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Influence of Abiotic Factors on Population Fluctuation of Leaf Hopper, *Amrasca biguttula biguttula* (Ishida) on Okra

Jamshaid Iqbal*, Muhammad Ashfaq, Mansoor ul Hasan, Muhammad Sagheer and Muhammad Nadeem

Department of Agricultural Entomology, University of Agriculture, Faisalabad, Pakistan (JI, MA, MH, MS) and Department of Entomology, Gomal University, D. I. Khan, Pakistan (MN)

Abstract.- The data on jassid population per leaf obtained from varietals trials in 2006-2007 at various dates of observation were correlated with the ambient weather conditions such as maximum, minimum and average temperatures, average relative humidity and rainfall. The coefficient of determination values were observed to find the role of weather effects on population fluctuation of jassid, *Amrasca biguttula biguttula* (Ishida) on okra. Minimum temperature during 2007 and on cumulative basis of 2006 and 2007 had significant and positive correlation with the jassid population and the other factors were not effective on jassid population. Rainfall showed maximum contribution *i.e.* 12% in population fluctuation of jassid during 2006 followed by maximum temperature, average temperature and relative humidity. Minimum temperature showed maximum contribution *i.e.* 20.5% in population fluctuation of jassid during 2007 followed by rainfall, relative humidity, maximum temperature and average temperature. On an average of two years data, rainfall was found to be the most important effects which contributed maximum *i.e.* 13.4% in population fluctuation of jassid on okra.

Key Words: *Abelmoschus esculentus*, abiotic factors, *Amrasca biguttula biguttula*, jassid, okra, weather factors.

INTRODUCTION

Climatic factors are effective on the survival, development and reproductive capacity of insect pests. Their activities are mostly dependent on the environmental temperature for maintenance. Prolonged periods of low or high temperatures or sudden change in them adversely affect the insect development. Different levels of humidity and rainfall, likewise, increase or reduce the population of certain insect pest species (Prasad and Logiswan, 1997). These factors affect the life cycle, propagation, and outbreaks of insects to such an extent that they are either compelled to adapt themselves to the changing climatic conditions or perish (Pedigo, 2004). Timings of the management activities are crucial for the implementation of pest management tactics. Okra, *Abelmoschus esculentus* (L.) Monech, is one of the most common vegetables in Pakistan and is extensively cultivated in Kharif and Rabi seasons. *Amrasca biguttula biguttula* is considered most destructive sucking pest of this crop (Singh *et al.*, 1993; Dhandapani *et al.*, 2003). Like other insects, the population of *A. biguttula biguttula* is governed by their innate ability to increase, under the influence of various environmental factors. Amongst various physical factors, temperature, humidity and rainfall are considered to be the most important cause of population fluctuations. The information available on the population fluctuation of jassid in Pakistan is scanty on okra crop. Considering the seriousness of the pest, the present studies were, therefore, initiated to study the impact of abiotic factors on the population and seasonal abundance of jassid on okra.

MATERIALS AND METHODS

The study was conducted to determine the role of weather in fluctuation of jassid during 2006 and 2007. Thirty genotypes of okra were sown in the experimental area of the Post-graduate Agricultural Research Station, University of Agriculture, Faisalabad on March 31, 2006. Based on per leaf population-density of jassid, three genotypes each showing resistant, susceptible and intermediate response for insect test was selected for further experiments. Nine genotypes of okra based on per leaf population density-count-data from

* Corresponding author: chishti_bk@yahoo.com
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preliminary screening trial were sown on March 31, 2007. Experiments were laid out in a Randomized Complete Block Design (RCBD) with three replications. The row to row distance was kept to be 75 cm and plant to plant to be 30 cm. The plot size was maintained at 15 × 20 m, during both the study seasons. No plant protection measure was applied. All the recommended agronomic practices were adopted during the experiment. Jassid population was recorded 24 days after sowing early in the morning twice a week. For the counts of jassid population, 15 plants of each genotype, in each replication, were selected at random and tagged. The leaves were observed in such a way that one leaf of the upper part of the first plant, one leaf of the middle part from the second plant and one leaf of the bottom part of the third plant of each variety, was taken into account. Metrological data related to the temperature, relative humidity and rainfall were recorded from the adjoining meteorological observatory of the Physiology Section, Ayub Agricultural Research Institute, Faisalabad, to study the effect of weather (a major abiotic factor) on the adult/nymph population of jassid feeding on different okra genotypes. The effect of abiotic factors on the adults/ nymphs population densities of jassid on different okra genotypes was determined by working out simple correlation (Steel *et al*. 1990). The combined effect of the factors like temperature, relative humidity and rainfall on the population of jassid for both study years was measured by using a Multiple Linear Regression Equation.

RESULTS AND DISCUSSION

In 2006 the maximum jassid population was recorded to be 5.925 per leaf on June 16 with a maximum temperature of 38.675°C, a minimum temperature of 24.90°C, an average temperature of 31.788 °C and with a relative humidity of 41% (Table I). The results regarding jassid population, per leaf on okra versus weather factors, during 2007, revealed that the maximum population of jassid, was recorded to be 12.286 per leaf on June 12 with a maximum temperature of 45.66°C, a minimum temperature of 27.63°C, an average temperature of 36.645°C and a relative humidity of 41.665% (Table I). The data regarding jassid population per leaf during 2006 and 2007 were correlated with the weather factors year wise as well as on cumulative basis to see the influence of weather factors on the population fluctuation of jassid per leaf on okra. The impact of weather factors on population fluctuation of jassid was also determined by processing the data in to Multiple Linear Regression analysis.

The results revealed that minimum temperature during 2007 and on cumulative basis showed a significant and positive correlation with the jassid population (Table II), whereas other factors, during both the study years, individually as well as on cumulative basis resulted in a non-significant correlation. The multiple effects of weather factors on the jassid population during 2006 (Table II) revealed that the rainfall contributed the maximum (12%) in population fluctuation of jassid, followed by a maximum temperature with a role of 2.4% in the population fluctuation. None of the regression equations fit the best. The present findings are in conformity with those of Mahmood *et al.* (1990), Sharma and Sharma (1997), Prasad and Logiswaran (1997), Mahmood *et al.* (2002) and Arif *et al.* (2006), who also reported a positive correlation of minimum temperature with the density count of the leaf hopper. The present findings are not in conformity with those of Patel *et al.* (1997), who reported a negative correlation between the population of jassid and temperature. The present findings can partially be compared with those of Kumawat *et al.* (2000), who reported that the maximum and minimum temperature showed a positive and non-significant correlation with the jassid population on okra. In the present studies, all the other factors showed a non-significant correlation with the jassid population. However, in the multiple regression analysis, rainfall showed a negative and non-significant impact on the population of jassid. The present findings are in conformity with those of Kumawat *et al.* (2000) and Mahmood *et al.* (2002). The present findings can be compared with those of Srinivasan *et al.* (1981), who reported that rainfall reduced the mean density and increased the aggregation among jassid on the okra crop. Similar results were also reported by Lal *et al.* (1990) who concluded that continuous rainfall was un-favorable for the population build-up of

Table I.- **Data regarding meteorological observations on various weather factors during 2006 and 2007.**

Sr. No.	Date	Temperature °C			Average relative humidity	Average rainfall (mm)	Average jassid population
		Maximum	Minimum	Average			
1	24.04.06	37.833	21.033	29.433	32.000	0.00	0.377
		(6.191)	(4.640)	(5.471)	(5.701)	(0.707)	(0.936)
2	28.04.06	41.575	21.550	31.563	34.375	0.00	0.638
		(6.487)	(4.696)	(5.662)	(5.906)	(0.707)	(1.067)
3	01.05.06	40.733	23.733	32.233	35.667	0.00	1.109
		(6.421)	(4.923)	(5.721)	(6.014)	(0.707)	(1.268)
4	05.05.06	39.352	23.000	31.176	38.125	0.00	1.925
		(6.313)	(4.848)	(5.628)	(6.215)	(0.707)	(1.557)
5	08.05.06	44.400	23.567	33.984	29.167	0.00	2.877
		(6.701)	(4.906)	(5.872)	(5.447)	(0.707)	(1.838)
6	12.05.06	42.250	24.575	33.413	33.875	0.00	3.865
		(6.538)	(5.007)	(5.823)	(5.863)	(0.707)	(2.089)
7	15.05.06	45.467	26.500	35.984	29.667	0.00	5.230
		(6.780)	(5.196)	(6.040)	(5.492)	(0.707)	(2.394)
8	19.05.06	39.300	25.300	32.300	48.250	15.20	0.534
		(6.309)	(5.079)	(5.727)	(6.982)	(3.962)	(1.017)
9	22.05.06	38.500	25.230	31.865	49.333	0.00	0.967
		(6.245)	(5.072)	(5.689)	(7.059)	(0.707)	(1.211)
10	26.05.06	38.950	24.500	31.725	47.250	7.20	0.322
		(6.281)	(5.000)	(5.677)	(6.910)	(2.775)	(0.907)
11	29.05.06	43.100	27.000	35.050	39.167	0.00	0.665
		(6.603)	(5.244)	(5.962)	(6.298)	(0.707)	(1.079)
12	02.06.06	41.050	27.050	34.050	36.250	0.00	1.196
		(6.446)	(5.249)	(5.878)	(6.062)	(0.707)	(1.302)
13	05.06.06	39.800	25.500	32.650	37.000	0.00	1.590
		(6.348)	(5.099)	(5.758)	(6.124)	(0.707)	(1.446)
14	09.06.06	40.100	25.025	32.563	32.250	0.00	2.705
		(6.372)	(5.052)	(5.750)	(5.723)	(0.707)	(1.790)
15	12.06.06	42.233	23.567	32.900	27.833	0.00	4.164
		(6.537)	(4.906)	(5.779)	(5.323)	(0.707)	(2.160)
16	16.06.06	38.675	24.900	31.788	41.000	0.00	5.925
		(6.259)	(5.040)	(5.682)	(6.442)	(0.707)	(2.535)
17	19.06.06	34.933	21.033	27.983	60.833	4.00	4.664
		(5.953)	(4.640)	(5.337)	(7.832)	(2.121)	(2.272)
18	23.06.06	38.275	22.075	30.175	45.625	17.20	1.584
		(6.227)	(4.751)	(5.539)	(6.792)	(4.207)	(1.444)
19	26.06.06	40.900	27.500	34.200	48.500	0.00	2.615
		(6.434)	(5.292)	(5.891)	(7.000)	(0.707)	(1.765)
20	30.06.06	37.320	26.500	31.910	65.375	2.00	2.827
		(6.150)	(5.196)	(5.693	(8.116)	(1.581)	(1.824)

Continued…..

Sr. No.	Date	Temperature °C			Average relative humidity	Average rainfall (mm)	Average jassid population
		Maximum	Minimum	Average			
21	03.07.06	38.000 (6.205)	24.830 (5.033)	31.415 (5.649)	61.830 (7.895)	23.00 (4.848)	0.796 (1.138)
1	24.04.07	39.333 (6.311)	21.733 (4.715)	30.533 (5.571)	37.833 (6.191)	- (0.707)	0.230 (0.854)
2	28.04.07	39.725 (6.342)	19.05 (4.422)	29.3875 (5.467)	32.375 (5.734)	- (0.707)	0.316 (0.903)
3	01.05.07	42.033 (6.522)	21.8 (4.722)	31.9165 (5.694)	37.995 (6.204)	- (0.707)	0.635 (1.065)
4	05.05.07	40.7 (6.419)	23.4 (4.889)	32.05 (5.705)	39.375 (6.315)	11.2 (3.421)	0.210 (0.843)
5	08.05.07	41.333 (6.468)	24.166 (4.966)	32.7495 (5.766)	35.666 (6.014)	- (0.707)	0.432 (0.965)
6	12.05.07	38.52 (6.247)	22.8 (4.827)	30.66 (5.582)	45.625 (6.792)	4 (2.121)	0.383 (0.940)
7	15.05.07	40.933 (6.437)	24.33 (4.983)	32.6315 (5.756)	37.833 (6.11)	- (0.707)	0.531 (1.015)
8	19.05.07	41.325 (6.467)	27.15 (5.258)	34.2375 (5.894)	40.375 (6.393)	- (0.707)	0.694 (1.093)
9	22.05.07	39.366 (6.314)	24.633 (5.013)	31.9995 (5.701)	42.5 (6.557)	- (0.707)	0.918 (1.191)
10	26.05.07	39.525 (6.327)	23.825 (4.932)	31.675 (5.672)	33.625 (5.842)	- (0.707)	1.504 (1.416)
11	29.05.07	35.833 (6.028)	21.133 (4.651)	28.483 (5.384)	40.663 (6.416)	- (0.707)	1.440 (1.393)
12	02.06.07	40.075 (6.37)	22.45 (4.791)	31.2625 (5.636)	35.00 (5.958)	- (0.707)	3.267 (1.941)
13	05.06.07	41.233 (6.46)	24.9 (5.04)	33.0665 (5.794)	40.333 (6.39)	- (0.707)	5.353 (2.419)
14	09.06.07	42.72 (6.57)	26.55 (5.201)	34.635 (5.927)	35.625 (6.01)	- (0.707)	9.575 (3.174)
15	12.06.07	45.66 (6.794)	27.63 (5.304)	36.645 (6.095)	41.665 (6.493)	- (0.707)	12.286 (3.576)
16	16.06.07	40.6 (6.411)	29.3 (5.459)	34.95 (5.954)	55.125 (7.458)	20 (4.528)	1.432 (1.390)
17	19.06.07	32.7 (5.762)	22.5 (4.796)	27.6 (5.301)	72.83 (8.563)	2.8 (1.817)	3.279 (1.944)
18	23.06.07	36.2 (6.058)	24.2 (4.97)	30.2 (5.541)	56.375 (7.542)	7.1 (2.757)	4.173 (2.162)
19	26.06.07	38.8 (6.269)	26.57 (5.202)	32.68 (5.76)	58.66 (7.692)	- (0.707)	5.351 (2.419)
20	30.06.07	36.7 (6.099)	26.22 (5.169)	31.46 (5.653)	67.875 (8.269)	0.5 (1.00)	5.862 (2.522)
21	03.07.07	36.167 (6.055)	26.067 (5.154)	31.117 (5.623)	68.833 (8.327)	15.3 (3.975)	1.096 (1.263)

Correlation coefficients (r) between population of jassid on Okra and various weather factors.

Weather Factors	Years		Cumulative
	2006	2007	
Maximum temperature (°C)	0.155	0.174	0.157
Minimum temperature (°C)	0.073	0.484 *	0.342 *
Average temperature (°C)	0.142	0.394	0.295
Relative Humidity (%)	– 0.130	0.242	0.110
Rainfall (mm)	– 0.313	– 0.189	– 0.231

***** Significant at ≤ 0.05

Table II. Multiple linear regression model/s along with coefficients of determination (R^2) regarding the impact of weather factors on the population of jassid during 2006, 2007 and for combined 2006-2007 years on okra.

Regression equation	R^2	100 R^2	Role of individual factor (%)
2006			
$Y = -0.978658 + 0.40053\ X_1$	0.024	2.4	2.4
$Y = -1.105833 + 0.38283\ X_1 + 0.48055\ X_2$	0.024	2.4	0.00
$Y = -1.062264 + 22.788\ X_1 + 17.576\ X_2 - 40.231\ X_3$	0.032	3.20	0.8
$Y = -0.590469 + 21.377\ X_1 + 16.577\ X_2 - 37.847\ X_3 - 22.206\ X_4$	0.033	3.3	0.1
$Y = -3.313567 + 54.699\ X_1 + 41.672\ X_2 - 96.648\ X_3 + 0.28898\ X_4 - 0.18644\ X_5$	0.153	15.3	12
2007			
$Y = -2.256243 + 0.61681\ X_1$	0.030	3.00	3.00
$^*Y = -6.693761 + 0.11938\ X_1 + 1.5241\ X_2$	0.235	23.5	20.5
$Y = -6.514041 + 6.7429\ X_1 + 6.7152\ X_2 - 11.929\ X_3$	0.236	23.6	0.1
$Y = -16.217914 + 37.650\ X_1 + 27.978 X_2 - 63.880\ X_3 + 0.61813\ X_4$	0.303	30.3	6.7
$^*Y = -16.840585 + 18.331\ X_1 + 13.578\ X_2 - 29.763\ X_3 + 0.72240\ X_4 - 0.32307\ X_5^*$	0.47	47	16.7
2006-2007 (Combined)			
$Y = -1.540054 + 0.49604\ X_1$	0.025	2.5	2.5
$Y = -4.261055 + 0.16040\ X_1 + 0.97328\ X_2$	0.120	12	9.5
$Y = -4.117482 + 7.5551\ X_1 + 6.7666\ X_2 - 13.307\ X_3$	0.121	12.1	0.1
$Y = -8.977431 + 21.697\ X_1 + 16.551\ X_2 - 37.034\ X_3 + 0.26796\ X_4{}^*$	0.146	14.6	2.5
$Y = -11.485062 + 29.113\ X_1 + 21.827\ X_2 - 49.709\ X_3 + 0.54537\ X_4{}^* - 23.286\ X_5{}^{**}$	0.280	28	13.4

*, Significant at $P \leq 0.05$; **, Significant at $P \leq 0.01$; Y, Jassid population per leaf; X_1, Maximum temperature (°C); X_2, Minimum temperature (°C); X_3, Average temperature (°C); X_4, Average relative humidity (%), and X_5, Rainfall (mm).

jassid. The present findings are in partial agreement with those of Mahmood *et al.* (2002) who reported that rainfall had no significant contribution towards increasing or decreasing the leaf hopper numbers, whereas Prasad and Logiswaran (1997) found a negative association between the jassid population and rainfall during winter 1991 and during summer 1992. They found that the rainfall had a significant and negative association with the jassid population. Similarly present findings cannot be compared with those of Sekhon and Singh (1985) and Lal *et al.* (1990) who reported a significantly negative correlation between rainfall and jassid population, on cotton.

The effect of weather factors on cumulative basis during 2007 (Table II) revealed that the minimum temperature showed a maximum contribution of 20.5% in the population fluctuation of jassid on okra followed by the rainfall, relative humidity and average temperature with 16.7, 6.7, 3.0 and 0.1% role in the population fluctuation, respectively. The 100 R^2 value was observed to be 47 percent, when the effect of all the factors on the population fluctuation of jassid on the okra crop was analyzed together. None of the regression equation was found to fit the best. These findings can be compared with those of Prasad and Logiswaran (1997). Minimum temperature during 2007 and on cumulative basis during 2006 and 2007, showed a significant and positive correlation with the jassid-population on okra. In the present studies the relative humidity showed a negative and non-significant correlation with the jassid population during 2006, while during 2007 and on cumulative basis, this factor exerted a positive and non-significant effect on the jassid population. Furthermore, this factor was not so important, which contributed a minimum role in the population fluctuation of the pest during both the study years as well as on cumulative basis. These findings are in conformity with those of Mahmood *et al.* (1990), who reported that the relative humidity had no significant contribution towards increasing or decreasing the leaf hopper numbers, but these findings are contradicted with those of Bishnoi *et al.* (1996), who reported a significant relationship between population and relative humidity. Furthermore the present findings cannot be compared with those of Sharma and Sharma (1997) who found a positive and non-significant correlation between the relative humidity and jassid population on the cotton crop. Similarly, Prasad and Logiswaran (1997) found a positive association between the jassid population and relative humidity, on brinjal. The present findings are partially in accordance with those of Kumawat *et al.* (2000), Mahmood *et al.* (2002) and Arif *et al.* (2006), who reported a negative and non-significant correlation between the relative humidity and jassid-population on okra.

The multiple effect of weather factors for both study years revealed that the rainfall showed a significant and maximum contribution of 13.4% towards the population fluctuation of the jassid on okra followed by the minimum temperature, maximum temperature, relative humidity and average temperature (Table II) with a role of 9.5, 2.5, 2.5 and 0.1% in the population fluctuation of jassid on okra crop and all the factors showed a non-significant impact. The 100 R^2 value, was calculated to be 28, when the effect of all the factors, was computed together. Furthermore, none of the equation was found to be fitted the best.

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