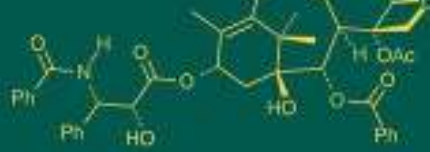
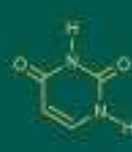
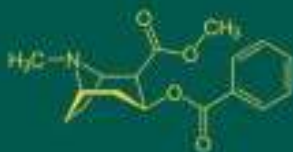


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Seasonal abundance of whitefly on tomato in Mandi district of Himachal Pradesh

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Abstract

The present investigation entitled “Seasonal abundance of whitefly on tomato in Mandi District of Himachal Pradesh” was conducted at Abhilashi University Mandi, Himachal Pradesh during 2021. Studies on seasonal abundance of tomato whitefly undertaken at two blocks of Mandi district viz., Gohar and Balh revealed its appearance in the 1st week of April in both the blocks. Adult population in trap catch was at its peak during the 1st week of July and 4th week of June in Gohar and Balh Block, respectively. The population followed a declining trend afterwards till the harvest of the crop. The adult population in trap catch ranged from 1.2 to 451.2 adults per trap and population of nymphs and adults varied between 1.0 to 22.1 nymphs per plant and 1.5 to 29.9 adults per plant in the two Blocks with the maximum incidence at Balh Block. From the correlation studies between whitefly population and abiotic factors, it can be concluded that the maximum and minimum temperature favours the development of pest population. However, relative humidity (morning and evening) had negative impact on whitefly abundance.

Keywords: *Bemisia tabaci*, tomato, seasonal abundance

Introduction

Tomato (*Solanum lycopersicum* L.) is an herb belonging to family Solanaceae and one of the widely grown vegetables in many parts of the world. It is grown from temperate to tropical regions, under greenhouse or open field conditions. Tomato is important cash crop and is nutritious, attractive and seed-bearing fruit. Tomato is a rich source of vitamins A and C and is therefore often referred to as the “poor man’s orange”. The production and quality of tomato fruits are considerably affected by a number of insects, mites and other non-insect pests infesting at different stages of crop growth due to their tenderness and softness. Among various factors responsible for low yield of tomato, insect pests viz., fruit borer, *Helicoverpa armigera* (Hubner) and sucking insect pests viz., whitefly, *Bemisia tabaci* (Gennadius); Jassids, *Amrasca biguttula biguttula* (Ishida); thrips, *Thrips tabaci* (Lindeman); and the serpentine leaf miner, *Liriomyza trifolii* (Burgess), are highly destructive pests, causing severe damage and significantly reducing the yield of the tomato crop. Out of these pests, white fly, *B. tabaci* is a serious pest in tomato and also reported to cause damage on vegetables, ornamental plants and agronomic crops throughout the tropical regions of the world and affects the yield in both quantitative and qualitative terms (Oliveira *et al.* 2001). *B. tabaci* adults are minute insects (usually 1 to 3 mm in length) that oviposit in large quantities on the underside of leaves. Both adult and immature stages of this pest damage the crop by sucking the sap and reduce the crop yield about 50 percent because it is highly polyphagous in nature and causes direct and indirect damage by feeding on leaves and acting as virus vector of around more than 111 viruses (Tiwari *et al.* 2013; Jahan *et al.* 2014 and Polston *et al.* 2014) [12, 2, 7]. Besides disease transmission, large amounts of honeydew excreted by the insect encourage the development of black sooty mould and other insects like ants on leaves and also affects the photosynthesis in plants and can cause crop yield losses of between 20 percent and 100 percent (Palumbo *et al.* 2000; Brown and Bird 1992) [4, 1].

Materials and Methods

The present investigation was carried out during 2021 under field conditions. The seasonal abundance of whitefly was recorded by surveying two Blocks of Mandi District in the School

of Agriculture, Abhilashi University, Chail Chowk Mandi (Himachal Pradesh). Survey studies on abundance of whitefly was undertaken at weekly intervals throughout the cropping season starting from ten days after transplanting (DAT) in two blocks of District Mandi, Himachal Pradesh till the harvest of crop. Three locations/villages in each block and three fields from each locality were selected for recording the abundance of whitefly during the cropping season. For recording the observations, three plots of 400 m² (approximately) each were selected at each locality which were 250m apart from each other. Nymphal and adult whitefly counts were recorded from all the leaves of one shoot of each randomly selected plant, for this, ten plants were selected from each field and observed at weekly intervals in the morning hours. The whitefly nymphs and adult population were averaged and expressed as numbers per plant. Whitefly adult population was monitored by using yellow sticky traps. The traps were installed ten days after transplanting (DAT) and traps were placed at 10-15 cm above the plant canopy and height was adjusted as plant grow. One trap per 10 m² area was placed in the field. Observation on number of adults trapped on yellow sticky trap was recorded by counting adult whiteflies at weekly intervals. Each yellow sticky trap was replaced with new trap when the colour faded out. Number of trapped whitefly adults were counted, averaged and expressed as number of whitefly adults per trap.

Results and Discussion

The perusal of data based on mean of three locations of Gohar Block presented in Table 1 on mean adult trapped through sticky trap revealed that the whitefly adults first appeared in 1st week of April (15th MSW) with mean adult trapped of 2.9 adult per trap on tomato crop. The whitefly population was low in the beginning but increased considerably by the (20th MSW) with 24.2 adult catch per trap. The highest population was observed in 28th MSW *i.e.* 1st week of July (400.2 adult catch per trap) with highest proportion of adults per trap (27.7%). The highest peak of both adults and nymphs per plant was obtained during 4th week of June (27th MSW) with 10.6 adults per plant and 18.4 nymphs per plant with highest proportion 14.1% and 16.8%, respectively.

The data presented in Table 2 on mean adult catch of three locations of Balh Block showed that the adults started appearing (8.1 adults per trap) in 1st week of April (15th MSW). The population was low in the beginning but rose up to 451.2 adults per trap in 4th week of June (27th MSW) with highest proportion 23.5% and thereafter showed declining trend to reach an adult count of 5.4 adults per trap during 3rd week of August (33rd MSW). The data on mean adult count per plant revealed that the number of adults per plant ranged between 1.5 to 29.9 adults per plant and the highest count (29.9 adults per plant) was recorded during 1st week of June with highest proportion 20.5%. However, the extent of nymphal population was also maximum (22.1 nymphs per

plant) during 1st week of June with highest proportion 16.2%. These results are in strong conformity with the findings of Rehman *et al.* (2018) [8] who also observed that the population of whitefly started appearing in 2nd week of April and reached peak period population during June month. Parmar *et al.* (2013) [5] recorded the whiteflies were 1st noticed during 14th standard meteorological week and increased gradually up to 21st standard meteorological week during summer months. Sarangdevot *et al.* (2010) [9] also reported that the incidence of *B. tabaci* was first noticed in the 14th MSW.

Correlation between whitefly population (nymphs and adults) with abiotic factors

Adults' population and nymphal population of two blocks when subjected to correlation analysis with abiotic factors (Table 3) revealed that the adult population in trap catch for Gohar Block had a non-significant positive correlation with maximum temperature ($r = 0.330$) and rainfall ($r = 0.171$) but significant positive correlation with minimum temperature ($r = 0.675$). However, non-significantly negative correlation was recorded with morning and evening RH and the values of 'r' obtained were -0.317 and -0.265, respectively. The adult count on plants showed non-significantly negative correlation with morning RH ($r = -0.344$) and evening RH ($r = -0.199$). The relationship of nymphal count also showed non-significant negative correlation with morning and evening RH and the corresponding 'r' values were -0.343 and -0.248, respectively.

The correlation analysis revealed that the adult catch for Balh Block had significantly positive correlation with maximum and minimum temperature ($r = 0.669$ and 0.548 , respectively). On the other hand, adult count also had a significantly positive correlation with the maximum and minimum temperature ($r = 0.726$ and 0.604 , respectively) though it was significantly positive correlated with morning RH, but non-significantly negative correlated with evening RH and rainfall ($r = -0.535$, -0.338 and -0.270 , respectively). The nymphal count also showed significant positive correlation with maximum and minimum temperature and the values of 'r' obtained were 0.746 and 0.654 , respectively.

The present studies are in agreement with that of Shahnaz *et al.* (2006) [10] who also recorded the whitefly population significant positive correlation with temperature (both maximum and minimum), whereas a significant negative correlation with relative humidity (maximum and minimum). Patra *et al.* (2016) [6] also reported the relationship between whitefly population and relative humidity (maximum and minimum) and rainfall was negative and non-significant. Sharma *et al.* (2017) [11] recorded a positive correlation between whitefly population and abiotic factors *viz.* temperature and sunshine hours was observed, whereas relative humidity and rainfall showed a negative correlation.

Table 1: Seasonal abundance of tomato whitefly at Gohar Block during 2021

Month	Meteorological Standard Week (MSW)	Gohar Block					
		*Mean no. of adults per trap	*Mean no. of nymphs per plant	*Mean no. of adults per plant	Proportion of adults per trap (%)	Proportion of nymphal count (%)	Proportion of adults per plant (%)
April	15	2.9	0.0	0.0	0.2	0.0	0.0
	16	10.2	0.0	2.0	0.7	0.0	2.6
	17	15.3	1.2	3.5	1.0	1.0	4.6
	18	16.1	3.1	4.3	1.1	2.8	5.7
May	19	17.9	1.4	2.7	1.2	1.2	3.6
	20	24.2	2.6	3.3	1.6	2.3	4.4
	21	18.9	4.1	2.0	1.3	3.7	2.6
	22	20.6	4.7	2.9	1.4	4.2	3.8
	23	28.3	6.7	3.4	1.9	6.1	4.5
June	24	28.4	8.9	3.9	1.9	8.1	5.2
	25	34.2	10.3	3.4	2.3	9.4	4.5
	26	128	13.7	6.3	8.8	12.5	8.4
	27	391.5	18.4	10.6	27.1	16.8	14.1
July	28	400.2	11.3	6.6	27.7	10.3	8.8
	29	295.1	9.1	3.6	20.4	8.3	4.8
	30	385.1	6.7	9.6	26.7	6.1	12.8
	31	14.2	4.2	2.9	0.9	3.8	3.8
August	32	12.1	2.0	2.4	0.8	1.8	3.2
	33	10.4	1.0	1.5	0.7	0.9	2.0
	34	1.2	0.0	0.0	0.0	0.0	0.0
Total		1441.4	109.4	74.9			

*Mean of three localities

Table 2: Seasonal abundances of tomato whitefly at Balh Block during 2021

Month	Meteorological Standard Week (MSW)	Balh Block					
		*Mean no. of adults per trap	*Mean no. of nymphs per plant	*Mean no. of adults per plant	Proportion of adults per trap (%)	Proportion of nymphal count (%)	Proportion of adults per plant (%)
April	15	8.1	0.0	3.1	0.4	0.0	2.1
	16	15.9	1.4	4.7	0.8	1.0	3.2
	17	28.2	2.5	3.6	1.4	1.8	2.4
	18	27.1	3.9	3.0	1.4	2.8	2.0
May	19	25.7	5.0	3.5	1.3	3.6	2.4
	20	31.3	7.4	4.5	1.6	5.4	3.0
	21	37.4	10.1	6.9	1.9	7.43	4.7
	22	35.2	11.7	8.8	1.8	8.6	6.0
	23	152.0	7.4	6.7	7.9	5.4	4.6
June	24	378.5	22.1	29.9	19.7	16.2	20.5
	25	287.1	8.1	11.8	14.9	5.9	8.1
	26	360.1	14.4	16.1	18.7	10.6	11.0
	27	451.2	18.4	19.8	23.5	13.5	13.6
July	28	25.2	7.6	8.2	1.3	5.5	5.6
	29	15.1	5.3	4.2	0.7	3.9	2.8
	30	12.6	3.4	3.3	0.6	2.5	2.2
	31	10.8	2.6	3.5	0.5	1.9	2.4
August	32	8.8	2.5	2.2	0.4	1.8	1.5
	33	5.4	2.0	1.5	0.2	1.4	1.0
	34	0.0	0.0	0.0	0.0	0.0	0.0
Total		1915.7	135.8	145.3			

*Mean of three localities

Table 3: Correlation (r) between whitefly population (nymphs and adults) with various abiotic factors of two Blocks during 2021

Weather parameters	Correlation (r)					
	Gohar block			Balh block		
	Adult trapped	Adult count	Nymphal count	Adult trapped	Adult count	Nymphal count
T. Max. (°C)	0.330 NS	0.423NS	0.628**	0.669**	0.726**	0.746**
T. Min. (°C)	0.675**	0.619**	0.806**	0.548*	0.604**	0.653**
Morning, RH (%)	-0.317 NS	-0.344NS	-0.343NS	-0.574**	-0.535*	-0.547*
Evening, RH (%)	-0.265NS	-0.199NS	-0.248NS	-0.452*	-0.338NS	-0.401NS
Rainfall (mm)	0.171NS	0.141NS	0.129NS	-0.244NS	-0.270NS	-0.253NS

r = Coefficient of correlation

Number of observations (n) = 20

* Significant at 5% level

**Significant at 1% level

NS = non-significant

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