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The Influence of Major Abiotic Factors on Pests of *Bt* Cotton Hybrid

U. Muthyalu*[1], G. Maruthi Ram[2] and S. Narsaiah[3]

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A B S T R A C T

The weather parameters play an important role in application of pest management practices. The study on the influence of major abiotic factors viz., maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rain fall, rainy days, sunshine, wind speed and evaporation against insect pests of Bt Kaveri cotton hybrid. The results revealed that significantly negative correlation of aphids, whiteflies and mealybugs was found with all abiotic factors except sunshine. Significantly positive correlation of leafhoppers was recorded with rainfall, morning relative humidity, rainy days and evening relative humidity and not significantly positive correlation with minimum temperature. Thrips were found highly significantly positive correlation with sunshine and not significantly positive correlation with morning relative humidity. *S. litura* population was recorded highly significantly positive correlation with rainfall and all others were negative effects on *S. litura* population. Overall, all the abiotic factors except sunshine have shown negative correlation with pests of Bt Kaveri cotton hybrid.

***Key words*:** Abiotic factors, *Bt* cotton, Sucking pests, Correlation, Regression

Cotton is nature's gift to mankind and the gentle fibre passes through tough mechanical rigour to become soft fabric, resulting in the making of clothes and thereby contributing to the development of civilizations [1]. For more than seven thousand years, cotton has been the best possible nature's fabric. Among all the fibre crops, cotton is the major fibre crop, thus deserving the name of "King of fibre crop" or "White Gold crop".

India occupies 37.56% of world cotton area and produces 24.26% of world cotton production. The second largest producer of cotton, China occupies 9.97% of world cotton area and produces 22.41% of world cotton production. India, China, United States and Brazil together take the share of 74% of world cotton production [2]. The cotton production in India during 2019-20 is expected around 360 lakh bales of 170 kg from 125.84 lakh hectares with a productivity of 486 kg lint/ha (CAB as on 28 -11-2019). During the year 2019-20, Maharashtra, Gujarat and Telangana were the major cotton growing states covering around 69.60% (87.59 lakh hectare) in area under cotton cultivation and 63.88% (230 lakh bales) of cotton production in India. In Southern Zone states comprising of Telangana, Andhra Pradesh, Karnataka and Tamil Nadu, occupies 24% of the total cotton area in the country and produces 26.94% of total cotton production. Both Andhra Pradesh and Karnataka state recovered significantly from pink bollworm damage and recorded productivity enhancement of 46% and 60%, respectively, compared to last year. Telangana state also recovered from last year poor yield and recorded 10 lakh bales higher than last year [3].

* **U. Muthyalu**
✉ muthyaluubbu@gmail.com

[1-2] Department of Zoology (Entomology), Osmania University, Hyderabad - 500 007, Telangana, India

[3] Department of Zoology (Parasitology), Osmania University, Hyderabad - 500 007, Telangana, India

MATERIALS AND METHODS

The present study was made on the influence of major abiotic factors on the population build-up of pests of *Bt* Kaveri cotton. Meteorological data on maximum temperature, minimum temperature, morning relative humidity (R.H-I), evening relative humidity (R.H-II), rain fall, rainy days, sunshine hours, wind speed and evaporation were collected from weather station at Choutuppal Mandal, Yadadri Bhuvanagiri district (Nalgonda) in the *Kharif* seasons of the years 2012-13, 2013-14, 2014-15 and 2015-16.

Layout of the test plot

The land was ploughed thrice thoroughly with a tractor drawn cultivator and evenly levelled after removing all the trash, stubbles and weeds for bulk plot along with the main plots. The test plot was laid out besides the main field thereafter one month old seeds were transplanted at a spacing of 45 × 30 cm and general package of practices were followed according to the recommendations to maintain a good crop for the *Kharif* seasons of the years 2012-13, 2013-14, 2014-15 and 2015-16. Sprays were not taken up during the entire crop period.

Counting the pests

After sowing, the pest count data were taken at weekly intervals for entire crop period on bollworms and sucking pests from 20 randomly selected tagged cotton plants in bulk plot.

Statistical analysis

After collecting weather data and pest counts with weekly intervals, the values were subjected to simple correlation and multiple linear regression analysis with a view to study on influence of weather parameters on the pest population of *Bt* Kaveri cotton crop.

RESULTS AND DISCUSSION

The results revealed that the impact of individual abiotic factors on pest population build up in *Bt* Kaveri cotton crop is as follows.

Table 1 Comparison of simple correlation between abiotic factors and pests of *Bt* Kaveri cotton crop

Abiotic factors	Aphids	Leafhoppers	Thrips	Whiteflies	Mealybugs	*S. litura*
Maximum Temperature (°C)	-0.323**	-0.251*	-0.005 (NS)	-0.451***	-0.438***	-0.145(NS)
Minimum Temperature (°C)	-0.820***	0.068	-0.233*	-0.752***	-0.700***	-0.369***
Morning Relative humidity (%) - (R.H-I)	-0.267**	0.530***	0.031(NS)	-0.129(NS)	-0.700***	-0.162(NS)
Evening Relative humidity (%) - (R.H-II)	-0.572***	0.302**	-0.241*	-0.401***	-0.341***	-0.291**
Rainfall (mm)	-0.406***	0.568***	-0.281**	-0.288**	-0.136(NS)	-0.148(NS)
Rainy days (d)	-0.576***	0.393***	-0.382***	-0.442***	-0.335***	-0.212*
Sunshine hours (h)	0.576***	-0.240*	0.304**	0.455***	0.385***	0.267**
Wind speed (Km/h)	-0.547***	-0.416***	-0.380***	0.511***	-0.534***	-0.162(NS)
Evaporation (mm)	-0.237*	-0.285**	-0.000 (NS)	-0.392***	-0.409***	-0.152(NS)

Significance levels: 0.05* 0.01** 0.005*** NS = Not Significant

Comparison of simple correlation between abiotic factors and pests of Bt Kaveri cotton

The results revealed (Table 1) that significantly negative correlation of aphids, whiteflies and mealybugs was found with all abiotic factors except sunshine. Significantly positive correlation of leafhoppers was recorded with rainfall, morning relative humidity, rainy days and evening relative humidity and not significantly positive relation with minimum temperature. Thrips were found highly significantly positive relation with sunshine and not significantly positive relation with morning relative humidity. *Spodoptera litura* (*S. litura*) population was recorded highly significantly positive correlation with rainfall and all others were negative effects on *S. litura* population. Overall, all the abiotic factors except sunshine have shown negative correlation with pests of *Bt* Kaveri cotton hybrid [4].

Multiple linear regression studies on pests of Bt Kaveri cotton

The results of multiple linear regression analysis on pests of *Bt* Kaveri cotton are given in the (Table 2).

Aphid population

Minimum temperature was showed highly negative regression (-0.43%) than other abiotic factors with aphid population and sunshine (0.07%) and evening relative humidity (0.02%) were positively regressed with aphids.

Leafhopper population

Maximum temperature was recorded superiorly negative impact (-0.22%) on leafhoppers over other abiotic factors. The population of leafhoppers was positively regressed with minimum temperature (0.13%), sunshine (0.07%), morning relative humidity (0.03%) and rainfall (0.01%).

Thrips population

The population of thrips was highly negative impacted (-0.39%) by rainy days and positively regressed by minimum temperature (0.12%), sunshine (0.071%), evaporation (0.038%) and morning relative humidity (0.04%).

Whitefly population

Evaporation was recorded negatively greater impact (-0.21%) on whitefly population than others and positive regression with sunshine (0.15%) and evening relative humidity (0.02%).

Mealybug population

Minimum temperature was found negative regression (-0.105%) with mealybug population and sunshine (0.097%), evening relative humidity (0.01%), morning relative humidity (0.004%) and rainfall (0.001%).

Spodoptera litura population (*S. litura*)

Evaporation was showed negative regression (-0.067%) with *S. litura* population and positive regression with rainy days (0.01%) which was on par with maximum temperature and sunshine (0.02%), wind speed (0.007%).

Overall, the results of multiple linear regression indicated that abiotic factors viz., maximum temperature, minimum temperature, rainy days and evaporation were highly negative regressed with different pest population of *Bt* Kaveri cotton hybrid.

Table 2 Multiple linear regression on pests of *Bt* Kaveri cotton crop

Pests	Regression equation (Y = a + bX)
Aphids	$Y = 11.28 + 0.08\ X_1 - 0.43\ X_2 - 0.02\ X_3 + 0.02\ X_4 - 0.01\ X_5 - 0.22\ X_6 + 0.07\ X_7 - 0.12\ X_8 - 0.25\ X_9$
Leafhoppers	$Y = 3.72 - 0.22\ X_1 + 0.13\ X_2 + 0.03\ X_3 - 0.01\ X_4 + 0.01\ X_5 - 0.03\ X_6 + 0.07\ X_7 - 0.15\ X_8 - 0.004\ X_9$
Thrips	$Y = 3.40 - 0.19\ X_1 + 0.12\ X_2 + 0.04\ X_3 - 0.008\ X_4 - 0.005\ X_5 - 0.39\ X_6 + 0.071\ X_7 - 0.156\ X_8 + 0.038\ X_9$
Whiteflies	$Y = 5.25 - 0.06\ X_1 - 0.11\ X_2 - 0.006\ X_3 + 0.02\ X_4 - 0.004\ X_5 - 0.05\ X_6 + 0.15\ X_7 - 0.04\ X_8 - 0.21\ X_9$
Mealybugs	$Y = 2.90 - 0.021\ X_1 - 0.105\ X_2 + 0.004\ X_3 + 0.01\ X_4 + 0.001\ X_5 - 0.061\ X_6 + 0.097\ X_7 - 0.04\ X_8 - 0.16\ X_9$
S. litura	$Y = 0.72 + 0.01\ X_1 - 0.03\ X_2 - 0.003\ X_3 - 0.001\ X_4 - 0.0002\ X_5 + 0.01\ X_6 + 0.02\ X_7 + 0.007\ X_8 - 0.067\ X_9$

X_1 = Maximum Temperature (°C); X_2 = Minimum Temperature (°C); X_3 = Morning Relative humidity (%) - (R.H-I); X_4 = Evening Relative humidity (%) - (R.H-II); X_5 = Rainfall (mm); X_6 = Rainy days (d); X_7 = Sunshine hours (h); X_8 = Wind speed (Km/h); X_9 = Evaporation (mm); Y = Dependent variable; X = Independent variable, a = Intercept; b = Regression coefficient

Maximum and minimum temperatures, evening relative humidity and rainfall have significantly positive influence on aphids, leafhoppers and thrips population [5]. Both maximum and minimum temperatures have significantly negative influence on whitefly population. Morning relative humidity had significantly positive impact on whiteflies and significantly negative impact on leafhoppers and thrips. They also reported that all the weather parameters were significantly influence on aphid, leafhopper, thrips and whitefly populations. Dahiya *et al.* [6] reported that the leafhopper population showed the positive relationship with maximum and minimum temperature, relative humidity and rainfall and negative relationship with relative humidity. Whitefly population showed the positive relationship with relative humidity and rainfall and negative relationship with maximum and minimum temperature and relative humidity. Thrips showed the positive relationship with all-weather parameters viz., maximum and minimum temperature, relative humidity relative humidity and rainfall. Leafhopper population and weather parameters have shown significantly positive correlation with both maximum and minimum temperatures and evening relative humidity while, not significantly negative correlation with morning relative humidity and rainfall [7-9]. Temperature and relative humidity showed a positive correlation with leafhopper and effect of rainfall was favourable for the activity of both leafhopper and whitefly population. There was a positive correlation with temperature, sunshine and wind speed while negative correlation with rainfall and relative humidity with Mealybug population. Sharma and Yogesh [10] observed maximum temperature, minimum temperature, evening relative humidity and rainfall negatively affected the whitefly population. Positive correlation of whitefly population was obtained with morning relative humidity and sunshine. Zakaria [11] reported that evaporation, minimum relative humidity and sunshine duration were the most effective climatic factors during preceding and succeeding periods on boll production and retention. Kadam *et al*. [12] who recorded that aphid, jassid and whitefly population showed significantly positive correlation with maximum temperature, whereas, jassids and thrips showed significantly negative with relative humidity and rainfall. Saner *et al.* [13] reported that studies on seasonal abundance of sucking pests on *Bt* cotton may assist to develop suitable forecasting model in initiation of insecticide application. Selvaraj *et al*. [14] observed that thrips population build up showed a significant and positive correlation with temperature, relative humidity and sunshine whereas negative correlation with wind velocity, rainfall and evaporation. Shivanna *et al.* [15] indicated that the maximum temperature was positive correlation with aphid, whitefly and thrips population. The minimum temperature and rainfall were negatively correlated with aphid population and with relative humidity [16].

CONCLUSION

Overall, all the abiotic factors except sunshine have shown negative correlation with pests of *Bt* Kaveri cotton hybrid. Abiotic factors viz., maximum temperature, minimum temperature, rainy days and evaporation were regressed with pest population of *Bt* Kaveri cotton. Thus, it is concluded from the present study that *Bt* cotton hybrids should be used with plant protection strategies and follow the impact of individual abiotic factors against sucking pest complex and bollworm complex which are help in increasing the production of cotton with minimum investment and maximum benefit to the farmers.

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