Journal of Agroecology and Natural Resource Management
p-ISSN: 2394-0786, e-ISSN: 2394-0794, Volume 3, Issue 3; July-September 2016 pp. 243-246

http://www.krishisanskriti.org/Publication.html

Influence of Weather Factors on the Incidence of Whitefly, *Bemisia tabaci* Genn. On Tomato in Darjeeling Hills of West Bengal

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Abstract—*Tomato is one of the most popular and widely grown vegetables in the world as well as India. This crop is infested by various insect and mite pest throughout its growing period. Reproduction, growth and survival of these insect pests are affected by number of abiotic factors viz.,temperature, humidity and rainfall. Considering all these facts, the present study was carried out under open field conditions at Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong, West Bengal during 2015-16. First appearance of whitefly (Bemisia tabaci Genn.) in the field was recorded at 50th standard week with a mean population of 15.49 per six leaves. The pest population reached to peak at 1st standard week with a mean population of 18.29 per six leaves. The least infestation was noticed on 17th standard week with a mean population of 5.26 per six leaves.The whitefly incidence persisted in the crop till the time of harvest. Maximum and minimum temperature showed negatively non-significant influence over the whitefly population. The relationship between whitefly population and relative humidity (maximum and minimum) was negative and non-significant. The relationship between the whitefly population and rainfall was also negative and non-significant.*

Keywords*: Tomato, whitefly, abiotic factors, correlation.*

1. INTRODUCTION

Vegetables are important part of healthy eating and provide a source of many nutrients. The nutrients in vegetables are vital for health and maintenance of our body. Owing to their richness in vitamins and minerals, vegetables crops occupy a prominent position in the human diet. Among various vegetables, tomato (*Lycopersicon esculentum L*) is one of the most popular and widely grown vegetables not only in India but also in many other parts of the world . It belongs to a large family of plants called the solanaceae, which contains many other important crops, including potato and brinjal [1]. It is a vegetable crop of considerable economic importance. The fruit is relatively nutritious and contains moderate quantities of vitamin C [2]. Tomato is used in the preparation of soup, salad, pickles, ketchup, sauces and also consumed as a vegetable in many other ways. The productivity of tomato in India is 21.2 mt/ha which is very low as compared to the productivity in many other countries like United States of America (88.0 mt/ha), Brazil (60.7 mt/ha), China (50 mt/ha) etc. [3]. This gap is attributed to number of yield reducing factors including both biotic and abiotic. The production and quality of tomato fruits are significantly affected by various insect pests infesting at different stages of crop growth. The key insect pests of tomato includes aphid (*Aphis gossypii* Glover), jassid (*Amrasca devastans* Ishida), white fly (*Bemisia tabaci* Genn.), leaf miner (*Liriomyza trifolii* Burgess), thrips (*Scirtothrips dorsolis* Hood) and fruit borer (*Helicoverpa armigera* Hub.) [4,5]. Whitefly has been recorded from more than 600 different plant species [6] and its polyphagous nature has been documented worldwide [7]. Being highly polyphagous in nature, it is known to feed on several vegetables including tomato. Whitefly is also one of the serious sucking pests for tomato cultivation in hill zone of West Bengal. Apart from direct damages by sucking and devitalizing of plants, it causes more damage by spreading tomato yellow leaf-curl virus (TYLCV) [8] disease leading to huge loss. Climatic factors such as temperature, humidity and rainfall exert a great influence on the growth, development, reproduction, survival, distribution and population dynamics of insect pest [9,10]. Pest abundance and distribution changes with abiotic factors [11].Temperature plays an important role in population dynamics of pests by exerting effects on egg laying and ovipositional behaviour [12]. So there is a need to carry out an experiment to understand the role of abiotic factors on the incidence of white fly on tomato, one of the major sucking insect pests of tomato in hill zone of West Bengal. Moreover, work done on these lines in the hill agro climatic zone of West Bengal is very scanty. Therefore, keeping all these facts in mind the present experiment was conducted for understanding the role played by the abiotic factors in the incidence of whitefly on tomato in hill agro-climatic zone of West Bengal.

2. MATERIALS AND METHODS.

The study was carried out under open field conditions at Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong West Bengal during 2015-16 (December to April). The farm is situated at 27°31' N latitude and 88°28' E longitudes at an elevation of 1097 m above sea level. The soil type of experimental fields was sandy loam with an average fertility. A bulk plot of 100 sq m was raised to study the population build up of the insect pests. The fields were well prepared and levelled having good drainage and adequate irrigation facility. Twenty five day old seedlings of tomato variety *Pusa rohini* were transplanted maintaining 60×75 cm spacing for the experimental purpose. The crop was raised adopting standard agronomic practices. No pesticide was applied on the plants. A total of 25 plants were selected randomly from five locations @ 5 plants from each location. These randomly selected plants were tagged for recording observation from transplanting to maturity of the crop or till the availability of the pest. Incidence of whitefly population were counted on six leaves (two upper, two middle and two lower canopy) from each of the 25 tagged plants. The observations were taken during early morning hours. The meteorological observations during entire period of investigation were recorded from the weather stations of Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong, West Bengal.

The collected data thus obtained were correlated [13] with prevailing meteorological conditions viz., maximum and minimum temperature (°C), maximum and minimum relative humidity (%) and rainfall (mm) to signify the impact of environmental factors on the pest activity.

3. RESULTS AND DISCUSSION

The data recorded on the incidence of *B. tabaci* during the period of experiment revealed that incidence of *B. tabaci* was observed from 50th to 17th standard week (10th December to 29th April). Initially, a high whitefly population was recorded in the first week of January, and then the population started to decline and a low number was recorded in the month of April. The whitefly population tended to decline as the crop matured. The first appearance of whitefly was recorded at 50th standard week from 10th December to 16th December, 2015 with a mean population of 15.49 per six leaves and persisted in the crop till the time of harvest as presented in the table-1. The average maximum and minimum temperature prevailed during the initial infestation were 24.5ºC and 17.0ºC, respectively and average maximum (morning) and minimum (evening) relative humidity was 99.0 and 82.0 per cent, respectively. The pest population reached to the highest peak at 1st standard week from 1st January to 7th January, 2016 with a mean population of 18.29 per six leaves. The average maximum and minimum temperature were 17.9ºC and 9.9ºC, respectively and average maximum and minimum relative humidity was 96.0 and 52.0 per cent, respectively. There after the pest population declined gradually and the least infestation was noticed on 17th standard week (23rd -29th April, 2016) with a mean population of 5.26 per six leaves with an average maximum and minimum temperature prevailed were 26.5 ºC and 17.6ºC, respectively.

Although the pest population reached to the highest peak at 1st standard week from 1st January to 7th January, but the activity of whitefly was also high in 2nd and 3rd week of February which was confirmatory with the findings of [14] who recorded the whitefly (*Bemisia tabaci*) incidence during the 2nd and 3rd week of February.

The relationship between whitefly population and major weather parameters were worked out through correlation coefficient studies. The results indicated that a negative non-significant association between the whitefly population and maximum (r= -0.296) and minimum temperature (r=-0.344). A negative and non-significant relationship was also observed between whitefly population and maximum relative humidity (r=-0.001) minimum relative humidity (r= -0.294). Rainfall also negatively influenced (r=-0.304) whitefly population. The present results were in close agreement with [15] who reported that whitefly population showed negative association with minimum temperature. The results were also in accordance with [16] who reported that increase in whitefly population was non-significant with abiotic factors. Our results were confirmatory with the findings of [17] who concluded that weather parameters (maximum and minimum temperature) had non-significant correlation with whitefly population. Similarly, the study made by [18,19] reported negative correlation of relative humidity and rainfall on population build up of white fly. Our present findings were not in conformity with [20] Meena and Bairwa (2014) who revealed that a positive and significant association between the whitefly population and maximum and minimum temperature in Varanasi, Uttar Pradesh. This might be due to variation in temperature and relative humidity in two completely different agroecological situation.

4. ACKNOWLEDGEMENT

The authors are thankful to the Associate Director of Research, Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong, West Bengal, India for providing facilities to carry out the experiments. We are also thankful to Dr. Sujit Sarkar, Scientist, IARI, Regional Station, Kalimpong for supplying the tomato seeds for the present study.

Table 1: Effect of weather factors on whitefly (*Bemisia tabaci* Genn.) population on tomato during 2015-16.

Sl. No.	Standard Week	Date	Total rainfall (mm)	Relative humidity (%)		Temperature (^{0}C)		Mean whitefly population/ six leaves
				Max	Min	Max	Min	
1	49	03 Dec-09 Dec	0.00	98	76	25.6	18.3	0.00
2	50	10 Dec-16 Dec	0.00	99	82	24.5	17.0	15.49
3	51	17 Dec-23 Dec	0.00	99	90	23.6	16.2	17.14
4	52	24 Dec-31 Dec	0.00	99	74	22.5	15.3	18.12
5	1	01 Jan-07 Jan	0.00	96	52	17.9	9.9	18.29
6	2	08 Jan-14Jan	0.00	99	68	15.5	8.8	17.54
7	3	15 Jan-21Jan	51.00	99	82	14.6	9.0	9.12
8	4	22 Jan-28 Jan	4.00	98	67	14.2	8.1	9.5
9	5	29 Jan-04 Feb	40.00	99	80	14.3	9.4	8.75
10	6	05 Feb-11 Feb	19.00	99	73	18.1	10.5	8.25
11	7	12 Feb-18 Feb	0.00	99	73	18.4	11.3	13.56
12	8	19 Feb-25 Feb	0.00	99	87	20.2	13.2	12.15
13	9	26 Feb-04 Mar	0.00	98	77	21.2	12.0	11.89
14	10	05 Mar-11 Mar	56.00	80	47	21.3	12.4	11.2
15	11	12 Mar-18 Mar	0.00	86	50	23.8	14.3	10.12
16	12	19 Mar-25 Mar	25.00	95	56	20.7	11.6	9.45
17	13	26 Mar-01 Apr	50.00	96	67	23.4	15.7	8.70
18	14	02 Apr-08 Apr	0.00	99	99	24.4	17.0	7.8
19	15	09 Apr-15 Apr	4.00	99	99	26.1	17.7	7.15
20	16	16 Apr-22 Apr	85.00	99	96	23.6	17.5	6.25
21	17	23Apr-29Apr	0.00	99	99	26.5	17.6	5.26

Table 2: Correlation coefficient (r) of whitefly population with weather factors during 2015-16.

Weather parameters	Whitefly (r)
Maximum Temp. (^{0}C)	-0.296
Minimum Temp. (^{0}C)	-0.344
Maximum (Morning) RH (%)	-0.001
Minimum (Evening) RH (%)	-0.294
Rainfall (mm)	-0.304

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