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Naveena JB
Department of Entomology,
College of Agriculture,
Shivamogga, Karnataka, India

Sharanabasappa
Department of Entomology,
College of Agriculture,
Shivamogga, Karnataka, India

Kalleswara Swamy CM
Department of Entomology,
College of Agriculture,
Shivamogga, Karnataka, India

Veeranna HK
Department of Agronomy,
College of Agriculture,
Shivamogga, Karnataka, India

Corresponding Author:
Naveena JB
Department of Entomology,
College of Agriculture,
Shivamogga, Karnataka, India

Studies on the population dynamics of sucking pests on MRC- 7918 (BG-II) *Bt* cotton

Naveena JB, Sharanabasappa, Kalleswara swamy CM and Veeranna HK

Abstract
The population dynamics of sucking pests on *Bt* cotton along with their correlation and regression between the weather parameters were studied during kharif 2016 at Farmer field Kommanalu village, Shivamogga with plot size of 300 m^2 area. The peak incidence of thrips (*thrips tabaci* Lind) was noticed during first fortnight of September (43.70/ 3 leaves).While, the leafhopper (*Amrasca biguttula biguttula* Ishida.) population reached peak during September second fortnight (19.80/3 leaves). The aphid (*aphis gossypii* Glover) population reached peak during December second fortnight of (25.22/3 leaves). The whiteflies (*Bemisia tabaci* Gennadius) population reached peak during November first fortnight (0.75/3 leaves) sucking pest incidence showed positive and significant correlation with maximum temperature and negative significant correlation with rainfall.

Keywords: *Bt* cotton sucking pests, thrips, aphids, leafhopper, whiteflies

Introduction
Cotton is one of the most important fiber and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. It provides the basic raw material to cotton textile industry. Cotton in India provides direct livelihood to 6 million farmers and about 40 -50 million people are employed in cotton trade and its processing. In India, there are ten major cotton growing states which are divided into three zones, *viz*. north zone, central zone and south zone.

The productivity of cotton in India is almost 92 per cent less as compared to the world productivity of 676 kg/ha. Being a long duration crop of hot and humid weather and succulent nature, the crop is attacked by a number of insect species which contributes to low yield particularly during cotton cultivation. With the cultivation of transgenic *Bt* cotton, it was expected to ensure favorable ecological, economical and sociological benefits apart from the drastic reduction in pesticide usage. But after the introduction, increased in area under *Bt* cotton to over 90 per cent till date lead to an unprecedented change in the pests and diseases scenario has been noticed. During the preceding years, majority of *Bt* cotton growing areas witnessed severe incidence of pests. Although introduction of *Bt* cotton could reduce the bollworm incidence, number of other pests *viz.*, leafhopper, mirid bugs, aphids and thrips are assuming potential threats to Bt cotton. The main aim of this objective is to study the population dynamics of sucking pests of *Bt* cotton with weather parameters.

Materials and Methods
This study was carried out at Farmer field Kommanalu village, Shivamogga, during *Kharif* 2016 with plot size of 300 m^2 area. The *Bt* hybrid MRC-7918 BG-II was sown on 3rd July 2016 with a spacing of 90cm x 60cm and maintained as per package of practices (spacing, fertilizers, weeding, etc.) except plant protection measures. Observations on sucking pests *viz.*, thrips, leafhoppers, aphidsand whiteflies recorded at 15 day intervals starting from 15 days after the sowing, continued throughout the crop growth on ten randomly selected plants avoiding the border rows. Sucking pests were recorded on three leaves per plant by selecting top, middle and bottom leaves. The data on a biotic factors *viz.*, temperature, relative humidity and rainfall, were obtained from ZAHRS Shivamogga.

Results
The result raveled that, the incidence of thrips, leaf hopper, whiteflies and aphids were started from 4th week of July and continued throughout crop growth.

The peak incidence of thrips was noticed during 2nd week of September with population of 43.70 per three leaves. The aphid population reached peak during December 4th week with population of 25.22 per three leaves. While, the leafhopper population reached peak during September 4th week and ranged between 8.90 to 19.80 per three leaves. The incidence of whiteflies population was started from September 2nd week and continued up to 2nd week of January. The whiteflies population reached peak during November 2nd week with population ranges from 0.20 to 0.75 per three leaves table. (1).

Correlation and regression between weather parameters

The incidence of thrips ,aphids, leaf hoppers and whiteflies were correlated with various weather parameters (maximum and minimum temperature, morning and evening relative humidity and rainfall). The incidence of thrips during *kharif* 2016 was significant and negatively correlated with the maximum temperature (r= -0.682) However, the correlation coefficients of thrips population with minimum temperature (r=0.727), morning relative humidity (r=0.596), evening relative humidity (r=0.632) and rainfall (r=0.428) were positive and significant. The weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall influenced the population of thrips to an extent of 63.80 per cent Table.(2). The incidence of leafhopper during *kharif* 2016 was significant and positively correlated with the maximum temperature (r=0.62) However, the correlation coefficient of leaf hopper with minimum temperature (r=-0.487), morning relative humidity (r=-0.092), evening relative humidity (r=-0.521) and rainfall (r=-0.246) were negative and non significant. The weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall influenced the population leaf hopper an extent of 42.2 per cent Table.(2) The incidence of aphids during *Kharif 2016* was non significant and positively correlated with the maximum temperature (r=0.428), minimum temperature (r=0.428), morning relative humidity (r=0.428), evening relative humidity (0.428) and correlation coefficient of aphid non significant and negatively correlated with rainfall (r= -0.503) The weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall influenced the population of aphid an extent of 44.60 per cent Table.(2). The incidence of white flies during *Kharif 2016* was significant and positively correlated with the maximum temperature (r=0.705), the correlation coefficients of whiteflies population with minimum temperature (r= -0.487), morning relative humidity (r=--0.283), evening relative humidity (r=-0.295) and rainfall (r=-0.524) were negative and non significant. The weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall influenced the population of whiteflies to an extent of 61.5 per cent Table. (2).

Discussion

The leafhopper population was started to notice from July second fortnight (32st SMW) and continued to increase gradually and reached its peak during October first fortnight (42nd SMW) the population of the leafhopper was ranged between 8.90 to 19.80 per three leaves

The leafhopper peak incidence was observed from September to October which might be due to prevailing congenial condition of weather parameters *viz.*, maximum temperature (r = 0.62) had showed positive and significant influence on higher leafhoppers incidence, however the correlation coefficient of leafhoppers with minimum temperature (r =-0.48), morning relative humidity (r = -0.09), evening relative humidity (r = 0.52) and rainfall (r = -0.24) were negative and non significant. The weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall influenced the population leafhoppers to an extent of 0.42 per cent table.2. The present results are closely associated with the findings of many workers, Muhammad *et al.*, 2006, Soujanya *et al.*, 2010 [4], Neelima *et al.*, 2012 [5] and Sitaramuju *et al.* 2010 who reported that leafhopper peak population was observed during October 1st week and maximum temperature had showed positive and significant influence on higher leafhopper incidence, while morning and evening relative humidity had significant negative correlation with peak leafhopper population. However the incidence of thrips was started to appear from second fortnight of July (38th Standard Week (SMW)) and continued to increase gradually and reached peak during September second fortnight the incidence declined gradually and reached to negligible level. The population of the thrips was ranged between 5.22 to 43.70 per three leaves during throughout crop growth.

The peak incidence of thrips was observed from October to November which might be due to prevailing congenial condition of weather parameters *viz.*, maximum temperature (r = 0.68) had positive and significant influence on thrips population, however, the correlation coefficients of thrips population with minimum temperature (r = 0.72), morning relative humidity (r = 0.59) and evening relative humidity (r = 0.63) were positive and significant. However rainfall show positive and non significant to thrips population. The weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall influenced the population of thrips to an extent of 0.63 per cent table .2

The present results are in line with the findings of many workers Muhammad *et al.* 2006, Sitaramuju *et al.* 2010; Soujanya *et al.* 2010 [4] who reported that thrips peak population was observed during September month and temperature had showed positive and significant influence on higher thrips incidence, while the weather parameters influenced the population of thrips to an extent of 80 per cent in *Bt* cotton. The incidence of whiteflies was started to appear from September second fortnight (38th SMW)) and continued to increase gradually and reached peak during November first fortnight (46th SMW) thereafter, the incidence declined gradually and reached to negligible level. The population of the whiteflies was ranged between 0 to 0.75 per three leaves. The peak incidence of whiteflies was observed from October to November which might be due to prevailing congenial condition of weather parameters *viz.*, significant and positively correlated with the maximum temperature (r = 0.70), the correlation coefficients of whiteflies population with minimum temperature (r = -0.48), morning relative humidity (r = -0.28), evening relative humidity (r = 0.23) were negative and non significant and rainfall show negative and significant influence on the whiteflies population. The weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall influenced the population of whiteflies to an extent of 0.61 per cent table.2

The present findings are in close agreement with Udikeri *et al.* (2003). They observed very low population of whitefly

which could not differ significantly amongst *Bt* and conventional genotypes of cotton. while The peak incidence of aphids was observed from August to September months which might be due to prevailing congenial conditions of weather parameters *viz.*, non significant and positively correlated with the maximum temperature (r = 0.428), minimum temperature (r = 0.428), morning relative humidity (r = 0.428), evening relative humidity (r = 0.428) and rainfall (r = -0.53) shows significant and negatively correlated with population of aphids. The weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall influenced the population of aphid an extent of 0.44 per cent table.2.

The present results are in line with the findings of many workers Soujanya *et al.* 2010 [4] and Sitaramuju *et al.*, 2010 who reported that aphid peak population was observed during November 2nd week (46th SMW) week and minimum temperature and evening relative humidity showed negative and significant influence on higher aphids population. However, the weather parameters influenced the population of aphids to an extent of 69.60 per cent in *Bt* cotton. Thus the second generation (BG-II) *Bt* cotton genotypes have shown the reaction against sucking pests similar to first generation (BG-I) genotypes.

Table 1: Studies on the Population dynamics of sucking pests on MRC-7918 *Bt* Cotton during *Kharif* 2016-17

Period of observation	SMW	Crop stage	No. of *A.biguttula biguttula*/ 3 leaves	No. of *T.tabaci* /3 leaves	No. of *A.gossypii* / 3 leaves	No. of *B.tabci* /3leaves
II Fortnight July	32	Vegetative	6.00	10.00	5.8	0.00
I Fortnight August	34	Vegetative	13.20	29.40	5.00	0.00
I Fortnight August	36	Vegetative	14.40	39.20	7.40	0.00
I Fortnight September	38	Vegetative	13.40	43.70	7.60	0.24
I Fortnight September	40	Vegetative	19.80	38.50	14.8	0.20
I Fortnight October	42	Flowering	19.01	16.20	21.2	0.48
II Fortnight October	44	Flowering	17.60	12.95	23.6	0.65
I Fortnight November	46	Flowering	15.00	11.40	11.21	0.75
I Fortnight November	48	Boll formation	15.20	9.65	14.30	0.51
I Fortnight December	50	Boll formation	14.50	8.15	21.00	0.51
I Fortnight December	52	Boll opening	10.20	6.20	25.22	0.44
I Fortnight January (2017)	2	Boll opening	8.90	5.22	5.25	0.24
II Fortnight January (2017)	4	Boll opening	6.21	6.32	8.20	0.0
Mean±SD			13.10±7.41	18.20±14.14	13.34±4.42	0.30±0.26

N=13; *Significance at p=0.05; Table r value at p=0.05 is r=0.553

Table 2: Correlation and regression between pest populations and weather parameters

Insects	Correlation coefficient					R^2	Regression Equation
	Rainfall (X_1) (mm)	Max. Tem. (X_2) (^{0}c)	Min.temp (X_3) (^{0}c)	RH-I (X_4) (%)	RH-II (X_5) (%)		
Thrips tabaci	0.42	0.68*	0.72*	0.59*	0.63*	0.63	$Y=59.059\ X_1-0.240-3.170+2.347X_3+0.144X_4+0.127X_5$
Aphis gossypii	-0.53	0.42	0.42	0.42	0.42	0.44	$Y= -90.387168X_1+2.797X_2+0.073X_3+0.136X_4+0.139X_5$
Amrasca biguttula biguttula	-0.24	0.62*	-0.48	-0.09	0.52	0.42	$Y=63.0690.112X_1+1.413X_2+0.895X_3+0.201X_4+0.044X_5$
Bemisia tabaci	-0.52	0.70*	-0.48	-0.28	-0.23	0.61	$Y=-4.574-0.003X_1+0.139X_2-0.011X_3+0.008X_4+0.004X_5$

Conclusion

The peak population of thrips was recorded during first fortnight of September. While, leafhopper peak population was highest during September second fortnight and October second fortnight. But, aphid population reached peak during second fortnight of December while, whiteflies population reached peak during November first fortnight.

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