Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(4): 1113-1115

Received: 17-05-2018
Accepted: 20-06-2018

A Ghosh
Department of Agricultural Meteorology and Physics, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India

M Bhattacharyya
Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India

Correspondence
A Ghosh
Department of Agricultural Meteorology and Physics, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India

Impact of agroclimatic factors on pest population of summer brinjal

A Ghosh and M Bhattacharyya

Abstract
One field experiment was to study the population dynamics of jassids and white fly in brinjal in relation to the prevailing weather conditions conducted at Regional Research Station, New Alluvial Zone, Nadia, West Bengal, India in the year 2017 during last week of March to last week of June. Numbers of jassids and white fly per leaf varied from 6.9 to 4.1 and 2.7 to 6.0 respectively. Results showed that jassid population was negatively correlated with the maximum air temperature (-0.44) and positively correlated with the minimum air temperature (0.27). On the other hand maximum air temperature showed positive association with whitefly population (0.14) while minimum air temperature (-0.10) had adverse effect on the numbers of white fly per leaf. Best-fit regression equations indicated that each weather factor exhibited polynomial relationship with the numbers of insect.

Keywords: Brinjal, correlation, jassid, weather parameters, white fly

1. Introduction

Brinjal (*Solanum melongena*) is one of the important vegetable crops grown in India [3]. In India, the crop is cultivated in 0.47 M ha area with 7.67 MT production and an average productivity of 16.30 MT/ ha [9]. Production of this crop was adversely affected by pest incidence. A large number of sucking insect may attack this crop [4]. White fly (*Bemisia tabaci* Gennadius) and jassid (*Amrasca biguttula biguttula*) are important insect pests of summer brinjal. Brinjal crop is very much susceptible to damage by jassids. Optimum temperature range for development of white fly is 20 ˚C to 30 °C [13].

Life cycle of jassids is greatly influenced by temperature [1]. Jassid population are greatly hampered by several weather parameters. Earlier experimental results showed that jassid and white fly population in summer brinjal were at the peak level during the month of April and May respectively [6]. Crop in its vegetative phase is more vulnerable to damage by sucking insects because of the succulent nature of the plant due to the abundance of chlorophyll [10]. Temperature and relative humidity have direct and linear relationship with jassid population. The optimum ranges of temperature, relative humidity and vapour pressure deficit for jassid population were 32.0 to 34.0 °C, 81-92 per cent and 1.0 to 6.0 mm of Hg, respectively [11]. This study was carried out to find the population dynamics of jassid and white fly in summer sown brinjal in relation to the prevailing agro-climatic condition.

2. Materials and methods

2.1 Details of the experiment: One field experiment was conducted at Regional Research Station, New Alluvial Zone, Nadia, West Bengal, India in the year 2017 during last week of March to last week of June to study the population dynamics of jassids and white fly in brinjal. The crop was transplanted on 9th March. Name of the variety was Muktakeshi. Numbers of jassids and white fly were counted every day and average numbers of jassids and white fly per leaf were calculated.

2.2 Agroclimatic factors: Mean and accumulated weather parameters viz. mean maximum (T_{max}) and minimum (T_{min}) air temperatures, total rainfall (R), mean evaporation (E), mean morning relative humidity (RH I) and afternoon relative humidity (RH II), mean morning vapour pressure (VP I) and afternoon vapour pressure (VP II) for each SMW (Standard Meteorological Week) were recorded from the principal agro meteorological observatory.

2.3 Statistical analysis: Correlation analysis was carried out between insect numbers per leaf and agro-climatic parameters. Best-fit regression equations were developed to identify the relationship between insect population and weather parameters.

3. Results and Discussion

3.1 Agroclimatic condition during the study period: Variations in agro-climatic parameters during the whole study period is presented in Table 1. Average maximum and minimum air temperature were found to be highest in 16th and 15th SMW respectively while lowest average maximum and minimum air temperatures were found during 21st and 18th SMW. Total rainfalls were 47.3 mm and 2.2 mm during 18th and 24th SMW and no rainfall occurred during other SMWs. Large variations were recorded in morning and afternoon relative humidity and vapour pressure during the entire study period.

3.2 Pest population dynamics: Numbers of white fly and jassids per leaf have been showed in Table 2. Results revealed that average numbers of jassids per leaf varied from 6.9 (21st SMW) to 3.3 (18th SMW). Highest numbers of white fly per leaf were observed during 20th SMW (6.0) while white fly population was lowest during 14th SMW (2.7). Results indicated that there was no definite trend in insect population though the results were in agreement with the earlier results [7].

3.3 Correlation study: Correlation study between numbers of insects per leaf and agro-climatic factors showed that numbers of jassids per leaf were negatively correlated with maximum air temperature (r = -0.44) and positively correlated with minimum air temperature (r = 0.27). Exactly same results were found earlier [8]. It was also demonstrated that maximum temperature had adverse effect on jassid population in Rajasthan. Beneficial effects of minimum and average temperatures and relative humidity on jassid population were reported [12]. Jassid population in brinjal was negatively associated with rainfall [5]. Positive association were found between numbers of jassids per leaf and morning and afternoon relative humidity (RH I: r = 0.25; RH II: r = 0.41) and vapour pressure (VP I: r = 0.21; VP II: r = 0.50).
Numbers of white fly per leaf were positively associated with maximum air temperature (r = 0.14) and negatively associated with minimum air temperature (r = -0.10). Earlier study found that maximum air temperature was positively correlated with white fly population [6]. It was reported that mean air temperature had adverse effect on white fly population in brinjal [2]. Total rainfall (r = 0.38) had beneficial effect on white fly population whereas average evaporation (r = -0.22) had adverse effect on it. Relative humidity and atmospheric vapour pressure showed positive correlation with numbers of white fly per leaf (RH I: r = 0.36; RH II: r = 0.23 and VP I: r = 0.28; VP II: r = 0.23)

3.4 Best-fit regression equations: In order to predict the insect population, best-fit regression equation were developed involving numbers of jassids and white fly per leaf and different agro-climatic parameters. Each weather parameter showed polynomial relationship with the insect population. Values of coefficient of determination (R^2) have been presented in Table 4.

Table 1: Agro-climatic condition during the study period

SMW	T_{max}	T_{min}	R	E	RH I	RH II	VP I	VP II
12	34	23.3	0	3.9	100	59	26.44	23.48
13	33.3	23.9	0	5.6	89	64	24.05	23.06
14	36.8	21.7	0	6	86	36	22.92	16.18
15	34	24.7	0	5.8	86	67	25.87	25.67
16	37.5	24.4	0	6.3	89	43	27.54	21.59
17	36	23.4	0	4.1	91	53	26.9	23.2
18	34.3	18	47.3	4.8	93	67	22.92	24.33
19	35.5	24.2	0	4.1	94	68	29.54	28.36
20	36.2	24.8	0	5.1	92	53	29.35	23.9
21	30	23.4	0	4	95	77	25.82	30.05
22	36.4	24.6	0	4.2	88	68	28.03	28.69
23	35.8	25.5	0	4.5	91	65	29.35	27.22
24	33.6	21.2	2.2	1.7	89	81	24.62	30.75

SMW: Standard Meteorological Week; T_{max}: maximum air temperature (˚C); T_{min}: minimum air temperature (˚C); R = rainfall (mm); E = evaporation (mm); RH I = morning relative humidity (%); RH II = afternoon relative humidity (%); VP I = morning vapour pressure (Kpa); VP II: afternoon vapour pressure (Kpa).

Table 2: Numbers of Jassids and white fly per leaf

SMW	Numbers of jassid/ leaf	Numbers of white fly/ leaf
12	5.7	5.3
13	5.0	5.1
14	4.3	2.7
15	5.4	4.1
16	5.9	4.2
17	4.5	4.7
18	3.3	5.9
19	6.7	5.3
20	4.5	6.0
21	6.9	3.3
22	4.1	5.5
23	4.9	4.0
24	6.8	4.6

SMW: Standard Meteorological Week

Table 3: Correlation coefficient (r) between jassid and white fly population and agro-climatic parameters

Agro-climatic parameters	Numbers of jassid/ leaf	Numbers of white fly/ leaf
T_{max}	-0.44	0.14
T_{min}	0.27	-0.10
R	-0.50	0.38
E	-0.41	-0.22
RH I	0.25	0.36
RH II	0.41	0.23
VP I	0.21	0.28
VP II	0.49	0.23

T_{max}: maximum air temperature (˚C); T_{min}: minimum air temperature (˚C); R = rainfall (mm); E = evaporation (mm); RH I = morning relative humidity (%); RH II = afternoon relative humidity (%); VP I = morning vapour pressure (Kpa); VP II: afternoon vapour pressure (Kpa).

Table 4: Best-fit regression equations involving numbers of jassid and white fly per leaf and agro-climatic parameters

Agro-climatic parameters	Best-fit regression equations		Coefficient of determination (R^2)	
	Numbers of jassid/ leaf	Numbers of white fly/ leaf	Numbers of jassid/ leaf	Numbers of white fly/ leaf
T_{max}	$Y_1 = 0.0433x^2 - 3.1839x + 63.424$	$Y_2 = -0.1009x^2 + 6.9124x - 113.31$	0.228	0.294
T_{min}	$Y_1 = -0.1179x^2 + 5.2977x -53.749$	$Y_2 = 0.0868x^2 - 3.8378x + 46.662$	0.312	0.181
R	$Y_1 = -0.0168x^2 + 0.7532x + 5.2576$	$Y_2 = -2E\text{-}05x^2 + 0.029x + 4.5697$	0.414	0.143
E	$Y_1 = 0.1711x^2 - 1.8047x + 9.6876$	$Y_2 = -0.1621x^2 + 1.1777x + 2.9156$	0.266	0.162
RH I	$Y_1 = 0.0023x^2 - 0.3622x + 18.703$	$Y_2 = -0.0151x^2 + 2.8737x - 131.94$	0.065	0.214
RH II	$Y_1 = 0.0023x^2 - 0.2328x + 10.494$	$Y_2 = -0.0034x^2 + 0.42x - 7.603$	0.305	0.468
VP I	$Y_1 = -0.0958x^2 + 5.1369x - 63.146$	$Y_2 = 0.03x^2 - 1.461x + 22.186$	0.208	0.098
VP II	$Y_1 = 0.0148x^2 - 0.5729x + 10.08$	$Y_2 = -0.031x^2 + 1.5505x - 14.26$	0.317	0.471

Y_1 = Numbers of jassid/ leaf; Y_2 = Numbers of white fly/ leaf; x = weather parameters [T_{max}: maximum air temperature (˚C); T_{min}: minimum air temperature (˚C); R = rainfall (mm); E = evaporation (mm); RH I = morning relative humidity (%); RH II = afternoon relative humidity (%); VP I = morning vapour pressure (Kpa); VP II: afternoon vapour pressure (Kpa)].

4. Conclusion
In the present study it should be concluded that jassid and white fly population in summer brinjal was greatly affected by the prevailing weather condition. Agro-climatic factors showed good correlation with the pest population. Insect populations were related with the weather factors through polynomial regression equations. There is a great scope of research on the impact of weather parameters on pest population in brinjal crop. Pest behavior can be studied in relation to agro-climatic factors. Critical limits of weather parameters for pest out breaks can be determined by studying on population dynamics study of pests as affected by environmental factors.

5. Acknowledgement
All the members of Regional Research Station, New Alluvial Zone, Nadia are acknowledged for their sincere co-operation. Fund for this research work has been provided by the Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia.

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