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Research Article

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Seasonal Incidence of Whitefly and Aphid on Tomato Crop at Tarai Region of Uttrakhand

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ABSTRACT

The present investigation was carried out during 2015-2016 at Vegetable Research center, G.B. Pant University of Agriculture and Technology, Pantnagar . The trial was conducted to know the seasonal population dynamics of whitefly and aphid in tomato (Lakshmi hybrid1) and their relation to weather parameters. The results found that incidence of the Bemisia tabaci occurred from 39th standard meteorological week (SMW) 2015 to 7th standard meteorological week. Maximum population of whitefly was recorded during first week of October with incidence upto the last week of May. Simple correlation worked out between the weather parameters and the population of Bemisia tabaci revealed that there was non-significant negative correlation with morning relative humidity, rainfall, sunshine hours, maximum and minimum temperature but significant negative correlation with evening relative humidity. However, wind velocity exhibited a positive non-significant correlation with whitefly population during crop season while the incidence of the aphid spp was noticed from 40th standard meteorological week (SMW) 2016 to 7th standard meteorological week 2016. Persistent high population was noticed from 40th to 43rd (SMW) Simple correlation worked out between the weather parameters and population of Aphis gossypii revealed that there was non significant positive correlation with maximum and minimum temperature and sunshine hour, while maximum relative humidity, wind velocity, rainfall and minimum relative humidity showed non significant negative correlation with aphid population during crop season 2015-2016.

Keywords: *Bemisia tabaci, Aphis gossypii, Persistent, Relative humidity.*

INTRODUCTION

India is the second largest producer of vegetables in the world after China. Vegetables act as a rich source of vitamins and minerals, in which other food materials are deficient. Tomato (*Lycopersicon esculentum* Mill.) of the family *Solanaceae* is one of the most important vegetables grown in the world. It is a good source of vitamins. Tomato traces its origin from Central and South America and its use as a food originated in Mexico, and spread throughout the world after the Spanish colonized the Americas.

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Major tomato producing countries are China, USA, Italy, Turkey, India and Egypt. Total area under tomato in the world is 4582438 thousand ha with production of 150513813 thousand tons and productivity of 32.8 tons per ha (Anonymous, 2015).

In Indian perspective, tomato is cultivated in an area of 879.6 thousand ha with an average annual production of 18226.6 thousand metric tonne and productivity of 19.5 t ha-1 (NHB 2013- 2014). Andhra Pradesh leads in total area dedicated to tomato production with an area of 167.72 thousand ha and production of 3354.47 thousand metric tons, while Karnataka ranks first in productivity with 33.2 t ha-1 (NHB 2013-2014). Though the total cultivated area and production of tomato in our country have been increasing gradually over the last few years but the productivity is still very low in comparison to the average of the world yield of 26.29 tons/ha (Anonymous, 2010).

Considering the production of tomato in Uttarakhand state; Dehradun, Udham singh nagar, Pithoragarh, Tehri, Nainital, Haridwar and Chamoli are the major tomato producing districts.

Like other vegetables, tomato is more prone to insect pests and diseases mainly due to their tenderness and softness compared to other crops (Sajjad et al. 2011).

The whitefly *Bemisia tabaci* (Gennadius) (Homoptera:Aleyrodidae) is an important pest of tomato plant (Butter et al. 1978) infesting wide range of crops, including tomato. The wide range of geographical distribution with variety of host range makes it difficult to control (Naresh et al. (1980). *B. tabaci* which sucks the phloem sap of growing tomato plant also transmits tomato yellow curl viruses (Rataul et al., 1989). Such direct feeding also induces plant physiological disorders, which results in early shedding of immature fruit-parts (Yokomi et al., 1990; Bharathan et al., 1990). Both adult and immature stages of this insect cause direct damage through sucking the plant sap (Brown et al., 1995) and causes insurmountable losses to tomato plants (Gerling, 1986).

MATERIALS AND METHODS

The present study was taken up to investigate the seasonal occurrence of whitefly and aphid on tomato plant at Pantnagar. Regular surveys were conducted at weekly interval in the experimental plots of tomato crop at Vegetable Research Centre, GBPUA&T, Pantnagar during winter season from August -Febuary during the year, 2015-2016 to explore the population of whitefly and their period of incidence and abundance .Geographically, Pantnagar is situated at 29^0N latitude and 79.3^0E longitude and an altitude of 243.84 meters above the mean sea level in the foot hills of Himalayas and falls under sub-humid and sub-tropic climate. During summer the climate of this part of country generally remains less dry and hot than the plains. The winter is experienced by quite cold and humid with adequate rainfall. Frost can be expected from last week of December to first week of February. The monsoon generally commences from the second week of June and ends by the last week of September with few winter showers. On the average of , 1350 mm average annual rainfall is received mainly (>80%) from July to September when relative humidity fluctuates around 90±5 per cent (rainy season of the year). The maximum temperature in summer may reach up to 43 ^{0}C, while minimum temperature in winter may fall as low as - 0.5 ^{0}C. The climatic conditions prevailing at Pantnagar throughout the cropping season are favorable for the growth of tomato crop. The mean monthly weather data during crop season as recorded at meteorological observatory, N.E. Bourlaug Crop Research Centre, Pantnagar, situated about 2 km from V.R.C Haldi, Variety taken was Lakshmi hybrid1. Population of whitefly, *Bemisia tabaci* (Gennadius) was recorded after 30 days of sowing (30 DAS) at weekly interval. These observations were taken on three leaves per plant, one each from top, middle and bottom region from five randomly selected plants per plot selected leaving border rows.

RESULTS AND DISCUSSION

Table 1: Fluctuation in population of white fly in relation to weather parameters in tomato crop grown at VRC, Pantnagar

	Date	SMW	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)	Sun-Shine Hrs.	Wind Velocity (km/hr.)	Average population of white fly/ plant
			Max.	Min.	0712 am	1412 pm				
Aug- sep(2015)	27-02	35	33.4	25.4	92	65	024.4	06.7	5.0	00
September	03-09	36	33.6	23.8	91	60	000.0	07.5	2.1	00
September	10-16	37	34.1	25	87	61	000.0	08.4	2.4	00
September	17-23	38	34.0	24.9	84	62	112.0	06.6	3.1	00
September	24-30	39	31.7	21.4	90	61	000.0	08.1	3.0	0.5
October	01-07	40	32.9	20.2	83	51	000.0	09.5	2.9	.54
October	08-14	41	32.5	20.3	83	52	000.0	07.5	3.0	8.85
October	15-21	42	31.5	19.3	86	51	000.0	05.1	2.8	8.43
October	22-28	43	31.2	13.9	88	48	000.0	08.7	1.6	8.99
Oct-Nov	29-04	44	29.0	13.7	90	43	005.0	06.2	2.7	5.80
November	05-11	45	28.0	12.1	91	43	002.0	06.6	2.3	5.45
November	12-18	46	29.0	11.9	91	38	000.0	07.8	4.3	5.08
November	19-25	47	27.7	11.3	92	41	000.0	07.2	2.5	4.56
Nov-Dec	26-02	48	26.7	12.6	91	46	000.0	03.7	3.0	4.00
December	03-09	49	24.6	10.2	96	49	000.0	01.8	5.0	4.24
December	10-16	50	21.1	10.3	94	64	000.0	02.1	4.3	3.32
December	17-23	51	20.5	4.6	96	50	000.0	05.3	2.5	4.58
December	24-31	52	21	5.0	95	46	000.0	06.1	3.0	3.33
January(2016)	01-07	1	23.6	6.9	92	39	000.0	06.0	2.7	2.19
January	08-14	2	22.3	7.0	94	49	000.0	04.3	3.3	3.01
January	15-21	3	17.4	6.6	94	64	000.0	02.3	4.6	3.32
Jan	22-28	4	17.9	4.1	94	53	000.0	03.3	3.2	3.08
Jan-Feb	29-04	5	22.2	6.8	96	48	000.0	04.8	5.3	3.54
February	05-11	6	23.3	8.3	93	46	000.0	05.4	3.7	3.10
February(2016)	12-18	7	26.4	9.4	82	32	000.0	06.8	5.5	3.09
Correlation larval population			**-0.102**	**-0.294**	**-0.061**	**-0.472***	**-0.328**	**-0.093**	**0.180**	

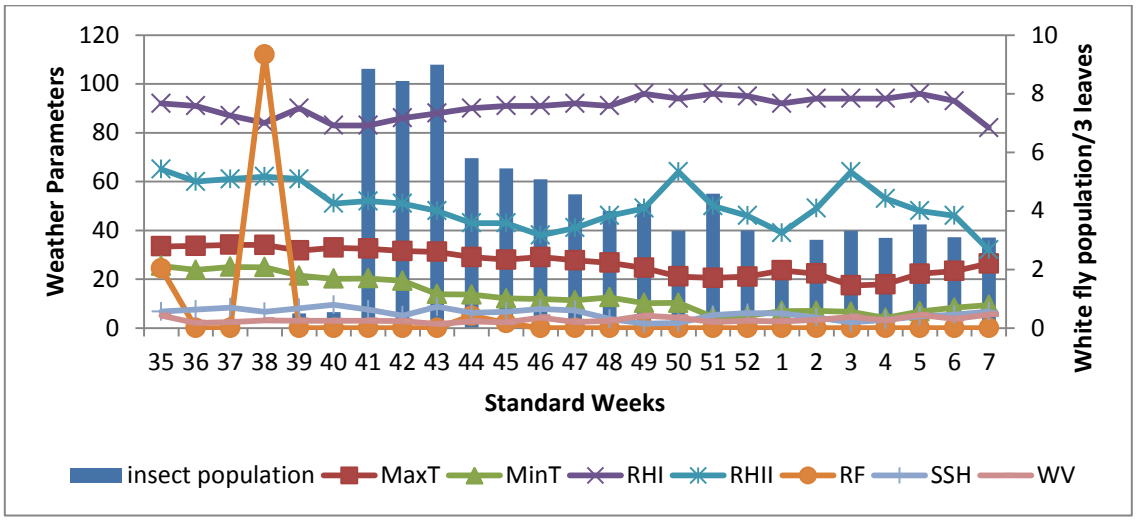

Fig. 1: Fluctuation in population of white fly in relation to weather parameters in tomato crop grown at VRC, Pantnagar, during winter season, 2015-2016

The incidence of the *Bemisia tabaci* occurred from 39th standard meteorological week (SMW) 2015 to 7th standard meteorological week (Table 1). The first appearance of this pest was marked by an average of 0.5 whitefly/plant in the 39th standard week when the maximum-minimum temperature, morning-evening relative humidity (RH), rainfall, sunshine hrs, wind velocity were 31.7^{0}C, 21.4^{0}C, 90% (0712am), 61% (1412pm), 0.00 mm, 08.1hrs, 3.0km/hr, respectively. The population gradually increased and attained maximum (8.99 whitefly/ plant) in 43rd standard week (maximum-minimum temperature, morning-evening relative humidity, rainfall, sunshine hrs, wind velocity 31.2^{0}C, 13.9^{0}C, 88% (0712am), 48% (1412pm), 0.0 mm, 08.7hrs ,1.6km/hr respectively) followed a marked decrease in population after 44th standard week till harvestation. (Fig 1).

In present investigation the whitefly population recorded showed its incidence from fourth week of September to seventh week of Feb. (Naresh et al., (1980). However , reported the maximum population of whitefly during first week of october with incidence upto the last week of May in tarai region of Uttrakhand. Chaudhuri et al. (2001) on the other hand, observed that white fly population was initiated on 49th standard week i.e early December and moderate population maintained upto 5th standard week i.e first week of February and peak population in Feb and mid March.

Borah and Bordoloi, (1998) recorded higher population of white fly on tomato from 10th -25th October. Saklani and Mathai, (1978) reported that infestation by whitefly on tomato on winter crop was more than summer crop. Butler and Rataul, (1978) also repoted marked increase in white fly population on tomato in Assam during October-November.

Simple correlation worked out between the weather parameters and the population of *Bemisia tabaci* (Table 1) revealed that there was non-significant negative correlation with morning relative humidity, rainfall, sunshine hours, maximum and minimum temperature but significant negative correlation with evening relative humidity. However, wind velocity exhibited a positive non-significant correlation (r = .180) with whitefly population during crop season 2015-2016. The study indicated that the *Bemisia tabaci* population decreased with increasing minimum temperature, bright sunshine hours, minimum relative humidity, maximum temperature, rainfall and wind velocity. These finding are in agreement with Sajjad et al. (2014), who reported that the population of white fly exhibited negative correlation with relative humidity and temperature. In a study conducted by Gupta et al. (1997) on the impact of abiotic factors on population buildup of white fly showed a negative correlation of relative humidity and

rainfall on population build up of white fly. However, non-significant correlations have been found with regard to the functional relationship between pest population and biotic factors.

Chakraborty, (2012) also found that the population of *B. tabaci* showed a significant negative relation with the minimum temperatuere also significant negative effect on the incidence of whitefly population.

Table 2: Fluctuations in population of Aphids in relation to weather parameters on tomato crop grown at VRC, Pantnagar, during winter season of, 2015-2016

	Date	SMW	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)	Sun-Shine Hrs.	Population ofaphid/ 3leaf
			Max.	Min.	0712 am	1412 pm			
Aug- sep(2015)	27-02	35	33.4	25.4	92	65	024.4	06.7	00
September	03-09	36	33.6	23.8	91	60	000.0	07.5	00
September	10-16	37	34.1	25	87	61	000.0	08.4	00
September	17-23	38	34.0	24.9	84	62	112.0	06.6	00
September	24-30	39	31.7	21.4	90	61	000.0	08.1	00
October	01-07	40	32.9	20.2	83	51	000.0	09.5	15.5
October	08-14	41	32.5	20.3	83	52	000.0	07.5	18.2
October	15-21	42	31.5	19.3	86	51	000.0	05.1	17.6
October	22-28	43	31.2	13.9	88	48	000.0	08.7	22.6
Oct-Nov	29-04	44	29.0	13.7	90	43	005.0	06.2	13.23
November	05-11	45	28.0	12.1	91	43	002.0	06.6	8.45
November	12-18	46	29.0	11.9	91	38	000.0	07.8	8.4
November	19-25	47	27.7	11.3	92	41	000.0	07.2	2.94
Nov-Dec	26-02	48	26.7	12.6	91	46	000.0	03.7	2.37
December	03-09	49	24.6	10.2	96	49	000.0	01.8	2.29
December	10-16	50	21.1	10.3	94	64	000.0	02.1	1.20
December	17-23	51	20.5	4.6	96	50	000.0	05.3	1.18
December	24-31	52	21	5.0	95	46	000.0	06.1	1.16
January(2016)	01-07	1	23.6	6.9	92	39	000.0	06.0	1.12
January	08-14	2	22.3	7.0	94	49	000.0	04.3	1.08
January	15-21	3	17.4	6.6	94	64	000.0	02.3	1.37
January	22-28	4	17.9	4.1	94	53	000.0	03.3	1.29
Jan-Feb	29-04	5	22.2	6.8	96	48	000.0	04.8	1.56
February	05-11	6	23.3	8.3	93	46	000.0	05.4	1.10
February	12-18	7	26.4	9.4	82	32	000.0	06.8	1.10
Correlation larval population			0.312	0.124	-0.361	-0.240	- 0.154	0.248	

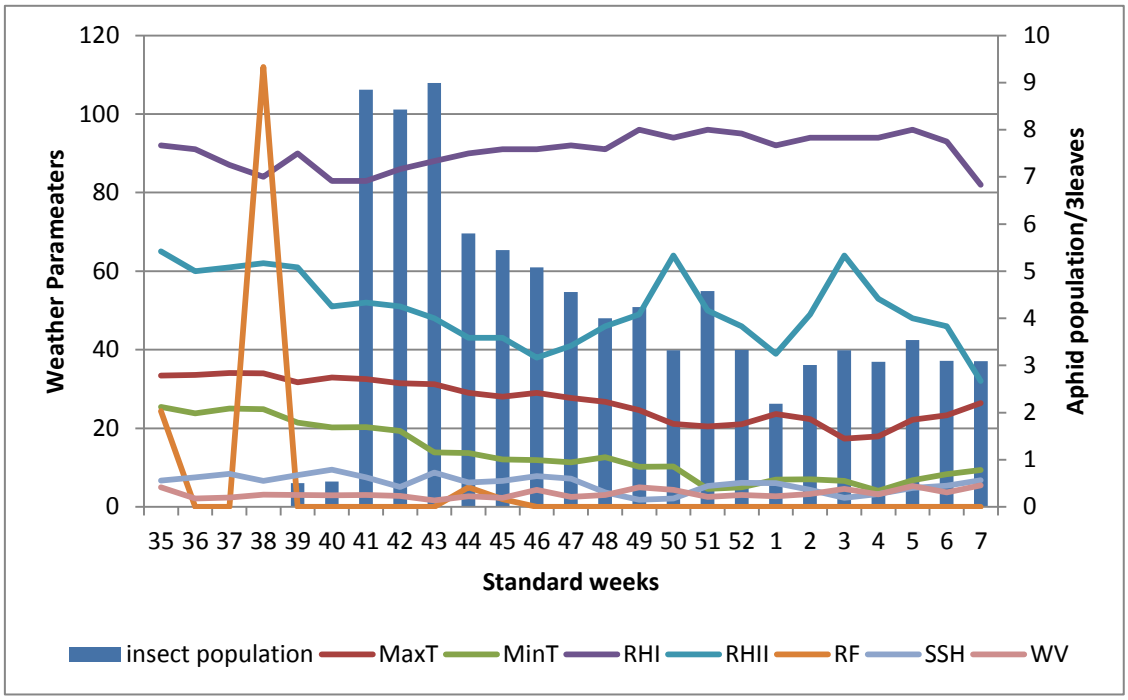

Fig. 2: Fluctuation in population of Aphid in relation to weather parameters in tomato crop grown at VRC, Pantnagar, during winter season of, 2015

The incidence of the aphid spp was noticed from 40th standard meteorological week (SMW) 2016 to 7th standard meteorological week 2016. **(Table 2).** The pest marked its first appearance by an average of 15.5 aphid/3 leaves (both nymphs and adults) in 40th standard week when the average maximum-minimum temperature, morning-evening relative humidity (RH), rainfall, sunshine hrs, wind velocity were 32.9^{0}C, 20.2 ^{0}C,83 % (0712am),51 % (1412pm), 0.00 mm, 09.5hrs, 2.9 km/hr, respectively. Persistent high population was noticed from 40th to 43rd SMW. After which the population was gradually decreased first slowly and then abruptly. Aphid population on tomato crop revealed that the population appeared from first week of October (40th SMW) to first week of February, till the harvesting of crop (39th standard week), which was in agreement with Muhammad et al. (2013) who recorded the incidence of aphid at Faisalabad, Pakistan during 2009-10, and observed the maximum aphid population during October. Followed by a marked decrease in December due to low temperature but regain the population builds up till harvesting of the crop.

Simple correlation worked out between the weather parameters and population of *Aphis gossypii* **(fig 2)** revealed that there was non-significant positive correlation with maximum and minimum temperature and sunshine hour, while maximum relative humidity, wind velocity, rainfall and minimum relative humidity showed non-significant negative correlation with aphid population during crop season 2015-2016. These data indicated that aphid population was adversely affected by maximum relative humidity, minimum relative humidity, wind velocity and rainfall but increased with increasing maximum and minimum temperature and sunshine hours

The present finding agrees appeared to be in close agreement with Chakraborty, (2011) who found that the maximum temperature, minimum temperature, temperature gradient, average temperature, minimum relative humidity and sunshine hours had significant negative influence on the population of *A. gossypii.* While maximum relative humidity and relative humidity gradient was found to have a positive influence. In addition, other factors such as average relative humidity, number of rainy

days, rainfall expressed insignificant positive effect on population development.

CONCLUSION

The incidence of the *Bemisia tabaci* occurred from 39th standard meteorological week (SMW) 2015 to 7 th standard meteorological week of 2016. Simple correlation worked out between the weather parameters and *Bemisia tabaci* population revealed that there was non-significant negative correlation with, morning relative humidity, rainfall, sunshine hours, maximum and minimum temperature and significant negative correlation with evening relative humidity. However, wind velocity exhibited a positive non-significant correlation (r = 0.180) with whitefly population during crop season 2015-2016, with highest population in 43 rd SMW (2nd forth night of October).

The incidence of the aphid was observed from 40 th standard meteorological week (SMW) 2015 to 7 th standard meteorological week 2016, with maximum population in 40 th SMW(first week of october). Simple correlation is worked out between the weather parameters and population of *Aphis gossypii* revealed that there was non significant positive correlation with maximum and minimum temperature and sunshine hour, while maximum relative humidity, wind velocity, rainfall and minimum relative humidity showed non-significant negative correlation with aphid population during crop season 2015-2016.

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