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RESEARCH ARTICLE

Incidence of sucking insect pests of transgenic Bt cotton in relation to abiotic factors

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SUMMARY

Among various sucking pest leaf hopper [*Amrasca biguttula biguttula* (Ishida)] and white fly (*Bemisia tabaci* Gennadius) remained active throughout the cropping season with varying density. No population of thrip was observed during this period. The peak population of leaf hopper was observed during 30th (1.3/3 leaves) and 31st (1.0/3 leaves) standard meteorological weeks. The peaks of whitefly adults were recorded during 30th (1.3/3 leaves), 34th (2.2/3 leaves) and 35th (1.4/3 leaves) standard meteorological week. The population of mealy bug was observed only in the hybrid RCH 134. The correlation analysis showed that the leaf hopper mean data over the season was negatively correlated with morning relative humidity, mean relative humidity and rainfall, while other parameters showed positive influence on the leaf hopper population. The white fly was positively correlated with morning relative humidity and means relative humidity and negatively correlated with maximum, minimum, mean temperature, rainfall and evaporation in all the *Bt* hybrids. Mealy bug was positively correlated with morning relative humidity, evening relative humidity, mean relative humidity and rainfall and remaining parameters were negatively correlated. The multiple linear regression analysis showed that all the weather parameters together responsible for a large and significant variation in the population of all the sucking pests.

Key Words : Bt Cotton, Sucking pest, Abiotic factors and incidence

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Cotton, *Gossypium hirsutum* Linn. is a major commercial crop grown in India and is highly vulnerable to insect pests (Selvaraj *et al*., 2011). India is the second largest producer of cotton in the world after China (AICCIP, 2009). Cotton ecosystem harbours of wide varieties of arthropods and consequently requires a constant protection from insect pests. Before the introduction of Bt cotton, bollworm and sucking insect pests were the two major groups in Punjab against which most of the insecticides were used. Although the Bt cotton provides effective management of bollworms but not effective against sucking pests (Mann *et al*., 2010) which still pose a great threat to its cultivation and necessitate insecticidal application to avoid yield losses (Shera *et al.,* 2010). The incidence and development of all the insect pests are much dependent upon the prevailing environmental factors such as temperature, relative humidity and rainfall (Aheer *et al*., 1994). Among various sucking pests, cotton leaf hopper [*Amrasca biguttula biguttula* (Ishida)] is one of the important pest of cotton crop. Both nymphs and adults of *A. biguttula biguttula* suck the plant sap and introduce salivary toxins that impair photosynthesis in the proportion to the amount of foliage. They feed on the underside of leaves and cause distortion, and leaf culing in the plant. Population of leaf hopper occurs throughout the crop season but it fluctuates with the various parameters (Vennila *et al*., 2007). Similarly, whitefly and mealy bug also cause severe damage to *Bt* cotton in relation to various abiotic factors. So, there is need to monitor the population of sucking pests and take up control measures for the management of these pests on Bt cotton. Keeping this in view, a study was undertaken to monitor the population of sucking insect pests on Bt cotton

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hybrids to know the influence of various abiotic factors on its population fluctuation.

MATERIALS AND METHODS

The study was carried out at Entomological Research Farm, Department of Entomolgy, Punjab Agricultural University, Ludhiana during 2009. Three commercially released Bt cotton hybrids *i.e.* MRC 7017, MRC 7031 and RCH 134 were grown in the Randomized Block Design with 3 replications having plot size 250m^2 each. These hybrids grown by adoption of all the PAU recommendations (Anonymous, 2009).The data of sucking insect pest population (leaf hopper, white fly, mealy bug and thrips) per three leaves recorded from 27th to 41st standard meteorological weeks (SMW) at weekly interval from upper canopy of 20 randomly selected plants from each plot. Daily observations of different meteorological parameters were recorded at Agro-meteorological observatory situated in PAU, Ludhiana (Fig. A). Correlation coefficients were calculated between population of sucking pests and meteorological parameters. Step wise regression analysis was also calculated between sucking pests and meteorological parameters.

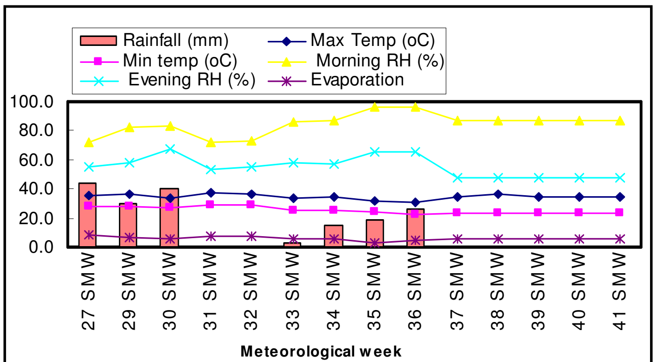

Fig. A : Meteorological week wise data recorded during 2009-2010 cotton crop season

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relavent discussion have been summarized under the following heads :

Leaf hopper :

The data presented in Table 1 revealed that there was regular incidence of leaf hopper throughout the crop growth with a peak population ranged from 0.1-1.5 per 3 leaves in all the hybrids. The population of leaf hopper was high during initial stage of crop growth with two peaks during 30th (1.3/3 leaves) and 31st (1.0/3 leaves) standard meteorological weeks. The population was maximum (1.3/3 leaves) during initial stages of crop growth with maximum temperature ranged from 34-38^{0}C and minimum temperature ranged from 27-29^{0}C, morning R.H. 72-83 per cent and evening R.H. 53-67 per cent, and 40 mm rainfall was favourable for multiplication of leaf hopper. The present findings are in conformity with earlier observations made by Abro *et al.* (2004). Correlation coefficient was calculated between the population of leaf hopper and weather parameters presented in Table 2. The mean data over the season revealed that morning relative humidity, mean relative humidity and rainfall showed negative correlation, while other parameters showed positive influence on the leaf hopper population. The data presented in Table 3 revealed that all the meteorological parameters influence the leaf hopper population in all the cotton hybrids.

White fly :

The data presented in Table 1 revealed that the population of whitefly adults remained actice throughout the cropping season. The population of white fly remained higher during the crop growth period. The three peaks of white adult population was recorded during 30th (1.3/3 leaves), 34th (2.2/3 leaves) and 35th (1.4/3 leaves) standard

Table 1 : Population of sucking pests per three leaves on different hybrids of Bt cotton during 26th to 42nd standard meteorological weeks

Treatments	Mean of sucking pest population/ 3leaves in Standard Meteorological Weeks														
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
								Leaf hopper							
7017	0	0.3	0.4	1.3	1.0	0.5	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1
7031	0.3	0.3	0.6	1.5	1.2	0.5	0.4	0.2	0.4	0.4	0.3	0.3	0.3	0	0.2
RCH 134	0.2	0.3	0.2	1.1	1.2	0.7	0.4	0.4	0.3	0.3	0.5	0.5	0.2	0.1	0
								White fly							
7017	0	0.4	0.6	1.3	1	1	0.8	2.2	1.4	1.1	1.2	1.2	1.2	1	1.2
7031	0.1	0.5	0.8	2.6	4	1.1	1.3	3	2.6	1.8	1.9	2.1	2.1	1.8	1.2
RCH 134	0.1	0.4	0.5	2.2	2	1.8	2.3	2.4	2.4	2.4	2.2	2.2	2.2	2.2	1.2
								Mealy bug							
7017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7031	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RCH 134	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0

meteorological week. The mean population was maximum (2.2/3 leaves) during initial stages of crop growth with maximum temperature ranged from 34-35^{0}C and minimum temperature ranged from 25-27^{o}C, morning R.H. 83- 87 per cent and evening R.H. 57- 67 per cent and 15.2-40 mm rainfall was favourable for multiplication of white fly. The present findings are in agreement with those of Kant *et al*. (2007) who reported that the maximum and minimum temperature ranged from 30.5 to 32.5^{0}C and 20 to 23.5^{0}C, respectively, had positive correlation. Similar results were reported by Rani *et al.* (2010). However, Tomar *et al.* (2004) reported the incidence of whiteflies from August to October, while Luo *et al.* (1989) reported from early July to September with three population peaks.

The white fly was positively correlated with morning relative humidity and mean relative humidity and negatively correlated with maximum, minimum, mean temperature, rainfall and evaporation in all the Bt hybrids (Table 1). The present findings are in accordance with Rote and Puri (1991) reported significant positive association between temperatures and the population of whiteflies. However, Singh *et al.* (2004) and Srinivasa Rao (2004) who reported significant negative correlation between the population of whiteflies and maximum and minimum temperatures.

Mealy Bug :

No incidence of mealy bug was observed during the entire cropping period on any hybrid except in the 36th

Table 2 : Correlation coefficients between leaf hoppers population and meteorological parameters in various Bt hybrid

Treatments	Meteorological parameters							
	Tmax	Tmin	Tmean	RHm	RHe	RHmean	Rain-fall	Evap
Leaf hopper								
7017	0.43	0.67	0.64	-0.54	0.16	-0.26	-0.26	0.34
7031	0.50	0.71	0.70	-0.64	0.13	-0.34	-0.17	0.50
RCH 134	0.49	0.55	0.59	-0.49	0.03	-0.30	-0.37	0.34
White fly								
7017	-0.41	-0.49	-0.52	0.61	0.08	0.45	-0.49	-0.78
7031	-0.03	-0.05	-0.05	0.10	0.01	0.07	-0.52	-0.25
RCH 134	-0.16	-0.53	-0.41	0.46	-0.21	0.17	-0.70	-0.52
Mealy bug								
7017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7031	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RCH 134	-0.61	-0.30	-0.49	0.44	0.40	0.54	0.24	-0.28

Tmax: Maximum temperature; Tmin: Minimum temperature, RHm: Relative humidity morning; RHe: Relative evening humidity
RF : Rainfall ; Evap: Evaporation

Table 3 : Regression analysis between sucking pest population and different meteorological parameters in various Bt hybrids

Hybrids	Regression equation	Multiple R
Leaf hopper		
7017	Y = -1.19 + 0.06 Tmax + 0.06 Tmin – 0.03 RHm + 0.04 RHe -0.03 RF -0.02 Evap	0.96
7031	Y = 1.63 + 0.08 Tmax -0.12 Tmin -0.07 RHm + 0.09 RHe + 0.04 RF -0.02 Evap	0.93
RCH 134	Y = -2.38 + 0.12 Tmax – 0.13 Tmin – 0.04 RHm + 0.09 RHe + 0.09 RF -0.03 Evap	0.94
White fly		
7017	Y = 5.31- 0.04 Tmax + 0.07 Tmin -0.02 RHm + 0.004 RHe -0.45 RF -0.02 Evap	0.92
7031	Y =8.23 – 0.12 Tmax – 0.02 Tmin -0.07 RHm + 0.10 RHe – 0.15 RF – 0.07 Evap	0.76
RCH 134	Y = 3.14 + 0.20 Tmax -0.47 Tmin – 0.06 RHm + 0.15 RHe + 0.07 RF -0.05 Evap	0.88
Mealy bug		
7017	Y = 0	1.00
7031	Y = 0	1.00
RCH 134	Y = - 0.59 – 0.06 Tmax – 0.32 Tmin + 0.02 RHm + 0.11 RHe + 0.69 RF -0.02 Evap	0.83

Tmax: Maximum temperature; Tmin: Minimum temperature, RHm: Relative humidity morning; RHe: Relative evening humidity
RF : Rainfall ; Evap: Evaporation

standard meteorological week its population was observed on the hybrid RCH 134. There was a positive correlation between weather parameters and the population of mealy bug for morning relative humidity, evening relative humidity, mean relative humidity and rainfall in RCH 134 cultivar. Mealy bug was positively correlated with morning relative humidity, evening relative humidity, mean relative humidity and rainfall and remaining parameters were negatively correlated with Bt hybrids. The data in Table 3 revealed that all the meteorological parameters influenced the sucking pest population in all the cotton varieties.

The multiple linear regression analysis indicated that the influence of all the weather parameters was high and significant. The regression equation further indicated that the maximum temperature had significant positive impact on the population of leaf hopper and white fly, morning relative humidity and evening relative humidity had negative impact on the population. *i.e.* for one unit increase in maximum temperature, there will be 0.96, 0.93 and 0.94 units increased in the leaf hopper population in 7017, 7031 and RCH 134, respectively. It may be concluded that climatic factors determined seasonal activity and population dynamics of sucking pests in cotton. This information generated in present study would be helpful in developing efficient pest management strategies against insect pests of cotton crop for increased production efficiency, profit, besides safety to the environment.

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