Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(6): 1158-1161

Received: 06-08-2020
Accepted: 19-09-2020

The population dynamics of insect-pest infesting tomato and there relation with different abiotic factor

Soniya Dhanda, Surender Singh Yadav, Sunita Yadav and Sonu Kumari

Soniya Dhanda
Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Surender Singh Yadav
Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Sunita Yadav
Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Sonu Kumari
Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Soniya Dhanda
Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Abstract
An experiment was conducted to study the population dynamics of insect-pest infesting tomato on entomology research farm, Chaudhary Charan Singh Harayana Agricultural University (CCSHAU), Hisar during crop season *Rabi* 2018-19. It was found that tomato was attacked by tomato fruit borer (*Helicoverpa armigera*), aphid (*Myzus persicae*), and leaf miner (*Liriomyza trifolii*). *H. armigera* incidence reaching its peak population (5.05 larvae/ plant) in 17th SMW (4th week of April) and aphid attained highest population of 23.26 aphids per three leaves during12th SMW (fourth week of March)**.** While peak population of whitefly was (6.28 whitefly adults per three leaves) reported during third week of April (16th SMW). Appearance of leaf miner was observed during first week of March (9th SMW) with 0.63 mines/ 3 leaves and maximum population (5.95 mines/ 3 leaves) was recorded during 15th (SMW) *viz.* second week of April. However correlation study with abiotic factors also carried out during experiment.

Keywords: Population dynamic, tomato, correlation, temperature, relative humidity

Introduction
Vegetables play a vital role in the daily intake of our food all around the world as they are important source of micro-nutrients, vitamins and minerals. Among different commercially cultivated vegetable crops in India, tomato (*Solanenum esculentum*) hold the third position in area as well as production (Sharma, 2004) [17]. It is an important commercial crop grown over all around the world which belongs to family Solanaceae and native to South America. India accounts for about 19697 (000'MT) of production over an area of 809 (000'Ha) (Anonymous, 2017) [1]. The main tomato producing states include West Bengal, Karnataka, Maharashtra, Uttar Pradesh, Haryana, Odisha, Andhra Pradesh, Madhya Pradesh and Bihar. In Haryana tomato is cultivated over an area of 29.03 (000'Ha) with production of 675.38 (000'MT) (Anonymous, 2017) [1]. Tomato production faces many biotic and abiotic stresses such as seasonal weather which includes temperature, relative humidity, diseases and insect pests. Among the various factors, insect-pest infestation is undoubtedly the most important one that minimize its production and quality. It is susceptible to incidence of huge number of insect like tomato fruit borer (*Helicoverpa armigera*), jassid (*Amrasca biguttula biguttula*), aphid (*Myzus persicae*),, mite (*Tetranychus urticae*), aphid (*Myzus persicae*), leaf miner (*Liriomyza trifolii*) and tobacco caterpillar (*Spodoptera litura*) (Anonymous, 2010) [2]. Integrated pest management (IPM) is one of the important methods and for that monitoring practice is very important for effectively managing different insect-pest. Therefore it is very important to study the different insect pest infesting tomato in relation to weather parameters that will help in insect management. So by taking all points into consideration *viz.* the economic importance of crop as well as amount of damage induced by different insect, this experiment to investigate the population dynamics of important key insect pest infesting the crop, tomato was carried out in relation to different weather parameters.

Material and Methods
The experiment was carried out in entomology research farm, Chaudhary Charan Singh Haryana Agricultural University, Hisar during *Rabi* 2018-19. Nursery of the tomato crop *cv.* Hisar Lalit was raised in Department of Vegetable Science, CCS Haryana Agricultural University, Hisar and it was transplanted in an area of 100 m^2 by adopting spacing of 60 cm ×

45 cm in the first week of February, 2019. The whole area was divided into 4 quadrates of 5m × 5 m each. The recommended package of practices was followed to raise the crop except the crop protection measures. To pursue this objective of investigation, no insecticidal treatment was applied at any growth stage of the crop. The data on population dynamics was recorded from transplanting till the last picking of crop. The population of important key insect pest attacking on tomato were noted down from five randomly selected plants at weekly interval from each plot starting from 20 days after transplanting. For sucking pest like whitefly and aphid observation were counted on randomly selected five plants per quadrate and on each plant three leaves were selected from top, middle and bottom of the crop canopy. For leaf miner observations were taken as number of mines per compound leaf from the upper as well as lower portion of each plant from five randomly selected plants per plot selected leaving border rows and incidence of fruit borer was recorded by counting the number of larvae on randomly selected 20 plants (5 plants/ quadrate) at weekly intervals till the time of crop maturity by using "direct visual counting method". Weekly weather data on different parameters like temperature (˚C), relative humidity (%), rainfall and total bright sunshine hours procured from Agro meteorological observatory of the Department of Agro meteorology, CCSHAU, Hisar during the crop period of *Rabi* season 2018-19. The relationships between these weather parameters and population fluctuations of tomato fruit borer, whitefly, aphid and leaf miner in the field were worked out. Correlation was calculated by using the statistical package for social science (SPSS) programme.

Results and Discussion

Tomato fruit borer, *H. armigera*

From results of the investigations it was found that initiation of incidence of larval fruit borer (*H. armigera)* was recorded during 10th SMW (2nd week of March) reaching its peak (5.05 larvae/ plant) in 17th SMW (4th week of April) (Table 1). These observations get supports from the findings of Chakraborty *et al.* (2012) [5] and Bisht (2014) [3] who also reported that incidence of *H. armigera* started during February and March with peak larval activity during April on tomato crop. Peak population of *H. armigera* concides with flowering and fruiting stage of tomato which is supported by Kamble *et al.* (2005) [11]. It was further noted that population of *H. armigera* followed a declining trend as the crop moves towards maturity with minimum number of larvae per plant during 21st SMW. Similar findings were reported by Chakraborty *et al.* (2012) [4] who recorded that the population of larvae start to decrease as the plant age reached the terminal stage. From studies on correlation it can be concluded that the population of fruit borer exhibited highly significantly positively correlated with temperature, maximum (r= 0.741) and minimum (r= 0.667) while relative humidity (RH) found to be highly significantly negatively correlated with morning RH (r = - 0.798) and evening RH (r=-688) as shown in Table 2. All these findings are in accordance with finding by Singh and Gupta (2017) [18], Vikram *et al*. (2018) [21] who also reported *H. armigera* population was positively correlated with temperature (maximum, minimum) and negatively correlated with relative humidity (morning, evening) was observed by Chula *et al.* (2017) [8]. But, present findings are in contrast with results obtained by Meena *et al.* (2014) [13] who recorded negative and non-significant association between the maximum temperature and minimum temperature.

Aphid

During the course of present investigations, occurrence of aphid population first noted during March's first week (9th SMW), attained highest population of 23.26 aphids per three leaves during12th SMW (fourth week of March) (Table 1) and aphid population showed a declining trend as the crop moved towards maturity.

Table 1: Seasonal incidence of major insect-pests on tomato crop during *Rabi,* 2018- 19

SMW	Dates	Number of Insect pest				Weather parameters						
		Fruit borer/ plant	Aphid/ 3 leaves	Whitefly/ 3 leaves	Leafminer/ 3 leaves	Temperature		RH(%)		Rainfall (mm)	Sunshine (hrs/day)	Wind velocity (km/hr)
						T.Max (⁰C).	T.Min. (⁰C)	Morning	Evening			
9	26 Feb-04 Mar	0.00	10.60	1.90	0.63	22.20	9.00	89	50	0.00	5.62	5.00
10	05 Mar-11 Mar	0.60	15.03	1.43	0.96	20.90	8.00	93	53	2.10	5.80	5.00
11	12 Mar-18 Mar	1.10	19.01	2.86	2.81	24.20	8.50	88	42.40	0.00	7.20	3.80
12	19 Mar- 25 Mar	1.55	23.26	2.93	2.00	24.90	9.10	91.00	48.30	0.00	6.10	3.70
13	26 Mar-1Apr	2.25	11.18	3.81	3.91	28.90	11.80	79.90	42.30	0.00	7.20	4.20
14	02 Apr-08 Apr	2.75	7.73	4.95	4.55	32.60	13.50	80.06	28.00	0.00	7.30	3.20
15	09 Apr-15Apr	3.65	3.38	5.53	5.95	35.70	19.80	61.04	33.60	0.00	5.40	5.60
16	16 Apr-22 Apr	4.20	1.05	6.28	3.61	33.70	18.00	72.00	39.10	2.00	5.40	7.00
17	23Apr-29 Apr	5.05	0.46	5.90	3.70	37.60	19.40	56.30	31.00	0.00	7.70	8.30
18	30 Apr-06 May	4.35	0.18	3.88	3.95	39.30	20.60	52.10	27.10	0.00	6.90	8.50
19	07 May-13 May	3.50	0	4.90	3.56	40.21	20.72	51.14	26.57	0.00	8.47	6.25
20	14 May-20 May	2.90	0	4.18	2.88	40.42	21.70	47.85	19.71	0.00	7.94	5.50
21	21 May- 27 May	0.40	0	1.40	0.51	35.68	20.54	81.85	38.28	0.00	8.31	6.01

Afterwards, no population of aphid was recorded from 18th SMW (1st week of May) till the maturity of the crop. Present findings are in accordance with results Shakeel *et al.* (2014) [15] recorded maximum aphid population (10.77 no. /plant) during 3rd week of March. During present investigation it was found that highly significant negative correlation exhibited by aphid population with temperature (maximum, minimum) and with wind velocity r= -0.874, -0.924 and r= -0.735 respectively but aphid population found to be highly positively significantly correlated with humidity *i.e.* morning (r= 0.796) and evening (r= 0.736). (Table 2). Other factors like sunshine hour and rainfall was found to be non-significantly correlated with aphid population. These results are supported by Shakeel *et al.* (2014) [15] in their experiment which also revealed that population of aphid was significantly negatively correlated with minimum (r= -0.936) and maximum temperature (r= -0.932) while positively correlated with relative humidity (r= 0.943). Likewise, Chakraborty (2011) [4] also observed a very high positive correlation of aphid population with temperature (maximum, minimum). But in contrast Ghosh (2017) [9] reported that the climatic factors for example temperature (maximum, minimum) express a highly non-significant positive correlation whereas humidity exhibits significantly positively correlated with aphid population.

Table 2: Correlation of major insect-pest population with different weather parameters

Weather parameter	Fruit Borer Larve /plant	Aphid/3leaves	Whitefly/3leaves	Leafminer/3leaves
Temperature (max) ^{0}C	0.741**	-0.874**	0.612*	0.514
Temperature (min) ^{0}C	0.667*	-0.924**	0.533NS	0.409
Relativehumidity (M) (%)	-0.798**	0.796**	-0.645*	-0.562*
Relativehumidity (E) (%)	-0.688**	0.736**	-0.607*	-0.580*
Rainfall (mm)	-0.035NS	0.063NS	-0.012NS	-0.207NS
Sunshinehours (hrs/day)	0.112NS	-0.377NS	0.020NS	-0.290NS
Wind velocity (km/hr)	0.638*	-0.735**	0.369NS	0.147NS

*Significant at 5% ** Significant at 1%

Furthermore, During present studies it was found that aphids population were significantly and negatively correlated with wind velocity which is in contrast with experiment conclusion of Chavan *et al.* (2013) [7] who observed significant positive correlation between aphids and wind velocity (r= 0.574).

Whitefly

Whitefly incident was observed on 9th Standard meteorological week (SMW) *i.e.* from 1st week of March and it continued attacking tomato until crop reached to maturity and peak population of whitefly (6.28 whitefly adults per three leaves) was recorded during 16th SMW (third week of April) and later on, it showed a declining trend with minimum number (0.40 whitefly adult/ 3 leaves) during 21st SMW *(*4th week of May) (Table 1). Present findings are supported by Subba (2013) [20] recorded that the peak population level (0.47 whitefly/ leaf) was maintained during 11th to 18th SMW. Less information is available in literature regarding population dynamics of whitefly on tomato in Haryana conditions. However, Khan and Ossain (2018) [12] recorded the peak population on tomato reached on 2nd March with highest percent of plant attacked (56.25%/plot) was recorded while the lowest attacked (9.09%/plot) was noticed on 15th February. These variations in whitefly population in present research could be due to different set of weather parameters and different growing area. Population of whitefly showed a negative correlation with morning (r=-0.645), evening relative humidity (r= -0.607) and rainfall (r=-0.012), but positive correlation with maximum temperature (r=0.612) and minimum temperature (r=0.533) and sunshine hours (r=0.020) (Table 2). These findings are in accordance with Sharma *et al.* (2017) [16] reported that whitefly population was positively correlated with maximum temperature, minimum temperature and sunshine hours while it was negatively correlated with rainfall and relative humidity. Results of present investigations are in contrast to the findings of Jha and Kumar (2017) [10] who reported weather parameters like temperature (maximum, minimum) and sunshine (hrs) showed significant negative correlation with whitefly population, while relative humidity (morning, evening) exhibited significant positive correlation. These variations might be due to different growing seasons and meteorological conditions during the experimentation.

Leaf miner

Leaf miner population first started appearing from 9th Standard Meterological Week (SMW) *viz.* 1st week of March with 0.63 mines/ 3 leaves and it remained active till crop mature. Population was gradually increase up to 14 SMW followed by peak population (5.95 mines/ 3 leaves) during 2nd week of April (15th SMW). Afterwards there was decrease in population with minimum number (0.51 mine/ 3 leaves) during 21st SMW (third week of May) (Table1). Selvaraj, *et al.* (2016) [14] also observed that the first incidence of pest occurred in 8th and 9th (SMW) *viz.* in month of February and March, and peak population recorded in 14th and 17th SMW *viz.* in month of April, respectively. Leaf miner population found to be highly negative significantly correlated with relative humidity, that is morning RH (r=-0.562) and evening RH (r= -0.718) whereas non-significant negatively correlated with rainfall (r=-207) and sunshine (r=-0.290) (Table 2). Non-significant positive correlation was recorded between leaf miner and all other weather parameters *viz.*, maximum and minimum temperature and wind velocity. These results are supported by Selvaraj, *et al.* (2016) [14] in their experiment noted that there was no significant correlation of pest population with various abiotic factors, except there was significant negatively correlation with relative humidity (morning and evening). Singh *et al.* (2018) [19] also recorded in their research that the pest population and temperature (maximum, minimum) was positively correlated between but significant negative correlation was evaluated with relative humidity (morning and evening). But in contrast Chakraborty (2011) [4] reported that abiotic factor like maximum and minimum temperatures are negatively correlated with leaf miner population.

References

1. Anonymous. Horticultural Statistics at a Glance 2018. National Horticulture Board 2017, Pp 143.
2. Anonymous. Indian tomato yet to sprout global demand. The Hind Business 2010.
3. Bish RS. Seasonal incidence of *Helicoverpa armigera* (HUB.) on tomato at Pantnagar, Uttarakhand. International Journal of Basic and Applied Agricultural Research 2014;12(3):351-355.
4. Chakraborty K. Incidence and Abundance of Tomato Leaf Miner, Burgess in Relation to the Climatic Conditions of Alipurduar, Jalpaiguri, West Bengal, India *Liriomyza trifolii*. Asian Journal of Experimental Biological Sciences 2011;2(3):467-473.
5. Chakraborty K. Incidence of Aphid, *Aphid gossypii* Glover (Hemiptera: Aphidae) on tomato crop in the agro climatic conditions of the Northern part of West Bengal,

India. World Journal of Zoology 2011;6(2):187-191.
6. Chakraborty K, Revadi S, Chakravarthy AK. Incidence and abundance of tomato fruit borer, *Helicoverpa armigera* (Hubner) in relation to the time of cultivation in the northern parts of West Bengal, India. Current Biotica 2012;5(1):91-97.
7. Chavan SM, Kumar S, Arve SS. Population dynamics and development of suitable pest management module against major insect pests of tomato (*Solanum lycopersicum*). Journal of Applied Horticulture 2013;15(2):150-155.
8. Chula MP, Jat SL, Kumarand A, Nitharwa RS. Seasonal incidence of tomato fruit borer, *Helicoverpa armigera* (Hubner) and their correlation with abiotic factors. Journal of Pharmacognosy and Phytochemistry 2017; 6(4):1445-1447.
9. Ghosh SKR. Seasonal Incidence of aphid (*Aphis gossypii* Glov.) infesting tomato (*Lycopersicon esculentus* (L.) and their management by using botanicals pesticides. International Journal of Advances in Science Engineering and Technology 2017;5(3):14-17.
10. Jha SK, Kumar M. Effect of weather parameters on incidence of whitefly, *Bemisia tabaci* (Gennadius) on tomato. Journal of Entomology and Zoology Studies 2017;5(6):304-306.
11. Kamble SK, Shetgar SS, Bilapate GG, Madansure AN, Nalwandikar PK. Population dynamics of *Helicoverpa armigera* (Hubner) on tomato and its relation with weather parameters. Indian Journal of Entomology 2005;67**(**1):88-89.
12. Khan MH, Hossain I. Abundance, distribution and population dynamics of *Bemisia tabaci* on brinjal and tomato. Journal of Biological Science 2018;7**(**1):65-71.
13. Meena LK, Bairwa B. Influence of abiotic and biotic factors on the incidence of major insect pests of tomato. The Ecoscan 2014;8(3-4):309-313.
14. Selvaraj S, Bisht RS, Ganeshamoorthi P. Seasonal Incidence of American Serpentine Leaf miner, *Liriomyza trifolii* (Burgess), On Tomato at Pantnagar, Uttarakhand. International Journal of Agriculture Sciences 2016;8(38):1777-1779.
15. Shakeel M, Akram W, Hamza A, Ali MW, Ali A. Population dynamics of aphid (*Aphis gossypii* G.) on tomato agro-ecosystem in Faisalabad region. International Journal of Research in Agricultural Sciences 2014;1(3):2348-3997.
16. Sharma D, Maqbool A, Jamwal VS, Srivastava K, Sharma A. Seasonal dynamics and management of whitefly (*Bemesia tabaci* Genn.) in tomato (*Solanum esculentum* Mill.). Brazilian Archives of Biology and technology 2017;60(1):1-7.
17. Sharma KC. Inheritance of important characters in bacterial wilt resistant × susceptible tomato (*Lycopersicon esculentum*) crop. Annals of Agricultural Research New Series 2004;25(3):403-405.
18. Singh N, Gupta N. Effect of weather on fruit borer, *Helicoverpa armigera* (Hub) activity in tomato. Journal of Agriculture and Veterinary Sciences 2017;4(10):414-417.
19. Singh S, Awasthi AK, Tomar RKS, Verma SK, Chaure NK. Seasonal incidence of serpentine leaf miner (*Liriomyza trifolii* Burgess) on tomato at Bilaspur district of Chhattisgarh. Trends In Biosciences 2018;11(1):28-30.
20. Subba. Studies on the pest complex of tomato (*Lycopersicon esculentum* L.) and their sustainable management. M.Sc. (Ag) Thesis, College of Agriculture, Pundibari, coochbehar, West Bengal, India 2013.
21. Vikram KA, Mehra K, Choudhary R. Effect of weather parameters on incidence of key pest, *Helicoverpa armigera* (Hubner) on tomato. Journal of Entomology and Zoology Studies 2018;6(1):97-99.