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RESEARCH **P**APER

Influence of abiotic and biotic factors on the incidence of white fly, *Bemisia tabaci* (Gen.) on tomato

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The incidence of whitefly was started in the fourth week of August (1.80 / plants). The whitefly population reached to its peak (21.10 white fly / plants) in the last week of September (39th meteorological week). Average maximum (33.61 °C) and minimum (18.58°C) temperature with average morning and evening relative humidity was 74.01 and 46.42 per cent, respectively, favoured the faster multiplication of white fly. The initial incidence of *C. septempunctata* was recorded in the last week of August and attained its peak in the last week of September. The population of C. *septempunctata* was influenced by the host insect as both were at peak the same time (3.50 beetles / 21.10 whitefly). Positive and non-significant correlation was found between whitefly and maximum temperature (r = 0.5546) and significant positive correlation was found between minimum temperature (r = 0,2025). The relationship between the whitefly population and rainfall was also negative and non-significant (r = - 0.1636). Positive non-significant correlation was found between beetle, *C. septempunctata* and maximum temperature (r = 0.2620), minimum temperature (r = 0.2990).

Key words : *Bemisia tabaci*, Abiotic factors, *C. septempunctata*

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INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) belonging to the family Solanaceae, is one of the most popular and widely grown vegetable crops of both tropics and subtropics of the world (Govindappa *et al*., 2013). India is the largest producer of tomato covering an area of 4.7 lakh ha with an annual production of 55.3 lakh tones (Anonymous, 2013). In India, the major tomato producing states are Uttar Pradesh, Assam, Bihar, Orissa, Maharashtra, West Bengal and Karnataka. The production of tomato is often limited to a great extent due to pest attack. Tomato is infested by almost 13 major insect pests (Cohic, 1958) but most important are fruit borer, *Helicoverpa armigera* Hubner, whitefly, *Bemisia tabaci* Gen; and jassids, *Amrasca devastans* Ishida. Reproduction, growth and survival of these insect pests are affected by number of abiotic factors *viz.*, temperature, humidity and rainfall (Ajij *et al*., 2009). The crop is infested by a number of sucking pests in vegetative stage and borers at fruiting stage. Among the sucking insects, whitefly *(Bemisia tabaci*) is one of the most damaging as it also acts as vector of tomato leaf curl virus (Dempsey *et al*., 2017). Whitefly is an important pest under the order hemiptera and carries piercing and sucking type of mouthpart (David and Ananthakrishnan, 2006). They cause direct and indirect damage to the tomato especially in the early growth stage. Both nymphs and adults suck the cell sap from the lower leaf surfaces. In addition, they disrupt transportation in conducting vessels and apparently introduce a toxin that impairs photosynthesis in proportion to the amount of feeding (

Sharma and Chander, 1998). When several insects suck the sap from the same leaf, yellow spots appear on the leaves, followed by crinkling, curling, bronzing, and finally drying of leaves. This phenomenon is known as "hopper burn" (Das and Islam, 2014). In case of severe damage all leaves of the plants become crinkled or twisted with drastic reduction in photosynthesis which ultimately causes severe yield reduction. Among the biotic factors natural enemies such as coccinellids *viz.,Coccinella septempunctata* are important which are most prevalent in natural conditions. This natural enemies are affected by temperature which are ultimately affects the pests population (Yadav *et al*., 2012). But the relationship among abiotic factors and tomato insect pests population are non-significant (Naik *et al*., 2009 and Meena *et al*., 2010). So, there is a need to carry out a study to understand the relationship between insect pests, biotic and abiotic factors of environment, to generate a general population trends and estimation role of natural control. It prevents the indiscriminate use of pesticides and saves agro-ecosystem balance. Keeping in view the importance of whitefly on tomato, present investigation was undertaken to study the influence of abiotic and biotic factors on the incidence of whitefly on tomato.

RESEARCH METHODOLOGY

Field experiment was conducted during *Kharif* 2015 at JNKVV, DHRTC Farm, Garhakota, Sagar (M.P.) to ascertain the pest incidence in tomato variety 'Shriram'. The experiment was laid out in a Randomized Block Design. The plot size was 10 x 5 metres with row to row and plant to plant distances were 60 and 60 cm, respectively. The crop was transplanted on 7th August, 2015. The experimental plots were kept free from weeds by weeding and hoeing. All the agronomic management practices were followed from time to time as per package and practices booklet of the region. Observations on whitefly population was recorded soon after the appearance of the whiteflies. The population of whitefly was recorded on tomato at weekly interval from appearance of the whiteflies on randomly selected and tagged plants per plot. The population of predator *Coccinella septempunctata* (egg, grubs, pupae and adults) were recorded on whole plant simultaneously with the population of whitefly on leaves and flowers at weekly intervals.

RESEARCH FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Incidence of white fly:

The data presented in Table 1 indicates that whitefly, *B. tabaci* appeared in 34 (SMW) during 2015.The initial incidence of *B. tabaci* was observed on 22.08.2015 *i.e.*, at 15 days after transplantation with a mean population of 1.80 /plants. The average maximum and minimum temperature prevailed during the initial infestation were

Table 1: Seasonal incidence of white fly and subsequent appearance of its predator in tomato during *Kharif* 2015

Date of observation	Meteorological week	Meterological condition				Mean* population of whitefly per plants	Mean* population of *C. septempunctata* per plants
		Max.temp. °C	Min. temp. °C	RH (%) morning	RH (%) evening		
22.08.2015	34	30.22	22.27	89.85	69.85	1.80	-
29.08.2015	35	31.07	22.71	92.14	81.28	3.20	2.33
05.09.2015	36	31.94	22.68	71.42	66.71	9.80	2.49
12.09.2015	37	34.57	22.9	74.85	57.28	14.60	2.64
19.09.2015	38	32.52	23.74	83.71	62.57	17.05	2.64
26.09.2015	39	33.61	18.58	74.01	46.42	21.10	3.50
03.10.2015	40	36.2	22.18	51.71	37.71	18.40	2.33
10.10.2015	41	32.07	20.6	52.14	35.28	7.80	0.37
17.10.2015	42	35.88	22.4	48.85	35.71	7.20	0.12
24.10.2015	43	33.68	22	60.85	44.14	5.05	0.12
31.10.2015	44	29.33	13.85	75.43	61.87	2.90	-
07.11.2015	45	32.82	20.01	64.14	51.57	0.70	-

30.22 ºC and 22.27 º C, respectively and average morning and evening relative humidity was 89.85 and 69.85 per cent, respectively. The population increased gradually and reached to its peak (21.10 white fly /plants) in the last week of September (39th meteorological week). Average maximum (33.61°C) and minimum (18.58°C) temperature coupled with average morning and evening relative humidity was 74.01 and 46.42 per cent, respectively, favoured the faster multiplication of white fly. Thereafter, the population of whitefly declined abruptly. The present findings are in agreement with that of Meena *et al.* (2010) who reported that infestation of whitefly on tomato was started in first week of September and remained active throughout the crop season and its population reached at maximum in fourth week of September.

Correlation between whitefly and abiotic factors:

Positive and non-significant correlation was found between whitefly and maximum temperature (r = 0.5546) and significant positive correlation was found between minimum temperature (r = 0.2025) (Table 2). The results revealed that a negative and non significant (r = - 0.1278) association between the whitefly population and morning and evening relative humidity (r = - 0.3087). The relationship between the whitefly population and rainfall was also negative and non-significant (r = - 0.1636). The results are also in accordance with Naik *et al*. (2009) who reported that increase in whitefly population was non-significant with abiotic factors. Meena *et al.* (2010) also concluded that maximum temperature had non-significant correlation with whitefly population.

Table 2 : Correlation co-efficients (r) between white fly and weather parameters during *Kharif* 2015

Weather parameters	Whitefly
Maximum temperature °C	0.5546 NS
Minimum temperature °C	0.2025*
Relative humidity morning (%)	-0.1278 NS
Relative humidity evening (%)	-0.3087 NS
Rainfall	-0.1636 NS

* indicate significance of value at P=0.05, NS=Non-significant

Incidence of *C. septempunctata* :

The data presented in Table 1 indicate that beetles *C. septempunctata* appeared in 35 (SMW) during 2015. The initial incidence of *C. septempunctata* was observed on 29.08.2015 *i.e.*, at 22 days after transplantation with a mean population of 2.33 / plants. The population of beetles increased gradually and attained its peak in the last week of September (39th meteorological week) reaching the maximum and minimum temperatures were 33.61°C and 18.5°C, respectively, coupled with average morning and evening relative humidity was 74.01 and 46.42 per cent, respectively favoured the faster multiplication of *C. septempunctata*. The data presented in Table 1 revealed that the population of *C. septempunctata* was influenced by the host insect as both were at peak the same time (3.50 beetles / 21.10 whitefly).

Correlation between whitefly predator and abiotic factors :

Positive non-significant correlation was found between beetle, *C. septempunctata* and maximum temperature (r = 0.2620), minimum temperature (r = 0.2990), morning relative humidity (r = 0.3015) and evening relative humidity (r = 0.2170). The relationship between the beetle and rainfall was negative and non-significant (r = - 0.3084) (Table 3).

Table 3 : Correlation co-efficients (r) between *C. septempunctata* and weather parameters during *Kharif* 2015

Weather parameters	*C. septempunctata*
Maximum temperature °C	0.2620 NS
Minimum temperature °C	0.2990 NS
Relative humidity morning (%)	0.3015 NS
Relative humidity evening (%)	0.2170 NS
Rainfall	-0.3084 NS

NS = Non-significant

Correlation between whitefly predator and abiotic factors :

Positive and significant correlation (r = 0.8073) was found between whitefly, *Bemisia tabaci* and beetle, *C. septempunctata* (Table 4).

Table 4: Correlation co-efficients (r) between whitefly and its predator during *Kharif* 2015

Whitefly, *Bemisia tabaci*	*C. septempunctata*
	0.8073*

* indicate significance of value at P=0.05

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