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Short Communication

Seasonal abundance of major insect pest on Bt cotton vis-à-vis weather parameters in Marathwada region, Maharashtra

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Cotton is the most important cash crop grown in India and plays a vital role in agricultural, industrial, social and monetary affairs of the country. In Maharashtra, cotton occupies 42.07 lakh ha area with a production of 78.29 lakh bales and productivity of 343 kg lint ha^{-1} and area of cotton in Marathwada region is 15.2 lakh ha with a productivity of 164 kg lint ha^{-1}, with total production of 15.35 lakh bales (Anonymous, 2019).

Weather influences the distribution and abundance of several species at both individual and population level affecting the insect migration, outbreaks through affecting physiology, behavior and population densities. Moreover, response of organisms to climatic variation is species specific occurring at different rates in each species thus, resulting in an altered community structure. Hence, understanding the complex interaction between insect pests and weather parameters would help in developing efficient and timely pest control strategies. The pests of major significance in Bt cotton are sucking pests like aphids (Aphis gossypii, Glover), leafhoppers (*Cicadellidae*)**,** whiteflies (Bemisia tabaci, Gennadius) and thrips (Thrips tabaci Linnman). These affect the yield considerably causing losses of 11.20 per cent to 20.90 per cent in Marathwada region. The cotton thrips (Thrips tabaci Lindeman) and aphid (Aphis gossypii Glover) are the most limiting factors in achieving higher productivity of cotton. Combined attack by thrips (14.6 / leaf) and jassid (4.6 / leaf) caused a 37.6% loss in the yield of seed cotton (Attique and Ahmad 1990). Aphid (both nymph and adult) causes direct damage to plant and it reduces the yield by feeding and indirect damage causes by lint contamination due to secretion of honey dew and associate fungi. So that quality of lint deteriorated and it reduces seed cotton yield varies from 25.9% to 48.9% (Rao *et al*, 1989). The knowledge about incidence of pests during the cropping season and its possible dynamics help in designing pest management strategies (Santhosh *et al*, 2009). Ambient weather is predominantly responsible for the incidence and growth/ activity of pests either directly or indirectly as well as the crop (Singh *et al*., 2012). So for developing weather based forewarning model, a thorough understanding of interaction between crop growth stage / meteorological parameters / pest dynamics is needed (Chandi *et al*., 2021). Developing a weather-based model for predicting whitefly incidence can enhance decision making processes for pest control and provide greater opportunity to control the pest within integrated pest management programs. Therefore, the present investigation was undertaken to find out the relationship between the populations dynamics of major insect pest on Bt cotton with meteorological parameter in marathwada region.

Field experiments were carried out during *Kharif* 2018 & 2019 at Research farm, Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S.). The geographical location of Parbhani is on 19° 16' North latitude and 76° 47' East longitude with an altitude of 408.50 Meter above Mean Sea Level. The sowing was done on 25th June during 2018 and 28th June in 2019 after receiving optimum rains. The crop was sown at a spacing of 120 x 60 cm. The plot was divided in four quadrants 25 m^2 each. Ten plants were randomly selected from each quadrant for observations. All agronomic practices recommended by VNMKV, University were followed to raise the crop except for crop protection measures.

Observations on the number of nymph and adults of aphids, jassids, thrips and whiteflies was recorded at weekly interval from three leaves per plant selected from top, middle and bottom canopy of ten randomly selected plants per quadrant. The all meteorological factors in different standard meteorological weeks (SMW) and their relationship between weather parameters and sucking pests was determined through correlations and stepwise multiple regressions. Data was analyzed statistically by SPSS software and simple correlation was worked out between the population of insect pests and weather parameters.

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Table 1: Mean Weekly weather data with seasonal incidence of major sucking pests in *Bt* cotton during both season

	No. of sucking pests/three leaves				Weather condition							
SMW	Aphid	Leaf hopper	Thrip	Whitefly	Rainfall (mm)	Tmax (^{0}C)	Tmin (^{0}C)	RH-I (%)	RH-II (%)	EVP (mm/ day)	BSS (hrs/ day)	WS (kmph)
28	0.0	0.0	0.0	0.0	37.1	31.2	22.3	88	65	4.0	3.5	6.0
29	6.4	0.0	0.0	0.0	57.3	31.9	22.4	84	61	4.7	5.0	5.6
30	14.6	2.7	4.6	0.8	33.3	30.3	22.3	82	64	3.8	2.8	5.6
31	21.4	6.3	10.2	3.3	42.7	30.5	21.8	86	68	3.7	4.0	6.0
32	28.5	7.9	14.5	4.8	34.7	30.5	22.0	87	67	4.5	2.8	6.3
33	27.8	6.3	17.7	14.2	79.1	30.3	21.5	85	66	3.9	3.1	5.1
34	38.2	9.2	20.4	7.3	55.7	30.5	21.3	86	65	4.4	5.7	5.9
35	23.3	14.7	22.2	14.2	43.4	30.5	21.2	86	60	4.1	5.3	4.8
36	22.8	12.9	33.2	14.4	7.8	30.5	20.9	83	62	4.0	4.8	5.1
37	37.9	12.8	22.9	19.0	43.2	31.5	21.0	86	59	4.4	6.9	4.2
38	12.8	11.2	37.5	12.8	60.3	31.7	21.6	89	62	3.5	4.3	4.0
39	30.5	9.7	31.1	21.8	19.8	33.0	21.0	87	52	4.7	7.4	3.3
40	22.3	10.7	30.8	23.4	10.6	33.2	20.3	83	50	5.0	8.2	3.1
41	25.4	8.8	48.3	25.3	2.6	33.5	18.2	80	37	5.4	7.9	3.5
42	13.2	5.8	55.2	17.0	60.7	32.3	17.6	79	41	4.9	7.4	3.7
43	16.4	5.1	24.2	22.3	50.0	32.2	18.4	77	45	4.1	6.5	3.2
44	29.2	6.9	25.1	24.8	6.5	31.7	17.8	79	46	4.6	8.3	4.3
45	20.3	5.1	22.2	32.6	0.0	32.7	17.4	80	41	4.5	8.5	2.2
46	28.5	3.8	18.5	37.9	0.0	31.7	13.1	76	34	4.3	8.9	2.8
47	34.3	4.7	14.8	21.3	0.0	31.1	14.8	79	40	4.0	8.0	2.9
48	37.3	3.7	8.4	11.3	0.0	30.3	12.8	79	35	4.1	8.3	2.7
49	31.1	3.7	6.7	12.3	0.0	30.0	14.6	76	41	4.3	7.4	3.2
50	27.5	2.5	2.7	6.1	0.0	30.2	14.6	81	39	4.1	7.4	3.4
51	20.9	0.7	0.4	3.5	0.0	27.7	12.4	82	40	4.2	6.9	3.7
52	12.0	0.1	0.0	1.5	2.2	27.4	11.9	78	35	3.8	6.0	4.0
Total/ Mean	23.3	6.2	18.8	14.1	646.8	31.0	18.5	82	51	4.3	6.2	4.2

Table 2: Correlation coefficient between weather parameters with seasonal incidence of major sucking pests in *Bt* cotton

Sr. No.	Parameters	Aphids	Leaf hoppers	Thrips	Whiteflies
1	Rainfall (mm)	-0.275	0.223	0.184	-0.291
2	Tmax (^{o}C)	0.002	0.390*	0.666**	0.630**
3	Tmin (^{o}C)	-0.234	0.475*	0.229	-0.209
4	RH-I (%)	-0.138	0.426*	0.018	-0.394*
5	RH-II (%)	-0.183	0.358	-0.058	-0.456*
6	EVP	0.155	0.168	0.480*	0.419*
7	BSS (hrs)	0.410*	-0.013	0.262	0.692**
8	WV (kmph)	-0.281	0.044	-0.250	-0.682**

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

Weather condition during growing season

The meteorological factors i.e. rainfall (mm), maximum and minimum temperature (^{0}C), relative humidity (%), wind velocity (kmh^{-1}) and BSS (hrs) in different standard meteorological weeks (SMW) during the crop season of 2018 & 2019 were recorded & poll data show in Table 1. The total mean rainfall was recorded 646.8 mm. The mean maximum temperature range was from 27.4 to 33.5 ^{0}C and mean minimum temperature range from 11.9 ^{0}C to 22.4 ^{0}C during growing season. The mean RH-I range was from 76-89% and RH-II range from 35-68 during growing season. The average mean evaporation (4.3 mm), bright sunshine hours (6.2 hours) and wind speed (4.2 kmph) during growing season.

Table 3: Stepwise regressions between weather parameters and major insect pests of *Bt* cotton

Regression equation	F Value	R^2	SEY
Aphids			
Y=10.48+(2.06*BSS)	4.66	0.41	9.13
Leaf hopper			
Y=-19.22+(0.98*Tmin)+(1.18*BSS)	7.24	0.62	3.39
Thrips			
YY=-191.26+(6.77*Tmax)	18.12	0.66	11.4
Whiteflies			
Y=-106.29+(3.29*Tmax)+(2.92*BSS)	22.10	0.82	6.29

R^2= Coefficient of determination, SE= Standard Error,

Effects of weather parameters on incidence of sucking pests of Bt cotton

***Population dynamics of aphids* (*Aphis gossypii Glover*):**

Among major insect pests, the aphids, thrips & whitefly were key pests and remained active through the cropping season. Based on the mean of two years data, Aphids was observed during third week of July and remained active through the cropping season in varying population density (Table 1).The highest population density of aphid (38.2/three leaves) was observed in 34th SMW whereas meteorological condition was total rainfall (55.7 mm), maximum temperature (30.5 °C), minimum temperature (21.3 °C), RH-I (86%) and RH-II (65 %) with bright sunshine hours (5.7 hours). The present studies are corroborates with Soujanya *et al*, (2010) who observed that the initial incidence of aphids was recorded on 34th SMW. More or less similar trends of aphid incidence were reported by More *et al*. (2009). They observed 52.20 aphids in first week of September, while Parsai and Shastry (2009) recorded 35.1 to 45.7 aphids/3 leaves during 33rd SMW (mid August).

Population dynamics of leaf hopper

The poll data on population of leaf hoppers during growing season on Bt cotton revealed that the incidence of leaf hoppers started from 30th SMW & mean highest leaf hopper observed in 35th SMW (14.7 leaf hopper/3 leaves). When, weather parameters total rainfall (43.4 mm), maximum temperature (30.5 °C), minimum temperature (21.2 °C), RH-I (86%) and RH-II (60 %) with bright sunshine hours (5.3 hours) (Table 1.). Gosalwad *et al*. (2009) reported that leafhopper attained its peak during September and October during 2004-05. A. bigutulla bigutulla population was maximum during 27th August to 2nd September in 2001-02 Rajput *et al*. (2010).

Population dynamics of thrips (Thrips tabaci) on Bt cotton:

The thrips occurrence started in 31th SMW and its infestation remained throughout the crop growth (Table 1). The mean population of thrips highest recorded (55.2 thrips/3 leaves) in 41st SMW whereas weather parameters total rainfall (60.7 mm), maximum temperature (32.3 °C), minimum temperature (17.6 °C), RH-I (79%) and RH-II (41 %) with BSS (7.4 hours). The present investigation is partially agreement with Gupta *et al*., (1997) who observed that the peak population of thrips was recorded during the second fortnight of August to the first fortnight of October with 30 ^{0}C temperature and 74-85 % RH. on the cotton in MP.

Population dynamics of whitefly (*Bemisia tabaci*) on Bt cotton:

The data on population dynamics of whitefly (B. tabaci) on Bt cotton during growing season (Table 1) revealed that the incidence of whitefly (B. tabaci) started in the 30th SMW during both the years (Table 1) & the highest population of whitefly (37.9/ three leaves) was found in 46th SMW when, weather parameters *i.e* no rainfall, maximum temperature (31.7 ºC), minimum temperature (13.1 ºC), RH-I (76%) & RH-II (34%) respectively. The whitefly attained its peaks during 35th to 47th SMW. The present findings are in conformity with the findings of Prabhjyot-Kaur *et al*. (2021) recorded that Whitefly incidence was so severe that whitefly remained above 50 adults/3 leaves during 28-38 and 31-34 SMW.

Correlation studies

Correlation coefficient between Aphid populations with weather parameters result revealed that Aphid population was positively significantly correlated with the Bright sunshine hours. The leaf hopper population was positively significant with maximum temperature, minimum temperature & RH-I. The whitefly population was positively significant correlated with maximum temperature & evaporation. Thrips population was positively significant correlated with maximum temperature, evaporation & bright sunshine hours whereas negatively significant correlated with RH-I, RH-II and wind speed (Table 2.).The present findings corroborated with Gupta *et al*., (1997) who reported that the positive correlation of temperature with thrips population. It was evident that the positive significant correlation was found between population of thrips and in both the crops.

Stepwise Regressions

The poll stepwise regression analysis revealed that all the weather parameters collectively accounted for variability in the major insect pest population with R^2 values of aphid (0.41), leaf hopper (0.62), Thrips (0.66) & whitefly (0.66) was found (Table 3). Thus, our study showed the seasonal abundance and crucial role of different weather parameters on the population fluctuation of major insect pest in cotton agroecosystem which can be helpful in forecasting and formulating effective management strategies for these insect pests.

Pest prediction model clearly suggested maximum & minimum temperature & BSS as the important weather parameters that influenced pest occurrence in marathwada. Apart from satisfactory validation, the model also revealed the significance of these three weather parameters in influencing pest interaction.

REFFERENCES

Anonymous (2019). Annual progress report year 2018-19 of Cotton Research Station, Nanded Maharashtra.

Attique, M. R. and Ahmad, Z. (1990) Investigation of thrips

(Thrips tabaci Lindeman) as a cotton pest and the development of strategies for its control in Punjab. *Crop Protection*., 9 (6): 469-473.

Chandi, R.S., Kaur, A,, Biwalkar, N. and Sharma, S. (2021). Forecasting of insect pest population in brinjal crop based on Markov chain model. *J. Agrometeorol*., 23(1): 132-136 DOI: https://doi.org/10.54386/jam.v23i1.99

Gosalwad, S.S., Gupta, G.P., Kamble, S.K., Wadnerkar, D.W. and Hasan, B.A. (2009). Population dynamics of major insect pests of cotton and their natural enemies *J. Cott. Res. Dev*., 23(1): 117– 125.

Gupta, M. P., Sandeep Sharma and Shrivastava, S. K. (1997). Population build-up of some sap sucking insects on cotton in Madhya Pradesh. *J. Insect Sci*., 10(2) 153- 156.

More, D.G., Gitte, A. N., Bhosle, B. B., Awaz, H. B. and Pawar, S.V. (2009). Population dynamics of different pests of Bt cotton under rainfed condition. National Symposium on Bt cotton: Opportunities and Prospects" at CICR, Nagpur, pp-123.

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, pp- 125–126.

Prabhjyot-Kaur, Vijay Kumar, S.S. Sandhu and Harpreet Singh. (2021). Weather based model for forewarning incidence of whitefly (Bemisia tabaci Gennadius) in cotton (Gossypium hirsutum) in Punjab. *J. Agrometeorol*., 23 (4): 476-480

Rajput, K.P., Mutkule, D.S. and Jagtap, K.P. (2010). Seasonal incidence of sucking pests and their pests and their correlation with weather parameters in cotton crop. *Pestol*., 24(3): 44-51.

Rao, N. V., Reddy, A.S. Ankaiah, R. and Mukundan (1989). Effects of Whitefly (Bemisia tabaci Gennadius) on cotton yield and associated components. *Intern. J. Tropical Insect Sci*., 10: 685-690.

Santhosh, B. M., Patil, S. B., Udikeri, S. S., Awaknavar, J. S. and Katageri, I. S. (2009). Impact of *Bt* cotton on pink bollworm, *Pectinophora gossypiella* (Saunders) infestation. Karnataka *J. Agric. Sci*., 22(2): 322-326.

Singh, S., Kaur, P., Kumar, V. and Singh, H. (2012). Incidence of insect pest damage in rice crop in relation to meteorological parameters in Punjab – A plant clinic data based case study. *J. Agrometeorol*., 14(1): 50-53. DOI: https://doi.org/10.54386/jam.v14i1.1381

Soujanya, P. L., N. V. V. S. Prasad, D. and Rao, P. A. (2010). Population dynamics of sucking pests and their relation to weather parameters in *Bt*, stacked *Bt* and non *Bt* cotton hybrids. *Trends in Biosci.*, 3(1): 15-18.