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EFFECT OF SOME CLIMATIC FACTORS ON THE POPULATION DYNAMICS OF SILVERLEAF WHITEFLY *BEMISIA TABACI* INFESTING COTTON PLANT *GOSSYPIUM HIRSUTUM*

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Abstract

The present study was undertaken to examine the effect of different weather parameters on the population dynamics of silverleaf whitefly *Bemisia tabaci* growing on cotton (*Gossypium hirsutum*) plants during the years 2017 and 2018. The whitefly infestation was initially noticed on the crop at 28th and 27th meteorological standard weeks (MSW), with population densities of 0.9 and 0.35 whiteflies/3 leaves during the years 2017 and 2018, respectively. It was found that the population of the insects increased with the advancement of crop growth and reached its peak at 8.53 whiteflies/3 leaves in 35th MSW during 2017 and 12.58 whiteflies/3 leaves in 37th MSW during 2018, when the crop was in the boll-development stage. Later, the population showed a decreasing trend, reaching its minimums of 0.8 and 1.18 whiteflies/3 leaves at 50th MSW during 2017 and 2018, respectively.

The above data indicate that silverleaf whitefly populations on cotton plants are favored by low temperatures and morning humidity, while rainfall did not significantly affect the dynamics: this could help in devising effective strategies against whitefly and prevent the infestation of cotton or related economically important agriculture.

KEY WORDS: population dynamics, climatic factors, *Bemisia tabaci*, infestation, *Gossypium hirsutum*

Introduction

Upland cotton, *Gossypium hirsutum* L. (family Malvaceae) is one of the most commercially important fiber crops in India, occupying a very prominent position in the economy of the country. As regards area, India ranks first in world (8.5-9.0 million hectares) and takes second place in cotton production (440 Kg/ha) after to China (Gopalakrishnan, *et al*. 2007). The pest spectrum of cotton crop is quite complex; about 162 insect pests have been reported in India, throughout its growth period, of which sucking pests have assumed a major status and cause considerable damage to the crop. Among the sucking pests, silverleaf whitefly, *Bemisia tabaci* Gennadius, attacks in the early stage of cotton growth and causes considerable damage by piercing and sucking cell contents and excreting huge amounts of honeydew that promote sooty mold fungal development and reduce the photosynthetic efficiency of the plant and hence yield. It also acts as a vector of many viral diseases of cotton worldwide, especially cotton leaf curl virus (CLCV). Moreover, weather factors such as temperature, relative humidity, rainfall, etc. play a significant role in the multiplication and distribution of this sucking pest on cotton crops (Mohapatra, 2008; Akram, *et al.* 2013).

Keeping in mind the economic importance of cotton and the need to eradicate its infection by pests, the present study was undertaken to find out the relationship between pest population and weather factors in the agroclimatic conditions of Indore district (M.P, India) under unsprayed conditions.

Materials and methods

A field experiment was carried out during the kharif cropping season (July-October) in 2017 and 2018 on the cotton hybrid Bunny BG II under unsprayed conditions at the farm of the Agriculture College, Indore. The experiment aimed to study the population dynamics of whitefly and its correlation with abiotic climatic factors, viz. maximum and minimum temperature, morning and evening humidity and total rainfall. Observations were recorded during the early morning hours from twenty randomly selected plants (3 leaves/plant) representing the top, middle and bottom canopy of the plants, at weekly intervals starting from 2nd week of July to the 4th week of December in 2017 and 2018.

Results and discussion

Population dynamics of white fly

The whitefly infestation was recorded initially from 28th and 27th MSW at 0.9 and 0.35 whiteflies/plant during 2017 and 2018, respectively. The results showed that the whitefly population gradually increased and reached to its peak at 35th MSW during 2017 (8.53 whiteflies/3 leaves) and 37th MSW during 2018 (12.58 whiteflies/3 leaves); after this the population declined with the increasing age of crop and reached its minimum (0.8 and 1.18 whiteflies/3 leaves) at 50th MSW during 2017 and 2018, respectively, when the crop was almost at its maturity stage (Fig. 1, Table I).Whitefly infestation started to buildup in early July and reached to its peak in the months of August and September, when weather conditions were warm and dry. The present findings are in corroboration with previous studies reporting the peak pest activity (Dhawan, 2000, Arif, *et al.*, 2006, Mukhtar, *et al.*, 2008; Kataria, 2014).

Correlations between silverleaf whitefly and abiotic environmental factors

The population data of the whitefly were subjected to statistical analysis to find correlations with various abiotic environmental factors, viz temperature, humidity and rainfall. The population number was correlated with the corresponding climatic factor – low/high temperature; morning/evening humidity and total rainfall during July-December, 2017 and 2018 (Table II). During 2017 it was observed that the whitefly population had a significant positive correlation with minimum temperature (r=0.494) and morning humidity (r=0.634), whereas no significant correlations with maximum temperature (r=0.017), evening humidity (r=0.182) or rainfall (r=0.129) were observed (Table II). During 2018 it was observed that morning humidity (r=0.499), evening humidity (r=0.458) and rainfall (r=0.579) exhibited statistically significant positive correlations with whitefly population (Table II). Further, a negatively non-significant correlation was noticed with maximum temperature (r=-0.034); however, minimum temperature (r=0.214) showed a non-significant positive correlation (Table II). The present research findings are in conformity with previous reports, which have reported that whitefly population has a significant positive correlation with minimum temperature and evening humidity, but no significant correlation with maximum temperature, morning humidity and rainfall (Kataria 2014). The results are in disagreement with some studies that reported a significant positive correlation of whitefly with evening humidity, high temperature or rainfall (Ahmed 2000, Otoidobiga, Vincent *et al*., 2004, Ali, Khan *et al*., 2005), although our results during 2018 showed a significant positive correlation of population dynamics with evening humidity and rainfall.

Table I. Population dynamics of silverleaf whitefly *Bemisia tabaci* by meteorological standard week (MSW). Population of whitefly *Bemisia tabaci* observed at weekly intervals during the kharif season in 2017-8, showing the variability in its distribution among different MSW during the course of study.

MSW	Period	Population of whiteflies / 3 leaves	
		Year 2017	Year 2018
27	9-15 Jul	0	1.35
28	16-22 Jul	0.9	3.58
29	23-29 Jul	1.51	3.99
30	30 Jul-05 Aug	4.85	7.14
31	06-12Aug	3.35	5.99
32	13-19 Aug	1.02	9.59
33	20-26 Aug	4.18	9.08
34	27 Aug-02 Sep	4.73	8.00
35	03-09 Sep	8.53	9.47
36	10-16 Sep	5.29	5.35
37	17-23 Sep	5.59	12.58
38	24-30 Sep	7.04	9.78
39	01-07 Oct	3.98	10.95
40	08-14 Oct	6.05	7.63
41	15-21 Oct	5.23	5.39
42	22-28 Oct	4.01	7.36
43	29 Oct-04 Nov	2.55	6.00
44	05-11 Nov	2.41	1.45
45	12-18 Nov	2.41	2.58
46	19-25 Nov	3.98	1.90
47	26 Nov-02 Dec	2.23	2.95
48	03-09 Dec	0.54	2.53
49	10-16 Dec	0.63	1.59
50	17-23 Dec	0.8	1.18

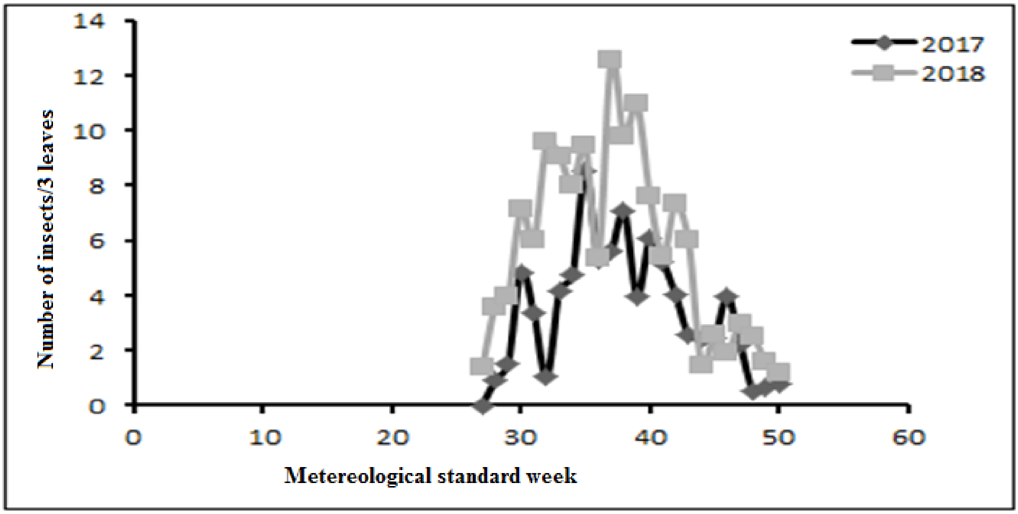

Figure 1. Population dynamics of silverleaf whitefly *Bemisia tabaci* during kharif seasons of 2017 and 2018 showing population growth during the respective MSW.

Furthermore, there are other studies partially similar to ours showing a positive significant correlation of pest population with evening humidity (Chauhan, Vekaria *et al*., 2017), a negative non-significant correlation of whitefly population with rainfall (Shitole and Patel 2009) and a negative non-significant correlation of whitefly population with temperature and relative humidity (Sahito, Abro *et al*., 2012).

Table II. Correlation matrix (r) and significance value (p) of population dynamics of silverleaf whitefly vs. weather variables during 2017 and 2018.

Weather parameter/s		2017		2018	
		R value	p-value	R value	p-value
Avg. temperature (ºC)	T_{max}	0.017	0.937#	-0.034	0.8747#
	T_{min}	0.494	0.014**	0.214	0.3153#
Avg. Humidity (%)	H_{mor}	0.634	0.001***	0.499	0.0131#
	H_{eve}	0.182	0.3947#	0.458	0.0244*
Rainfall (mm)		0.129	0.5480#	0.579	0.0030**

Statistical analysis

All statistical analyses and p value calculations were done using graph pad prism version 8.1.0 software. The p values were obtained by performing unpaired students t test. p values lesser than 0.05 were considered statistically significant at $^{*}p \leq 0.05$, $^{**}p \leq 0.01$, $^{***}p \leq 0.001$ while as $^{\#}p > 0.05$ were considered non-significant. Results are expressed as average± standard deviation of three replicates.

Conclusion

On the basis of our results, it was concluded that pest densities were quite high throughout the investigation. Peak populations of whitefly adults were recorded during 35^{th} and 37^{th} MSW with numbers as high as 8.53 and 12.58 whiteflies/3 leaves during the kharif seasons of 2017 and 2018, respectively. Population growth of silverleaf whitefly indicates that its fluctuation was due to the occurrence of one or the other environmental factor, indicating the role of prevailing ecological conditions and the impact of climate change. The results of the present study could help in formulating an effective insect-pest monitoring system that would assist farmers in their pest-management strategies.

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ЕФЕКАТ НЕКИХ КЛИМАТСКИХ ФАКТОРА НА ДИНАМИКУ ПОПУЛАЦИЈЕ ВРСТЕ *BEMISIA TABACI* НА ПАМУКУ *GOSSYPIUM HIRSUTUM*

САМИНА КАНДЕЈ, РАЈИС АХМАД, РИЈЕС УН АЗИЗ И ГУРУДУТ Д. ШАРМА

Извод

Ово истраживање је спроведено са циљем да се испита ефекат различитих метеоролошких параметара на динамику популације врсте *Bemisia tabaci* која се храни на листовима памука (*Gossypium hirsutum*) током 2017. и 2018. године. Инфестација овом врстом је примећена током 27. и 28. стандарне метеоролошке недеље (MSW) са густином популације од 0,9 и 0,35 јединки на 3 листа током 2017. и 2018. године. Утврђено је да је популација ових инсеката расла са растом памука и достигла је максимум од 8,53 јединки на 3 листа у 35. стандардној метеоролошкој недељи током 2017. године и 12,58 јединки на 3 листа током 37. стандардне меторолошке недеље у 2018. години када је памук био у стадијуму формирања лопте. Касније, популација је показала опадајући тренд, достижући максимум од 0,8 и 1,18 јединки на 3 листа у 50. стандардној метеоролошкој недељи током 2017. и 2018. године.

Добијени резултати указују да је популација врсте *Bemisia tabaci* на памуку подстакнута нижом температуром и влажним јутрима, док киша није значајно утицала на динамику популације. Ова сазнања могу да помогну у развијању ефикасних стратегија против ове штеточине и смање утицај ове врсте на производњу памука.

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