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Incidence of Insect Pests on Tomato Under the Influence of Weather Factors

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ABSTRACT

The incidence of whitefly (*Bemisia tabaci*), Jassid (*Amrasca biguttulla biguttulla*), serpentine leaf miner (*Liriomyza trifolii*) and tomato fruit borer (*Helicoverpa armigera*) initiated during 45th SMW. The highest incidence of Whitefly was observed in 1st SMW (7.13 whitefly 3 leaves^{-1}) and lowest during 8th SMW (0.46 whitefly 3 leaves^{-1}) and the highest incidence of Jassid 52th SMW (8.30 Jassids 3 leaves^{-1}) and lowest during 8th SMW (0.03 Jassids 3 leaves^{-1}). The maximum incidence of Serpentine leaf miner at 1st SMW (7.10 mines plant^{-1}) and lowest at 8th SMW (0.60 mines plant^{-1}). The incidence of tomato fruit borer was recorded highest during 4th SMW (3.50 larvae plant^{-1}) and lowest during 48th SMW (0.20 larvae plant^{-1}). The Maximum and minimum temperature and morning relative humidity showed a negative non-significant correlation with whitefly, while the evening relative humidity, wind speed, sunshine showed a positive non-significant correlation with whitefly. The Jassid population showed a negative significant correlation with maximum and minimum temperature, morning relative humidity and a positive non-significant correlation with evening relative humidity, wind speed and sunshine. The serpentine leaves miner population showed a negative non-significant correlation with maximum and minimum temperature, morning relative humidity and positive non-significant correlation with evening relative humidity, wind speed and sunshine. The tomato fruit borer showed the negative highly significant with maximum and minimum temperature, positive highly significant with evening relative humidity and positive non-significant correlation with morning relative humidity, wind speed and negative non-significant correlation with sunshine.

Keywords Incidence, Abiotic factors, Tomato, Insect pests, Correlation.

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INTRODUCTION

Tomato, *Lycopersicon esculentum* (Miller) is herbaceous, annual, prostrate and sexually propagated crop plant with hermaphrodite flowers. The genus *Lycopersicon* consists of short-lived perennial herbaceous plants belonging to the family Solanaceae. The species of tomato are native to Peru (South America)

(Rich 1976). Tomato fruit contains water 93.1 %, Protein 1.9 %, fat 0.3g, fiber 0.7 %, Carbohydrates 3.6 %, calorie 23, Vitamin 'A' (320 I. U). Vitamin 'B_1'(0.07mg) Vitamin B_2 (0.01mg), Nicotinic acid (0.4 mg,) Vitamin 'C' (31mg,) Calcium (20mg,) Phosphorus (36mg) and Iron (0.8mg.) (Mandloi 2013).

Insects pests are major constraint in the production of tomato, which can cause the death of the tomato plants and damage to fruits in the form of tissue destruction and aberration in shape or colour. Insects can also introduce decay organisms into fruits or can act as vectors for many viruses and several mycoplasmas that cause growth disorders or death of the plants. Among the factors responsible for low yield of tomato, insect pests are major one. The insect pests attacking on tomato are the fruit borer, *Helicoverpa armigera* (Hübner) and sucking insect pests viz. whitefly, *Bemisia tabaci* (Gen), Jassid, *Amrasca biguttulla biguttulla* (Ishida), aphid *Myzus persicae* (Thomas) and *Aphis gossypi* (Glover), thrips, *Thrips tabaci* (Lind.), Serpentine leaves miner, *Liriomyza trifolii* (Burgess) tobacco caterpillar (*Spodoptera litura*) and hadda beetle, *Epilachana dodecastigma* (Widemann), which are highly destructive and causing serious damage and are also responsible for lowering the yield of tomato crop (Meena and Bairwa 2014). Reproduction, growth and survival of these insect pests are greatly influenced by several abiotic factors viz., temperature, humidity and rainfall (Ajij *et al*. 2019) Temperature plays a great in the population dynamics of pests by exerting effects on egg-laying and ovipositional behavior (Cammel and Knight 1992). Keeping these facts in mind present investigation was accompanied to find out the of weather factors on population build-up on major insect pests of tomato.

MATERIALS AND METHODS

The present experiment was carried out at Student's Instructional Farm, Acharya Deva University of Agriculture and Technology, Kumarganj, Ayodhya (UP) during *rabi* season 2020-21. The experiment was conducted in Randomized Block Design (RBD) with three replications on a variety of ND-7 and recommended agronomic practices were followed except plant protection measures. The unit plot size was kept at 10×10m with a spacing of 60×45 cm row to row and plant to plant, respectively. The crop was regularly observed at weekly intervals for the incidence of insect pests. The incidence of insect pests was recorded from10 randomly selected plants starting from 25 days after transplanting till harvesting. The data on abiotic factors such as minimum and maximum temperature (°C), relative humidity (%) and rainfall (mm), Wind speed (km/h) Sunshine (hrs) of the crop season was obtained from the Department of Agriculture Meteorology to correlate the incidence major of insect pests with abiotic factors.

$$R = \frac{\sum dndy}{Nn\sqrt{\frac{\sum d^2xi}{N} \times \frac{\sum d^2y}{N}}}$$

Where - Y= Insect population
xi = Weather parameter
N =Number of observations
Σ=Summation

RESULTS AND DISCUSSION

Incidence of whitefly, *B. tabaci*: The incidence of whitefly, *B. tabaci* was noticed for the first time during 45th SMW (0.86 whiteflies 3 leaves^{-1}). The peak population was recorded at 1st SMW (7.13 whiteflies 3 leaves^{-1}) and during this period maximum and minimum temperature ranged from 24.60°C and 9.60°C, whereas the morning and evening relative humidity was ranged from 87.40% and 45.40% with no rainfall and wind speed (1.70 km per hrs) and sunshine (6.00 hrs). Though, the minimum population was recorded at 8th SMW (0.46 whiteflies 3 leaves^{-1}) and during this period maximum and minimum temperature ranged from 28.60°C and 11.70°C, whereas the morning and evening relative humidity was ranged from 88.60% and 44.70% with no rainfall and wind speed (2.70 km per hrs) and sunshine (6.50 hrs) (Table 1 and Fig. 1). The present findings are in conformity with the Meena and Bairwa (2014) who reported the incidence of whitefly (*B. tabaci*) observed at 34th SW and the whitefly population peak incidence at 44th SW.

Table 1. Incidence of insect pests of tomato under the influence of weather factors during *rabi* 2020-21. SMW= Standard Meteorological Weeks.

SMW	Mean No. whitefly per three leaves	Mean No. of Jassid per three leaves	Mean No. of serpentine leaves mines per plant	Mean No. of H. armigera larvae per plant
45	0.86	0.26	0.70	0.00
46	1.50	1.60	1.30	0.00
47	2.06	2.50	2.30	0.00
48	3.16	3.36	3.10	0.20
49	3.90	4.96	3.88	0.50
50	4.50	5.66	4.70	0.30
51	5.76	7.53	5.10	1.30
52	6.33	8.30	6.10	1.70
1	7.13	6.86	7.10	2.10
2	5.66	5.73	6.00	2.70
3	3.63	4.16	4.70	3.10
4	2.16	3.13	3.50	3.50
5	1.43	2.03	2.20	2.60
6	1.06	1.80	1.40	1.20
7	0.83	0.73	1.00	0.70
8	0.46	0.03	0.60	0.00

Table 1. Continued.

SMW	Weather parameters						
	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Wind speed (km/h)	Sunshine (hrs)
	Min	Max	Morn	Even			
45	11.80	30.00	92.90	33.30	0.00	0.80	5.20
46	14.86	27.86	92.86	49.57	0.00	1.57	6.76
47	10.21	26.00	92.00	36.00	0.00	1.70	7.19
48	8.86	26.71	91.57	36.71	0.00	1.91	7.49
49	10.29	27.43	93.71	47.14	0.00	0.67	5.17
50	11.00	22.50	90.71	57.71	0.00	1.51	1.86
51	5.14	20.57	90.14	46.71	0.00	2.20	6.00
52	5.07	22.50	89.86	41.43	0.00	1.91	7.17
1	9.60	24.60	87.40	45.40	0.00	1.70	6.00
2	8.80	20.20	89.30	59.10	0.00	4.00	5.90
3	8.00	19.10	96.00	57.40	0.00	1.80	2.90
4	7.10	16.40	96.70	72.30	0.00	1.60	2.80
5	5.50	22.10	93.60	48.90	0.00	1.40	4.30
6	9.00	24.60	88.70	51.00	0.00	2.30	1.90
7	9.50	27.40	94.60	42.90	0.00	1.50	5.70
8	11.70	28.60	88.60	44.70	0.00	2.70	6.50

Incidence of Jassid, *A. biguttula biguttula*: The population of Jassid, *A. biguttula biguttula* was noticed for the first time at 45th SMW (0.26 Jassids 3 leaves^{-1}). The peak population was observed at 52th SMW (8.30 Jassids 3 leaves^{-1}) and during this period maximum and minimum temperature ranged from 22.50°C and 5.07°C, whereas the morning and evening relative humidity was ranged from 89.86% and 41.43% with no rainfall and wind speed (1.91 km per hrs) and sunshine (7.17 hrs). However, the minimum population was recorded at 8th SMW (0.03 Jassids 3 leaves^{-1}) during this period maximum and minimum temperature ranged from 28.60°C and 11.70°C, whereas the morning and evening relative humidity was ranged from 88.60% and 44.70% with no rainfall and wind speed (2.70 km per hrs) and sunshine (6.50 hrs) (Table 1 and Fig. 1). These findings are in close conformity with the Kumar *et al*. (2017) who reported the incidence of major insect pests on

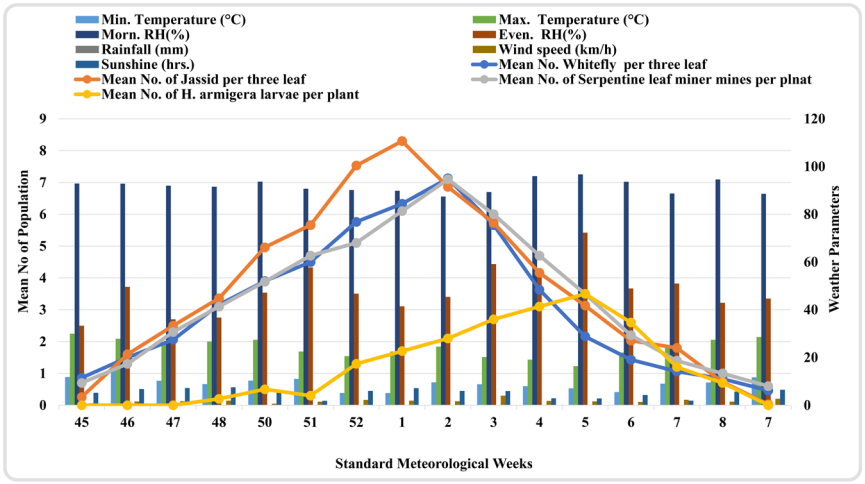

Fig.1. Incidence of insect pests of tomato under the influence of weather factors during *rabi* 2020-21.

the brinjal crop. The incidence of leaves hopper (*A. biguttula biguttula*) was highest during December (52nd SW) and minimum during March (12th SW).

Incidence of serpentine leaf miner, *L. trifolii*: The serpentine leaf miner, *L. trifolii* was first time noticed at 45th SMW (0.70 mines plant^{-1}). The highest population was observed at 1st SMW (7.10 mines plant^{-1}) during this period maximum and minimum temperature ranged from 24.60°C and 9.60°C, whereas the morning and evening relative humidity was ranged from 87.40% and 45.40% with no rainfall and wind speed (1.70 km per hrs) and sunshine (6.00 hrs). The minimum population was observed at 8th SMW (0.60 mines per plant) during this period maximum and minimum temperature ranged from 28.60°C and 11.70°C, whereas the morning and evening relative humidity was ranged from 88.60% and 44.70% with no rainfall and wind speed (2.70 km per hrs) and sunshine (6.50 hrs) (Table 1 and Fig. 1). The results are partial agreement with the Mandloi *et al*. (2015) who reported the peaks incidence at 7th and 11th SW and *L. trifolii* distinct peaks at 10th, 11th and 12th SW.

Incidence of tomato fruit borer, *H. armigera*: The incidence of tomato fruit borer, *H. armigera* was recorded at the first time 48th SMW (0.20 larvae plant^{-1}). The highest population was observed at the 4th SMW (3.50 larvae plant^{-1}) during this period maximum and minimum temperature ranged from 16.40°C and 7.10°C, whereas the morning and evening relative humidity was ranged from 96.70% and 72.30% with no rainfall and wind speed (1.60 km per hrs) and sunshine (2.80 hrs). Though, the minimum population was observed at 48th SMW (0.20 larvae plant^{-1}) during this period maximum and minimum temperature ranged from 26.71°C and 8.86°C, whereas the morning and evening relative humidity was ranged from 91.57% and 36.71% with no rainfall and wind speed (1.91 km per hrs) and sunshine (7.49 hrs) (Table 1 and Fig. 1). The similar results were also obtained by Bhati *et al*. (2017) who observed the incidence of fruit borer larvae in the 2nd SW and reached its peak (1.4 larvae/plant) during the 4th SW.

Relationship between abiotic factors on the incidence of major insect pests of tomato: Incidence of whitefly and temperature (minimum and maximum) and relative humidity (morning and evening) had a negative and non-significant correlation (-0.410 and -0.440, respectively, -0.440 and 0.132, respectively) and wind speed and sunshine both had positive and non-significant correlation (0.246 and 0.147, respectively) (Table 2). The similar results were also Mondal *et al*. (2019) also reported the population of whitefly had non-significant effect against maximum temperature (r=-0.010) and rainfall (r=0.007).

The incidence of Jassid between minimum and maximum temperature had a negative and signifi-

Table 2. Relationship between different weather factors and insect pests of tomato during *rabi* 2020-21. * Correlation is significant at 0.05 level, ** Correlation is significant at 0.01 level.

Insect Pests	Weather parameters						
	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Wind speed (km/h)	Sunshine (hrs)
	Min	Max	Morn	Even			
Whitefly	-.410	-0.440	-0.403	0.132	-	0.246	0.147
Jassid	-.523*	-0.525*	-0.324	0.188	-	0.188	0.066
Serpentine leaves miner	-.474	-0.593*	-0.284	0.299	-	0.263	0.009
Helicoverpa armigera	-.647**	-0.862**	0.248	0.688**	-	0.276	-0.395

cant correlation (0-0.523* and -0.525* respectively) whereas, non-significant negative correlation with morning and evening relative humidity (-0.324 and 0.188 respectively) and wind speed had non-significant positive correlation (0.188), sunshine non-significant positive correlation (0.066) (Table 2). The results are in similarity with Kumar *et al*. (2017) who observed a significant negative correlation with both maximum and minimum temperature and wind speed while a positive correlation was apparent with mean relative humidity and rainfall and wind speed.

The incidence of serpentine leaf miner had a negative and non-significant correlation minimum temperature (0-0.474) and significant at maximum temperature (-0.593*), respectively, while the non-significant negative correlation with morning and evening relative humidity (-0.284 and 0.999 respectively) and wind speed non-significant positive correlation (0.263), sunshine non-significant positive correlation (0.009) (Table 2). These findings are in close conformity with the Selvaraj *et al*. (2016) who noticed that serpentine leaf miner population exhibit non-significant correlation with various abiotic factors, except significant positive correlation with sunshine hours and significant negative correlation with morning and evening relative humidity.

Incidence of tomato fruit borer had highly significant with negative correlation minimum and maximum temperature (-0.647** and -0.862** respectively). Whereas, significant positive correlation with relative morning humidity (0.248) and highly significant evening humidity (0.688**) and wind speed non-significant positive correlation (0.276), sunshine non-significant negative correlation (-0.395) (Table 2). The similar results were also noticed by Pathan *et al*. (2018) who observed that fruit damage caused by *H. armigera* (Hubner) showed a highly significant negative association with minimum and maximum temperature.

CONCLUSION

In this research work; the highest and lowest whitefly mean population was recorded at 1st SMW and 8th SMW i.e., 7.13 and 0.46 whitefly per three leaves respectively. The highest and lowest Jassid mean population was recorded in 52th SMW and 8th SMW i.e., 5.30 and 0.03 Jassid per three leaves respectively. The highest and lowest serpentine leaves miner mean population was recorded in 1st SMW and 8th SMW serpentine leaves miner mines per plant respectively. The highest and lowest larval population was observed in 4th SMW and 48TH SMW i.e., 3.50 and 0.20 larvae per plant respectively. In the case of whitefly, the correlation was negative non-significant with min and max temperature, morning RH and positive non-significant evening RH, wind speed and sunshine. In the case of Jassid. The correlation was negative significant with min and max temperature, negative non-significant with morning RH and positive non-significant with evening RH, wind speed and sunshine. In the case of serpentine leaves miners, the correlation is negative non-significant with min and max temperature, morning RH and positive non-significant with evening RH, wind speed and sunshine. In the case of larval population, the correlation negative is highly significant with min and max temperature, positive highly significant with evening RH and positive non-significant with morning RH, wind speed and negative non-significant with sunshine. The information obtained in present experiment may be utilized for the formulation of

suitable management of major insect pests of tomato.

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