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Impact of meteorological factors on population of major insect pests in tomato, *Lycopersicon esculentum* Mill. under middle Gujarat condition

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ABSTRACT

Investigation on major insect pests in tomato was carried out at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand during *rabi* seasons of 2012-13 and 2013-14. Whitefly population was noticed from 39th standard meteorological week (SMW) with maximum population in 45th SMW (2.72 whiteflies/ 3 compound leaves). Aphid population was noticed from 42nd SMW with highest peak in 52nd SMW (0.98). Maximum larval population of leaf miner was observed in 48th SMW with number of larva 0.86 per 3 compound leaves. The activity of *Helicoverpa armigera* commenced from 39th SMW with larval population in the range of 0.12 to 1.86 per 3 twigs. Correlation study was carried out to find out impact of abiotic factors on the activity of insect pests. Wind speed on whitefly, *H. armigera*, leaf miner, spider; maximum temperature on aphid and spider; evening relative humidity on whitefly, aphid, leaf miner and evaporation on aphid were key abiotic factors influencing significantly on the fluctuation of the pests.

Key words: Population dynamics, major insect pests, tomato, abiotic factors.

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important "protective foods" because of its superior nutritional values. It is one of the most important vegetables grown in the world, which is good source of vitamins. This crop is attacked by number of insects and diseases which became a major constraint in optimum production of tomato (Hoffmann *et al*., 2007). Some common tomato pests are leaf miners, *Liriomyza trifolii* (Burgess); aphids, *Aphis gossypii* Glover; whiteflies, *Bemisia tabaci* (Gennadius) and tomato fruit borer, *Helicoverpa armigera* (Hubner) Hardwick. Information on pest complex in particular agro climatic condition is a pre-requisite, which helps in designing a successful pest management strategy. However, no systematic efforts have been made in recent past to observe the diversity of insect pests and their seasonal occurrence with relation to phenological stages of tomato under middle Gujarat condition. Therefore, an investigation was envisaged to study the diversity pests of tomato agro ecosystem.

MATERIALS AND METHODS

Investigation on population of insect pests in tomato was carried out at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand during *Rabi* season, 2012-13 and 2013-14. Tomato variety GT 2 was transplanted during 1st fortnight of September (plot size: 9 × 24 m, spacing: 90 × 60 cm) and raised by adopting standard agronomical practices. The whole experimental plot was divided into five equal sectors and five plants from each sector were selected for recording the observations. The experimental plot was kept free from the spraying of any insecticides. The observations on insect pests were recorded at weekly interval starting from one week after transplanting till the harvest.

Observations on *L. trifolii* were recorded based on mines, larvae and damaged leaves. The number of mines and larval population was recorded from the three compound leaves from the middle portion of the five selected plants while total and damaged leaves were counted from three compound leaves of the same selected plants. Sucking pest's *viz*., *B. tabaci* and *A. gossypii* were recorded from the three selected compound leaves of the same selected plants.

For recording observations on *H. armigera*, five selected plants were critically observed for recording eggs and larval population. Three twigs were selected from each selected plant for recording the population. The fruit damage was recorded at each picking by counting healthy and damaged fruits from each sector and per cent fruit damage was worked out. The major natural enemies' *viz.,* spiders

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Table 1: Population of major insects pests and natural enemies in tomato (Mean of 2012-13 and 2013-14)

Month/ Week	SMW	No. of Sucking pests/ 3 compound leaves				Infestation of leaf miner			Population of *H. armigera* /3 twigs		No. of natural enemies/ plant		
		Whitefly	Leaf	Aphid hopper	No. of Mealybug/ 10 cm twig)	No./ 3 compound leaves		Damaged leaves(%)	Egg	Larva(e)	Spiders	*Chrysopids* (egg)	Coccinellids (adult)
						Mines	Larva(e)						
September IV	39	0.08	0.00	0.00	0.06	0.16	0.04	1.71	0.14	0.12	0.08	0.00	0.00
October I	40	0.30	0.00	0.00	0.02	0.46	0.12	3.48	0.24	0.26	0.16	0.00	0.00
II	41	0.66	0.04	0.00	0.02	1.08	0.42	5.28	0.30	0.32	0.10	0.00	0.00
III	42	1.42	0.04	0.06	0.06	1.44	0.48	7.28	0.42	0.40	0.16	0.00	0.04
IV	43	1.46	0.02	0.08	0.04	2.08	0.32	6.81	0.24	0.32	0.12	0.00	0.06
V	44	1.88	0.10	0.10	0.02	2.74	0.78	8.20	0.38	0.40	0.26	0.00	0.04
November I	45	2.72	0.12	0.20	0.14	4.24	0.42	12.97	0.26	0.72	0.26	0.00	0.04
II	46	1.68	0.12	0.24	0.04	4.06	0.66	12.23	0.72	1.48	0.16	0.00	0.10
III	47	1.48	0.16	0.30	0.10	4.14	0.64	12.37	0.64	1.58	0.14	0.04	0.12
IV	48	2.64	0.24	0.86	0.06	5.52	0.86	18.77	0.60	1.56	0.22	0.08	0.04
December I	49	1.82	0.12	0.96	0.12	5.86	0.56	21.49	0.52	1.32	0.12	0.06	0.06
II	50	2.32	0.24	0.82	0.06	6.06	0.50	22.53	0.54	1.86	0.14	0.10	0.04
III	51	2.02	0.12	0.80	0.04	6.10	0.48	24.82	0.48	1.86	0.12	0.12	0.02
IV	52	1.98	0.06	0.98	0.00	6.32	0.36	26.43	0.32	0.78	0.08	0.02	0.08
January I	1	1.12	0.10	0.68	0.00	7.30	0.40	28.51	0.22	0.56	0.08	0.06	0.04
II	2	0.74	0.12	0.60	0.00	7.78	0.32	30.00	0.16	0.42	0.06	0.04	0.00
III	3	0.72	0.08	0.50	0.00	8.38	0.22	33.20	0.10	0.28	0.04	0.00	0.00
	Mean± SE	1.47 ± 0.19	0.10 ± 0.02	0.42 ± 0.09	0.05 ± 0.01	4.34 ± 0.64	0.45 ± 0.05	16.24 ± 2.46	0.37 ± 0.05	0.84 ± 0.15	0.14 ± 0.02	0.03 ± 0.01	0.04 ± 0.01

Note: SMW = Standard Meteorological Week

Table 2: Correlation coefficient (r) between insect pests of tomato and weather parameters (mean of 2012-13 and 2013-14)

Weather parameters	Sucking pests			Leaf miner (larva)	*H. armigera*		Spiders
	Whitefly	Leaf hopper	Aphid		Egg	Larva	
Evapotranspiration (EP)	-0.073	-0.409	-0.783**	0.055	-0.047	-0.403	0.359
Bright sunshine (BSS)	0.429	0.334	-0.478	0.458	0.472	0.397	0.400
Wind speed (WS)	-0.635**	-0.261	0.272	-0.614*	-0.678**	-0.487	-0.589*
Maximum temperature (T_{max})	0.035	-0.182	-0.699**	0.176	0.220	-0.168	0.624**
Minimum temperature (T_{min})	-0.299	-0.426	-0.693**	-0.140	-0.034	-0.412	0.381
Morning relative humidity (RH_1)	-0.422	-0.019	0.022	-0.370	-0.244	-0.166	-0.248
Evening relative humidity (RH_2)	-0.677**	-0.296	0.533*	-0.574*	-0.458	-0.443	-0.321
Morning vapour pressure (VP_1)	-0.388	-0.452	-0.686*	-0.233	-0.116	-0.448	0.289
Evening vapour pressure (VP_2)	-0.486	-0.396	-0.489	-0.294	-0.170	-0.437	0.189

Note: * Correlation is significant at 0.05 level; ** Correlation is significant at 0.01 level

(adults), *Chrysoperla* (eggs) and coccinellids (adults) were also recorded from the selected plants.

In order to study the instantaneous effect of weather parameters on population fluctuation of various pests, the data of environmental factors of *viz.,* evapotranspiration (ET), bright sunshine (BSS), rainfall (RF), wind direction, wind speed (WS), maximum (T_{max}) and minimum (T_{min}) temperature, morning (RH_1) and evening (RH_2) relative humidity as well as morning (VP_1) and evening (VP_2) vapour pressure were correlated. Simple correlation was worked out between various pests and their natural enemies using their weekly mean incidence by adopting a standard statistical procedure (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

***Whitefly,* (*Bemisia tabaci* Gennadius)**

The data on population of whitefly (Table 1) indicated that the population was commenced from 4th week of September (39th SMW) and continued throughout the crop period. The population showed three peaks, during 1st week of November (45th SMW) (2.72 whiteflies/ 3 compound leaves), 4th week of November (48th SMW) (2.64) and 2nd week of December (50th SMW) (2.32). Correlation study (Table 2) clearly revealed that the whitefly population was negatively correlated with WS (-0.635**) and RH_2 (-0.677**). Chavan *et al.* (2013) reported that whitefly population commenced just after the transplanting in tomato crop with significant negative association with maximum and minimum temperatures, while wind velocity showed significantly positive impact on whitefly population.

Leaf hopper (Amrasca biguttula biguttula Ishida)

Very little occurrence of leaf hopper was observed from 2nd week of October (41st SMW) with number of leafhoppers 0.04 per 3 compound leaves and remained throughout the crop period (Table 1). According to Bhatt (2004), leaf hopper appeared during early vegetative stage in brinjal and was active throughout the crop season.

Aphid (Aphis gossypii Glover)

The data presented in Table 1 indicated that the pest was noticed from 3rd week of October (42nd SMW) with two peaks, 1st week of December (49th SMW) (0.96/ 3 compound leaves) and 4th week of December (52nd SMW) (0.98). Among the physical factors, RH_2 (r = 0.533*) exhibited significant positive, whereas EP (-0.783**), T_{max} (-0.699**), T_{min} (-0.693**) and VP_1 (-0.686*) exhibited negative association with the activity of this pest (Table 2). Chakraborty (2011) reported that aphid population was initiated at 48th SMW, increased slowly up to 52nd SMW and then remained steadily up to 6th SMW, attained on maximum at 8th SMW and maintained up to 11th SMW in tomato crop. Abiotic conditions *viz*., T_{max}, T_{min}, temperature gradient, average temperature, minimum relative humidity and BSS had significant negative influence on aphid population, whereas maximum relative humidity and relative humidity gradient had a significant positive influence.

Mealy bug (Phenacoccus solenopsis Tinsley)

There was minimum incidence of mealy bug during the crop period. The population commenced from 4th week of September (39th SMW) and observed the population to

the tune of 0.02 to 0.14 per 10 cm twig (Table 1) till 3rd week of December (51st SMW).

Leaf miner (*Liriomyza trifolii Burgess*)

The data (Table 1) indicates that the infestation commenced from 4th week of September (39th SMW). The number of mines ranges from 0.16 to 8.38 per 3 compound leaves. Larval population of leaf miner exhibited to the tune of 0.04 to 0.86 with two peaks, 5th week of October *i.e.* 44th SMW (0.78) and 4th week of November *i.e.* 48th SMW (0.86) with damaged leaves ranged from 1.71 to 33.20 per cent. Abiotic factors *viz*., WS (-0.614*) and RH_2 (-0.574*) exhibited highly significant negative association with leaf miner population (Table 2). Chavan *et al*. (2013) reported that peak level of per cent infested leaves (31.75%) due to leaf miner was at 10 WAT *i.e.* 3rd week January and it was partially supported the present findings.

Fruit borer (Helicoverpa armigera* (Hubner) Hardwick*)

Egg population : The activity of *H. armigera* was noticed from 4th week of September (39th SMW) with the population to the tune of 0.14 to 0.72 egg per 3 twigs (Table 1). The egg population showed its first peak (0.42) during 3rd week of October (42nd SMW) and second or highest peak (0.72) at 2nd week of November (46th SMW). Among various weather parameters under study, WS (-0.678**) showed highly significant negative correlation with egg population (Table 2).

Larval population : Larval population was recorded to the tune of 0.12 to 1.86 per 3 twigs with three peaks, 3rd week of November *i.e.* 47th SMW (1.58) and 2nd (50th SMW) and 3rd (51st SMW) week of December (1.86) (Table 1). Kharpuse and Bajpai (2006) revealed that *H. armigera* appeared on tomato during 3rd week of February and reached to a peak during last week of March. Mandal and Roy (2010) reported that the combination of temperature and humidity adversely affected the survival of *H. armigera* in chickpea in their ambient environment.

Natural Enemies

Spiders: The data (Table 1) revealed that spider population (0.04 to 0.26 spider/ plant) appeared on the crop from 4th week of September (39th SMW) with highest activity (0.26) during 5th week of October (44th SMW) and 1st week November (45th SMW). Among various physical factors, T_{min} (0.624**) showed highly significant positive correlation, whereas WS (-0.589*) was negatively associated with the activity of spiders (Table 2).

Chrysopids: The data (Table 1) revealed that the eggs of *Chrysopids* (0.02 to 0.12 egg/ plant) appeared on the crop during 3rd week of November (47th SMW) showing higher activity during 2nd (50th SMW) and 3rd week of December (51st SMW).

Coccinellids : The population appeared during 3rd week of October (42nd SMW) which ranged from 0.02 to 0.12 with higher activity during 2nd (46th SMW) and 3rd week of November (47th SMW) (Table 1).

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