



Studies on the effect of weather conditions on whitefly (*Bemisia tabaci*) population and tomato leaf curl disease

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Abstract: Tomato leaf curl disease is caused by Tomato leaf curl virus (genus *Begomovirus* and family *Geminiviridae*) of the most serious disease of tomato. The studies on the whitefly (*Bemisia tabaci*) population in tomato crop were conducted during *Kharif*, 2013 and 2014 at Student Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). To know the effect of various abiotic factors (rainfall, temperature and relative humidity) on the population of whitefly (*Bemisia tabaci*) and per cent disease incidence the simple correlation has been worked out between meteorological parameter (rainfall, temperature and relative humidity), population of whitefly (*Bemisia tabaci*) and per cent disease incidence of tomato leaf curl disease.

Key words: Whitefly, Population, Tomato leaf curl and Correlation

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular and widely grown vegetable crops of both tropics and subtropics of the world, belonging to the family Solanaceae. It was originated in Peru (South America). Over all, tomato becomes more important among vegetables due to its wide variety of uses e.g. like salad, paste, puree, syrup, sauce, juice, ketchup, soup and drinks etc. are prepared on a large scale. Tomato is a very good appetizer and its soup is said to be a good remedy for patients suffering from constipation. It is a rich source of carbohydrate (3.6%), vitamin A (585 IU/100g), vitamin B₁ (Thiamine, 0.12 mg/100g), vitamin B₂ (Riboflavin, 0.06 mg/100g), and vitamin C (26 mg/100g of fruit weight) (Thamburaj and Singh, 2000). This crop is suitable for cultivation as a garden crop as well as on large commercial farms. India is the largest producer of tomato covering an area of 4.7 lakh ha with an annual production of 55.3 lakh tones (Anonymous, 2013). In India, the major tomato producing states are Uttar Pradesh, Assam, Bihar, Orissa, Maharashtra, West Bengal and Karnataka. A number of fungi, bacteria, viruses, nematodes and insects attack this crop. Among them viral diseases, leaf curl virus caused by tomato leaf curl begomovirus and its vector whitefly (*Bemisia tabaci*) is the major limiting factors, which cause substantial yield loss in India and worldwide (Sastry and Singh, 1973; Muniyappa, 1980; Muniyappa and Veeresh, 1984; Saikia and Muniyappa, 1989; Harrison *et al.*, 1991 and Muniyappa *et al.*, 2000). ToLCV disease incidence is correlated with the size of the *B. tabaci* population. The incidence of ToLCV disease in the crop depends primarily on the

immigration of vectors from alternative hosts, which act as reservoir of both virus and vector and the ease with which the vectors could acquire the virus from infected plants had little impact on disease incidence in the tomato crop. It is also appeared that very low rate of vector immigration into tomato crop would suffice to cause almost total infection (Ramappa *et al.*, 1998, Holt *et al.*, 1998). Production of this crop is affected by a large number of biotic and abiotic stresses. More than 20 viruses are known to infect tomato around the world and losses up to 20-90% by different viruses have been reported (Hameed, 1995). Important among them is tomato leaf curl (Vasudeva and Samraj, 1948). Sastry and Singh (1973) estimated the losses in fruit yield upto 92.3 per cent if the plants are injected with tomato leaf curl virus in 20 days after transplanting. Keeping the importance of crop and viral diseases in view the present study was carried the objective like Population dynamics of the insect vector white fly (*Bemisia tabaci* Genn).

Materials and Methods

The whitefly population was taken in terms of number of whitefly per plant by using rectangular cage 45 cm long, 30 cm wide and 90 cm high, according to the stage of crop. To record the whitefly population, cage was placed on plant. The flies congregated on inner surface of fibre glass screen due to its phototactic behaviour, which enable to count them very easily. Five plants of each row were randomly selected and observed the population of whitefly at weekly interval started with 12-14 days after transplanting of the seedlings. The observations were recorded between 5-7 AM on the defined day. Meteorological data on rainfall, temperature and

relative humidity were obtained weekly from the meteorological observatory of this University. The incidence of tomato leaf curl disease was calculated and grading on the basis of mean percentage infection of two years as described by Sharma and Sharma (1984) as given in table-1.

The incidence of tomato leaf curl was also recorded by using the following formula:

$$\% \text{ disease incidence} = \frac{\text{No. of infected plants}}{\text{Total No. of plants}} \times 100$$

Result and Discussion

Data was recorded on whitefly (*Bemisia tabaci* Genn.) population in *Kharif*, during 2013 and 2014 are presented in table-2. It is evident from the data that whitefly activity was started with 12 and 14 days after transplanting and till first week of November. The whitefly population was recorded for the first time at 37th with minimum temperature (25.00^o and 24.85^o C), maximum temperature (31.00^o and 34.42^o C), relative humidity (79.20 and 88.85 per cent) and rainfall (17.90 and 06.00 mm) in years 2013 and 2014, respectively. While, white fly population (03.01 and 03.15 per plant) was recorded at 37th standard week during 2013 and 2014, respectively. Its

Table-1: Rating scale (I-IV) for scoring the disease incidence of tomato leaf curl disease

Disease incidence per cent	Grade	Reaction
0-0	I	Resistant (R)
1-30	II	Moderately resistant (MR)
31-70	III	Susceptible (S)
71-100	IV	Highly susceptible (HS)

population increased upto 41th standard week (19.41 and 20.17 per plant) with minimum temperature (20.70^o and 23.50^o C), maximum temperature (30.50^o and 30.92^o C), relative humidity (75.50 and 88.28 per cent) and rainfall (86.21 and 00.44 mm), the whitefly population more than about four time as compared to 37th standard week in years 2013 and 2014,. The population of whitefly showed increasing trend in 38th and 39th standard week and the increasing trend was continued till 41th standard week during 2013 and 2014, respectively. Thereafter, decline trend in number of white fly population (08.01 and 11.08) was recorded from 42th standard week with minimum temperature (17.40^o and 21.64^o C), maximum temperature (29.20^o and 28.50^o C), relative humidity (72.70 and 94.14 per cent) and rainfall (07.40 and 00.00 mm) till 44th standard week in 2013 and 2014. Concurrent with present findings have also been reported earlier by Singh (1990) noted that hot weather with little or no rainfall was conducive for disease development of tomato leaf curl disease and also for multiplication of *Bemisia tabaci*. Cooler weather with high relative humidity and rainfall were detrimental to whitefly population and spread. Borad et al. (1993) found that the populations of *Bemisia tabaci* and the incidence of tomato leaf curl disease were high in August-October. The population reached a maximum size during the first week of October. Meena et al. (2010) studied the seasonal incidence and correlation coefficient between whitefly population and weather parameters at semi-arid region during *Kharif* season. The infestation of whitefly (0.8 and 1.2 whiteflies/plant) on tomato was started in the first week of September and remained active throughout the

Table-2: Effect of meteorological factors on whitefly population during 2013 and 2014

Observations	Standard weeks	2013						2014					
		Rain-fall (mm)	Temperature (°C) Min.	Temperature (°C) Max.	Relative humidity (%)	Whitefly population (No.)	Per cent disease incidence	Rain-fall (mm)	Temperature (°C) Min.	Temperature (°C) Max.	Relative humidity (%)	Whitefly population (No.)	Per cent disease incidence
27-02 Sep	35	12.50	25.80	34.50	72.50	0.00	00.00	00.00	26.00	34.80	71.25	00.00	00.00
03-09 Sep	36	11.60	25.50	32.40	75.20	0.00	00.00	00.00	25.71	35.00	82.85	00.00	00.00
10-16 Sep	37	17.90	25.00	31.00	79.90	3.01	07.43	06.00	24.85	34.42	88.85	3.15	08.80
17-23 Sep	38	00.00	25.10	33.90	72.50	5.91	12.56	01.20	25.21	33.85	84.71	7.36	14.35
24-30 Sep	39	00.00	23.80	33.60	70.30	11.25	21.20	10.57	25.35	33.21	85.70	13.20	22.20
01-07 Oct	40	04.40	21.60	32.80	74.10	18.12	35.55	00.51	23.57	30.07	84.85	19.63	37.23
08-14 Oct	41	86.21	20.70	30.50	75.50	19.41	50.01	00.44	23.50	30.92	88.28	20.17	51.37
15-21 Oct	42	07.40	17.40	29.20	72.70	8.01	60.49	00.00	21.64	28.50	94.14	11.08	62.03
22-28 Oct	43	00.00	17.70	30.60	69.90	2.06	71.10	00.00	18.78	31.28	79.28	4.10	73.21
29-04 Nov	44	00.00	14.90	29.90	68.30	1.05	82.21	00.00	17.35	29.78	86.85	1.26	84.16

Table-3: Correlation coefficient between meteorological factors, whitefly population and percent disease incidence (PDI) of tomato leaf curl disease during *Kharif*, 2013 and 2014

	PDI	2013					2014					
		Whitefly population	Rain fall (mm)	Min. temp. (°C)	Max. temp. (°C)	Relative humidity (%)	Whitefly population	Rain fall (mm)	Min. temp. (°C)	Max. temp. (°C)	Relative humidity (%)	
PDI	1											
Whitefly population(No.)	0.760572*	1				0.815729*						
Rain Fall(mm)	0.039213	0.531018	1			-0.31743	0.147678	1				
Minimum temp. (°C)	-0.98602	-0.07844	0.031179	1		-0.94193	0.092048	0.365683	1			
Maximum temp. (°C)	-0.82341	-0.14376	-0.23371	0.831276	1	-0.87639	-0.50104	0.326138	0.72423	1		
Relative humidity(%)	-0.55446	0.168615	0.445224	0.548823	0.069741	1	0.367095	0.44401	0.190841	-0.21318	-0.53865	1

crop season and its population reached at maximum (6.2 and 8.6 whiteflies/plant) in fourth and third week of September.

In case of correlation studies, it is evident from table-3 that whitefly population with the minimum temperature showed non significant negative correlation in 2013 but in 2014, minimum temperature showed non significant positive correlation. Maximum temperature showed non significant negative correlation but relative humidity and rainfall showed non significant positive correlation in both the years. The incidence of tomato leaf curl disease with whitefly population showed significant positive correlation in both the years. The above findings are also supported by Pun *et al.* (2005) revealed a significant positive correlation between whitefly population and maximum temperature, minimum temperature and sunshine hours. Disease incidence also had a significant and positive correlation with whitefly population, minimum temperature and sunshine hours.

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