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Population dynamics of major insect-pests on tomato under polyhouse conditions

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Abstract
Tomato (*Solanum lycopersicum* L.) is one of the most important vegetable crops widely grown throughout the world under open field conditions and protected conditions for fresh market consumption and processing. It is ranked second in importance among vegetable crops after potato in India. Under poly house conditions, the observations on population dynamics of major insect-pests were recorded from crop establishment stage (35 SMW i.e. 27th Aug.- 02nd Sept., 2019) till crop maturity stage (18 SMW i.e. 30th April – 06 May, 2020) and worked out their correlation with weather parameters under polyhouse conditions. The whitefly remained active from 39th SMW till whereas leaf miner appeared on 43rd SMW till crop maturity. The peak population of whitefly (5.20 nymph & adults/three leaves) and leaf miner (6.40 live mines/3 leaves) was observed in 12th SMW (19th-25th March), when maximum temperature was 33.5 ºC, minimum temperature 18.7 ºC and relative humidity was 70%. The weather parameters were further correlated with the population build up of whitefly and leaf miner. Maximum and minimum temperature had significant positive correlation with whitefly and leaf miner population, while significant negative correlation with mean relative humidity under polyhouse conditions. Under polyhouse conditions, after establishment of tomato plants, the observations on population dynamics of major insect-pests *viz.*, whitefly (nymphs and adults/3 leaves) and leaf miner (live mines/3 leaves) were recorded from 20 randomly selected and tagged plants and pests population were correlated with temperature and humidity.

Keywords: Tomato, whitefly, leaf miner, polyhouse, weather parameters

Introduction
Tomato (*Solanum lycopersicum* L.) is one of the most important vegetable crops widely grown throughout the world under open field conditions and protected conditions for fresh market consumption and processing. It is ranked second in importance among vegetable crops after potato in India. Tomato is rich in minerals, vitamins, essential amino acids, sugar and dietary fibres. It also contains Lycopene, an antioxidant that may contribute to protection against carcinogenic substances and decrease the risk of neurodegenerative disease.

The tomato is grown throughout the world either in open field or protected structures mainly in India, China, USA, Italy, Turkey, Mexico and Japan. In India, tomato crops are mainly grown in the states of Madhya Pradesh, Orissa, West Bengal, Karnataka, Bihar, Gujarat, Tamil Nadu, Uttar Pradesh Rajasthan, Haryana etc. Total cultivated area under tomato crop in India is about 0.9 million ha with production of 19.19 million tonnes and average yield of 21.20 tonnes per ha. Haryana is one of the major tomato growing states covering an area of 29.40 thousand ha with production of 0.62 million tonnes and average yield of 21.32 tonnes per ha (Anonymous, 2014) [1].

Among various factors responsible for low yield of tomato, insect-pests viz. the fruit borer (*Helicoverpa armigera* Hub.) and sucking insect-pests viz. whitefly (*Bemisia tabaci* Genn.), leaf hopper (*Amrasca devastans* Ishida), thrips (*Scirtothrips dorsalis* Lind), serpentine leaf miner (*Liriomyza trifolii* Burgess) are highly destructive causing serious damage and are responsible for lowering the yield of tomato crop (Lal *et al.*, 2008) [5]. Polyhouse protects the growing crop against insect-pests and disease and thus improve the fruit quality and increase the production and productivity per unit area per unit time. However, very limited information is available on insect-pests attacking tomato under polyhouse conditions (Sri *et al.*, 2017b) [6]. Among the key insect pests whitefly (*T. vaporariorum*), leaf miner (*Liriomyza trifolii*) and tomato pin worm (*Tuta absoluta*) are the most dangerous pests having a pandemic distribution and damaging many vital crops including vegetable tubers, fiber crops and ornamentals from tropics and sub-tropic to temperate climates in crop grown under open and protected environment (Anu *et al.*, 2020) [2]. Kachave *et al.* (2020) [4] carried out an investigation on population dynamics of major insect pests of tomato at Research Farm, Vasant Rao Naik

Marathawad Krishi Vigyapeeth, Parbhani and found that peak incidence of sucking pests i.e. Aphid *Aphis gossypii* (Glover), whitefly (*Bemisia tabaci* Gennadius) and thrips (*Frankliniella schultzei* Tryhom) of 8.0, 10.2 and 6.7 population/3 leaves of plant on 41st, 42nd and 44th standard meteorological week whereas peak activity of tomato fruit borer *Helicoverpa armigera* (Hubner) was recorded on 41st SMW (3.7 larvae/plant). As regard the fruit damage, tomato fruit borer, *H. armigera* and leaf miner *T. absoluta* was recorded of 44.48 and 10.58 per cent fruit damage at the time of 6th picking of the fruit on 20th December.

Materials and Methods

The polyhouse experiment, "Population dynamics of major insect-pests on different varieties of tomato under polyhouse conditions" were carried out at farmers' field, Village Surajgarh, Block Matanhail, Distt. Jhajjar (Haryana) during the years 2019 and 2020.

Tomato crop were raised in polyhouse at farmer's field at Village Surajgarh, Block Matanhail, Distt. Jhajjar, Haryana in the month of September, 2019. After establishment of the plants, the observations on major insect-pests were recorded from 20 randomly selected and tagged plants.

The following observations were recorded:

- The insect-pests population complex viz. whitefly, leaf hopper, thrips and mined leaves caused by leaf miner were recorded from top, middle and lower leaves on the tagged plants.
- Pests population were correlated with temperature and humidity in polyhouse condition.

Results

Under poly house conditions, the observations on population dynamics of major insect-pests were recorded from crop establishment stage (35 SMW i.e. 27th Aug.- 02nd Sept., 2019) till crop maturity stage (18 SMW i.e. 30th April – 06 May, 2020) and worked out their correlation with weather parameters under polyhouse conditions. The data presented in Table 1 revealed that the first appearance of whitefly population (0.30 nymphs & adult/three leaves) was reported during 39th SMW (24th – 30th Sept., 2019) reaching its highest (5.20 nymphs and adults/three leaves) in the 12th SMW (19th – 25th March, 2020) and after that the population of whitefly decreased upto crop maturity. During this period (12 SMW), the maximum temperature and minimum temperature were 33.5 ºC and 18.7 ºC, respectively whereas relative humidity was 70 per cent under polyhouse conditions during cropping season 2019-20.

Table 1: Population dynamics of major insect-pests on tomato under polyhouse conditions during 2019-20

Standard Meteorological Week	Date of Observation	Population of Insect-pests (No./3leaves)		Weather Parameters		
		No. of Whitefly (Nymphs and adults)	Leaf miner (Live mines)	Max. Temp. (ºC)	Min. Temp. (ºC)	RH (%)
35	02.09.2019	0.00	0.00	37.0	26.6	83
36	09.09.2019	0.00	0.00	38.0	27.6	81
37	16.09.2019	0.00	0.00	38.2	27.7	75
38	23.09.2019	0.00	0.00	36.5	25.3	78
39	30.09.2019	0.30	0.00	34.1	24.3	81
40	07.10.2019	0.52	0.00	34.6	22.1	69
41	14.10.2019	0.65	0.00	35.7	20.1	56
42	21.10.2019	1.35	0.00	35.5	19.7	59
43	28.10.2019	1.48	0.20	34.0	17.2	57
44	04.11.2019	1.67	0.40	32.6	18.3	64
45	11.11.2019	1.97	0.60	31.1	15.6	65
46	18.11.2019	2.02	1.00	30.3	15.2	66
47	25.11.2019	2.23	1.80	29.6	13.2	68
48	02.12.2019	1.08	1.93	26.3	13.1	80
49	09.12.2019	1.23	2.06	25.9	8.5	73
50	16.12.2019	1.42	2.20	21.5	9.8	84
51	23.12.2019	1.63	2.46	19.0	8.1	85
52	30.12.2019	1.72	2.80	16.5	4.8	90
1	07.01.2020	1.80	3.13	22.8	8.9	72
2	14.01.2020	1.87	3.40	20.0	9.5	75
3	21.01.2020	1.92	4.20	19.2	9.8	80
4	28.01.2020	2.02	4.46	23.0	9.2	69
5	04.02.2020	2.37	4.93	22.3	8.3	76
6	11.02.2020	2.60	5.06	23.4	8.3	73
7	18.02.2020	2.87	5.40	28.0	11.6	55
8	25.02.2020	3.75	5.62	27.7	14.2	75
9	04.03.2020	4.15	5.80	29.7	16.2	77
10	11.03.2020	4.43	6.06	26.8	14.3	81
11	18.03.2020	4.64	6.22	29.5	15.5	73
12	25.03.2020	5.20	6.40	33.5	18.7	70
13	01.04.2020	3.90	5.66	32.1	18.4	69
14	08.04.2020	3.50	5.20	35.6	18.9	55
15	15.04.2020	2.40	3.66	39.8	21.8	49
16	22.04.2020	2.10	2.80	39.2	22.9	48
17	29.04.2020	1.62	2.40	37.6	23.5	62
18	06.05.2020	1.27	1.80	40.3	25.8	59

The observation recorded on the mined leaves caused by serpentine leaf miner infestation under polyhouse conditions indicated the presence of larval population of leaf miner. The data recorded in Table 1 revealed that commencement of mined leaves (0.20 live mines/three leaves) was reported from 43rd standard meteorological week (22nd-28th October, 2019) and mined leaves with the population of leaf miner going on increase with the crop growth till 3rd week of march, reaching at peak infestation level in 12 SMW 2020 (19th – 25th March, 2020) i.e.6.40 live mines/ three leaves, during this period, the maximum temperature, minimum temperature and relative humidity were 33.5 ºC, 18.7 ºC and 70%, respectively.

Discussion

The observation on population dynamics of whitefly and leaf miner was recorded from establishment stage till crop maturity under polyhouse conditions and their correlation was worked out with weather parameters in Table 1. The whitefly remained active from 39th SMW till whereas leaf miner appeared on 43rd SMW till crop maturity. The peak population of whitefly (5.20 nymph & adults/three leaves) and leaf miner (6.40 live mines/3 leaves) was observed in 12th SMW (19th-25th March), when maximum temperature was 33.5 ºC, minimum temperature 18.7 ºC and relative humidity was 70%. The weather parameters were further correlated with the population build up of whitefly and leaf miner and results are presented in Table 1. Maximum and minimum temperature had significant positive correlation with whitefly and leaf miner population, while significant negative correlation with mean relative humidity under polyhouse conditions. Almost similar results were found by earlier scientist while studying insect-pest of tomato and their relations with weather parameters under polyhouse conditions. Sri *et al.* (2017) [6] observed peak population of whitefly and leaf miner during 8th and 9th SMW on tomato. These findings are also in agreement with the findings of Dibbad *et al.* (2020) [3].

Summary and Conclusion

The studies on Population dynamics of major insect-pests on tomato under polyhouse conditions on tomato under polyhouse conditions were carried out at farmers' field, Village Surajgarh, Block Matanhail, Distt. Jhajjar (Haryana) during the years 2019 and 2020. Under polyhouse conditions, after establishment of tomato plants, the observations on population dynamics of major insect-pests *viz*., whitefly (nymphs and adults/3 leaves) and leaf miner (live mines/3 leaves) were recorded from 20 randomly selected and tagged plants and pests population were correlated with temperature and humidity.

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