Indian Journal of Applied Entomology **25**(1) : 6–9 (2011)

POPULATION DYNAMICS OF SUCKING INSECT PESTS IN *BT*, STACKED *BT* AND NON *BT* COTTON HYBRIDS

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ABSTRACT

The seasonal occurrence of sucking pests was similar on *Bt*, stacked *Bt* and non *Bt* cotton hybrids and the population means did not differ significantly. The initial incidence of aphids was recorded on 34th standard metrological week (SMW) and the peak incidence was observed during 39th SMW to 46th SMW. The incidence of leafhoppers showed an increasing trend from 39th SMW onwards crossing the ETL during 42nd to 47th SMW; while the peak incidence was during 35th to 37th SMW for thrips and 44th to 48th SMW week for whiteflies. The incidence of aphids recorded in the *Bt,* stacked *Bt* and non *Bt* hybrids had a positive correlation with most of the weather factors except maximum temperature with which it showed a significant negative correlation. The total influence of all the weather parameters was high and significant on the leafhoppers (59.10 per cent) and thrips (80.5 per cent), while it was non–significant on aphids and whiteflies.

Keywords: Sucking pests, correlation, weather parameters, Multiple Linear Regression, stacked *Bt* cotton, *Bt* cotton

INTRODUCTION

Cotton (*Gossypium hirsutum*) is an important commercial crop of India and is grown in 9.60 million hectares area with a production of 310 lakh bales (AICCIP, 2007–08). Of the several production constraints insect pests are one of the major biotic factors causing enormous loss to seed cotton yield. Among various insect species, sucking pests alone cause 22.85 per cent reduction in seed cotton yield under rainfed conditions (Satpute *et al.*, 1990). Leafhoppers cause much damage which leads to reduction in growth and vigour of the plants during vegetative phase. In order to evolve sustainable pest management strategies, studies on population dynamics of pests of the crop are essential in view of the changing scenario of insect pest incidence and with the introduction of *Bt* and stacked *Bt* cotton hybrids. The transgenic *Bt* cotton with single or double genes are able to control major bollworm complex on cotton to a large extent. The currently available transgenic *Bt* cotton cultivars do not control sucking pests.

MATERIALS AND METHODS

Two Bt cotton hybrids (TCH–4*Bt*, TCH–117*Bt* containing CryIAc) two stacked Bt cotton hybrids (TCH–4, BGII, TCH–117BGII containing CryIAc+2Ab) and their corresponding non–*Bt* versions were chosen to study the incidence of major sucking pests on a bulk plot of 200 sq. m. for each hybrid, which were raised by following recommended agronomic practices under unprotected conditions at Regional Agricultural Research Station, Lam, Guntur during 2006–07 and 2007–08 for two consecutive seasons. Observations on the incidence of the aphid, *Aphis gossypii,* leafhopper, *Amrasca biguttula biguttula*; thrips, *Thrips tabaci* and whitefly, *Bemisia tabaci* were recorded on 25 randomly selected tagged plants between 8.00 to 9.00 a.m. at weekly intervals through out the crop growth period. The counts were recorded from three leaves on the main stem from the top of the plant. The weather data was recorded at meteorological observatory of Regional Agricultural Research Station, Lam, Guntur. The mean population counts for the sucking pests were subjected to correlation and regression studies with weather parameters *viz.*, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall to interpret the results. The seasonal mean incidence for the two years for different hybrids was subjected to 't' test to know the level of significance.

RESULTS AND DISCUSSION

The initial occurrence of aphid population was during 34th standard meteorological week (SMW), which progressively increased and attained peak level during 46th SMW in all the hybrids with the population of 17.40 (TCH–4*Bt*), 17.92 (TCH–117*Bt*), 17.68 (TCH–4BGII), 18.72, 16.24 and 16.60 aphids/3 leaves/ plant TCH–4*Bt*, TCH–

117*Bt*, TCH–4BGII, (TCH–4N*Bt*) and (TCH–117N*Bt*) with a sudden decline in the population during 47th SMW; thereafter the population levels progressively declined reaching to negligible levels during 1st SMW (Fig. 1). The seasonal mean incidence of aphids was slightly more in stacked *Bt* hybrids (5.39 to 5.54), *Bt* hybrids (5.06 to 5.39) as compared to non *Bt* hybrids (4.37 to 4.56), but the differences were non significant. Seshamahalakshmi (2007) also reported the peak incidence of aphids in the month of November and that the incidence of aphids was slightly higher in stacked *Bt* and *Bt* versions than their corresponding non *Bt* versions though the population did not differ significantly indicating more or less similar incidence (Table 1). Bambawale (2004) reported no significant difference between stacked *Bt, Bt* and non *Bt* versions with regard to the incidence of sucking pests. The correlation analysis revealed positive correlation between all the weather factors and the population of aphids except maximum temperature (r = – 0.401), which showed significant negative correlation (Table 2). The regression equation indicated that for every 1°C rise in maximum temperature there was a corresponding reduction of 2.87 aphids (Table 3). Srinivasa Rao (2004) earlier reported that the total variation due to all the weather parameters was nearly 50 per cent for aphids in different cotton hybrids.

The initial incidence of leafhoppers was observed during 34th SMW and the population was above ETL during 42nd to 47th SWM reaching the peak during 46th SMW in all the hybrids with 14.96 (TCH–4*Bt*), 15.12 (TCH–117*Bt*), 15.04 (TCH–4BGII), 15.20 (TCH–117BGII), 13.04 (TCH–4N*Bt)* and 13.16 (TCH–117N*Bt*)/3 leaves/plant . The population levels declined from 5th SMW. The seasonal mean incidence of leafhoppers was slightly more in all stacked *Bt* (4.32 to 4.49) and *Bt* hybrids (4.26 to 4.40)

Table 1. Seasonal mean population of sucking pests on *Bt*, stacked *Bt* and non *Bt* cotton hybrids

	TCH4 Bt	TCH4 NBt	TCH117 Bt	TCH117 NBt	TCH4 BGII	TCH4 NBt	TCH117 BGII	TCH117 NBt	TCH4 Bt	TCH4 BGII	TCH117 Bt	TCH117 BGII
Aphids (no/3leaves/plant)												
Means	5.06	4.37	5.39	4.5	5.39	4.37	5.44	4.56	5.06	5.39	5.39	5.54
Variance	22.98	20.06	24.01	20.51	24.01	20.06	25.27	20.51	22.98	24.01	24.01	25.27
TTEST	NS		NS		NS		NS		NS		NS	
Leafhoppers (no/3leaves/plant)												
Means	4.26	3.83	4.40	3.91	4.32	3.83	4.49	3.91	4.26	4.32	4.40	4.49
Variance	21.78	18.01	22.0	18.01	21.90	18.01	22.18	18.01	21.78	21.90	22.01	22.18
TTEST	NS		NS		NS		NS		NS		NS	
Thrips (no/3leaves/plant)												
Means	5.93	4.86	5.77	4.80	5.97	4.86	5.86	4.80	5.93	5.97	5.77	5.86
Variance	57.35	41.87	56.25	40.41	59.83	41.87	57.73	40.41	57.35	59.83	55.28	57.73
TTEST	NS		NS		NS		NS		NS		NS	
Whiteflies (no/3leaves/plant)												
Means	1.38	1.13	1.47	1.18	1.42	1.13	1.53	1.18	1.38	1.42	1.47	1.53
Variance	2.26	1.89	2.32	1.92	2.29	1.89	2.34	1.92	2.26	2.29	2.32	2.34
TTEST	NS		NS		NS		NS		NS		NS	

Table 2. Correlation between weather parameters and sucking pests of cotton

	Correlation coefficient values				
Sucking pests	Max. Temp. (°C)	Min. Temp. (°C)	Mor. RH (%)	Eve. RH (%)	Rainfall (mm)
Aphids	–0.401*	0.040	0.128	0.266	0.271
Leafhoppers	–0.2221	0.3111	0.0128	0.5536*	0.3831*
Thrips	0.623*	0.780**	–0.071	0.558*	0.410*
Whiteflies	–0.406*	–0.229	0.020	–0.103	–0.110

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

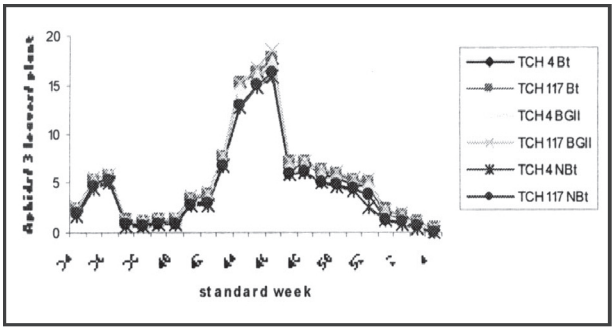

Fig. 1. Seasonal incidence of aphids on stacked *Bt, Bt* non *Bt* cotton hybrids

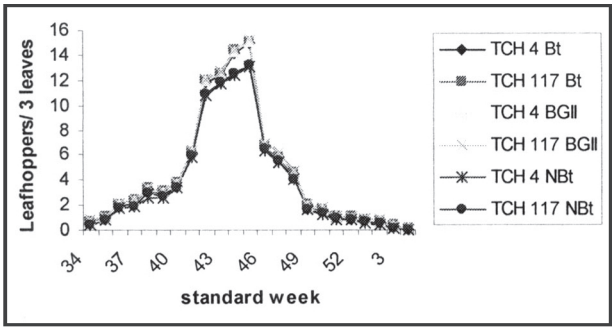

Fig. 2. Seasonal incidence of leafhoppers on stacked *Bt, Bt* non *Bt* cotton hybrids

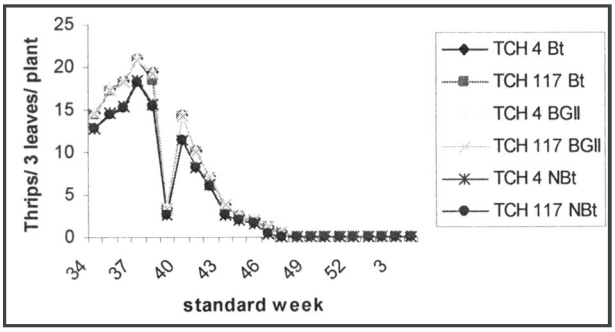

Fig. 3. Seasonal incidence of thrips on stacked *Bt, Bt* non *Bt* cotton hybrids

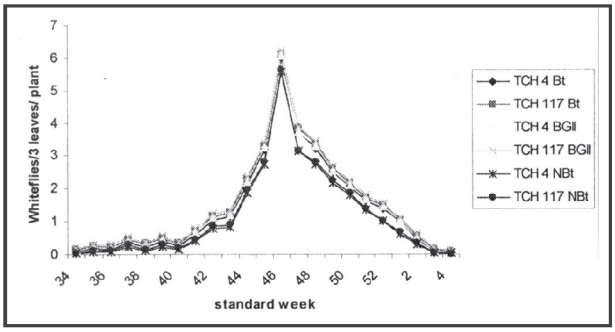

Fig. 4. Seasonal incidence of whiteflies on stacked *Bt, Bt* non *Bt* cotton hybrids

compared to non *Bt* hybrids (3.83 to 3.91), but the differences were non significant. Earlier, Longwa *et al.* (2005) reported little differences on incidence of sucking pests between *Bt* and non *Bt* cottons. Most weather parameters showed a positive correlation with the leafhopper population; however, evening relative humidity (r = 0.5536) and rainfall (r = 0.3831) showed significant positive correlation with the population of leafhoppers (Table 2). Similar observations were made by Jayaswal and Sundaramurthy (1992), Sewasingh *et al.* (2004), Singh *et al.* (2005) and Mohapatro (2008). No biotic factors have been studied. It was also observed that for every one per cent increase in the evening relative humidity there was a corresponding increase of 0.30 leafhoppers. Similarly, for every 1 mm increase in the rainfall, there was a corresponding increase of 0.15 leafhopper population (Table 3).

The initial incidence of thrips was observed during 34th SMW and the peak incidence was observed during 37th standard week in all the hybrids with a population (No./3 leaves/plant) of 20.94 (TCH–4*Bt*), 20.72 (TCH–117*Bt*), 21.02 (TCH–4BGII), 20.82 (TCH–117BGII), 18.42 (TCH–4N*Bt*) and TCH–117N*Bt*) (Fig. 3). The activity of thrips was recorded only during initial stages of crop period from 34th to 43rd SMW irrespective of cotton hybrids. The seasonal mean incidence of thrips was similar in all stacked *Bt* (5.97 to 5.86) and *Bt* hybrids (5.93 to 5.77) as compared to non *Bt* hybrids (4.80 to 4.86). For every 1°C rise in maximum and minimum temperature, there was a corresponding increase of 3.28 and 0.33 thrips respectively; similarly for every 1 mm increase in rainfall and 1% rise in evening relative humidity, there was a corresponding increase of 0.17 thrips (Table 3).

Table 3. Multiple linear regression analysis between weather parameters and sucking pests of cotton

Season	Regression Equation	R^2
Aphids	Y = 76.69 – 2.87 X1 + 1.210 X2 – 0.023 X3 – 0.060 X4 – 0.041 X5	0.327
Leafhoppers	Y = 26.15 – 0.80 X1 – 0.79 X2 – 0.29 X3 + 0.302 X4 + 0.150 X5	0.591
Thrips	Y = – 105.77 + 3.28 X1 + 0.33 X2 + 0.93 X3 + 0.170 X4 + 0.170 X5	0.805
Whiteflies	Y = 28.14 – 1.04 X1 + 0.40 X2 + 0.02 X3 – 0.05 X4 – 0.030 X5	0.382

X1 Maximum temperature, X2 Minimum temperature, X3 Morning relative humidity
X4 Evening relative humidity, X5 Rainfall

The incidence of whiteflies was very low upto 42nd SMW that gradually reached a peak during 46th SMW in all the hybrids with the mean population of 5.98, 6.12, 6.06, 6.20, 5.54, 5.62/ per 3 leaves/ plant in TCH–4*Bt*, TCH–117*Bt*, TCH–4BGII, TCH–117BGII, TCH–4N*Bt* and TCH–117N*Bt*, respectively (Fig. 4). Unlike the other sucking pests, the incidence of whiteflies was observed from the end of August in all the hybrids and was low throughout the period except for two to three weeks during November. The seasonal mean population of whiteflies was relatively high in all stacked *Bt* hybrids (1.42 to 1.53) and *Bt* hybrids (1.38 to 1.47) as compared to all non *Bt* hybrids (1.13 to 1.18). Maximum atmospheric temperature showed a significant negative correlation with the incidence of whiteflies (Table 2). Nandihalli *et al.* (1993), Sewasingh *et al.* (2004), Srinivasa Rao (2004) also reported significant negative correlation between the population of whiteflies and maximum and minimum temperatures. The total influence of all the weather factors on whiteflies was around 39 per cent and for every 1°C rise in maximum temperature, there was a corresponding decrease of 1.04 whitefly population (Table 3). Earlier, Srinivasa Rao (2004) reported the overall influence of weather factors on incidence of whiteflies upto 30 per cent in different cotton hybrids.

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