Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(5): 1067-1070

Received: 21-07-2019
Accepted: 25-08-2019

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Influence of abiotic factors on the incidence of mango hopper (Hemiptera: Cicadellidae) in Chhattisgarh

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Abstract
The mango hopper is one of the major devastating pest of mango at flowering stage. The present investigation on influence of abiotic factors on the incidence of mango hopper and the result indicated that the mango hoppers appeared during last week of October with 1.70 hoppers per twig/panicle. The hoppers population continued to build up and attained peak incidence (12.38/twig/panicle) during third week of February at flowering stage (7th standard meteorological weeks). Declining trend of hoppers population was recorded from last week of February, when tree enters in fruiting stage. The lowest hopper population (0.13/twig/panicle) was recorded during first week of April at fruit maturity stage (14th standard meteorological weeks). The correlation coefficient studies revealed that hopper population and weather parameters were found negative and non-significant correlation with temperature and rainfall whereas, positive and non-significant correlation was calculated with relative humidity.

Keywords: Meteorological factors, correlation, seasonal Incidence, mango hoppers

Introduction
Mango (*Mangifera indica* Linnaeus) is the national fruit of India and also known as "King of fruits" due to wide range of adoptability, test, colour, flavour and nutritive value etc. India is the first ranks in production of mango in the world. The tree is damaged by about 492 species of insects, 17 species of mites and 26 species of nematodes at the world level. Of these, 188 species of insects have been reported from India [24]. Nearly 250 insect and mite pests attack the tree in different stages [17].

Among the mango pests, mango hoppers are the harmful and economically pest in which hoppers causes a loss of 20-100% of inflorescence [27] and these are the two important species of mango leaf hoppers *viz., Amritodus atkinsoni* and *Idioscopus nagpurensis*, the former is most predominant in the central eastern part of Chhattisgarh.

Due to infestation of Mango leaf hoppers, *Amritodus atkinsoni* and *Idioscopus nagpurensis* are the major yield limiting factors which reduce the productivity and quality of mango fruits [1].

The damage is mainly caused by both nymphs and adults of the hoppers suck the phloem sap from young leaves, inflorescences and shoots which cause non-setting of flowers and dropping of immature fruits, thereby reducing the yield [7]. Moreover, hoppers also secret honey dews during feeding, by which shooty mold develops. This interferes with photosynthesis, adversely affected plant growth and yield. Affected inflorescences turn brown, become dehydrated, and fruit set does not occur. In mango, the hopper activity coincides with maximum appearance of inflorescence, tender leaves and shoots [29]. Usually these hoppers found colonized for the period of both vegetative (on newly emerging leaves) and reproductive (on inflorescence) phase of the mango tree. Highest population of mango hoppers was observed at the time of flowering period (full bloom stage) of the tree and this pest is active throughout the year in cracks and crevices of the tree trunk [2].

Many workers have been studied the seasonal incidence and fluctuation of weather parameters on development of the hoppers time to time [15]; [20]; [13]; [3] Similarly, [10]; [22] also observed on the effect of some meteorological factors on seasonal abundance of mango hoppers.

Therefore in order to develop suitable management techniques, it is essential to have thorough understanding of the population dynamics and damage potential of the mango leafhopper hence the present experiment was carried out to study the influence of abiotic factors on the incidence of mango hoppers under field conditions.

Materials and Methods

Influence of abiotic factors on the incidence of mango hopper in Chhattisgarh, field trials were conducted during October-May 2015-16 at the Horticultural orchard, Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, Chhattisgarh (22.1049° N, 82.1406° E) in Randomized Block Design. Bilaspur comes under the tropical region of India is situated in central part of Chhattisgarh plains. Bilaspur is situated in central-eastern part of Chhattisgarh and situated within latitude 21047 ' to 2308 ' and longitude 81014 ' to 83015 ' with an altitude of 263 meters above the mean sea level. This place falls under dry sub humid region of the country. The trees were kept free from any insecticide spray.

In this experiment five trees of mango (var. Dashehari) having equal age (about 15-20 years old trees) were randomly selected and tagged in the middle of the orchard. From each trees, one branch from each direction (North, South, East, and West) was considered for recording observations on hoppers. Again within each branch, five twig/panicle were selected and tagged for making the hoppers count. For counting the hoppers, both nymph and adult stages, the selected twigs/panicle was inserted into the polythene bag (30-60 cm. size) during the morning hours between 6-9 am and their population was recorded at weekly intervals. The sample size of each panicle/inflorescence was of about 10 to 12 cm. The data thus, obtained were correlated with various abiotic factors and simple correlation coefficient (r) was worked out by following [6] method.

The weather parameters *viz.*, maximum and minimum temperature, relative humidity and rainfall of the experiment site were collected from meteorological station, Bilaspur, Chhattisgarh, India. This data was used for the correlation and regression analysis.

Statistical analysis

Statistical analysis correlation between the pest population and weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall, were assessed using Carl Pearson's correlation analysis.

Results and Discussion

The seasonal incidence of mango leaf hopper was recorded on mango (cv. Dashehari) starting from October 26, 2015 to May 23, 2016 at weekly interval (Table No 1). The leaf hopper complex of mango at Bilaspur comprises two species *viz.*, *Amritodus* sp. and *Idioscopus nagpurensis*, identified by National Bureau of Agricultural Insect Resources, Bangalore, Karnataka.

The first appearance of the mango leaf hoppers (1.70/twig/panicle) was observed on mango during last week of October, subsequently, there was an increase in its infestation with slight up and downs in some observations. The highest hoppers population (12.38/twig/panicle) was recorded during third week of February (Flowering stage), the weather conditions prevailed during this period were maximum (28.12 ^{0}C), minimum (16.88 ^{0}C) and average (22.5 ^{0}C) temperatures, morning (56.28%), evening (39.71%) and average (47.99%) relative humidity, and rainfall (0.0 mm). Declining trend of hopper population was recorded from March onwards, at fruiting stage. The lowest hopper population (0.13/twig/panicle) was recorded during first week of April. The hoppers incidence was again gradually increased to reach (1.25/twig/panicle) in first week of May. The overall average hopper population was ranged from 0.13 to 12.38 hoppers per twig/panicle during the observational period *i.e.* from October 26, 2015 to May 23, 2016.

Present finding are in agreement with [28]; [9]; [8]; [18]; [14]; [11]; [19]; [5] who were also observed the incidence of mango hoppers throughout the year. The peak incidence and activity of the hoppers coincided with vegetative and reproductive phases of the crop. However, they remained stable in cracks and crevices of the tree trunk during the absence of flowering panicles [25] and [16] reported *A. atkinsoni* remained active throughout the year in the cracks and crevices of the mango trunk. Hoppers populations on twigs were found only during the period when young leaves and inflorescence were available [23] and [12], are of the same opinion who also observed the hopper incidence during vegetative, flowering and fruiting stage of the crop, but the flowering was most congenial.

Fig: Hopper infestation along with its damage symptoms in mango tree (var. Dashaheri) at Bilaspur, Chhattisgarh

The fluctuation of hopper population was correlated with important weather parameters like temperature, humidity and rainfall which play an important role in the fluctuation of insect population. The correlation coefficient studies revealed that hopper population and weather parameters was found negative and non-significant correlation with maximum (r = -0.243), minimum (r = -0.158), average temperature (r = -0.170) and rainfall (r = -0.195) whereas, positive and non-significant correlation with morning (0.116), evening (r = 0.054) and average relative humidity (r = 0.043), respectively (Table No 2). The maximum hoppers population (12.38/twig) was recorded during second week of February.

On the contrary, [21] observed that temperature was positively correlated (r=0.302) with the incidence of mango hopper and rainfall (r=-0.062) and relative humidity (-0.383) was negatively correlated with the incidence of mango hopper. According to [4], [26], who reported mango hoppers population, negatively and significantly correlated with morning relative humidity (r=-0.445) and evening relative humidity (r=-0.118),

respectively, whereas temperature had significant and positive impact on hopper population. No significant effect of rainfall and rainy days was observed on hopper population. Therefore, it can be concluded from the present findings that the population of *Amritodus atkinsoni* is strongly affected by abiotic factors.

Table 1: Average climatic parameters and incidence of mango hoppers population during the experimental period

S. N.	Standard Meteorological Week (SMW)	Temperature (ºC)			Relative Humidity (%)			Rainfall (mm)	Mean hopper population per twig/ inflorescence
		Maximum	Minimum Temperature (ºC)	Average Temperature (ºC)	Morning (%)	Evening (%)	Average (%)		
1	44	31.62	19.28	25.45	78.57	69.85	74.21	0	1.7
2	45	32.07	19.77	25.92	71.25	56.82	64.03	0	2.54
3	46	32	17.82	24.91	77.57	65.42	71.49	0	2.03
4	47	31.62	16.31	24	75.42	56.28	65.85	0	1.65
5	48	31.52	16.47	24	73.42	59.85	66.5	0	1.81
6	49	31.75	17.7	24.72	73.57	63.42	68.49	0	1.53
7	50	30.85	14.74	22.79	64.85	58.14	61.49	0	1.24
8	51	28.62	13.94	23	61.71	56.71	59.21	0	0.85
9	52	25.08	13.18	19.13	74.14	58.42	66.28	0.14	0.71
10	53	30.42	12.17	12.29	58	48	53	0	1.45
11	1	30.31	12.18	21.24	66.71	46.57	56.64	0	1.6
12	2	28.78	12.88	20.83	67.42	53	60.21	0.01	1.8
13	3	26.18	11.77	18.67	72.57	46.57	59.57	2.55	2.29
14	4	30.7	12.6	21.65	61.57	40.42	32.8	0	5.8
15	5	31.08	14.97	23.02	54.28	35.57	44.92	0	6
16	6	28.12	16.88	22.5	56.28	39.71	47.99	0	10.4
17	7	35.12	19.9	27.51	54.14	36.42	45.28	0	12.38
18	8	33.71	20.48	27.09	55.57	44	49.78	0.2	12.3
19	9	35.64	20.13	27.88	50	37.85	43.92	0	6.14
20	10	34.92	20.92	27.92	61.57	37	49.28	0.75	2
21	11	33.97	20.7	27.33	52.14	32	42.07	0.38	0.74
22	12	39.04	20.44	29.74	34.57	22	28.28	0	0.53
23	13	39.58	23.31	31.44	44.14	27.28	35.71	0.21	0.32
24	14	40.65	24.3	32.47	41.42	28	34.71	0.57	0.13
25	15	42.55	25.27	33.91	24.28	18.28	21.28	0	0.63
26	16	43.8	26.28	35.04	29.85	15	22.42	2.24	0.76
27	17	42.55	26.65	34.6	31.85	19.71	25.78	0.11	0.95
28	18	40.74	25.28	33.01	38.42	22.71	30.56	0.67	1.25
29	19	42.45	26.7	34.57	39.57	24.85	32.21	0.11	0.95
30	20	43.65	26.91	35.04	31.14	18.28	24.71	0.9	0.75
31	21	42.8	25.02	34.06	27.24	24.65	32.02	1.23	0.46

Table 2: Simple correlation co-efficient ($r^{\#}$) between mango leaf hopper population and meteorological parameters during 2015 -16

pest	Temperature (º C)			Relative humidity (%)			Rainfall (mm)
	Maximum	Minimum	Average	Morning	Evening	Average	
Leaf hopper population	-0.243	-0.158	-0.170	0.116	0.054	0.043	-0.195

[#]Non-Significant at 5% level

Conclusion

The studied on the seasonal incidence of mango leaf hoppers indicated that the pest was appeared during last week of October with 1.70 hoppers per twig/panicle. The pest population continued to build up and attained peak (12.38/twig/panicle) during third week of February at flowering stage. Declining trend of hopper population was recorded from last week of February, when tree enters in fruiting stage. The lowest hopper population (0.13/twig/panicle) was recorded during first week of April. The correlation coefficient studies revealed that hopper population and weather parameters were found negative and non-significant correlation with temperature and Rainfall whereas, positive and non-significant correlation was calculated with relative humidity.

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