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Original Research Article

Population Dynamics of Thrips, *Thrips tabaci* and Whitefly, *Bemisia tabaci* on Bt Cotton Hybrids

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A B S T R A C T

The population fluctuation of thrips, *T. tabaci* on BG-I and BG-II Bt cotton during 2008-2009 ranged between 0.3 to 108.8 and 1.0 to 110.2 thrips/three leaves, The incidence of thrips started from 32nd standard week and goes its highest peak population (108.8 and 110.2 thrips/three leaves) was recorded in 40th MW on Both BG-I and BG-II Bt cotton, respectively. During 2009-2010 it ranged from 2.3 to 68.9 and 3.9 to 75.4 thrips/three leaves. The incidence of thrips started from 33rd MW and reached to its peak (68.9 and 75.4 thrips/three leaves on Both BG-I and BG-II hybrids respectively. Whiteflies population during 2008-2009 ranged from 0.2 to 61.0 and 0.2 to 59.8 whiteflies/three leaves, respectively. The incidence of whiteflies started from 35th MW. The peak activity of whitefly was observed from 41st to 45th MW on Both BG-I and BG-II respectively. During 2009-2010 the population of whitefly ranged from 0.8 to 68.2 and 1.0 to 66.2 whiteflies/three leaves. The incidence of whiteflies started from 33rd MW with first peak in 38th MW (15.9 and 16.4) and second peak with maximum population of 68.2 and 66.2 in 42nd MW on BG-I and BG-II Bt cotton hybrids, respectively. It indicates that thrips and whiteflies are the predominant sucking pests of Bt cotton as their incidence recorded throughout the season. The incidence of whiteflies and thrips more on BG-II than BG-I Bt cotton, there is a combined effect of weather parameters on pest population and their incidence on BG-I and BG-II Bt cotton.

Keywords

Population Dynamics, Thrips, *Thrips tabaci*, Whiteflies, *Bemisia tabaci*, BG-I and BG-II Bt Cotton

Introduction

Cotton is an important commercial crop of India and is grown in three agro-climatic zones. India is unique to grow all the four cultivated spp. (*Gossypium hirsutum*, *G. barbadense*, *G. arborium* and *G. herbaceum*) and their intra and inter specific hybrids under diverse agroecological conditions, (Phundan Singh and Mahendra Singh, 2005).

Although India stands first in acreage of cotton however, the yields are well below other cotton growing countries. Though, there are several reasons attributed to this low yield, losses due to insect pests assume significant importance. The pest spectrum of cotton crop is quite complex comprising of several species of the insects.

A total of 1326 species of insects have been recorded on cotton (Kranti *et al.*, 2005). The sucking pests like aphid (*Aphis Gossypii* Glover), Jassid (*Amrasca biguttula biguttula* Ishida); thrips (*Scirtothrips dorsalis* Hood) and white fly (*Bemisia tabaci* Gennadius) have assumed serious proportions.

India has the largest area under cotton in the world, representing 20 to 25 per cent of the global area, it ranks only third in terms of production next to China and the USA. The yield of cotton in India is one of the lowest averaging 300 kg/ha as against the world average of 580 kg/ha. Among the factors responsible for low yields, the losses due to pests are more important. More than 160 species of insect pests have been reported to attack the cotton crop at various stages of its growth, causing losses up to 60 per cent, requiring major efforts to save the crop from pests (Manjunath, 2004). Among the insect pests, a complex of sucking pests viz., whitefly, *Bemisia tabaci* (Gennadius) and thrips, *Thrips tabaci (Linnman)* occupy major pest status and cause considerable damage in Bt cotton. Information on seasonal activity of these sucking pests on Bt cotton helps to take up effective management strategies. Keeping this in view present study was undertaken.

Materials and Methods

The experiment on the population dynamics of thrips, whitefly occurring on BG-I and BG-II Bt cotton hybrids was conducted during *kharif* 2008-2009 and 2009-2010, at the experimental farm of the Department of Entomology Marathwada Agricultural University, Parbhani (Maharashtra). The cotton crop (Bunny Bt hybrids, BG-I and BG-II) was sown in both the seasons at 90 cm x 60 cm spacing, on 12-7-2008 and 22-7-2009 after receipt of adequate precipitation, respectively. The experiment was conducted without plant protection in a plot size of 89.1 m^2 and each plot was divided in four quadrants for recording observations. Population of thrips and whitefly were recorded at weekly intervals from three leaves (each from top, middle and bottom canopy) on five randomly selected plants from each of the quadrant.

The data pertaining to population of thrips and whitefly on BG-I and BG-II Bt cotton was correlated to various environmental factors to find their relationship with weather factors and simple correlation, simple regression and multiple regression was worked out by using SAS software. (Anonymous, 2014)

Results and Discussion

Population dynamics of thrips (*Thrips tabaci* Lindeman)

The population fluctuations of thrips *T. tabaci* on BG-I Bt cotton during *kharif* 2008-2009 ranged between 0.3 to 108.7 thrips/three leaves. The incidence of thrips started from 32^{nd} MW (Expand at first instance and thereafter abbreviate) (11.8 thrips/three leaves) and first peak was observed at 35^{th} MW (65.75 thrips/three leaves). Thereafter population declined to 3.5 thrips/three leaves in 38^{th} MW. The second peak of thrips incidence was observed from 39^{th} to 47^{th} MW with highest population (108.7 thrips/three leaves) in I^{st} week of October (40^{th} MW). While on BG-II Bt cotton thrips population ranged between 1.0 to 110.2 thrips/three leaves with its first peak (67.2 thrips/three leaves) in 35^{th} MW thereafter population declined upto 3.7 thrips/three leaves in 38^{th} MW. The second peak of thrips incidence was observed from 39^{th} to 47^{th} MW with highest population (110.2 thrips/three leaves) in 40^{th} MW. The population declined thereafter to 1.0 thrips/three leaves in 2^{nd} MW (Fig. 1).

During *kharif* 2009-2010 on BG-II Bt cotton thrips population ranged from 2.3 to 68.9 thrips/three leaves. The incidence of thrips started from 33rd MW and reached to its first peak (68.9 thrips/three leaves) in 38th MW. The second peak of thrips incidence was observed in 41st MW (62.9 thrips/three leaves). While in BG-II Bt cotton the thrips population ranged from 3.9 to 75.4 thrips/three leaves and it attained first peak (75.4 thrips/three leaves). Thereafter the population decreased gradually upto (5.0 thrips/three leaves) in 2nd MW. These fluctuations in population buildup were due to variation in temperature and relative humidity (Table 1).

The present findings of peak incidence of thrips is more or less similar with those of Patel (1992) who reported that the population of thrips first appeared in 34th standard week to 40th standard week with highest population was observed in 37th standard week (2nd week of September). Gupta *et al.,* (1997) noticed that the peak population of thrips was recorded during the last week of August to the first fortnight of October. Kudale (2000) observed the maximum population of thrips (14.7 thrips/plant) in fourth week of September i.e. in 39th MW when temperature and relative humidity were 31^{0}C and 83 per cent, respectively.

Bhede (2003) reported that thrips *Scirtothrips dorsalis* is commenced in last week of August and reached peak during first week of October on chilli. Aggrawal and Dhawan (2009) noticed that population of thrips was slightly higher on transgenic cotton in the last two years due to a reduced number of insecticide sprays against lepidopterous pests compared with the number of sprays in the normal cotton.

The present findings are also supported by those of Panickar and Patel (2001), Anonymous (2004), Prasad *et al.,* (2008) and Parsai and Shastry (2009).

Simple correlation studies

The impact of weather parameter, maximum temperature on incidence of *T. tabaci* population was significantly positive (r = 0.74**) and non-significant association with all-weather parameters excluding maximum temperature during 2008-09 on BG-I Bt cotton. On BG-II Bt cotton the correlation between rainy days, maximum temperature, morning RH, and evening RH was significantly positive (r = 0.41*, r = 0.62**, r = 0.58** and r = 0.65**, respectively) and non-significant with rainfall and minimum temperature (Table 2). During 2009-2010 on BG-I Bt cotton the correlation between maximum temperature and *T. tabaci* population was significantly positive (r = 0.81**) and with morning RH it was significantly negative (r = -0.53*) while, non-significant association was observed with all other parameters. Whereas on BG-II Bt cotton *T. tabaci* population was positively significant with maximum temperature (r = 0.77**) whereas negatively significant with morning RH (-0.53**) and non-significant correlation with all other weather parameters (Table 3).

Simple regression studies

During 2008-09 on BG-I Bt cotton simple regression equation was Y = -411.5 + 14.27X indicating that with every unit increase in maximum temperature the thrips population increased by 14.27 while on BG-II Bt cotton the regression equations were Y= 41.87 - 5.80 X, Y= -41.64 + 14.50X, Y=113.80 - 1.00 X and Y= 51.95 - 0.36X indicating that every unit increase in rainy days, maximum temperature, morning RH and evening RH thrips population was increased by 5.80, 14.50, 1.00 and 0.36, respectively (Table 2). During 2009-10 on BG-I Bt cotton the regression equations were Y= -245.8 + 8.69X, Y= 162.7 - 1.71X indicating that every unit increase in maximum temperature thrips population increased by 8.69 and every unit increase in morning RH thrips population decreased by 1.71 While, on BG-II Bt cotton the simple regression equations were Y= -248.6 + 8.86X and Y= 177.40 - 1.86X which indicates that every unit increase in maximum temperature thrips population increased by 8.86. It also indicated that every unit increase in morning RH thrips population decreased by 1.86 (Table 3).

Multiple regression studies

The multiple regression was worked out between weather parameters and thrips population on BG-I and BG-II Bt cotton during 2008-09 and 2009-10 presented in table 6. The regressions are as follows.

The coefficient of determination R^2 value indicates that the weather parameters contributed for 64.0 % of total variation in the population of thrips on BG-I Bt cotton in 2008-09. The high value of coefficient of determination (R^2 = 65.0 %) showed that maximum temperature is the critical factor of maintaining thrips population on BG-II Bt cotton during 2008-09. The coefficient of determination of R^2 represents the proportion of common variation in two variables.

The investigation revealed that the weather parameters contributed for 80.80% of total variation in population of thrips on BG-I Bt cotton during 2009-10. The coefficient of variation was very high indicating that the prediction of thrips population by using weather parameters was reliable. The coefficient of determination R^2 was 68.60%. This indicated that the total variation in the population of thrips on BG-II Bt cotton during 2009-10 was 68.60 % due to weather parameters.

The above findings are parallel with Al-Faisal and Kadri (1986) who reported that temperature above 35^0C and high RH helps in rapid multiplication of the thrips on cotton young plants. Thrips incidence had significantly positive correlation with maximum temperature and morning relative humidity (Patel, 1992) and Kudale (2000) and negatively significant with evening relative humidity and rainfall (Bhede, 2003). Daware *et al.*, (2003) found significant positive correlation between thrips population and minimum temperature and prolonged dry spell. Prasad *et al.*, (2008) reported that the total influence of all the weather parameters was low and non-significant on thrips population. Shera *et al.*, (2009) noticed that thrips, population build up was positively and significantly correlated with minimum and mean temperature. Thrips population was maximum (13.4/3 leaves) during 27^{th} SMW with positive significant correlation with temperature. Shivanna *et al.*, (2009) reported that on transgenic Bt cotton MRC 7201 (BG-II), the maximum temperature also correlated positively with thrips population, it did not show significant effect with minimum temperature and relative humidity whereas precipitation was negatively correlated with the thrips population. The references are more or less justifying the results of present investigation indicating the positive correlation of thrips with maximum temperature.

Population dynamics of whitefly (*Bemisia tabaci* Gennadies)

The population dynamics of whitefly *B. tabaci* during *kharif* 2008-2009 on BG-I Bt cotton ranged from 0.2 to 61.0 whiteflies/three leaves. The incidence of whiteflies started from 35^{th} MW (3.6 whiteflies/three leaves). The peak activity of whitefly was observed from 41^{st} to 45^{th} MW while the highest incidence (61.0 whiteflies/three leaves) in this peak was recorded in 2nd week of November (45th MW). Thereafter population decreased from 49th MW to 1st MW. On BG-II Bt cotton similar trend of whitefly incidence was observed in which population ranged from 0.2 to 59.8 whiteflies/three leaves. The 1st peak was recorded in 36 MW (13.6 whiteflies/three leaves), second peak during 41st to 45th MW with maximum incidence (59.8 whiteflies/three leaves) in 45th MW. Thereafter population gradually decreased upto 2nd MW (0.2 whiteflies/three leaves).

During 2009-2010 on BG-I Bt cotton population ranged from 0.8 to 68.2 whiteflies/three leaves. The incidence started from 33rd MW (1.7 whiteflies/three leaves) and reached to the 1st peak of whitefly incidence in 38th MW (15.9 whiteflies/three leaves), second peak of whitefly incidence was observed from 41st MW to 1st MW with a peak of (68.2 whiteflies/three leaves) in 42 MW and 60.2 whiteflies/three leaves in 46th MW (60.2 whiteflies/three leaves) (Table 1 and Fig. 2).

While on BG-II Bt cotton population ranged from 1.0 to 66.2 whiteflies/three leaves and attained 1st peak in 38th MW (16.4 whiteflies/three leaves). The second peak incidence of whitefly was started upto end of season with a peak of 66.2 in 42nd MW.

The present findings are similar with the findings of Rote and Puri (1991) and Patel (1992) who reported that *B. tabaci* was at peak during 2nd week of October to 3rd week of November. Daware *et al.*, (2003) reported first appearance of whiteflies from first week of August (31st MW) and peaked in first week of October to second week of November (40th- 46th MW). Prasad *et al.*, (2008) observed that the peak incidence of whiteflies was from 44th to 48th standard week (November). Mohapatra (2008) reported the peak population of *B. tabaci* attained during 44th standard week (October 29 to November 04). Parsai and Shastry (2009) observed the incidence of whitefly from 33rd – 48th SW with its maximum incidence (21.1 – 31.1 per three leaves) during 41st SMW. The findings are also supported with those of Anonymous (2004), Sharma *et al.*, (2004) and Pawar *et al.*, (2008).

Simple correlation studies

During 2008-09 on BG-I Bt cotton correlation between maximum temperature (r = 0.54**) was positively significant and correlation with minimum temperature (r = 0.40*), morning RH (r = -0.44*), evening RH (r = -0.48*) was negatively significant whereas the rest of the parameters i.e. rainfall and rainy days has non-significant correlation. Similarly on BG-II Bt cotton also correlation between *B. tabaci* and maximum temperature (r = 0.54*) was positively significant and correlation with minimum temperature (r = -41*), morning RH (r = -0.45*), evening RH (r = -0.50**) was negatively significant whereas the rest of the parameters i.e. rainfall and rainy days had non-significant correlation (Table 4).

During 2009-10 on BG-I Bt cotton correlation between rainy days, (r = 0.64**), maximum temperature (r = 0.67), minimum temperature (r = 0.57**) and *B. tabaci* population was positively significant whereas morning RH (r = -0.79*) was negatively significant and as rest of the parameters i.e. rainfall and evening RH had non-significant correlation. While on BG-II it was negatively significant with minimum temperature (r=-0.48*), morning RH (r= -0.59**) and evening RH (r =-0.56), whereas non-significant with rainfall, rainy days and maximum temperature (Table 5).

Simple regression studies

The regression equations during 2008-09 on BG-I Bt cotton were Y= -134.5 + 4.78X, Y= 35.09 - 1.32X, Y= 80.85 - 0.84 X and Y= 33.98 - 0.42X. It indicates that for every unit increase in maximum temperature *B. tabaci* population increased by 4.78 and unit increase in minimum temperature, morning RH and evening RH, *B. tabaci* population decreased by 1.32, 0.84 and 0.42, respectively. Similarly on BG-II Bt cotton the regression equations were Y= - 133.8 + 4.75X, Y= 35.40-1.35X, Y= 81.64-0.86X and Y= 34.28 - 0.43X indicating that for every unit increase in maximum temperature *B. tabaci* population increased by 4.75 and unit increase in minimum temperature, morning RH and evening RH, *B. tabaci* population decreased by 1.35, 0.85 and 0.43, respectively.

During 2009-10 on BG-I Bt cotton the regression equations were Y= 25.67 + 0.58X, Y= -12.94 + 1.21X, Y= 14.44 + 0.72X and Y= 186.5 - 1.97X indicating that for every unit increase in rainy days, maximum temperature, minimum temperature *B. tabaci* population increased by 0.58, 1.21, 0.72, respectively and unit increase in morning RH *B. tabaci* population decreased by 1.97.

Whereas on BG-II Bt cotton the regression equation were Y= 61.24 - 2.09X, Y= 184.5 - 1.95X and Y= 63.71 - 0.74X which indicates that for every unit increase in minimum temperature, morning RH and evening RH *B. tabaci* population decreased by 2.09, 1.95 and 0.74, respectively.

Multiple regression studies

The multiple regression was worked out between weather parameters and whitefly population on BG-I and BG-II Bt cotton during 2008-09 and 2009-10 presented in table 6. The regressions are as follows.

The high value of coefficient of determination (R_2=57.70%) showed that these are the critical factors for maintaining population of whiteflies on BG-I Bt cotton, similarly on BG-II Bt cotton. The coefficient of determination (R^2) indicated that the weather parameters maximum temperature and minimum temperature contributed for 59.30% of the total variation in the population of whitefly during 2008-09. Whereas during 2009-10 regression analysis indicated that all weather parameters was low and non-significant on whiteflies population in BG-I and BG-II Bt cotton.

The above findings are in confirmation with those of Sekhon *et al.,* (1994) who observed that the incidence of whiteflies on cotton starts from end of June and it increases considerably in dry season while the rains above 40 cm affected the population adversely. Gupta *et al.,* (1997) reported that a significant negative linear relation exists between the whitefly population and the minimum temperature and evening relative humidity. Purohit *et al.,* (2006) noticed that whitefly showed positive correlation with all abiotic factors. Dhaka and pareek (2008) observed that the maximum temperature had positive significant and evening RH exerted negative significant effect on whitefly population. Desai *et al.,* (2009) observed negative and significant correlation of whitefly with evening and average relative humidity while positive and significant correlation with maximum temperature, irrespective of Bt and non-Bt hybrid as observed in present investigations and confirming the results obtained. Dhawan *et al.,* (2009) observed that population dynamics of whitefly was negatively correlated with maximum, minimum and mean temperature in all the districts. In the

Ferozepur district a positive correlation was found between whitefly and the maximum, minimum and mean temperature. Population dynamics of whitefly was negatively correlated with the morning RH, evening RH and mean RH in all the districts. Rainfall had a negative impact on the population dynamics of whitefly. Rathod *et al.,* (2009) indicated that whitefly population showed significant positive correlation with maximum temperature. Shivanna *et al.,* (2009) noticed that on transgenic Bt cotton MRC 7201 (BG-II) whitefly population gradually increased. The maximum temperature correlated positively with whitefly population. It did not show significant effect with minimum temperature and relative humidity whereas precipitation was negatively correlated with whitefly population. The present findings of multiple regression are in line with findings of Prasad *et al.,* (2008), who reported that the influence of all-weather parameters was low and non-significant on whitefly population (R^2 = 0.6026).

Studies on population dynamics of major pests of BG-I and BG-II Bt cotton clearly indicate that thrips and whiteflies are the predominant sucking pests of Bt cotton as their incidence recorded throughout the season. The incidence of jassids and thrips more on BG-II than BG-I Bt cotton, the correlation studies indicated that there exists correlation of pest population with different weather parameters. Also there is a combined effect of weather parameters on pest population and their incidence on BG-I and BG-II Bt cotton. It shows per cent variation in pest population and their incidence along with their direct and indirect effects.

Table.1 Population fluctuation of *T. tabaci* and *B. tabaci* on BG-I and BG-II Bt cotton at MAU, Parbhani (Kharif 2008 – 2009-10)

Standarad week (SW)	Duration	*T. tabaci* /3 leaves.				*B. tabaci* /3 leaves.			
		2008-09		2009-10		2008-09		2009-10	
		BG-I	BG-II	BG-I	BG-II	BG-I	BG-II	BG-I	BG-II
30	23-29 July	0.0	0.0	-	-	0.0	0.0	-	-
31	30-05 Aug.	0.0	0.0	-	-	0.0	0.0	-	-
32	06-12 Aug.	11.8	12.3	-	-	0.0	0.0	-	-
33	13-19 Aug.	27.7	28.4	12.6	4.1	0.0	0.0	1.7	2.0
34	20-26 Aug.	50.6	54.3	3.0	3.9	0.0	0.0	0.8	1.2
35	27-02 Sept.	65.8	67.2	2.3	6.1	3.6	4.1	1.4	1.0
36	03-09 Sept.	14.2	15.4	25.1	32.3	13.1	13.6	2.0	2.0
37	10-16 Sept.	12.1	13.4	64.7	67.2	11.6	11.8	2.3	2.5
38	17-23 Sept.	3.6	3.7	**68.9**	**75.4**	7.0	7.2	15.9	16.4
39	24-30 Sept.	74.6	78.2	38.3	12.6	18.3	18.3	9.3	9.8
40	01-07 Oct.	**108.8**	**110.2**	12.3	16.1	9.5	9.6	6.3	7.0
41	08-14 Oct.	93.3	95.2	63.0	66.2	23.0	23.2	37.7	39.1
42	15-21 Oct.	82.0	83.6	57.3	62.1	28.1	27.4	68.2	**66.2**
43	22-28 Oct.	67.3	69.3	48.4	52.5	35.6	35.2	52.3	51.4
44	29-04 Nov.	42.3	44.5	36.5	38.9	43.4	44.0	49.9	54.8
45	05-11 Nov.	42.8	50.1	27.3	35.4	**61.0**	**59.8**	57.9	62.3
46	12-18 Nov.	33.3	34.3	19.9	21.3	24.8	25.1	60.2	61.5
47	19-25 Nov.	49.6	50.7	20.7	30.5	17.1	17.3	38.7	39.8
48	26-02 Dec.	14.9	15.9	17.7	20.1	22.5	21.1	42.1	43.2
49	03-09 Dec.	12.1	14.8	6.7	7.6	10.6	11.2	43.0	37.8
50	10-16 Dec.	3.1	13.9	5.8	7.1	9.3	9.7	34.1	32.5
51	17-23 Dec.	2.1	6.3	6.2	7.2	9.8	10.1	28.4	31.7
52	24-31 Dec.	0.8	3.2	5.3	6.6	4.5	5.2	26.2	28.4
1	01-07 Jan.	0.3	1.3	5.2	5.8	0.2	0.5	13.7	14.8
2	08-14 Jan.	0.0	1.0	4.3	5.5	0.0	0.2	8.0	10.1

Table.2 Simple correlation and regression of weather parameters with *T. tabaci* population in BG-I and BG-II Bt cotton (2008-09)

Sr. No.	Parameters	BG-I			BG-II		
		Intercept(a)	**Slope(b)**	**'r' values**	**Intercept(a)**	**Slope(b)**	**'r' values**
X_1	Rainfall	38.03	-0.31	-0.26	40.77	-0.34	0.30
X_2	Rainy days	39.02	-5.25	-0.27	41.87	-5.80	**0.41***
X_3	Max.temp.	-411.50	14.27	**0.74****	-41.64	14.50	**0.62****
X_4	Min. temp.	14.63	1.13	0.16	19.91	0.93	**0.30****
X_5	Morning RH	102.10	-0.8	-0.21	113.80	-1.00	**0.59****
X_6	Evening RH	47.13	-0.31	-0.16	51.95	-0.36	**0.65****

N=25

Table.3 Simple correlation and regression of weather parameters with *T. tabaci* population in BG-I and BG-II Bt cotton (2009-10)

Sr. No.	Parameters	BG-I			BG-II		
		Intercept(a)	**Slope(b)**	**'r' values**	**Intercept(a)**	**Slope(b)**	**'r' values**
X_1	Rainfall	28.64	-0.15	-0.32	31.52	-0.16	-0.32
X_2	Rainy days	31.09	-4.99	-0.36	34.35	-5.45	-0.37
X_3	Max.temp.	-245.8	8.67	**0.81****	-248.6	8.86	**0.77****
X_4	Min. temp.	1.405	1.50	0.34	4.353	1.48	0.31
X_5	Morning RH	162.7	-1.71	**-0.52***	177.40	-1.86	**-0.53****
X_6	Evening RH	43.19	-0.37	-0.28	46.51	-0.39	-0.27

N=22

Table.4 Simple correlation and regression of weather parameters with *B. tabaci* population in BG-I and BG-II Bt cotton (2008-09)

Sr. No.	Parameters	BG-I			BG-II		
		Intercept(a)	**Slope(b)**	**'r' values**	**Intercept(a)**	**Slope(b)**	**'r' values**
X_1	Rainfall	17.24	-0.18	-0.32	17.35	-0.19	-0.34
X_2	Rainy days	18.05	-3.18	-0.36	18.00	-3.18	-0.36
X_3	Max.temp.	-134.5	4.78	**0.54****	-133.8	4.75	**0.54****
X_4	Min. temp.	35.09	-1.32	**-0.40***	35.40	-1.35	**-0.41***
X_5	Morning RH	80.85	-0.84	**-0.44***	81.64	-0.85	**-0.50***
X_6	Evening RH	33.98	-0.42	**-0.48***	34.28	-0.43	**-0.50****

N=25

Table.5 Simple correlation and regression of weather parameters with *B. tabaci* population in BG-I and BG-II Bt cotton (2009-10)

Sr. No.	Parameters	BG-I			BG-II		
		Intercept(a)	**Slope(b)**	**'r' values**	**Intercept(a)**	**Slope(b)**	**'r' values**
X_1	Rainfall	42.99	-0.07	-0.13	32.44	-0.19	-0.42
X_2	Rainy days	25.67	0.58	**0.64****	34.77	-5.76	-0.42
X_3	Max.temp.	-12.94	1.21	**0.67****	-18.88	1.50	0.14
X_4	Min. temp.	14.44	0.72	**0.57****	61.24	-2.09	**-0.48***
X_5	Morning RH	186.5	-1.97	**-0.79****	184.5	-1.95	**-0.59****
X_6	Evening RH	63.67	-0.42	-0.24	63.71	-0.74	**-0.56****

N=22

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

Table.6 Multiple regression of weather parameters with *T. tabaci* and *B. tabaci* in BG-I and BG-II Bt cotton during 2008-09 and 2009-10

Variable	**Regression – coefficient**							
	Thrips				**Whitefly**			
	2008-09		**2009-10**		**2008-09**		**2009-10**	
	BG-I	**BG-II**	**BG-I**	**BG-II**	**BG-I**	**BG-II**	**BG-I**	**BG-II**
Intercept	-312.113 (0.076)	-310.097 (0.075)	188.230 (0.284)	375.650 (0.126)	-169.454 (0.057)	-166.83 (0.053)	-115.440 (0.678)	-91.696 (0.738)
Rainfall (X1)	-0.208 (0.530)	-0.214 (0.515)	0.127 (0.327)	0.190 (0.290)	-0.200 (0.237)	-0.199 (0.226)	-0.201 (0.317)	-0.234 (0.259)
Rainy days (X2)	-2.670 (0.683)	-2.774 (0.669)	-4.098 (0.305)	-6.502 (0.240)	3.084 (0.354)	3.169 (0.326)	7.245 (0.262)	8.180 (0.201)
Max. Temp. (X3)	11.687 (0.029)	11.689 (0.028)	-0.674 (0.878)	-5.084 (0.401)	9.384 (0.001)	9.334 (0.001)	9.324 (0.199)	9.436 (0.187)
Min. Temp. (X4)	3.387 (0.473)	3.417 (0.464)	4.622 (0.073)	6.193 (0.078)	-6.165 (0.016)	-6.158 (0.014)	-6.182 (0.130)	-6.504 (0.108)
Morning R.H. (X5)	-0.900 (0.643)	-0.869 (0.653)	-2.361 (0.030)	-3.179 (0.032)	-1.216 (0.221)	-1.228 (0.203)	-1.395 (0.394)	-1.784 (0.271)
Evening R.H. (X6)	0.134 (0.941)	0.068 (0.570)	-0.501 (0.533)	-0.630 (0.566)	1.826 (0.056)	1.821 (0.050)	1.213 (0.353)	1.407 (0.276)
Coefficient of determination (R^2)	**0.640**	**0.650**	**0.808**	**0.686**	**0.577**	**0.590**	**0.491**	**0.516**

*Figures in parenthesis are P- value

Multiple regression studies

Pest	Year	Bt cotton hybrid	Regression equation
Thrips	2008-09	BG-I	$Y = -312.113 + 0.029X_3$
		BG-II	$Y = -310.097 + 0.028X_3$
	2009-10	BG-I	$Y = 118.230 + 0.030X_5$
		BG-II	$Y = 375.650 + 0.032X_5$

Whereas X_3 = Maximum Temperature, X_5 = Morning Relative Humidity

Multiple regression studies

Pest	Year	Bt cotton hybrid	Regression equation
Whitefly	2008-09	BG-I	$Y = -169.454 + 0.001X_3 + 0.016X_4$
		BG-II	$Y = -166.83 + 0.001X_3 + 0.014X_4$

Whereas X_3 = Maximum Temperature, X_4 = Minimum Temperature

Fig.1 Population dynamics of *T. tabaci* on BG-I and BG-II Bt cotton

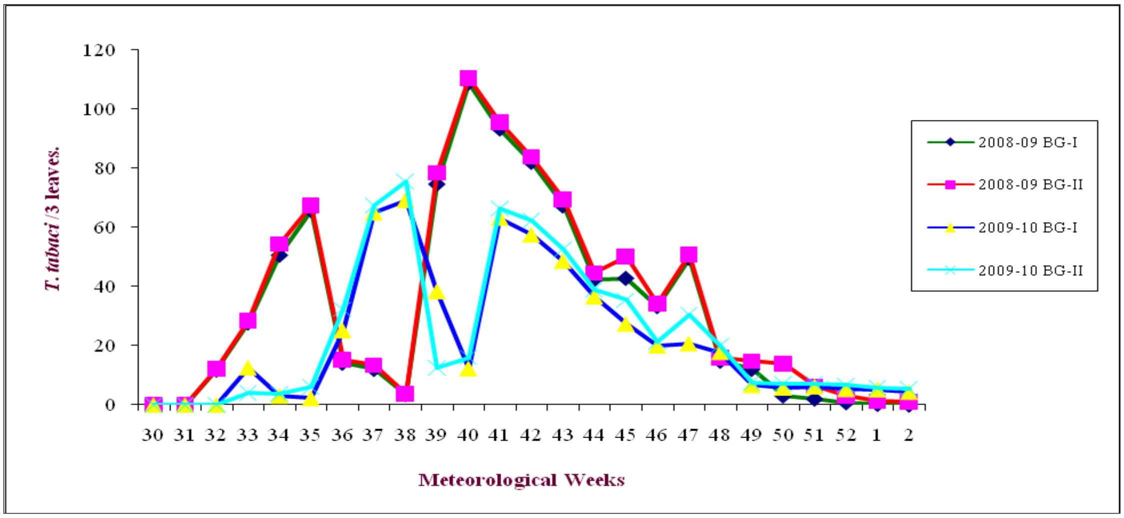
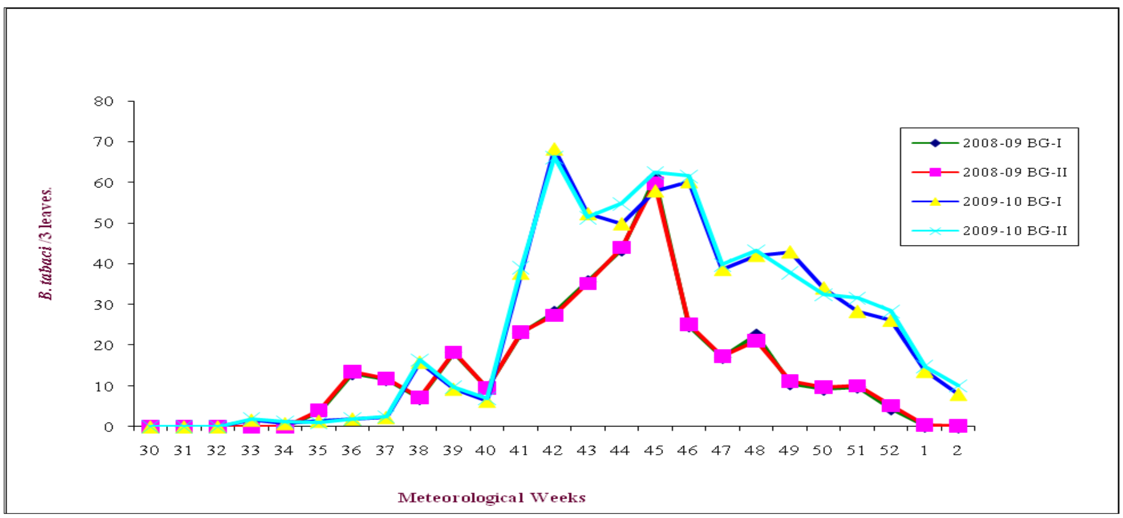


Fig.2 Population dynamics of *B. tabaci* on BG-I and BG-II Bt cotton



References

Aggrawal N and Dhawan A K 2009. Seasonal abundance of non-target pests on Bt cotton in northern India. National Symposium on *"Bt-cotton: Opportunities and Prospects"* at CICR, Nagpur. November 17-18, 2009: 95.

Anonymous 2004. Studies on population dynamics of key pests of cotton. *Annual Progress Report of Cotton Research*, 2003-2004, MAU, Parbhani ENT: 78-80.

Anonymous 2014. Statistical Analysis Systems Institute, Inc. 1982. SAS user's guide: Statistics, 1982 ed. SAS Institute Inc., Cary, N.C. (IASRI).

Bhede B V 2003. Studies on population dynamics and bioefficacy of newer insecticides against major pests of chilli. M.Sc. (Agri.) Thesis, MAU, Parbhani.

Daware D G, Kurtadikar J S, Lavekar R C and Bhosle B B 2003. Achievements in insect pest management in cotton. State level seminar on *Pest management for sustainable Agriculture* February 6-7, 2003 MAU, Parbhani: 4-6.

Desai H R, Maisuria I M, Patel C J, Solanki V Y, Bhadsuria S and Kumar V 2009. Incidence of different pests in Bt and non-Bt cotton hybrid in relation to weather parameters under south Gujarat condition. National Symposium on "*Bt-cotton: Opportunities and Prospects*" at CICR, Nagpur, November 17-18, 2009: 126-127.

Dhaka S R and Pareek B L 2008. Weather factors influencing population dynamics of major insect pests of cotton under semi-arid agroecosystem, *Indian Journal of Entomology*, 70: 157-163.

Dhawan A K, Grewal H S, Aneja A and Kaur M 2009. Case study of socioeconomic impact of cotton IPM on Punjab farmers. Proc. National Symposium on *IPM strategies to combat emerging pests in the current scenario of climate change*, January 28-30, 2009. College of Horticulture and Forestry Central Agricultural University, Pasighat, Arunachal Pradesh: 76.

Gupta M P, Sandeep Sharma and Srivastava S K 1997. Population build up of some sap sucking insects on cotton in Madhya Pradesh. *Journal of Insect Science*, 10: 153-156.

Kranthi K R, Naidu S, Dhawad C S, Mate T K, Patil E, Bharose A A, Behere G T, Wadaskar R M and Kranthi S 2005. Temporal and intraplant variability of cry 1 Ac expression in Bt cotton and its influence on the survival of the cotton bollworm, *Heliocoverpa armigera* Hubner (Noctuidae lepidoptera) *Current Science*, 89: 291-298.

Kudale J P 2000. Bioecology and management of key pests on desi cotton. M.Sc. (Agri.) Thesis, MAU, Parbhani (M.S).

Manjunath T M 2004. Bt-cotton in India: the technology wins as the controversy wanes. Presented at the 63rd Plenary Meeting of the International Cotton Advisory Committee (ICAC), Mumbai, 28 Nov-02 Dec, 2004.

Mohapatra L N 2008. Population dynamics of sucking pests in hirsutum cotton and influence of weather parameters on its incidence in western Orissa. *Journal of Cotton Research and Development*, 22: 192-194.

Panickar, B.K. and Patel, J.R. 2001. Population dynamics of different species of thrips on chilli, cotton and pigeonpea, *Indian Journal of*

Entomology, 63: 170-175.

Parsai S K and Shastry P P 2009. Seasonal incidence of key pests and their natural enemies on cotton. National Symposium on "Bt-cotton: Opportunities and Prospects" at CICR, Nagpur. November 17-18, 2009: 125-126.

Patel J R 1992. Integrated pest Management in Cotton Hybrid-6. Ph.D. Thesis submitted to GAU, Anand.

Pawar A V, Chavan S J, Bhute N K and Kadam D R 2008. Population dynamics of sucking pest complex on cotton at Marathwada region of Maharashtra *Journal of Plant Protection & Environment*, 5: 150-153.

Phundan Singh and Mahendra Singh 2005. Cotton varieties and hybrids for Indian farmers Financing Agriculture. *An Inhouse Journal Agriculture Finance Co-op. Ltd.*, 37: 3-8.

Prasad N V V S D, Rao N H P and Mahalakshmi M S 2008. Population dynamics of major sucking pests infesting cotton and their relation to weather parameters. *Journal of Cotton Research and Development*, 22: 85-90.

Purohit D, Ameta D P and Sarangdevot S S 2006. Seasonal incidence of major insect pests of cotton and their natural enemies. *Pestology*, 30: 24-29.

Rathod R T, Sureja B V, Jethva D M and Barad A H 2009. Population dynamics of whitefly *Bemisia tabaci* (Gennadius) in cotton and its correlation with weather parameters. *International Journal of Bioscience Reporter*, 7: 209-211.

Rote N B and Puri S N 1991. Population dynamics of whitefly *B. tabaci* on cotton and its relationship with weather parameters. *Journal of Cotton Research and Development* 5: 181-189.

Sekhon B S, Singh J and Sambyal J S 1994. Population dynamics of whitefly on different varieties of cotton. National Symposium on Emerging trends in Pest Management: 8-9.

Sharma P D, Jat K L and Takar B L 2004. Population dynamics of insect pests on American cotton (*Gossypium hirsutum* L.) in Haryana. *Journal of Cotton Research and Development*, 18: 104-106.

Shera P S, Jindal V, Aggrawal N and Singh J 2009. Population dynamics of sucking insect pests vis-a vis weather parameters in Bt cotton National Symposium on "*Bt-cotton: Opportunities and Prospects*" at CICR, Nagpur. November 17-18, 2009: 112.

Shivanna B K, Nagaraja D N, Manjunath M and Naik M I 2009. Seasonal incidence of sucking pests on transgenic Bt cotton and correlation with weather factors. *Karnataka Journal of Agricultural Sciences*, 22: 666-667.