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Population Dynamics of Sucking Pests with Relation to Weather Parameters in Bt Cotton in Buldana District, Maharashtra, India

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A B S T R A C T

The population dynamics of sucking pests *Bt* cotton along with their correlation with weather factors were studied during 2008-2013 in five talukas of Buldana district, Maharashtra. According to five year average data the maximum aphid population (43.56 per cent) was recorded in 33rd meteorological week whereas jassid population were reached maximum of 4.42 jassid in 37th meteorological week. The population of thrips was more abundant (6.96 thrips/3 leaves/plant) on the crop in 36th meteorological week. In case of white fly, maximum population of 6.57 whiteflies per 3 leaves per plant was recorded in 37th meteorological week whereas, minimum of 0.82 whiteflies recorded in 31st meteorological week. Among the weather parameters maximum temperature showed positive correlation with *A. bigutulla bigutulla*, *T. tabaci* and *B. tabaci* except whitefly whereas, minimum temperature showed positive correlation with all above mentioned sucking pests. The rainfall favored the activity of all sucking pests with positive correlation except whitefly.

Introduction

Cotton (*Gossypium sp.*) is the leading natural fibre and oil seed crop which plays a key role in Indian economy with global position of second in production after China and offering livelihood security for the Indian farming community. It also plays a dominant role in the industrial and agricultural economy of the nation and has a unique place in social affairs. Many allied activities like ginning, fabric production, textile processing, garment manufacture and their marketing etc. provides employment about 6 million people. It also provides 65 percent raw material to textile industry and contributed 1/3rd of total foreign exchange earning of India (Mayee and Rao, 2002).

In India, the area under cotton crop is 121.91 lakh ha with production of 347.05 lakh bales (170 kg) and productivity of 484 kg lint/ha, however Maharashtra state comes under central zone occupies an area of 40.95 lakh ha with production of 73.75 lakh bales and productivity of 306 kg lint /ha (Anonymous, 2011). The sucking pests viz. Aphids (*Aphis gossypii*), Jassids (*Amrasca biguttula*

biguttula) Whiteflies (*Bemisia tabaci*) and Thrips (*Thrips tabaci*) are most serious and destructive pests with regular occurrence. After introduction of Bt cotton hybrid a general shift in sucking pest complex towards thrips, aphids, jassids, white fly and other sucking pests was observed. These minor pests attained economic importance after introducing Bt cotton. The pest problems, particularly that of up till now minor pests, had not be monitored regularly and often remedial majors were undertaken only after they reached epidemic or causes heavy losses. A regular surveying of cotton pest, using preferably information communication technologies and development of suitable IPM strategies was the need of the hour, as it would have lay to better by all agencies involved in plant protection and issue proper advice to farmer based on actual pest problem. Amongst various reason of low productivity of *Bt* transgenic cotton, the sucking pests gain much importance due to havoc created by most of the sucking pest in the recent years. A broad range of insecticides available in market have proved as effective in reducing the pest population. However, negligence in following the principles of crop protection, indiscriminate and extensive use of synthetic insecticides led to development of insecticidal resistance, pest resurgence, residue, destruction of natural enemies etc. Hence, it is require moving on other molecules with different mode of action to overcome such types of consequences (Patel, *et. al.*, 2014). Thus the present study was conducted to share the information on sucking pest scenario with farmer, state agencies and central agencies for developing appropriate management strategies.

Materials and Methods

The field survey was conducted in Buldana district (Maharashtra) under project entitled "*National Information System for Pest Management- Bt Cotton*" between the years 2008-09 to 2012-13. In the present study, 20 villages from five talukas of Buldhana district were selected. From these talukas two circles were preferred and from which two villages were selected and two *Bt* cotton growing farmer were chosen from each village. The observations were recorded in each week from these farmers field. Observations on aphids, jassids, thrips, whiteflies count were recorded by randomly selecting 20 plants from each field plot on top, middle and bottom leaves per plant. Sowing of cotton by project farmers was done from 15th May to 1st week of July at a different spacing under rain fed situation. For this purpose, different *Bt* hybrid varieties were selected for sowing purpose and regular agronomic practices were carried out. Data on weather parameters were obtained from the Meteorology unit, Regional Research Station, Buldana under Dr. PDKV, Akola. The relationship between weather parameters and sucking pests was established by using simple correlation coefficient and regression analysis.

Results and Discussion

The cumulative data on aphid was averaged out of between the years 2008-09 to 2012-13. Average population of aphid was ranged from 7.91 to 43.56 per cent on presence or absence basis. The maximum (43.56 % aphids) population was recorded in 33rd meteorological week; the aphid population was observed above ET level during 31st to 37th standard meteorological week, however it was lower (7.91 %) in 50th meteorological week. The peak population of aphid was increased at 33rd standard meteorological week and thereafter the peak population goes decreasing up to 41st week. Thereafter, the second peak of population was observed in 42nd SMW after that the population continues decreasing up to 50th SMW after that third peak of aphid was observed in 51st SMW (Fig. 1). Dhobi and Bharpoda (2013) also reported

that population of aphid (*Aphis gossypii* Glover) was appear during 37th standard meteorological week and reached to a first peak during 39th SMW.

The population of jassid was recorded during the same period of years. The result depicted in Figure 1 revealed that the population of jassid was ranged between 0.51 and 4.42. The peak period of jassid population was observed during 31st to 41th standard meteorological week which shows that the maximum (4.42 jassid per 3 leaves) population was recorded in five year average in 37th meteorological week and it was observed minimum of 0.51 jassids/3 leaves/plant in 2nd meteorological week.

Reddy *et al.,* (2011) showed that the peak incidence was observed from the second fortnight of October to first fortnight of November in 2009-10 (10.11 to 10.82/leaf) and in the season of 2010-11, the peak incidence was noticed in mid-September to first fortnight of October (6.02 to 5.48/leaf). Similarly, Bharpoda *et al.,* (2013) concluded that the peak activity of jassid was recorded during 38th to 45th SMW to the tune of 3.17 to 4.82 per 3 leaves. These results are in line with the present findings.

Average population of thrips was ranged from 0.21 to 6.96 thrips per 3 leaves per plant. The peak activity of thrips was recorded during 34th to 39th SMW (Fig. 1) during which maximum population of 6.96 thrips/3 leaves was recorded in 36th meteorological week; whereas least in 2nd meteorological week i.e. 0.21 thrips/3 leaves /plant. The present findings are supporting the results of Bharpoda *et al.,* (2013) who stated that the activity of thrips was concerned in Vadodara district to the tune of 0.06 (5th SMW) to 4.30 (32nd SMW). The population showed number of fluctuation in its activity. However, higher activity of thrips was noticed during 32nd to 44th SMW. Shivanna *et al.,* (2009) reported that the maximum incidence of thrips population was noticed from April to May with a peak incidence of 26.81 per three leaves was recorded in April second fortnight.

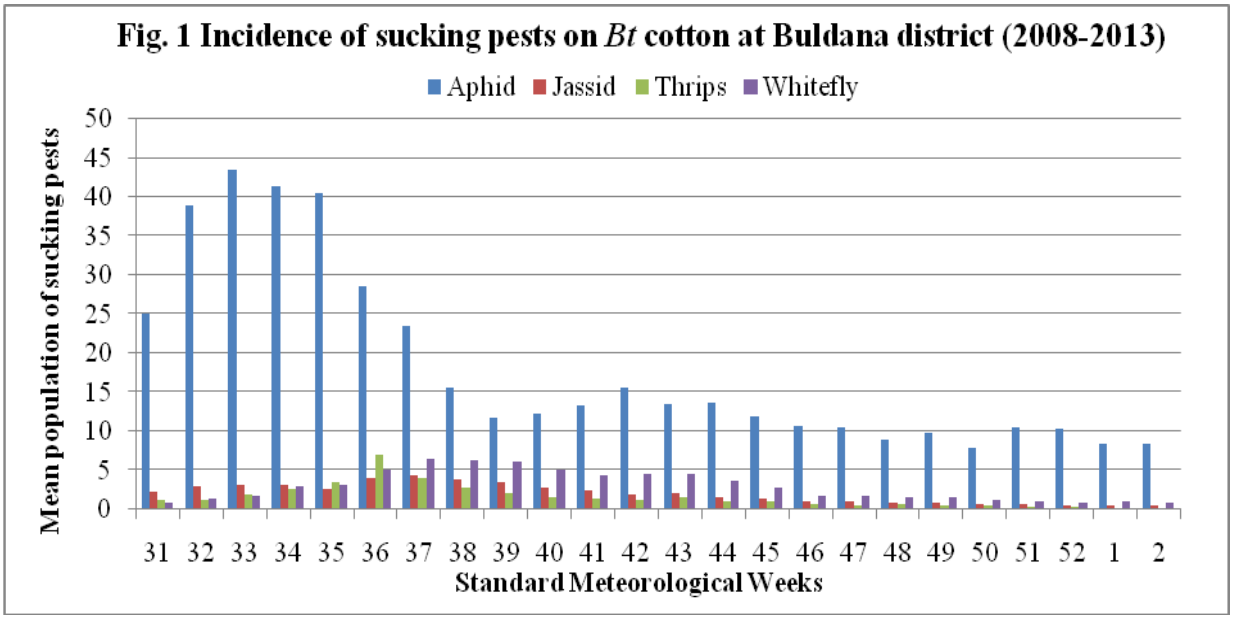
The average population of white fly incidence was observed between the ranged of 0.82 to 6.57 whitefly per 3 leaves per plant during the five year in respective SMW. The peak activity of white fly was recorded during 36th to 44th SMW (Fig. 2) where the maximum (6.57 whiteflies/ 3 leaves) population was recorded in 37th meteorological week whereas, minimum of 0.82 whiteflies recorded in 31st meteorological week. These present findings are in line with the results obtained by Deb and Bharpoda (2013) who reported that the peak activity of white fly was observed during 46th SMW (2nd week of November).

Correlation studies

The five years (2008 to 2013) mean weekly counts of various sucking pests from 31st std. week were correlated separately with weather parameters and the correlation coefficients analysis is presented in Table 1.

Aphid

The maximum temperature did not show any significant impact on the *A. gossypii* as the correlation was negatively non-significant with the population of aphids (-0.102) but the minimum temperature had showed highly significant positive correlation with the population of aphid (0.725*) which showed that the minimum temperature was most favorable to the incidence aphids in *Bt* cotton (Table 1). The rainfall showed highly significant positive impact on population buildup of aphid (0.773*) which reflects that the rainfall was very favourable for the positive population buildup of aphid.



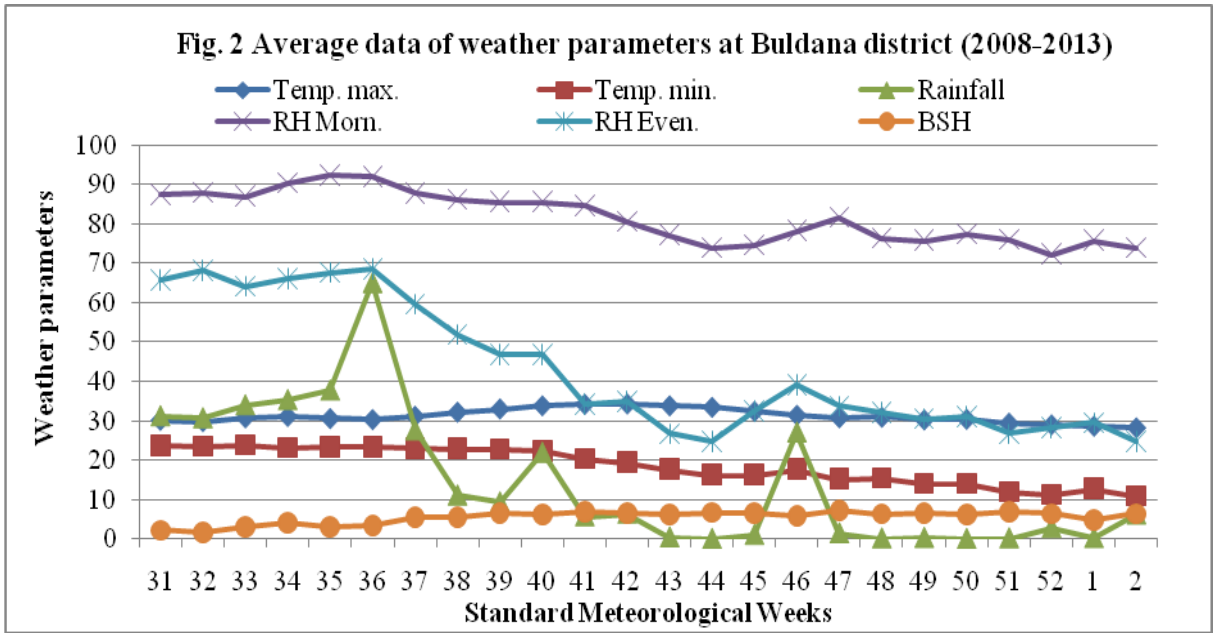


Table.1 Correlation of weather parameters with incidence of sucking pests on *Bt* cotton

Sucking pests	Temperature (°C)		Rainfall (mm)	Relative Humidity (%)		BSH (hr)
	Maximum	Minimum		Morning	Evening	
Aphid	-0.102	0.725*	0.773*	0.773*	0.871*	-0.839*
Jassid	0.358	0.912*	0.677*	0.849*	0.789*	-0.471
Thrips	0.124	0.685*	0.784*	0.752*	0.699*	-0.419
Whitefly	0.691*	0.584*	0.217	0.460	0.262	0.136

*Significant at p =0.05% r (5%) = 404 and r (1%) = 515

Table.2 Multiple regression equation of sucking pests with weather parameters on *Bt* cotton at Buldana district (2008-2013)

Sr. No.	Sucking pests	Regression equation	R^2 Value
1.	Aphid	$Y_1 = -144.33+5.658X_1-4.321X_2-0.109X_3+0.390X_4+1.360X_5-4.113X_6$	0.845
2.	Jassid	$Y_1=5.528-0.346X_1+0.475X_2+0.009X_3-0.034X_4-0.023X_5+0.406X_6$	0.885
3.	Thrips	$Y_1= -5.408-0.120X_1+0.122X_2+0.074X_3+0.068X_4 -0.021X_5+0.482X_6$	0.744
4.	Whitefly	$Y_1= 0.583-0.433X_1+0.805X_2+0.028X_3-0.004X_4-0.111X_5+1.035X_6$	0.773

Relative humidity both in morning (0.773*) and evening (0.871*) was positively correlated with aphid population. The impact of BSH on the population of all sucking pests revealed that the population was significantly negative correlated with aphid (-0.839). The present findings are in line with Bhute (2012) who stated that simple correlation studies revealed that rainfall showed significant and negative correlation with aphids. The present findings on positive relationship between relative humidity and population buildup of aphids corroborate with observations of Mohapatra (2008) and Selvaraj and Adiroubne (2012).

Jassid

The maximum temperature did not show any significant impact on the *A. biguttula biguttula.* The correlation with jassid (0.358) population was positively non-significant and the minimum temperature (0.912) and rainfall (0.677*) had showed highly significant positive relationship with the population of jassid (Table 1). Relative humidity both in morning and evening was positively correlated with jassids. The average of morning (0.849*) relative humidity had positive relationship whereas, the relative humidity at the evening (0.789*) had showed highly significant positive relationship. The impact of BSH on the population of jassids revealed that the population was significantly negative correlated with aphid jassid (-0.471). Mohapatra (2008) reported that rainfall had a non-significant positive effect on population of *A. biguttula biguttula* (0.284).

Thrips

The maximum temperature was negatively non-significant correlated (0.124) population but minimum temperature was highly significant positive (0.685*) relationship with thrips (Table 1). The rainfall showed highly significant positive impact on population buildup of thrips (0.784*) during all the years.

This shows that the rainfall was very favourable for the positive population buildup of thrips. The average of morning relative humidity had positive relationship (0.752*) whereas, the relative humidity at the evening had highly significant positive relationship with thrips (0.699*). The impact of BSH showed significantly negative correlation with thrips (-0.419). The present findings are in controversy with Selvaraj and Adiroubne (2012) who stated that thrips population build up showed a significant and positive correlation with BSH.

Whitefly

The maximum (0.691*) and minimum (0.584*) temperature exhibited highly significant positive correlation with population of whitefly (Table 1). The population of whitefly showed the non-significant positive relationship (0.217) with the rainfall. The average of morning relative

humidity had positive relationship (0.460*) but at the evening it showed non -significant positive (0.262) correlation with the population of whitefly. The impact of BSH on the population of whitefly showed the non-significant positive correlation (0.136). Shera *et al.*, (2013) found that the population of *B. tabaci* was positively correlated with maximum and minimum temperature during all the years; however, it was significant with minimum temperature. Meena *et al.*, (2013) concluded that whitefly population exhibited positive correlation with maximum, minimum and mean temperature on chilli.

Regression studies

Based on regression analysis by taking sucking pest population (Y) as a dependent variable and weather parameters (X) as independent variables following equations were fitted for the year 2008-2013 (Table 2). The regression equation indicated that an increase in 1ºC of maximum temperature increases the aphid population by 5.658 per 3 leaves per week and the population decreases by 4.321 per 3 leaves as the 1ºC of minimum temperature increases. The increase of 1% morning and evening relative humidity increases the aphid population by 0.390 and 1.360 per 3 leaves per week. Increase in 1% maximum temperature resulted for decreasing the jassid population by 0.346 per 3 leaves similarly, 1% increasing of morning and evening relative humidity the population of jassid were decreases by 0.034 and 0.023 per 3 leaves, respectively. Whereas, in case of thrips, the population were decreased by 0.120 and 0.021 per 3 leaves as the 1°C of maximum temperature and 1% evening humidity were increased, respectively. Due to the increase in maximum temperature of 1ºC whitefly population almost reduces by 0.433 and similarly whitefly population reduction (0.111 per 3 leaves) was also observed at increasing of evening humidity by 1%.

The prediction of sucking pests of *Bt* cotton were made by developing multiple regression equations by using regression models. The results of regression models and the coefficients of determination (R^2) indicated that the sucking pests *viz.*, aphid, jassid, thrips and whitefly were predicated to an extent of 84, 88, 74 and 77 per cent, respectively. The correlation and regression analysis clearly showed the importance of weather factors in predicting the sucking pest incidence in *Bt* cotton.

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