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Population dynamics of leafhopper, *Amrasca bigutulla bigutulla* (Homoptera : Cicadellidae) in upland cotton (*Gossypium hirsutum* L.)

ARUN JANU*, OMBIR, K. K. DAHIYA AND PRITISH JAKHAR

Department of Entomology, CCS Haryana Agricultural University,Hisar – 125 004

**E-mail: januhau@gmail.com*

ABSTRACT : The population dynamics of leafhopper, *Amrasca bigutulla bigutulla* (Homoptera: Cicadellidae) along with their correlation with abiotic factors were studied during 2014 and 2015 at Cotton Research Area, CCS Haryana Agricultural University, Hisar. During the 1st season, the incidence of leafhopper was recorded from the 26th SMW (standard meteorological week) onwards and the peaks of the leafhopper population 3.41, 4.10 and 3.39 nymphs/leaf were observed in 28th, 33rd and 39th SMW, respectively. The maximum and minimum mean leafhopper population was recorded in KSCH 209 BG II (4.11 nymphs/leaf) and H 1226 (0.64 nymphs/leaf) genotype, respectively. During the 2nd season the incidence of leafhopper was observed throughout the crop season. The peaks of the leafhopper population 4.33 and 2.21 nymphs/leaf were recorded in 29th SMW and 35th SMW, respectively. The minimum mean leafhopper population of 1.07 nymphs/leaf was recorded in H 1226 genotype whereas NCS 9002 BG II had the maximum mean leafhopper population of 2.56 nymphs/leaf. Correlation studies revealed that the maximum temperature was significant and negatively correlated with the leafhopper population whereas, morning and evening relative humidity were significant and positively correlated with the leafhopper population. Minimum temperature and rainfall was non significantly correlated with the leafhopper population.

Key words: Abiotic factors, *Amrasca bigutulla bigutulla,* upland cotton, leafhopper

Cotton (*Gossypium* spp.) is an important commercial crop of India and is grown in three agro climatic zones. Besides serving as a source of natural fibre, it is also an oilseed crop, providing raw material to the oil and textile industries and thus performs a key role in the national economy and trade. India is unique to grow all the four cultivated spp (*Gossypium hirsutum, G. barbadense, G. arboreum* and *G. herbaceum*) and intra and inter specific hybrids under diverse agro ecological conditions. In India, the area under cotton was 118.81 lakh ha with a production of 352 lakh bales of 170 kg and productivity of 503 kg/ha whereas, in Haryana the area under cotton stood at 5.76 lakh ha with a production of 14.00 lakh bales and productivity of 502 kg/ha during 2015-2016 (Anonymous, 2015).

Amongst several factors responsible for the low productivity, the loss caused due to insect pests is one of the major reasons. About 145 insect pests attack this crop and among them the sucking pests like leafhopper (*Amrasca bigutulla bigutulla* Ishida), whitefly (*Bemisia tabaci* Genn.), thrip (*Thrips tabaci* Linn.) and aphid (*Aphis gossypi* Glover) are of regular occurrence. Among these sucking pests, cotton leafhopper is an important sucking pest causing quantitative and qualitative losses (Kumar and Sharma, 2012). Its attack starts on the vegetative phase of the crop and the adults and nymphs suck the plant sap usually from under surface of the leaves. As the infestation increases, the affected leaves turn pale at the margins first and then crinkling, curling, reddening and browning of leaves follow. Under high infestation on susceptible varieties, the plants get defoliated and their growth remains stunted and unable to produce flowers and bolls (Hole *et al.,* 2013).

The cotton leafhopper, *Amrasca biguttula biguttula* (Ishida) (Hom., Cicadellidae) is an important pest of several field crops including cotton, okra, egg plant, potato, tomato, sunflower, cluster bean. The character istic symptom of leafhopper attack is phytotoxemia (hopper burn) caused by desapping of leaves by nymphs and adults. In severe attacks, plants are stunted and unable to produce flowers and fruits. However, the potential of the leafhopper to inflict damage depends on its oviposition preference and subsequent population build-up on different host plants.

The meteorological factors play a vital role in the development and population build up of insect species. Among the weather factors, temperature and relative humidity are the most important controlling parameters providing favourable environment. Therefore, it was felt necessary to determine the optimum conditions required for multiplication of leafhopper and to work out the relationship between pest population and weather parameters so that prediction of population peaks could be made to help in effective pest management.

MATERIALS AND METHODS

The field experiments were conducted during *kharif,* 2014 and 2015 at Cotton Research Area, CCS Haryana Agricultural University, Hisar, under unprotected conditions with three replications of each treatment with the plot size of 5 rows of 5 m each. The seeds of 23 genotypes were sown at 2 seeds/hill on 18th May, 2014 and 16th May, 2015 by hand dibbling method. Gap filling was done within 5-7 days after emergence of the crop and thinning was done at 15 days after emergence of the crop, keeping one healthy seedling/hill.

The observations on population of leafhopper were recorded at weekly interval (F 23 to 41 SMW) from three leaves (each from top, middle and bottom) on five randomly selected plants from each replication. The data pertaining to seasonal incidence of leafhopper of cotton crop were compared with various weather factors. The relation between weather parameters and leafhopper of cotton was studied and simple correlation was worked out.

Statistical analysis: The data obtained for 2014 and 2015 in the above experiments were pooled and computed for analysis of variance after transformation.

RESULTS AND DISCUSSION

Population dynamics of leafhopper during *kharif,* 2014 : Leafhopper population of 0.25 nymphs/leaf was recorded during 24th SMW *i.e.* fourth week of June and remained active during the season as shown in the Fig 1. Population peaks of 3.41, 4.10 and 3.39 nymphs/leaf were recorded in 28th, 33rd and 37th SMW, respectively. In the 28th SMW the maximum leafhopper population of 5.92 nymphs/leaf was observed in KSCH 209 BG II followed by 5.87 nymphs/leaf in KDCHH 541 BG II genotype. The minimum leafhopper population was recorded in H 1226 (1.05 nymphs/leaf) followed by HHH 223 (1.56 nymphs/leaf). The second peak was found 4.10 nymphs/leaf during 33rd SMW, where the maximum leafhopper population was observed in KSCH 209 BG II (6.67 nymphs/leaf). The minimum population was 1.31 nymphs/leaf followed by 1.95 nymphs/leaf in H 1226 and HHH 223 genotype, respectively.

Third peak was recorded in 37th SMW, wherein maximum leafhopper population was recorded in KSCH 209 BG II (6.90 nymphs/leaf) followed by KDCHH 541 BG II (6.11 nymphs/leaf). During this season, the maximum and minimum mean leafhopper population was recorded in KSCH 209 BG II (4.38 nymphs/leaf) and H 1226 (0.78 nymphs/leaf) genotype, respectively (Table 1). Both the genotypes were statistically at par with other genotypes.

Population dynamics of leafhopper during *kharif*, 2015 : As evident from the Fig. 2, the incidence of leafhopper was observed throughout the crop season. The minimum and maximum population of leafhopper recorded was 1.09 and 2.78 nymphs/leaf in H 1226 and KDCHH 541 BG II genotype, respectively. The peaks were observed at 29th and 35th SMW, where the leafhopper population was 4.33 and 2.59 nymphs/leaf. The maximum population of leafhopper was found in KDCHH 541 BG II (6.11 nymphs/leaf) significantly *at par* with the KSCH 541 BG II (6.00 nymphs/leaf) and minimum population was 3.11 nymphs/leaf in the genotype HHH 223 significantly *at par* with the H 1226 (3.22 nymphs/leaf) in the first peak at 29th SMW. The minimum leafhopper population was observed at 1.30 nymphs/leaf in both HHH 223 and H 1226 and 0.39 nymphs/leaf in HHH 223

Table 1. Average population of leafhopper (*Amrasca bigutulla bigutulla*) on upland cotton genotypes

S. No.	Genotypes	Leafhopper/leaf		
		2014	2015	**Pooled**
1	SP 7010	1.38 (1.54)	1.27 (1.51)	**1.33 (1.52)**
2	PRCH 333 BG II	1.65 (1.63)	1.6 (1.61)	**1.63 (1.62)**
3	VICH 310 BG II	1.84 (1.69)	1.91 (1.71)	**1.88 (1.70)**
4	GBCH 85 BG II	2.32 (1.82)	1.92 (1.71)	**2.12 (1.77)**
5	KSCH 210 BG II	1.76 (1.66)	1.54 (1.59)	**1.65 (1.63)**
6	S 07 H 878 BG II	2.94 (1.98)	1.74 (1.66)	**2.34 (1.83)**
7	SP 7007 BGII	1.57 (1.60)	1.45 (1.57)	**1.51 (1.58)**
8	KSCH 209 BG II	4.38 (2.32)	2.55 (1.88)	**3.47 (2.11)**
9	KSCH 541 BG II	1.5 (1.58)	1.41 (1.55)	**1.46 (1.57)**
10	KDCHH 541 BGII	3.76 (2.18)	2.78 (1.94)	**3.27 (2.07)**
11	PCH 876 *Bt*	3.28 (2.07)	2.31 (1.82)	**2.80 (1.95)**
12	PCH 406 *Bt*	3.69 (2.17)	2.47 (1.86)	**3.08 (2.02)**
13	KCH 14 K 59 BG II	2.62 (1.90)	1.83 (1.68)	**2.23 (1.80)**
14	NCS 9002 BG II	3.43 (2.10)	2.56 (1.89)	**3.00 (2.00)**
15	PCH 877 BG II	1.91 (1.71)	1.69 (1.64)	**1.80 (1.67)**
16	WESTERN NIROGA 151 BG II	2.76 (1.94)	1.77 (1.66)	**2.27 (1.81)**
17	ANK 3028 BG II	2.51 (1.87)	2.01 (1.73)	**2.26 (1.81)**
18	SP 7171 BG II	1.51 (1.58)	1.33 (1.53)	**1.42 (1.56)**
19	RCH 653 BG II	1.22 (1.49)	1.44 (1.56)	**1.33 (1.53)**
20	BIOSEED 6588 BG II	2.07 (1.75)	1.94 (1.71)	**2.01 (1.73)**
21	RCH 314 BG II	3.06 (2.01)	2.35 (1.83)	**2.71 (1.92)**
22	HHH 223	1.08 (1.44)	1.22 (1.49)	**1.15 (1.47)**
23	H 1226	0.78 (1.33)	1.07 (1.44)	**0.93 (1.39)**
	C.D. (p=0.05)	(0.10)	(0.06)	**(0.09)**
	SE(m)	(0.04)	(0.02)	**(0.03)**

Figures in parentheses are $\sqrt{X+1}$ transformed values at the 35th and 37th SMW, respectively. The highest leafhopper population at the 35th SMW recorded in the KDCHH 541 BG II genotype was 4.05 nymphs/leaf followed by 3.56 nymphs/leaf in RCH 314 BG II. At the 37th SMW the maximum population of leafhopper reached 3.22 nymphs/ leaf in the KSCH 209 BG II significantly different from KDCHH 541 BG II (2.44 nymphs/leaf). During 2015 season the minimum mean leafhopper population of 1.07 nymphs/leaf was recorded in the H 1226 genotype statistically *at par* with the HHH 223 (1.22 nymphs/leaf), whereas the maximum mean leafhopper population (2.56 nymphs/leaf) was found in the NCS 9002 BG II statistically *at par* with the KSCH 209 BG II (2.55 nymphs/leaf), PCH 406 BT (2.47 nymphs/leaf) and RCH 314 BG II (2.35 nymphs/ leaf) genotypes.

Population dynamics of leafhopper during (2014 and 2015) : Two years (2014 and 2015) pooled mean results presented in Fig. 3 revealed that the activity of leafhopper nymphs on cotton crop commenced from 23rd SMW. The

Table 2. Correlation coefficient (r) of leafhopper population with abiotic factors

Pest	Leafhopper		
	2014	2015	**Pooled**
T_{max}	-0.628**	-0.369	**-0.637****
T_{min}	0.009	0.631**	**0.447**
RH_M	0.511*	0.479*	**0.613****
RH_E	0.423	0.544*	**0.706****
Rainfall	-0.271	0.345	**0.066**

*Significant at 5%, **Significant at 1%

peak nymphal population of leafhopper 3.68, 2.88 and 2.70 nymphs/leaf was observed in 29th, 33rd and 37th SMW. The maximum and minimum mean nymphal population of leafhopper was recorded in the KSCH 209 BG II (3.46 nymphs/ leaf) and H 1226 (0.92 nymphs/leaf).

Kalkal (2011) reportd that the highest leafhopper population was observed during the 28th (1.65 nymphs/leaf) and 32nd (0.60 nymphs/ leaf) SMW during the 2008, whereas in the 2009 the maximum leafhopper population was observed in the 32nd (1.37 nymphs/leaf) SMW. The present findings are in line with Bhute *et al.,* (2012) which observed the highest population

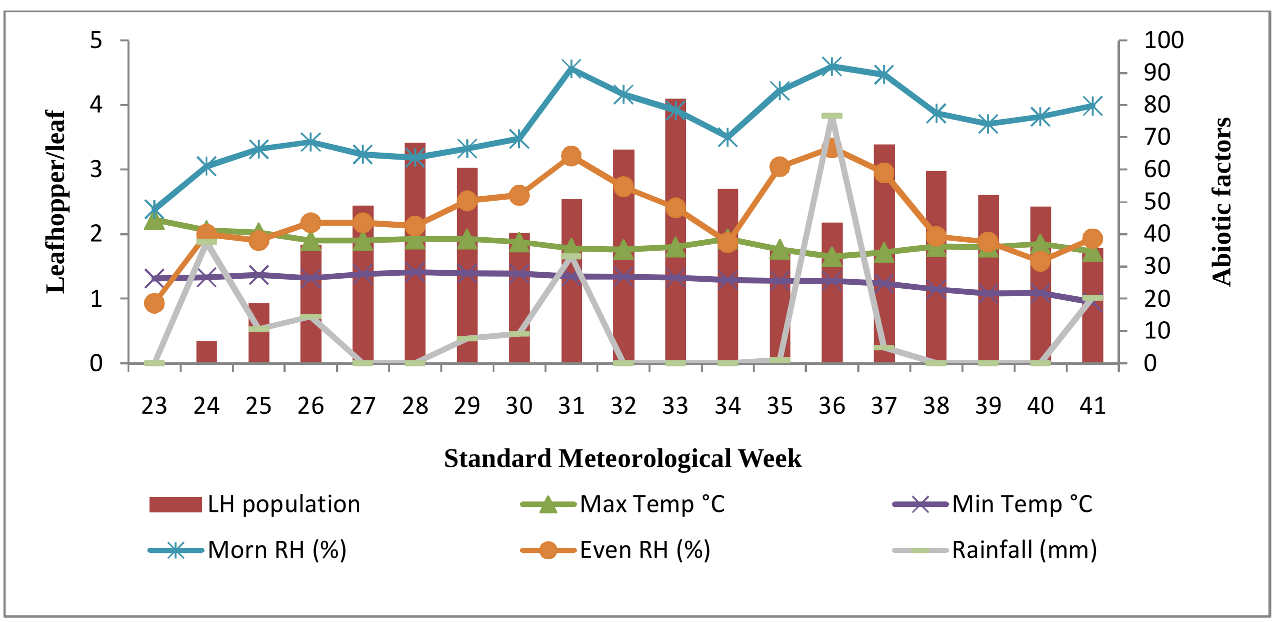

Fig.1. Population Dynamics of leafhopper in relation to abiotic factors during 2014

of leafhopper (13.80/3 leaves) in 40th SMW during the 2007-2008 and in 39th (13.75/3 leaves) SMW during the 2008-2009 season. Reddy *et al.,* (2011) reported that the peak incidence of leafhopper was from the second fortnight of October to first fortnight of November (10.11 to 10.82/leaf) during the year 2009-2010 and in the year 2010-2011, the peak incidence advanced to mid September till first fortnight of October (6.02 to 5.48/leaf) in central Telangana agro climatic zone of Andhra Pradesh.

Correlation of leafhopper dynamics with weather parameters during *kharif*, 2014: The coefficient of correlation between nymphal population of leafhopper and weather parameters are presented in Table 2. The correlation between nymphal population and maximum temperature was significant and negative, while significant and positive with morning relative humidity. The minimum temperature and evening relative humidity showed the non significant and positive correlation with the nymphal population of leafhopper. The rainfall was found to be non significantly and negatively correlated with the leafhopper dynamics.

Correlation of *leafhopper* dynamics with weather parameters during *kharif*, 2015: During 2015, the significantly positive correlation was found between the nymphal incidence and minimum temperature, morning and evening relative humidity, whereas the maximum temperature showed non significant and negative correlation Contrary to 2014, the rainfall showed the non-significant and positive correlation with the leafhopper nymphal population.

Correlation of dynamics with the weather parameters (2014 adn 2015) : The pooled data of 2014 and 2015 indicated that the correlation was significantly negative between the leafhopper nymphal population and the maximum temperature, while it was non significant and positive with the minimum

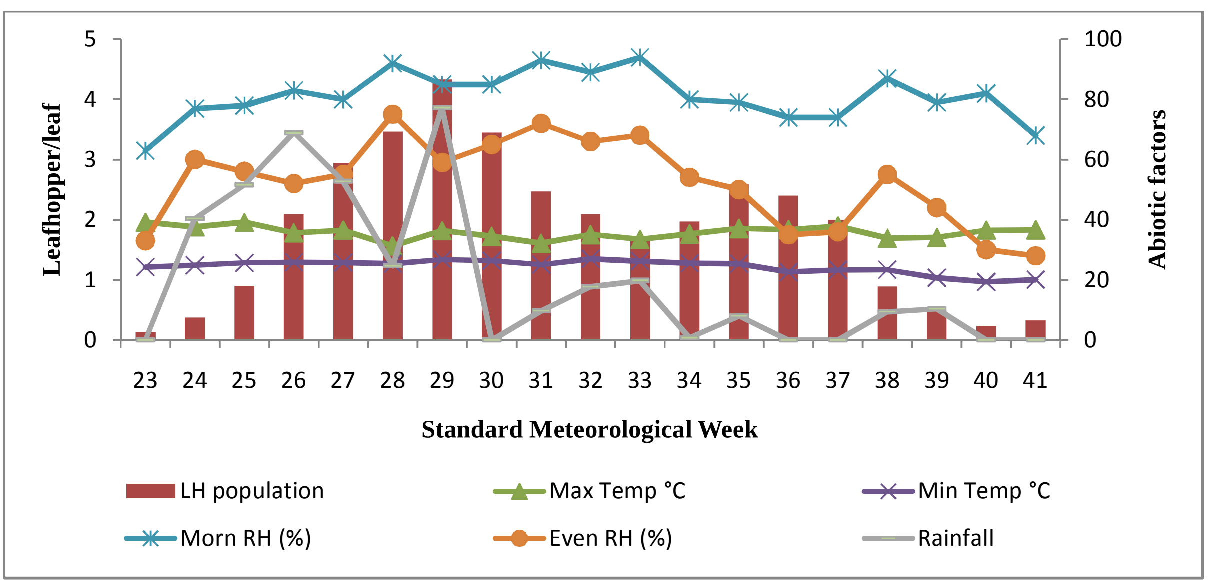

Fig.2. Population Dynamics of leafhopper in relation to abiotic factors during 2015

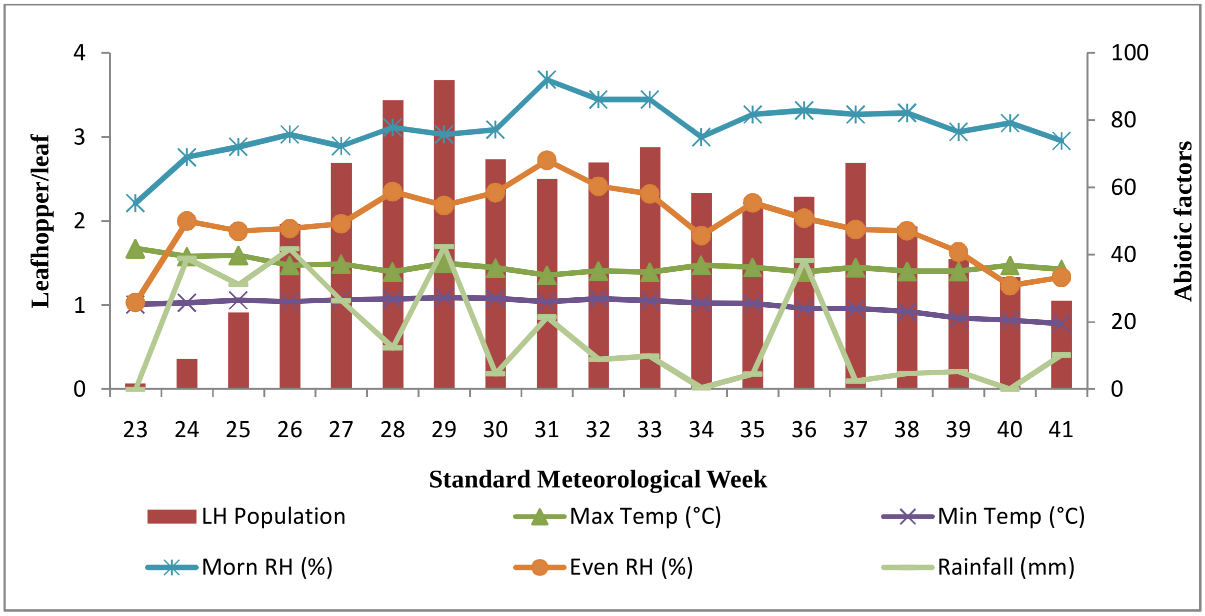

Fig. 3. Population dynamics of leafhopper in relation to abiotic factors (pooled data)

temperature. The morning and evening relative humidity seemed to have significantly positive effect on the leafhopper nymphal dynamics. The rainfall did not appear to have remarkable effect on leafhopper nymphal population. Similar studies reported that the major weather parameters showed positive correlation with the population of leafhoppers except maximum temperature (Soujanya *et al.,* 2010), whereas Kalkal, (2011) suggested that leafhopper population was positively correlated with temperature and negatively correlated with rainfall. Studies conducted by the Selvaraj *et al.,* (2011) found the population build up of leafhopper depended positively on morning, evening relative humidity and rainfall but showed significantly negative association with minimum temperature. The present findings are in agreement with those of Babu and Meghwal, (2014) who reported that the maximum temperature was significant and negatively correlated, whereas the morning relative humidity was significant and positively correlated with the leafhopper population.

It may be concluded that the weather factors especially minimum temperature and relative humidity determined seasonal activity and population dynamics of leafhopper in cotton. The information generated in present study would contribute towards formulating weather based forecasting models, predicting pest population and developing efficient pest management strategies against cotton leafhopper and thus would help in increased production, besides safety to the environment.

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