategies in mango. Karnataka Journal of Agricultural Sciences. 2010;25:22(3).
11. Debnath MK, Seni A, Sharma HL. Population dynamics of mango hopper, Amritodus atkinsoni on mango plant, Mangifera indica. Indian J. Plant Prot. 2013;41:308-13.
12. Shawan SI, Rashed RU, Mitu AS, Jahan M. Efficacy of different chemical and botanical insecticides in controlling mango hopper (*Amritodus atkinsoni* L.). Advances in Plants & Agriculture Research. 2018; 8(2):127-31.
13. Debnath MK, Seni A, Sharma HL. Population dynamics of mango hopper, *Amritodus atkinsoni* on mango plant, *Mangifera indica*. Indian J. Plant Prot. 2013;41:308-13.
14. Baldaniya AM, Patel NB, Raghunandan BL, Pavan JS. Influence of weather Parameters on the Seasonal Incidence of Mango Hopper, *Idioscopus nitidulus* Walker in Middle Gujarat. In Biol. Forum. 2022;14:1531-1534.
15. Zala MB, Bharpoda TM. Biology of mango leaf gall midge, *Procontarinia matteiana* Kieffer & Cecconi (Diptera: *Cecidomyiidae*).
16. Anant AK. Studies on insect-pests of mango with special reference to seasonal incidence and management of mango leaf hoppers. Master of Science in Entomology; 2016. Jul.
17. Sharma S, Tara JS. Seasonal abundance and effect of abiotic factors on mango leaf hopper *Amritodus atkinsoni* (Leth.) population on wild and different cultivators of mango in Jammu region. Environment Conservation Journal. 2013; 14(3):161-8.
18. Goswami D, Arya D, Kaushal BR. Insects diversity in an agro-ecosystem of Bhabar region of Uttrakhand. Indian Journal of Entomology. 2023;1:372-80.
19. Raut PP, Desai VS, Narangalkar AL, Naik KV, Mehendale SK, Karmarkar MS. Effect of weather parameters on mango hoppers population. Journal of entomology and zoology studies. 2018; 6(4):112-4.
20. Bana JK, Saxena S, Ghoghari P, Sharma H, Sharma D. Prediction of mango hopper, Idioscopus nitidulus (Walker) based on diurnal variations under south Gujarat climatic conditions. J Entomol Zool Stud. 2018;6(5):1042-104.
21. Raut PP, Desai VS, Narangalkar AL, Naik KV, Mehendale SK, Karmarkar MS. Effect of weather parameters on mango hoppers population. Journal of entomology and zoology studies. 2018;6(4):112-4.
22. Kumari DA, Anitha V, Girwani A, Reddy CN. Efficacy of various insecticidal modules against hoppers in mango.
23. Jha S, Marak JC, Kasar N, Barma P, Chakrabarti S. Population dynamics of mango hopper on ‘amrapali’mango (*Mangifera indica* L.) and their species composition. Trend. Biosci. 2017;10(15): 2752-7.

24. Ghaffar A, Khan A, Hameed A, Iqbal J, Ahmad M, Raza S, Imran M, Muhammd N, Shas S, Raza M. Establishment of strategy for mango hopper *Idioscopus clypealis* (lethierry) management and impact of weather factors on its population in south Punjab Pakistan. Biological and Clinical Sciences Research Journal. 2022;4(1): 2022.
25. Venkata Rami Reddy P, Gundappa B, Chakravarthy AK. Pests of mango. Pests and their management. 2018:415-40.
26. Patel T, Shukla A. Seasonal incidence and impact of some abiotic factors on hoppers, *Idioscopus spp*. Infesting mango cv Amrapali. Journal of Experimental Zoology India. 2021;124(2).

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/116968