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The effect of microclimatic parameters on population dynamics of tomato whitefly

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Abstract
The present study entitled as "Effect of population dynamic of whitefly and different transplanting dates on yield of tomato (*Solanum lycopersicum*) under climatic conditions of Allahabad" was conducted during *rabi* season 2017-2018 at the field Experimentation Center of Department of Genetics and Plant Breeding, SHUATS, Allahabad. The experiment was laid out in Factorial Randomized Block Design in three dates of transplanting (10, 20 and 30 November). Results revealed that the maximum temperature, wind speed and bright sunshine hours were negatively correlation to population on whitefly at fifth standard week due to sudden fluctuation of weather parameters while at the same time growing degree day and humid thermal ratio showed a positive correlation to whitefly population. Therefore climate change would result in changes in the population dynamics of insect pests. Thus temperature rise plays a pivotal role in insect population dynamics.

Keywords: tomato, whitefly, population

1. Introduction
Tomato (*Solanum lycopersicum*) is an important and remunerative vegetable crop grown as commercial and kitchen garden in India. In India, tomato is grown across the length and breadth of the country. In 2015-16 total area under cultivation is 7.74 lakh ha with annual production 188 lakh tonnes and productivity 24 tonnes per ha. Both biotic and abiotic factors are responsible for low yield of tomato. The whitefly, *Bemisia tabaci* is one of the most economically important pests of tomato in many tropical and sub-tropical regions. In warmer region, it is serious pest in open field vegetable production but crop grown under protected cultivation (polyhouse) are equally suffering from whitefly. In addition, it has recently become a serious pest of protected Horticulture in temperate regions. Whitefly, *Bemisia tabaci* causes significant damage to crops through phloem feeding, induction of phytotoxic disorders, excretion of honeydew and most importantly, transmission of plant viruses. It can transmit more than 15 viruses that cause almost 40 plant diseases. Among the viral diseases, tomato leaf curl virus (TLCV) has emerged as the most important gemini viral disease. Weather parameters like temperature, reltive humidity, sunshine and rainfall were played limiting factors for the buildup of whitefly population. On tomato crop contribution of maximum temperature, minimum temperature and relative humidity was 83 to 91, 75 to 85 and 78 to 85, respectively in whitefly population development. Whitefly population has significant negative correlation with maximum and minimum temperature while positive correlation with relative humidity and rainfall. Whitefly population was significantly and positively correlated with temperature. The insect showed a negative correlation for wind speed and positive for sunshine hrs. The experiment was conducted to study the population dynamics of whitefly, *Bemisia tabaci* on tomato during crop season in relation to abiotic factors.

2. Material and Methods
The present investigation was carried out at the Field Experimentation Centre, Department of Genetics and Plant Breeding, SHUATS, Allahabad (U.P.) during *Rabi2017-2018*.tomato variety Arkaalok seedling (25 days old) of 8-10 cm in length were transplanted from nursery to the main field and crop was grown with application of any insecticide. This was done to allow natural population of whitefly on crop. Meteorological observations with regard to ambient (maximum and minimum) temperature (ºC), per cent relative humidity (at 07: 00 and 14: 00 hrs), wind speed (km per hr) and sunshine hours, Relative humidity, Rainfall, cloud cover,

growing degree days, humid thermal ratio. At field experimentation center, during the crop season i.e. December 2017 to April 2018 (Rabi) were recorded on daily basis in the observatory of the Department of Meteorology SHUATS Allahabad (Prayagraj). The observations on the population of whitefly were recorded at five days interval starting from thirty days after transplanting. The number of whitefly was counted on five randomly selected plants by observing three leaves (upper, middle and lower), randomly during early morning hours in each plot.

3. Result and Discussion

It was evident from the data presented in Table 1. That the whitefly population was present on the crop throughout the cropping period. Whitefly was initially observed on the crop 30 days after transplanting). It was observed that the tomato whitefly appeared in the morning of December with 0.8, 0.21 and 0.39 number of whitefly per 3 leaves of the for 1st, 2nd, 3rd, transplanting date respectively. Gradually its reached in January with 4.23,4.36 and 4.89 number of whitefly per plant for 1st, 2nd, 3rd, transplanting dates and reduced suddenly with an increase in temperature.

The maximum and minimum temperature 29.14 °C and minimum temperature 10 °C, relative humidity 90.71% (max) and 41.71% (min), rainfall (0mm), wind speed (0.96 km/hr) bright sunshine 8.31 hours, cloud cover (0),Growing Degree Days (GGD)7.57, Humid Thermal Ratio (HTR) 4.54 are highly conducive for population of whitefly. The maximum temperature (>38.4), wind speed (>1.64), bright sunshine hours (>7.7), was negatively correlation to population on whitefly. Growing degree day (>19.57) and humid thermal ratio (<3.3) is positive correlation to population on whitefly.

Table 1: Effect of dates of transplanting and weather parameters on whitefly population

Standard week	Insect population			temperature		Relative humidity (%)		Rainfall	Wind speed (km/hrs)	Sunshine (24hrs)	cloud cover (octa)		GDD	HTR
	D0	D1	D2	Tmax	Tmin	7:00am	7:00pm				7:00AM	2:00PM		
Nov-45	0	0	0	32.3	18.6	89	31	0	0.58	8.8	0	0	13.45	2.36
46	0	0	0	31.65	16.28	90	40.14	0	0.72	8.77	0	0.28	11.97	2.71
47	0	0	0	29.48	12.54	91.57	43.57	0	0.84	8.74	0.28	0.71	9.01	3.22
48	0	0	0	27.48	8.94	92.42	39.14	0	0.73	8.62	0	0.71	6.21	3.61
Dec-49	0.8	0.21	0.39	27.8	9.08	92.42	40.14	0	0.66	8.85	0	0	6.44	3.59
50	1.09	1.12	1.35	28.62	9.25	92.42	39.71	0	0.73	8.57	0.42	0	6.94	3.49
51	1.19	1.21	1.83	28.4	10.62	92.42	42.28	0	0.72	8.54	0	0	7.51	3.45
52	3.21	3.24	2.75	26	10.2	94.75	47.12	0	0.69	5.82	0.25	0.37	6.10	3.92
January1	3.46	3.63	3.85	24.37	8.45	96.42	53.57	0	0.83	2.31	0	0	4.41	4.57
2	3.53	3.69	3.75	23.97	8	93.57	48.71	0	0.86	5.91	0	0	3.99	5.94
3	3.72	3.83	3.89	25.45	6.8	93.57	47.57	0	1.33	7.45	0	0	4.13	5.54
4	4.13	4.11	4.75	27.85	9.85	91.71	43.42	0	0.79	7.8	0	0	6.86	4.85
5	4.23	4.36	4.89	29.14	10	90.71	41.71	0	0.96	8.31	0	0	7.57	4.54
February6	3.44	3.31	3.72	28.62	10.78	90.14	44	0	1.03	6.14	2.14	4	7.71	4.73
7	3.65	4.02	4.71	28.51	11.68	89.57	45.71	0.94	1.24	5.71	1.14	1.85	8.10	4.74
8	3.11	3.43	3.51	32.94	12.91	85.42	40.71	0	1.91	8.48	0	0	10.93	3.83
9	2.35	2.52	2.89	34.11	14.94	84.14	39.28	0	1.32	8.25	1.14	0.71	12.53	3.62
march10	2.23	2.39	2.55	33.77	16.02	83.71	40	0	1.5	8.17	0.28	1.42	12.90	3.66
11	2.11	2.19	2.36	35.88	17.74	82.71	35.28	0	1.23	8.68	0.71	1.28	14.81	3.29
12	1.81	1.59	1.78	37.85	22.42	81.85	33.85	0	1.14	8.91	0.42	0.85	18.14	3.06
13	1.29	1.45	1.88	38.4	21.25	80.57	35.85	0	6.9	8.88	0.85	0	17.83	3.03
april14	1.11	1.52	1.81	38.05	23.74	82.42	38.42	1.74	1.27	7.48	2.84	3.14	18.90	3.18
15	1.5	1.6	1.11	38.4	24.74	83	44	0.8	1.64	7.77	2.71	1.42	19.57	3.31
1st Dot whitefly population		r		-0.368	-0.407	0.204	0.579	-0.055	-0.034	-0.566	-0.036	0.038	-0.394	0.831
		t=		-1.813	-2.045	0.955	3.257	-0.251	-0.157	-3.146	-0.164	0.172	-1.967	6.857
		f-test		NS	S	NS	S	NS	NS	S	NS	NS	S	S
2nd Dot whitefly population		r		-0.341	-0.392	0.168	0.541	-0.053	-0.029	-0.555	-0.054	0.043	-0.373	0.798
		t=		-1.662	-1.953	0.783	2.950	-0.242	-0.133	-3.059	-0.248	0.196	-1.845	6.059
		f-test		NS	S	NS	S	NS	NS	S	NS	S	NS	S
3rd Dot whitefly population		r		-0.363	-0.419	0.193	0.560	-0.038	-0.033	-0.556	-0.029	0.058	-0.398	0.829
		t=		-1.788	-2.112	0.900	3.094	-0.174	-0.153	-3.064	-0.132	0.266	-1.991	6.802
		f-test		NS	S	NS	S	NS	NS	S	NS	NS	S	S

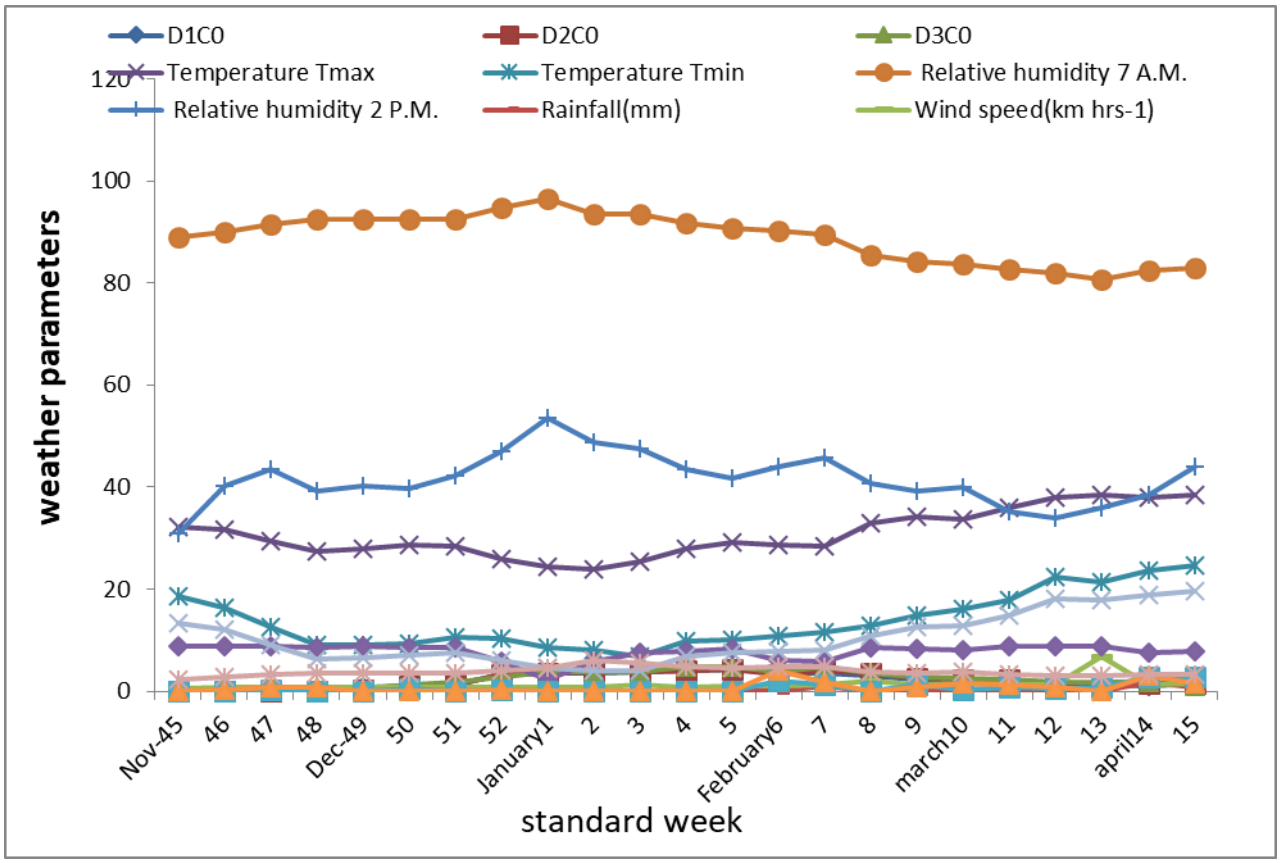

Fig 1: Effect of dates of transplanting and weather parameters on whitefly population

Conclusion

The population of white fly was negatively correlated and Non-significant with maximum temperature, morning cloud cover, rainfall, wind speed, GDD (2nd date of transplanting). Negatively correlated and significant with minimum temperature, sunshine hours, GDD (1stand 3rd date of transplanting). Positively correlated and non-significant with Relative humidity (Morning), cloud cover (afternoon-1st, 3rd date of transplanting). Positively significant in HTR, Relative humidity (Afternoon), cloud cover (afternoon, 2nd date of transplanting).

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