Pakistan J. Zool., vol. 48(5), pp. 1511-1515, 2016.

Role of Physio-Morphic Characters of Different Genotypes of Eggplant, *Solanum melongena* L. and its Association with the Fluctuation of Jassid, *Amrasca biguttula biguttula* (Ishida) Population

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ABSTRACT

The experiment was conducted on different brinjal genotypes to find out the impact of physio-morphic plant characters on the jassid fluctuation. The seedlings of the six brinjal varieties *i.e.*, Purple Long F1, Oval Round White F1, Virb-02-F1, Round black, Long shape white F1 and Dil Nasheen were sown by keeping the plot size 9 m x 12 m on 24 June 2013. All the recommended agronomic practices were applied without using any plant protection measures for the control of pest population. The data regarding the population of jassid was taken randomly from fifteen leaves of fifteen plants /treatment/replication in such a way that each variety in each replication was selected and tagged. The different physio-morphic plant characters were recorded at the crop maturity. The maximum variations were observed among the resistance and susceptible brinjal genotypes due to plant height, hair density, number of primary branches and length of hair and moisture percentage. The effects of plant characters of brinjal were correlated with the population of jassids and calculated their impact by processing the data into simple and multiple linear regression equation. The hair density on the lamina showed the maximum impact (52.1%) for the population fluctuation of jassid. The number of primary branches and height of plants showed the minimum impact on jassid. The hair density and length of hair on the lamina and veins showed a highly significant negative correlation with the jassids population while midrib hair density showed the negative and non significant effects, but by the simple linear equation the moisture percentage, plant height and number of primary branches showed non significant and positive correlation.

Article Information
Received 2 February 2015
Revised 13 March 2016
Accepted 25 May 20016
Available online 1 August 2016

Authors' Contributions
MA conducted experimental work and wrote the article. AUB collected data about the pest. AA helped in leaf analysis. AG statistically analyzed the data. M. Ashfaq and UM helped in preparation of manuscript.

Key words
Brinjal (*Solanum melongena* L.), physio-morphic characters, Jassid, correlation

INTRODUCTION

Brinjal (*Solanum melongena* L.) is an important vegetable crop in Pakistan and many other countries. Insect pests are the main hurdle for the cultivation of the brinjal crop. Many insect pests attack the brinjal plants at different developmental stages of the crop which ultimately results for its low yield. The level of losses caused by insect pests depends upon the time of year, variety and additional factors (Dhamdhera *et al.*, 1984). The important insect pests of brinjal are fruit borer, stem borer, hadda beetle, jassid and whitefly but out of these pest brinjal jassid (*Amrasca biguttula biguttula*) is regarded as a severe pest of brinjal crop from sucking insect (Mahmood *et al*., 1990). The damage of the crop is done by both nymphs and adults by sucking the cell sap and turning the leaf pale yellow and curling downward. It also injects a toxic material into the leaf veins which cause necrosis of leaves around edges and in severe cases they fell down on the ground *A. biguttula biguttula* lays its eggs on the midrib of the leaves (Taylo and Bernardo, 1995). There is very little movement of the jassid nymphs between leaves and they remain confined to plants where hatched (Mabbett *et al.*, 1984).

The use of resistant genotypes is familiar as the imperative tool for the bio-intensive pest management system. The physio-morphic characteristics of plants and fruits are associated with attraction, feeding and egg lying of the insect pests. Development of varieties resistant to the insect pests is an important strategy of integrated pest management (Gaikwad *et al.*, 1991). The recognition of physical and morphological characteristics of resistant varieties may lead to introduction of resistance character in favored genotypes. Uthamasamy (1985) observed that the resistant genotypes had more hairs than the susceptible ones. The degree of trichomes, on the leaves occur in large number and plays a very important role in the plant defense particularly among phytophagous insects. Similarly Taylo and Bernardo (1995) concluded

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0030-9923/2016/0005-1511 $ 8.00/0

that emergence of *A. biguttula biguttula* was significantly and negatively correlated with the density of trichomes.

Therefore, the present study was undertaken to find out the correlation of different physico- morphological plant characteristics of different brinjal cultivars having various degrees of resistance and susceptibility with the population of jassid.

MATERIALS AND METHODS

The seedlings of the six brinjal cultivars (Purple Long F1, Oval Round White F1, Virb-02-F1, Round black, Long shape white F1, Dil Nasheen) were sown on 24 June 2013 in the experimental area of Institute of Agricultural Sciences (IAGS), University of the Punjab, Lahore. Randomized Complete Block Design (RCBD) was used with three replications. The Row x Row and Plant x Plant distance was kept as 30 x 30 cm respectively keeping the plot size 9 x 12 m. All the recommended agronomic practices were applied without using any plant protection measures for the control of pest population. The data were recorded immediately upon the appearance of jassid on the crop. The attack of the jassid was noted at vegetative stage of brinjal after forty days of seedling transplant. The data regarding the population of jassid was taken randomly from fifteen leaves of fifteen plants/treatment/replication in such a way that each variety in each replication was selected and tagged. The leaves were observed in such a way that one fully expanded leaf from the upper part of the first plant; second one from the middle part of the second plant and the third one from lower part of the third plant of each variety were selected at random. The average population of nymphs and adults per leaf, for each genotype, was calculated by simple arithmetic means. The different physio-morphic plant characters were recorded at the crop maturity. Leaves were collected, sealed in transparent white plastic bags and shifted to the laboratory for analysis.

The hair density on lamina, midrib and leaf vein of 5 plants were randomly selected in each genotypes within each replications , total 5 leaves (the leaves were observed in such a way that one fully expanded leaf from the upper part of the first plant; second one from the middle part of the second plant and the third one from the lower part of the third plant of each variety and so on) and their hair-density noted under a stereo microscope, which was converted in to (cm^2) with a simple multiplication. Number of primary branches/plant of 10 randomly plants were selected to count the number of primary branches in each test entry and their average/plant was calculated. Area of the leaf lamina (cm^2) of 5 randomly plants from each replication was selected and 3 full-grown leaves were taken randomly from (top, middle and lower part of each plant). Laser Leaf Area Measuring Meter Model CI 202 (USA made), was used to calculate the area of each leaf investigated.

The plant height (cm) of 10 plants was selected randomly from each test entry to measure the height of plant from ground level to top of canopy using the ordinary meter rod. Length of the hair on the leaf-lamina, midrib and vein (µm), five plants were selected randomly and from these three full-grown leaves were taken at random from each test entry to determine the length of hair on the leaf- veins, midrib and lamina under the microscope and ocular micro-meter was used. Moisture percentage in the leaves the ten grams of fresh leaves from (top, middle and bottom) parts of various plants were taken from every plot. All the leaves were cleaned with a muslin cloth, weighed and kept into a drying oven at a temperature 65°C, for 72 h. After the completion of time dry leaves were weighed and put back in to the oven again at 65°C for another 6 h. After the completion of time the leaves were taken out from the oven and kept in desiccators for 10 min and weighed when weight of the dry material became constant the moisture percentage was calculated, according to the following formula:

$$\text{Moisture percentage} = \frac{\text{Wt. of fresh leaves} - \text{Wt. of dry leaves}}{\text{Wt. of fresh leaves}} \times 100$$

The analysis of variance (ANOVA) was calculated and all the treatment means were compared by New Duncan's Multiple Range Test (DMR) at $P \leq 0.05$. The data on different physio-morphic plant characters was correlated with the jassid population. Multivariate regression models, by steps, were developed between pest-population and different physio-morphic plant characters**.** Simple correlation was worked out, between the population and physio-morphic factors individually and cumulatively, by using a Multiple Linear Regression Equation. The data was analyzed on an IBM-PC Computer, using M Stat Package (Steel *et al.*, 1997).

RESULTS

The consequences of physio-morphic characters of plants on the population fluctuation of the brinjal jassid were exhibited in present investigation. The seedling of six genotype of brinjal plant i.e., Purple Long F1, Oval Round White F1, Virb-02-F1, Round black, Long shape white F1 and Dil Nasheen were sown. The data on the different effects were processed for the simple correlation (r) and multiple linear regression analysis. Table I showed

Table I.- Jassid population per leaf on selected genotypes of brinjal at various dates of observations.

Name of genotypes	1 August	8 August	15 August	22 August	29 August	5 Sept	12 Sept	19 Sept	26 Sept	03 Oct
Purple Long F1	0.073 c	0.547 c	0.773 b	1.223 c	1.217 d	1.633 c	15.91 a	2.067 c	1.700	2.023 d
Oval round white F1	0.433 bc	1.073 c	1.567 b	1.247 c	1.937 cd	1.913 c	2.780 e	4.200 b	2.423	2.090 cd
Virb-02-F1	1.493 ab	2.753 a	3.197 a	3.617 b	3.133 bc	2.333 bc	3.710 d	3.687 bc	2.723	2.990 bc
Round black	2.177 a	1.417 bc	3.827 a	4.090 ab	3.757 b	3.890 ab	3.087 e	3.690 bc	2.580	3.220 b
Long shape white F1	1.310 abc	2.353 ab	2.897 a	2.933 bc	3.043 bc	2.823 bc	4.577 c	5.290 ab	3.730	4.710 a
Dil Nasheen	2.403 a	3.113 a	2.957 a	5.910 a	7.310 a	5.510 a	6.997 b	6.733 a	3.573	2.470 bcd
LSD value	**1.276**	**1.130**	**1.314**	**2.243**	**1.286**	**1.837**	**0.3156**	**1.679**	**NS**	**0.9169**

Table II.- Correlation coefficient values between jassid population per leaf and various physical plant characters on brinjal crop.

Morph-physical characters		r-values
Hair density	Lamina	-0.8245**
	Mid rib	-0.1473ns
	Vein	-0.8234**
Hair length	Lamina	-0.5775*
	Mid rib	-0.7253**
	Vein	-0.6617**
Moisture (%)		+0.3274ns
Plant height (cm)		+0.0565ns
Number of primary branches		+0.0680ns

*Significant at $P \leq 0.05$; **Significant at $P \leq 0.01$; ns, Non- Significant.

per leaf population of jassid on selected varieties of brinjal during different dates in 2013. Table II showed the correlation coefficient values of jassid population per leaf and physio-morphic characters of brinjal plant, while Table III reveal that hair density on lamina, midrib, and vein with (r) values were 0.521, 0.581 and 0.766. Hair length on lamina, midrib and veins and moisture % with (r) values were 0.784, 0.800, 0.815 and 0.857 highly significant correlations as well on the population fluctuation of jassids. On the other hand, (r) value of plant height was (0.857). According to the multiple liner regression results (Table IV) hair density on leaf lamina has a maximum impact 52.1% in fluctuation of jassid population and appeared to be the most significant physio-morphic plant character. The 2nd important factor was hair length on lamina which contributed 27.88% role in fluctuation of the pest population while plant height and number of primary branches has no any impact for jassid fluctuation. In the simple linear regression (Table IV) factors hair density at lamina, mid rib and vein have negative and significant effects on population fluctuation of jassid. The moisture percentage, number of primary branches and plant height showed positive and non significant impacts of each. The results being evident clearly indicate that hair density and hair length played very important role in the leaves of brinjal for the fluctuation of jassid population and showing negative and significant correlation.

DISCUSSION

The present study can be compared with Gaikwad *et al.* (1991) who reported that different morpho- physical plant characters have a correlation with brinjal jassid population. They showed that hair density on leaves was the main factor for causing resistance of jassid to brinjal. The hair density on the leaf veins is the second important factor which caused the resistance in the leaves of brinjal against the jasssid. Lokesh and Singh (2005) found the effect of hair density on the veins in relation with oviposition which showed negative and significant results. The results can be compared with Cassi-Lit and Bernardo (1990) who reported the significant and negative correlation between trichome-length, density of leaf hairs and number of primary branches caused the reduction of adult oviposition on the brinjal plant. In the same way Taylo and Bernado (1995) found that emergence of jassid has negative and significant correlation with hair density. The present study can compared with Naqvi *et al.* (2008) who reported that trichome density has negative correlation with the population of leafhopper *(Amrasca biguttula biguttula)* on the brinjal crop**.** Gaikwad *et al.* (1991) reported different morpho-physical plant characters and their correlation with the leaves of brinjal. The present study showed length of hair highly significant and negative correlation with the jassid, whereas Singh *et al.* (1988) also found the negative and significant correlation of jassid and hair length. Iqbal *et al,(2011*) reported hair-length on midrib of middle leaves, hair-length on the vein

Table III.- Morpho-physical plant characters in the leaves of various selected genotypes of brinjal.

Name of genotypes	Hair density			Hair length			Moisture (%)	Plant height (cm)	Number of primary branches
	Lamina (cm^{-2})	Midrib (cm^{-1})	Vein (cm^{-1})	Lamina (cm^{-2})	Midrib (cm^{-1})	Vein (cm^{-1})			
Purple long F1	1109 a	3021	530 a	35.89 a	31.32 a	26.44 a	84.04 a	71.53 a	5.40 a
Oval round white F1	749 b	729	513 a	23.47 b	16.94 b	17.89 b	80.48 bc	60.60 b	4.10 b
Virb-02-F1	790 b	766	472 ab	18.12 c	18.59 b	18.18 b	78.25 d	53.38 b	4.90 ab
Round black	707 b	491	383 b	16.97 cd	15.13 b	12.50 cd	78.67 cd	55.37 b	4.87 ab
Long shape white F1	765 b	640	440 ab	14.70 de	15.78 b	15.45 bc	82.55 a	55.07 b	5.49 a
Dil Nasheen	300 c	326	249 c	13.34 e	9.77 c	10.18 d	82.13 ab	59.03 b	4.67 ab
LSD value	**155.8**	**NS**	**127.0**	**3.101**	**4.240**	**3.085**	**2.013**	**9.050**	**1.262**

Table IV.- Multiple linear regression equations along with coefficient of determination between jassid population and various physical plant characters on brinjal crop.

Regression Equation	R^2	Impact (%)	F. Value±SE
$^{**}Y= 5.13-0.003X_1^{**}$	0.521	52.1	17.43±0.501
$^{**}Y= 5.19-0.003X_1^{**}+1.524X_2$	0.581	11.52	10.38±0.487
$^{**}Y= 6.19-0.001X_1+2.101X_2^{*}-0.005X_3^{**}$	0.766	27.88	15.25±0.481
$^{**}Y= 6.327-6.335X_1+2.831X_2^{*}-0.005X_3^{**}-0.032X_4$	0.784	2.35	11.78±0.497
$^{**}Y= 6.29-0.002X_1+3.220X_2^{*}-0.005X_3^{*}-0.065X_4+0.060X_5$	0.800	2.04	9.61±0.498
$^{**}Y= 6.285-0.001X_1+2.366X_2-0.007X_3^{*}-0.070X_4+0.008X_5+0.100X_6$	0.815	1.87	8.09±0.501
$^{**}Y= -1.061-7.853X_1+2.135X_2-0.007X_3^{*}-0.076X_4-0.005X_5+0.098X_6+0.093X_7$	0.857	5.15	8.57±4.313
$^{**}Y= -0.877-7.791X_1+2.265X_2-0.007X_3-0.083X_4-0.002X_5+0.094X_6+0.086X_7+0.008X_8$	0.857	0.00	6.76±4.909
$^{*}Y= -0.873-7.715X_1+2.271X_2-0.007X_3-0.083X_4-0.002X_5+0.095X_6+0.086X_7+0.008X_8-0.003X_9$	0.857	0.00	5.34±5.249

Where: X_1, hair density on lamina (cm^2); X_2, hair density on midrib (cm^{-1}); X_3, hair density on vein (cm^{-1}), X_4, hair length on lamina (mm); X_5, hair length on midrib (mm); X_6, hair length on vein (mm); X_7 , moisture percentage (%); X_8, plant height (cm); X_9, number of primary branches; R^2, coefficient of determination, and SE, Standard Error.

of middle leaves, plant-height and number of primary branches also showed a negative and significant correlation with the pest-population

In the present study number of primary branches showed positive and non significant correlation with the jassid population which is contrary to the studies done by Taylo and Bernardo (1995) who showed that leaf thickness and number of primary branches did not have the significant variation in resistant and susceptible genotype. In present study the moisture percentage showed positive and non significant correlation. While comparing these studies with Singh and Agarwal (1988) and Dhamdhera *et al.* (1984) who found that moisture contents had positive correlation with incidence of jassid (*A. biguttula biguttula).* From these results, it was concluded that resistance/susceptibility is governed by a combination of various factors rather than only from a single factor. The jassid not preferring hairiness or even long hairs on the leaf surface indicating that there may be oviposition hindrances observed by the jassids. As similar type of results were observed by Naqvi *et al*. (2008). Lit and Bernardo (1990) and Taylo and Bernardo (1995) showing reduced adult oviposition by jassid on hairy varieties. Therefore, we can conclude that there are many factors that can cause fluctuation of jassid population. The number of hairs, its length on leaf lamina, midrib and leaf veins can cause the increases or decrease of jassid population because if hairs will be more jassid population will be less if hairs will be less than jassid will be more.

ACKNOWLEDGMENT

We are highly grateful to the University of the Punjab for granting the financial support of research work.

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