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Seasonal incidence of whitefly, *Bemisia tabaci* (Gennadius) in tomato (*Solanum lycopersicum* Mill)

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Abstract
A experiments on "Management of whitefly, *Bemisia tabaci (*Gennadius) in Tomato, *(Solanum lycopersicum* Mill)" was conducted at College of Agriculture, Bikaner during *Rabi* 2017-18. The seasonal incidence of white fly on tomato and correlation with abiotic factors during *Rabi* 2017-18. The incidence of whitefly on tomato started, when there was 20.5^{0}C maximum and 7.1^{0}C minimum temperature, 81.3 and 46.1 per cent maximum and minimum relative humidity, respectively with no rainfall. The maximum infestation (15.00 whiteflies/3 leaves) was observed at 35.0 ^{0}C maximum, 16.9 ^{0}C minimum temperature, whereas, 55.6 per cent maximum and 17.7 per cent minimum relative humidities with 0.8 mm rainfall during the study period. A significant positive correlation was recorded between pest population and maximum(r=0.565) and minimum(r=0.526) temperature, whereas, it was non-significant negative with maximum relative humidity (r= -0.430) and a significant negative correlation with minimum relative humidity(r= -0.525). A non- significant negative correlation was computed between pest population and total rainfall (r= -0.087).

Keywords: whitefly, *Bemisia tabaci*, tomato, seasonal incidence

1. Introduction
Tomato (*Solanum lycopersicum* Mill.) belongs to family Solonaceae, is one of the most highly praised vegetable crops and widely consumed. It is the major source of vitamins and minerals. It is one of the most popular and widely grown vegetable throughout the world ranking second in importance after potato in india In India, tomato is cultivated in almost all parts of the country and occupy an area of about 8.09 lakh hectares with total production of 197 lakh tonnes and productivity of 24 tonnes per ha (Anonymous, 2016-17) [1]. In Rajasthan it contributes about 7.52 million tones production covering an area of 1.6 lakh hectares with 45 lakh per hectare productivity (Anonymous, 2016-17) [1]. Tomato growers in northan Rajasthan regularly experienced the economic damage caused by fruit borer (*Helicoverpa armigera* Hubner), whitefly (*Bemisia tabaci* Gennadius), aphid (*Aphis gossypii* Glover) and thrips (*Frankliniella schultzei* rybom). The sucking pests' *viz*., thrips, whiteflies and aphids cause severe damage to crop by transmitting virus disease rather than direct feeding. (Kumar *et al*. 2010). The white fly (*Bemisia tabaci* Gennadius, Hemiptera: Aleurodidae) is a widely distributed polyphagous pest in tropical and subtropical regions of India. Both adult and nymph suck the cell sap from phloem by secreting honey dew, causes weakening and dryness of plant. *B. tabaci* also transmit the leaf curl virus, which is a major problem in tomato cultivation. In order to prevent the loss caused by insects and to produce a quality crop, it is essential to manage the pest population at appropriate time with suitable measures. A thorough knowledge of seasonal activity of different insect pests determines the predisposing climatic factors affecting their population dynamics.

2. Materials and Methods
The present investigations were conducted at the Research Farm College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan. The field experiments were conducted during tomato growing season *Rabi*, 2017-18. The region falls under agro-climatic zone I C, ('Hyper Arid Partially Irrigated Western Plain Zone') of Rajasthan and Agro Climatic Zone XlV (Western Dry Region) of India.

2.1 Layout of experiment

To study the seasonal incidence of white fly on tomato a block of 10x10 m^2 was laid out. The seedlings were transplanted in the experimental block during thrid week of November keeping row to row 60 cm and plant to plant distance of 40 cm. All recommended agronomical practices were followed from time to time to raise the crop successfully, as per Package and Practices booklet of the region.

2.2 Population estimation

The crop was kept under constant observation for appearance of pest just after transplanting. The whitefly was recorded on ten randomly selected and tagged plants on three leaves i. e. (upper, middle and lower), portion of each tagged plant. In early hours when insect have minimum activity. Correlation of insect population with temperature (maximum and minimum), relative humidity and rainfall was worked out to find out relationship, if any, exits between them.

2.3 Statistical analysis

Population data of white fly thus obtained were subjected to statistical analysis to find out the coefficient of correlation with maximum & minimum temperature, relative humidity and rainfall. A simple correlation was worked out between the population of white fly and abiotic environmental factor using the following formula.

$$r_{xy}=\frac{\sum XY-\frac{\sum X\sum Y}{n}}{\sqrt{\left[\sum X^2-\frac{(\sum X)^2}{n}\right]\left[\sum Y^2-\frac{(\sum Y)^2}{n}\right]}}$$

r_{xy} = Simple correlation coefficient

X = Variable i.e. Abiotic component. (Maximum & minimum temperature, relative humidity and rainfall)

Y = Variable i. e. Mean number of insect pests

n = number of paired observations

3. Results

The results of experiments conducted during *Rabi* 2017-18.To study the seasonal incidence of whitefly on tomato and correlation with abiotic factors**.** The population of whitefly was observed to suck the cell-sap from the lower surface of leaves and spread leaf curl diseases virus. The data presented in Table 1. Revealed that the incidence of whitefly on tomato initiated in the second week of December (50^{th} SMW). Initial mean population of white fly on tomato variety (SL-1) was (1.20 whiteflies/3 leaves). The population increased gradually and reached to its peak (15.00 whiteflies/3 leaves) in second week of March, 2018. Thereafter, whiteflies population decreased and reached up to (3.40 whiteflies/3 leaves) in the second week of April when harvesting of fruit was over. During this period maximum and minimum temperatures ranged from 20.5^0C to 40.7^0C and 3.8^0C to 22.2^0C respectively. Relative humidity ranged from 35.9 per cent to 82.0 per cent maximum and 12.0 per cent to 46.1 per cent minimum. An occasional scanty rain was also observed (Table 1 and Fig 1).

3.1 Correlation between seasonal incidence of whitefly on Tomato and abiotic factors.

The incidence of whitefly on tomato started, when there was 20.5^0C maximum and 7.1^0C minimum temperature, 81.3 and 46.1 per cent maximum and minimum relative humidity, respectively with no rainfall. The maximum infestation (15.00 whiteflies/3 leaves) was observed at 35.0 ^{0}C maximum, 16.9 ^{0}C minimum temperature, whereas, 55.6 per cent maximum and 17.7 per cent minimum relative humidities with 0.8 mm rainfall during the study period.

A significant positive correlation was recorded between pest population and maximum(r=0.565) and minimum(r=0.526) temperature, whereas, it was non-significant negative with maximum relative humidity (r= -0.430) and a significant negative correlation with minimum relative humidity(r= -0.525). A non- significant negative correlation was computed between pest population and total rainfall (r= -0.087).

4. Discussion

In the present investigation, the incidence of whitefly, *Bemisia tabaci* Gennadius started three weeks after transplanting *i.e.* in the second week of December (50^{th}SMW). The population increased gradually and reached to its peak (15.00 whiteflies/3 leaves) in second week of March, 2018. Thereafter, whiteflies population decreased and observed as to 3.40 whiteflies/3 leaves in the second week of April when harvesting of fruit was over. The present findings on the population fluctuation of whitefly, *Bemisia tabaci* on tomato are in agreement with that of Chevan *et al*. (2013) who reported that whitefly population commenced just after the transplanting and reached to peak level at 11^{th} week after transplanting. Chaudhuri *et al.* (2001) [4] and Lin *et al.* (2007) reported the peak level of whitefly population from mid February to mid March also partially confirm the present results. However, Patel *et al.* (2015) observed peak population of whitefly during last week of April, while, Dhatonde (2014) [5] and Indirakumar *et al.* (2016) [7] reported the peak population of whitefly during the month of January contradicts the present results. The difference in the activity of whitefly may be due to the difference in date of transplanting, climate and field conditions

4.1 Correlation between whitefly incidence and abiotic factors

The incidence of whitefly on tomato started, when there was 20.5^0C maximum and 7.1^0C minimum temperature, 81.3 and 46.1 per cent maximum and minimum relative humidity, respectively, with no rainfall. The maximum infestation (15.00 whiteflies/3 leaves) was observed at 35.0 ^{0}C maximum, 16.9 ^{0}C minimum temperature, whereas, 55.6 per cent maximum and 17.7 per cent minimum relative humidities with 0.8 mm rainfall during the study period. The present results corroborate with those of Barde (2006) [2] and Pandey *et al.* (2008) [9] who reported maximum population of whitefly at 29.32 ^{0}C maximum, 18.22 ^{0}C minimum and 61.5 per cent relative humidity.

A significant positive correlation was computed between pest population with maximum (r=0.565) and minimum (r=0.526) temperature, whereas, it was non-significant negative with maximum relative humidity and significant negative correlation with minimum relative humidity (r=-0.525). A non- significant negative correlation was recorded between pest population and total rainfall.

The present result are in agreement those of Shahnaz *et al.* (2006) [10], Dhaka and Pareek (2008) [6] and Indirakumar *et al.* (2016) [7] who reported a significantly positive correlation with maximum and minimum temperatures and a significant negative correlation with relative humidity and a negative but non-significant with rainfall. Reported a non- significant positive correlation with mean temperatures, mean relative humidity and rainfall contradicts the present results.

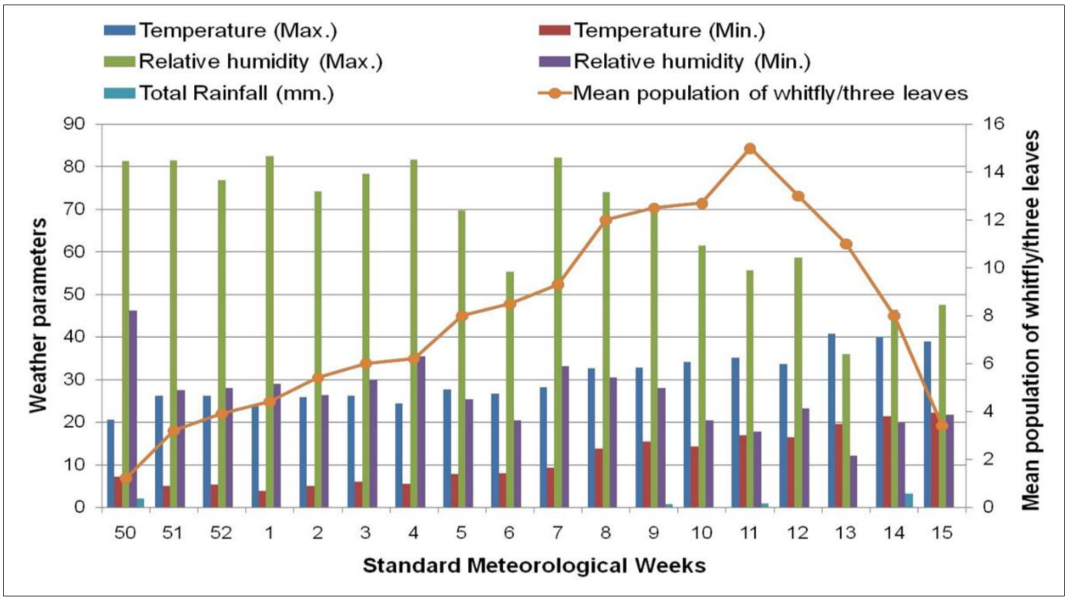

Fig 1: Seasonal incidence of whitefly on tomato in relation to abiotic factors during *Rabi* 201

Table 1: Seasonal incidence of whitefly on tomato in relation to abiotic factors during *Rabi* 2017-18

Standard Week	Period of Observation		Mean population/3 leaves	Temperature (°C)		R.H. (%)		Total Rainfall (mm.)
	From	To		Max.	Min.	Max.	Min.	
50	10.12.2017	16.12.2017	1.2	20.5	7.1	81.3	46.1	2.0
51	17.12.2017	23.12.2017	3.2	26.1	4.9	81.4	27.4	0.0
52	24.12.2017	31.12.2017	3.9	26.2	5.3	76.8	27.9	0.0
1	01.01.2018	07.01.2018	4.4	23.6	3.8	82.4	29.0	0.0
2	08.01.2018	14.01.2018	5.4	25.8	5.0	74.1	26.3	0.0
3	15.01.2018	21.01.2018	6.0	26.1	6.0	78.3	29.9	0.0
4	22.01.2018	28.01.2018	6.2	24.4	5.5	81.6	35.4	0.0
5	29.01.2018	04.02.2018	8.0	27.6	7.7	69.7	25.3	0.0
6	05.02.2018	11.02.2018	8.5	26.6	*7.9*	55.3	20.4	0.0
7	12.02.2018	18.02.2018	9.3	28.1	9.3	82.0	33.1	0.0
8	19.02.2018	25.02.2018	12.0	32.6	13.7	73.9	30.4	0.0
9	26.02.2018	03.03.2018	12.5	32.8	15.4	69.7	28.0	0.6
10	04.03.2018	10.03.2018	12.7	34.0	14.2	61.3	20.4	0.0
11	11.03.2018	18.03.2018	15.0	35.0	16.9	55.6	17.7	0.8
12	19.03.2018	25.03.2018	13.0	33.6	16.4	58.6	23.1	0.0
13	26.03.2018	01.04.2018	11.0	40.7	19.5	35.9	12.0	0.0
14	02.04.2018	08.04.2018	8.0	39.9	21.4	46.3	19.9	3.2
15	09.04.2018	15.04.2018	3.4	38.9	22.2	47.4	21.7	0.0
			Correlation	0.565*	0.526	-0.430 NS	-0.525*	-0.087 NS

NS= Non-significant, SMW= Standard Meteorological Week *Significant

5. Conclusion

The Infestation of whitefly on tomato started in the second week of December. The population increased gradually and reached to its peak in second week of March. There was a significant correlation of whitefly population with maximum and minimum temperatures and a significant negative correlation with minimum relative humidity.

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