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THE PHYSIO-MORPHIC CHARACTERS OF THE BRINJAL (*SOLANUM MELONGENA* L.) PLANT AND THEIR RELATIONSHIP WITH THE JASSID (*AMRASCA BIGUTTULA BIGUTTULA* (ISHIDA) POPULATION FLUCTUATION

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The brinjal is one of the most favorite host plants of the jassid (*Amrasca biguttula biguttula)* in the Pakistan. From the last few years it has gained the status of serious pest for different crops. The present study was conducted on some selected varieties of brinjal to find out the role of physio-morphic plant characters on the population fluctuation of jassid. The effects of physio-morphic characters of brinjal were correlated with the jassids population and their role was calculated by processing the data into simple and multiple linear regression equation. The maximum variations were observed among the resistance and susceptible brinjal genotypes due to plant height, hair density, number of primary branches, thickness of leaf lamina, leaf area, length of hair and moisture percentage. The hair density and length of hair on the lamina, midrib, and veins showed a highly significant negative correlation with the jassids population. While, the moisture percentage is significant and showed negative correlation and plant height showed the non significant negative correlation with the jassid population. Hair density on the lamina and the leaf area showed 78.2% and 5.9 % role respectively in the population fluctuation of jassid. The results showed that the physio-morphic characters of the brinjal plant play vital role in the population fluctuation of jassid.
Keywords: brinjal (*Solanum melongena* L.), pest resistance, physio-morphic characters, insect population

INTRODUCTION

Brinjal (*Solanum melongena L.*) is the important summer vegetable crop in the Pakistan and many other countries. The insect pests are the main hurdle for the cultivation of the brinjal crop. Many insect pests attack on the brinjal plants at the different developmental stages of the crop which ultimately results for its low yields. The level of losses caused by insect pests depends upon the time of year, variety and additional factors (Dhamdhare *et al.,* 1984). The most important insect pests of brinjal are brinjal fruit and shoot borer, stem borer, hudda beetle, and some sucking insect-pests like Jassid, aphid and whitefly. Out of these brinjal jassid (*Amrasca biguttula biguttula*) is regarded as a severe pest of brinjal crop (Mahmood *et al*., 1990). The damage of the crop is done by the 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 can cause necrosis of leaves around edges and in severe cases they fell down on the ground *A. biguttula biguttula* lays it's eggs in the midrib of the leaves. The eggs require about a week to hatch, and the nymphs require another two weeks to become adults. On transformation in to winged adults, they live for 5-7 weeks, feeding constantly on the plant cell-sap. There is very little movement of the leafhopper nymphs between leaves (Mabbett *et al*., 1984) and they remain confined to plants where hatched. The use of resistance 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 laying of the insect pests. Development of varieties resistant to the insect pests is an important strategy of integrated pest management (Bhatti *et al*., 1976). The recognition of physical and morphological characteristics of resistance varieties may lead to introduction of resistance character to 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 numbers and plays a very important role in the plant defense particularly among phytophagous insects. Similarly, Taylo and Bernardo (1995) concluded 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 jassids.

MATERIALS AND METHODS

The seed of nine different varieties of brinjal showing different response to the population of jassid is shown in the

(Table 1). These varieties were collected from Ayub Agricultural Research Institute (AARI), Faisalabd.

Table 1. Status of the different varieties of brinjal and their response against jassids

S.No	Varieties	Response
1	Rubi	***
2	Vrib-01	***
3	Culster king	***
4	Vrib-9901	**
5	Vrib-0401	**
6	Vrib-02-F1	**
7	Vrib-04	*
8	Nirala	*
9	Bemissal	*

* = Susceptible; ** = Intermediate; *** = Resistant

The seedling of the brinjal was sown on 19 February, 2010 in the experimental area of the Post Graduate Agricultural Research Station (PARS), using Randomized Complete Block Design (RCBD) with the three replications. The row to row and plant to plant distance was kept as 36 cm and 30 cm respectively keeping the plot size of 500 square feet (20x25) feet. All the recommended agronomic practices were applied without using any plant protection measures for the control of pest population. The data was noted immediately upon the appearance of jassid on the crop. The attack of the jassid was noted at vegetative stage of brinjal after the 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 the lower part of the third plant of each variety and so on. 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 transported to the laboratory for analysis. The various plant characters noted are given below.

***Hair density on lamina, midrib and leaf vein*:** The 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 at the different spots under a stereo microscope, which was converted in to cm^2 with a simple multiplication.

***Number of Primary branches/plant*:** The 10 randomly plants were selected to count the number of primary branches in each test entry & their average/plant were calculated.

***Area of the Leaf lamina (cm^2)*:** The 5 randomly plants from each replication was selected and 3 full-grown leaves were taken randomly. These leaves were taken 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.

***Plant height (cm)*:** 10 plants were selected randomly from each test entry to measure the height of plant from ground level to canopy. The ordinary meter rod was used to measure the height of brinjal plants.

***Thickness of the leaf lamina (μm)*:** The 5 full-grown leaves (top, middle and bottom parts) were taken each from five, randomly selected plants of each test entry. A fine razor was used to cut the cross-section of the leaves and six different places were determined for the thickness of leaf-lamina from of each leaf with the help of an ocular micrometer under a CARL ZEISS binocular microscope.

***Length of the hair on the leaf-lamina, midrib and vein (μm)*:** The five plants were selected and from these plants three full-grown leaves were taken from each test entry. Theses leaves were selected 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 (%)*:** 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 the temperature 65°C, for 72 hours. After the completion of time dry leaves were weighed again and put back in to the oven again at 65°C for another six hours. After the completion of time the leaves were taken out from the oven and kept in desiccators for 10 minutes and weighed. The weight of the dry material become constant the moisture percentage was calculated, according to the following formula:

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

***Statistical Analysis*:** 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 (Steel *et al*., 1997) Package.

RESULTS

The data on the different physio-morphic characters of plants were processed for the simple correlation (r) and multiple linear regression analysis with the objective to see the impact and effect of these factors on the population fluctuation of the brinjal jassid. Figure 1 shows per leaf population of jassid on selected varieties of brinjal during different dates in 2010. Correlation coefficient values of population of jassid per leaf and different physio-morphic plant characters are presented in the Table 2, where the results showed that hair density on lamina, midrib, and vein with (r) values of 0.884, 0.827 and 0.879 of all genotypes of leaves showed negative and significant correlation with brinjal jassid. Hair length on lamina, midrib and veins and moisture % with (r) values of 0.811, 0.835, 0.807 and 0.466 of all the leaves showed negative and highly significant correlation as well on the population fluctuation of jassids. On the other hand, the plant height (r) value of 0.266 showed non significant effect with jassid population.

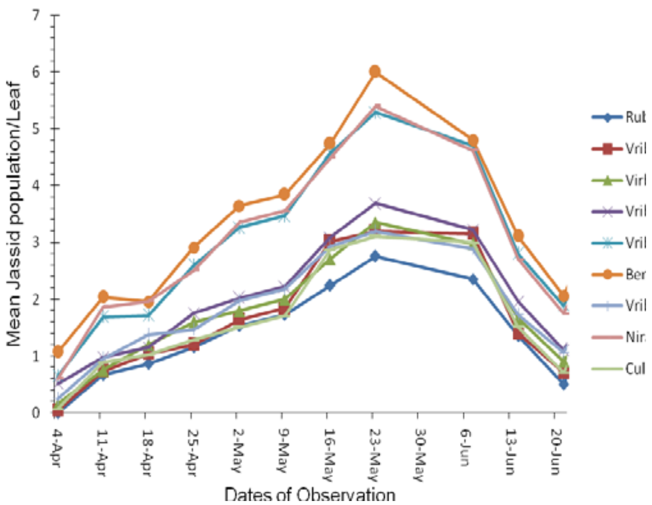

Figure 1. Mean population (leaf^{-1}) of brinjal jassid on different dates of selected genotypes of brinjal

Leaf area, number of primary branches and thickness of leaf lamina (r) values (0.753, 0.603 and 0.385 respectively) showed the positive and significant correlation effect on the jassid population fluctuation. The results being evident clearly indicating that hair density, hair length and moisture percentage played the very important role in the leaves of brinjal for the fluctuation of jassid population and showing negative & significant correlation. Similarly, leaf area, number of primary branches and thickness of leaf lamina are also very important factors contributing positive role for jassid population fluctuation significantly. According to the results, hair density on leaf lamina has a maximum role (78.2%) in fluctuation of jassid population and appeared to be the most significant physio-morphic plant character. The 2nd important physio-morphic plant character was leaf area which contributed (5.9%) role in fluctuation of the pest population. Some factors have negative and significant effects on population fluctuation of the jassid like the hair density on veins (2.9%), length of hairs on the mid rib area (0.02%), length of hairs on veins (1.4%) and hair density on midrib (2.9%). Thickness of leaf lamina showed positive and significant impact and its role was (0.1%) for jassid fluctuation. The moisture percentage and number of primary branches has 0.00% no impact of each.

DISCUSSION

The above results indicate that hair density on leaves showed to be the main important factor which played vital role in producing the resistance to jassid in 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. The present study can be compared with that of Naqvi *et al.* (2008). They reported that trichome density have a negative correlation with the population of leafhopper *(Amrasca biguttula biguttula)* on the brinjal crop**.** Likewise, Gaikwad *et al.* (1991) reported that different morpho- physical plant

Table 2. Correlation coefficient values between jassid population per leaf and various physical plant characters on brinjal crop

Name of Morph-Physical Characters		r-values
Hair Density	Lamina	-0.884**
	Midrib	-0.827**
	Vein	-0.879**
Length of Hair	Lamina	-0.811**
	Midrib	-0.835**
	Vein	-0.807**
Leaf Area		+0.753**
Moisture (%)		-0.466**
Plant Height (cm)		-0.266ns
Number of Primary Branches		+0.603**
Thickness of Leaf Lamina		+0.385*

**Significant at P ≤ 0.05; **Significant at P ≤ 0.01; ns, Non- Significant.*

Table 3. 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=	8.377 – 0.223X1**	0.782	78.2	89.55± 0.332
**Y=	8.396-0.235X1**+0.0159X2	0.782	0.00	43.05 ±0.339
**Y=	8.579-0.162X1*+0.0602X2-0.173X3	0.811	2.9	32.85±0.323
**Y=	8.247-0.0973X1+0.043X2-0.190X3 – 0.164 X4	0.814	0.3	24.00±0.327
**Y=	8.149-0.0882X1+0.0481X2-0.189X3+0.1307X4-0.372X5	0.816	0.2	18.60± 0.333
**Y=	8.304-0.126X1+0.0487X2-0.170X3+0.739X4-0.987X5+0.815X6	0.830	1.4	16.33± 0.327
**Y=	-4.949 – 0.204X1 + 0.025 X2 + 0.024 X3 – 0.404 X4 – 0.869 X5 + 1.367 X6** + 1.028 X7**	0.889	5.9	21.73±0.272
**Y=	-9.006 – 0.949X1 + 0.024 X2 + 0.004X3 – 0.395 X4 – 0.872 X5 + 1.359 X6* + 1.009 X7** + 0.491 X8	0.889	0.00	18.09 ±0.279
**Y=	-8.995 – 0.194X1 + 0.024X2+0.003X3 – 0.393X4 – 0.871X5 + 1.357 X6* + 1.008X7** + 0.494X8 – 0.009 X9	0.889	0.00	15.18±0.287
**Y=	-11.017-0.186X1+ 0.025 X2 + 0.023X3 – 0.453 X4 – 0.958 X5 + 1.466X6* + 1.054 X7** + 0.422 X8 + 0.129 X9 + 0.424 X10	0.890	0.1	12.99±0.294

Where: X1= Hair Density on Lamina (cm^{-2}), X2= Hair Density on Midrib (cm^{-1}), X3= Hair Density on Vein (cm^{-1}), X4= Length of Hair on Lamina (µm), X5= Length of Hair on Midrib (µm), X6= Length of Hair on Vein (µm), X7= Leaf Area (cm^2), X8= Moisture (%), X9= Number of Primary Branches X10= Thickness of Leaf Lamina (µm), R^2 = Coefficient of Determination and SE = Standard Error

characters do have a correlation with brinjal jassid. The results can be compared with Bernardo and Taylo (1990) they reported that significant and negative linear correlation among hair length, number of primary branches, and density of leaf hairs and causes larval liking and reduced adult oviposition on the brinjal plants. In the same way Taylo and Bernardo (1995) found that emergence of jassid showed the negative and significant correlation with hair density. The present study can also be compared by the Subbaratnam *et al.* (1983) who observed that thickness of the lamina & midrib have a positive correlation with infestation by the brinjal jassid while other observed characters showed no correlation with infestation. Lokesh and Singh (2005) found the effect of hair density on the veins in relation with oviposition which showed negative and significant results. Arvind and Ram (1999) reported that leaf vein thickness and length are the important factors in influencing of oviposition behavior against the leafhopper on brinjal. In the present study the thickness of leaf lamina and number of primary branches showed positive and significant correlation with the target pest 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 this study moisture % age showed negative and highly significant correlation. While comparing these studies with Singh (1988), who found that moisture contents has 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.

Therefore, putting the matter in a nutshell we can say about the findings of our research in a conclusion that as the number of hair and hair length on leaf lamina, midrib and leaf veins increases the population of jassid decreases likewise due to non- liking or non-preference. Similarly, as the leaf area, thickness and number of primary branches increases the jassid population also increases likewise. The jassid not preferring hairyness 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 Bernardo (1995) showing reduced adult oviposition by jassid on hairy varieties.

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