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# SCREENING OF OKRA GENOTYPES (*Abelmoschus esculentus* L.) AGAINST JASSID (*Amrasca biguttula biguttula* Ishida) UNDER AGRO-CLIMATIC CONDITIONS OF BAHAWALPUR, PAKISTAN

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**ABSTRACT**

Okra *(Abelmoschus esculentus* L.*)* is one of the important vegetable crops grown all over the world from tropical to sub-tropical areas. It can be grown throughout the year. It is also grown in Pakistan. There are many diseases and a number of insects which cause severe damage to okra and among these, jassid (*Amrasca biguttula biguttula* Ishida*)* is an important sucking pest, which causes damage by sucking the cell sap. Thus, current study was conducted regarding varietal screening of okra genotypes against jassid. Five different varieties*, i.e.,* Green wonder, Local cultivar, Pusa swani, Sabz pari and Sharmeeli were sown and investigated for jassid infestation. All genotypes were non-significantly different from each other regarding jassid population. Results showed maximum jassid population on Pusa swani (6.256 ± 1.978 per leaf) and minimum was on Green wonder (4.937 ± 1.561 per leaf). Jassid population significantly varied on okra genotypes with respect to different dates of observation, *i.e.* maximum jassid population was recorded on 29th of June and minimum was on 11th of May. Host Plant Susceptibility Indices (HPSIs) for okra genotypes showed that Pusa swani had maximum value (23%) and minimum on Green wonder (17%). Subsequently yield was maximum in Green wonder variety and minimum in Pusa swani and Sabz pari. Correlation of environmental factors (average temperature and relative humidity) showed temperature had negative and humidity had a positive correlation with jassid population. This study will be helpful for managing the *A. biguttula* on okra under agro climatic conditions like in Bahawalpur.

**Keywords:** Okra, jassid population, HPSI, Okra resistance, Okra yield.

## INTRODUCTION

The agro climatic conditions of Pakistan are extremely supportive and suitable for the cultivation of variety of crops, *i.e.* cereals, fiber, oilseed and others. Vegetables provide many nutrients, minerals, carbohydrates, proteins and vitamins (Rathod and Singh, 1990). They are grown because they are high yielding and mature in short duration. In Pakistan, more or less 35 vegetables are grown in different regions. About 3.1 % (6.62 million hectares) out of 22.45 % cropped area is used for vegetable sowing purposes which provide almost 3110.6 thousand tonnes of production (GOP, 2013). Among the vegetables grown in Pakistan, Okra (*Abelmoschus esculentus* L.) belonging to family Malvacae is a widely grown vegetable. It is traditional vegetable crop of Pakistan and cultivated in Kharif and Rabi seasons. In local trade, it is economically well established and usually handled by small farmers. It is economically and commercially grown as garden crop and used all over the world (Arapitsas, 2008; Saifullah and Rabbani, 2009; Akbar *et al.,* 2012). Being the native crop, it originated from Africa, south East Asia and north Australia to the pacific and cultivated in tropical to subtropical parts of the world (Memon *et al*., 2004). In the world, it occupies a land area of 1148 thousand hectares with a total production of 7896.3 thousand tons. However, in worldwide okra production, Pakistan is ranked at 6th number in comparison to India which is the biggest grower of okra all over the world (FAO, 2012).

Taxonomists have described about 50 different species of okra till now. Mainly it is grown in summer season *i.e.,* Mid March, in Pakistan with an average temperature ranging from 30 to 35°C in all soil types but usually sandy loam soil is best for sowing with an optimum pH range between 6.0-6.8 (Akande *et al*., 2003; Akinyele and Temikotan, 2007; Adilakshmi *et al*., 2008; Akanbi *et al*., 2010). It can also be grown in soil affected from salinity up to 6 mmhos per cm EC. It is propagated through seeds with duration of 90 to 100 days. Seed germinates well above 20°C however temperature higher than 42°C causes the dropping of flowers. Soil should be well drained and contain suitable amount of organic matter because okra roots are very sensitive to stagnation of water.

Okra is mainly grown for its fruit, the tender green pod capsule almost 18 cm in length. Pod contains seed which are white gray to black in color with a diameter of 3-6 mm (Dada and Fayinminnu, 2010). Pod is the actual edible part and used as vegetable in the entire world. Stems and roots of okra are also used to clean the sugarcane juice from which brown sugar is made. Ripe seeds of okra crop are used to roast and ground is used as an alternate of coffee while the dried seeds are used in the preparation of vegetable curds. Okra leaves can be used as animal feed. Fruit can be boiled, boiled in butter and cooked with spicy ingredients. It can also be used in soup thickness. Immature okra fruit can be used for pickling (Akintoye *et al*., 2011). Fruits and stem of okra contains

crude fiber and gummy material which is used in confectionary and glace paper making. It can also be used as a sauce and a mixture with rice, chicken, fish and maize. Okra seed contains almost 40 % oil contents. Extracts from okra seeds are also used as edible oil source because it has a good odor and pleasant taste. Okra seed oil is also high in oleic and linoleic type unsaturated fats (Arapitsas, 2008). In some of the regions, the leaves of okra are also used as salad. Leaves are also used as a non-caffeinated substitute for coffee and seed is a good source of seed oil (FAO, 2006).

Yield of okra crop is low in Pakistan as compared to other countries because like all other crops, okra is also infested by a number of diseases caused by fungi, insect pests, bacteria and nematodes which are responsible for not only yield but also for the qualitative loss in the production and decrease the income of the grower. Other factors which are responsible for low fruit yield include diseased seeds, weeds, minimum plant density, unnecessary fertilizer application, availability of space and salinity affected soils (Rahman *et al*., 2012). Among many diseases that attack okra includes okra vein mosaic virus, *Cercospora* leaf spot, *Fusarium* wilt, powdery mildew, damping off, enation leaf curl of bhindi, and leaf spot.

Almost 72 insect species have been recorded on okra crop (Pal *et al.*, 2013). Sucking insects cause significant damage by sucking cell sap. Insect pests cause 35-40% loss in the crop yield and damage can go up to 70% (Salim, 1999). Among the various sucking and chewing insect pests that attack okra at different stages from sowing to harvesting include jassid (*Amrasca biguttula* Ishida*)*, whitefly (*Bemisia tabaci* G.), aphid (*Aphis gossypi*), thrips (*Thrips tabaci* L.), spotted bollworm (*Earias vittela*), American bollworm (Helicoverpa armigera), fruit borers, shoot borer (*Earias insulana* B. and *Earias vittella* Fab.), mites, leaf rollers and some root feeding insects (Dubey *et al.,* 1999; Oliveria *et al.,* 2001; Nizamani *et al.*, 2002; Ali *et al.*, 2005; Mastoi *et al.*, 2013). The root-knot nematode (*meloidogyne spp*.) is also a severe pest of okra and all other vegetables (Sikora and Fernandez, 2005). All these insect pests along with reducing the yield also transmit different pathogenic and viral diseases (Atwal, 1994).

Among all the sucking insects, jassid *Amrasca biguttula* Ishida (Homoptera: Cicadellidae) is an important pest (Kumawat *et al*., 2000). Jassid is important because the environmental conditions of tropics and subtropics are more suitable for the growth and development of both the host and the pest (Dhandapani *et al.,* 2003). Okra is an important crop for the nymphal survival and feeding. Both nymph and adults are agile and suck plant juice. They move briskly forward and sideward when disturbed which is their identifying characteristic. Jassid attacks many crops including okra. Both the nymph and adult of jassid cause damage as they suck cell sap and meanwhile insert toxic saliva into the plant cells. Their saliva contains protease and lipase for proteins and lipids digestion. Saliva also contains toxins which cause tissues necrosis and phytotoxemia in host plants. The insect not only reduces the farmer's profit but also transmits many pathogenic diseases. The leaves color changes from green to yellow brown, turn downward, which is the characteristic feature of sucking insects especially jassid, leaves margins become grayish, plant growth stunts, it weakens, photosynthetic area decreases and ultimately die (Bhatangar and Sharma, 1991; Lohar, 2001; Asi *et al*., 2008 ).

Use of pesticides is considered an easy approach to control the pests whatever the crop is but it is not environment friendly. Economically it is costly and the agro ecosystem has destabilized. It has gone out of the reach of the common farmer to use pesticides year after year. The pesticides are hazardous to human health and all other organisms. They also decrease the density of beneficial insects and soil microorganisms. Insects have developed resistance to insecticides and minor pests are changing to major pests. Other alternate control measures should be adopted so that agriculture can be saved for next generations. So it is important to develop alternate non-insecticidal techniques for controlling insects.

Host Plant Resistance is considered as one of the most safe and effective technique. Plants have many chemical and structural adaptations which they can use against their enemies. A resistant variety when used in connection with other useful management practices proves a useful control system. HPR is seen as very sustainable approach and a varietal trial of different okra genotypes against jassid has become essential. The present study was designed to test the response of available okra genotypes to jassid to measure their susceptibility. The objective of this experiment was to screen some locally available genotypes of okra for susceptibility/resistance to *A. biguttula* on the basis of insect pest population per leaf and their yield comparison under Bahawalpur agro-climatic conditions.

## MATERIALS AND METHODS

The study was conducted for okra varietal screening against jassid (*Amrasca biguttula* Ishida*)* under the natural circumstances in field research area of Entomology section of Islamia University of Bahawalpur, Pakistan. The row to row distance was 60 cm with a 30 cm plant to plant distance. Seeds of five different varieties namely Green wonder, Local cultivar, Pusa swani, Sabz Pari, and Sharmeeli were obtained from Ayyub Agricultural Research Institute (AARI) Faisalabad, Pakistan. The sowing was done in mid of March, 2015 in a Randomized Complete Block Design with 3 replications.

### Land preparation

The land was cleared and ploughed twice with a tractor. The land was leveled manually and any roots stumps were eradicated prior to sowing. Ridges were prepared by ploughing and raking. The field was divided into 15 plots with plot size 2.5m x 2.5m. The distance between the plots was 60 cm. The path between the replications was 90 cm. During the cropping period weeds were removed manually in plots to avoid their competition for water, nutrients, space and light with the crop.

Seed treatment

Seed after seed treatment (Anam *et al.,* 2002) with a fungicide was sown manually as 2 seeds at a spot for better germination.

**Nymph/adult jassid population count**

The observations were taken on the pest infestation from 11th of May until the crop harvesting. The observations from five selected plants from each treatment at random were taken and six leaves from each plant were studied thoroughly *i.e*., 2 leaves from bottom, 2 from middle and 2 from top. The nymphs of the jassid were also recorded by turning the leaves as gently as possible to avoid the escape of the insect pests from plants. The data was recorded at weekly interval in the morning hours. The screening of selected okra genotypes was based on per leaf population density count and data was subjected to statistical analysis. To calculate and correlate the yield of each variety, hand picking of fruit from five randomly selected plants from each plot was done with standard day interval.

The average adult and nymph, jassid population per leaf for each genotype was calculated by simple arithmetic means by using following formula (Iqbal *et al*., 2008):

$$X = \frac{X1 + X2 + X3 + X4 + X5}{N}$$

Where X is average population per leaf, N is the total number of plants observed and $X_1 + X_2 + X_3 + X_4 + X_5$ are the number of observed plants

**Host Plant Susceptibility Indices (HPSIs)**

Host Plant Susceptibility Indices of different okra genotypes were calculated on the basis of jassid adult/nymph density. Following formula (Afzal *et al.*, 2015) was used to calculate HPSI:

$$\text{HPSI}\ (\%) = 100 - \frac{B - A}{B} \times 100$$

Where A = Adult/nymph population in individual okra genotype

B = Adult/nymph population on all okra genotypes on average basis.

**Yield calculation**

Five different plants were tagged per plot in each plot. Manually okra pods were picked and per plant weight was determined by mathematical conversions. Yield per acre and per hectare was calculated.

**Statistical analysis**

The recorded data was analyzed statistically by using Analysis of variance (ANOVA) and means were separated by Least Significance Difference (LSD) test at 5 % probability level (Steel *et al*., 1997).

**RESULTS**

The present study was designed to screen five different okra genotypes against jassid *A. biguttula* under field conditions of Bahawalpur. Data regarding per leaf population of jassid on okra was recorded with weekly interval from randomly selected five plants per plot. Yield was also calculated. Population of jassid was also correlated with the environmental factors, *i.e.,* average temperature and relative humidity. The statistically analyzed data with the Analysis of Variance and Least Significance Difference is described as under:

**Observation of Jassid (nymphs and adults) population**

**Screening of the genotypes**

The analysis of variance of the data regarding jassid per leaf population taken from various okra genotypes during 2015 at weekly observation revealed a non-significant difference among genotypes ($P > 0.05$; Table-1). Genotypes regarding per leaf population of jassid, varied in a descending order as: Pusa swani > Local cultivar > Sharmeeli > Sabz pari and Green wonder. From these results it is clear that Pusa swani and Local cultivar were most preferred by the jassid as compared to Sharmeeli and Sabz pari which were intermediately preferred by the jassid while the Green wonder was found comparatively resistant variety. The means were compared by LSD Test. It is clear from results that the okra genotype Pusa swani showed a maximum jassid population (6.256 ± 1.978 jassid per leaf) followed by Local cultivar (6.117 ± 1.934 jassid per leaf), Sharmeeli (5.689 ± 1.799 jassid per leaf) and Sabz pari (5.297 ± 1.675 jassid per leaf) respectively. These differed with one another non-significantly however minimum jassid population was recorded on Green wonder (4.937 ± 1.561 jassid per leaf).

**Trends in the population fluctuations of jassid on different dates of observation**

The data regarding population of jassid per leaf on various dates of observation was taken. The analysis of variance of the data showed a significant result (Table-4.2). The means were compared by a LSD Test at P=0.05 (Table-4.2a). The minimum jassid population per leaf was recorded at 11 May, 2015 while an increasing trend was observed thereafter in upcoming dates. An increasing and decreasing trend was observed on the subsequent dates and reached to a high peak on 29 June 2015. A slight decrease in jassid population was again observed on 6 July 2015.

**Table-1.** Means comparison of data regarding per leaf population of jassid on selected genotypes of okra.

| **Genotype** | **Jassid Population** (Mean ± S.E) |
|---|---|
| Pusa swani | 6.256 ± 1.978a |
| Local cultivar | 6.117 ± 1.934a |
| Sharmeeli | 5.689 ± 1.799a |
| Sabz pari | 5.297 ± 1.675a |
| Green wonder | 4.937 ± 1.561a |
| *F* | .67 |
| *Df* | 4 |
| *P* | .6116 |

(P=0.05)

**Table-2.** Means comparison of data regarding per leaf population of jassid on selected genotypes of okra on different dates.

| **Dates** | **Means** |
|---|---|
| 29.06.2015 | 13.422a |
| 06.07.2015 | 12.124b |
| 22.06.2015 | 8.164c |
| 15.06.2015 | 6.713d |
| 08.06.2015 | 4.591e |
| 13.07.2015 | 3.262f |
| 25.05.2015 | 2.647fg |
| 01.06.2015 | 2.478g |
| 18.05.2015 | 1.787h |
| 11.05.2015 | 1.498h |
| *F* | *358.75* |
| *Df* | *9* |
| *P* | *0.0000* |

Means sharing same letter are not significantly different from each another by LSD Test at P=0.05.

**Host Plant Susceptibility Indices (HPSIs)**

On the basis of jassid population density on okra genotypes, the Host Plant Susceptibility Indices were also calculated (Table-3). Pusa swani showed a maximum of 23 % HPSI, followed by Local cultivar 21%, Sharmeeli 20 % and Sabz pari 19 %. Minimum Host Plant Susceptibility Indices was recorded on Green wonder *i.e.,* 17% (Figure-1).

**Table-3.** Host Plant Susceptibility Indices (HPSIs).

| **Genotypes** | **Host plant susceptibility indices** (%) |
|---|---|
| Pusa swani | 23 |
| Local cultivar | 21 |
| Sharmeeli | 20 |
| Sabz pari | 19 |
| Green wonder | 17 |

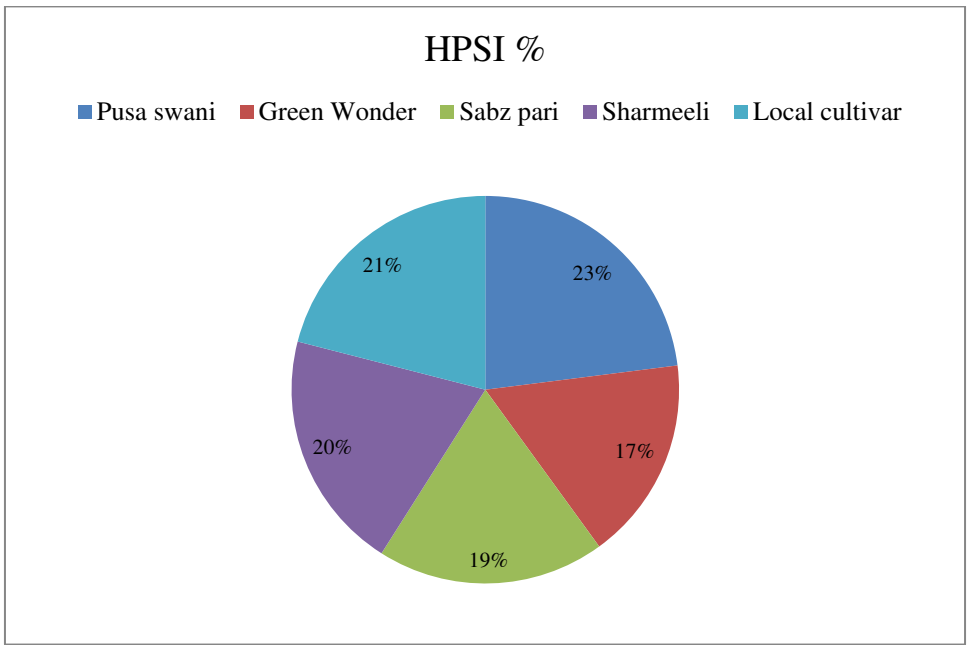


**Figure-1.** Host plant susceptibility indices of different okra genotypes.

**Fruit yield per plant, per plot, per acre and per hectare**

The data regarding fruit yield from various selected okra genotypes was also taken and their analysis of variance showed a significant difference among different genotypes (Table-4). The means were compared by LSD Test at P = 0.05. The genotype Green wonders showed a maximum yield of 9074.997 kg/hectare and minimum yield was recorded from Sabz pari 7049.711 kg/hectare (P < 0.05).

**Table-4.** Mean comparison of yield in grams per plant of different okra genotypes.

| Genotypes | Means ± SE |
|---|---|
| Green wonder | 131.72±3.742a |
| Local cultivar | 131.52±1.778a |
| Sharmeeli | 123.15±1.848a |
| Pusa swani | 117.98±1.019ab |
| Sabz pari | 102.32±3.879b |
| F | 4.72 |
| Df | 4 |
| P | 0.0025 |

(P=0.05)

**Table-5.** Calculation of okra yield per plant, per plot, per acre and per hectare.

| Genotype | Yield in kg/plant | Yield in kg/plot | Yield kg/acre | Yield in kg/hectare |
|---|---|---|---|---|
| Pusa swani | 0.117983 | 4.95521 | 3289.837 | 8129.187 |
| Green Wonder | 0.131716 | 5.53207 | 3672.601 | 9074.997 |
| Sabz pari | 0.102316 | 4.29702 | 2852.979 | 7049.711 |
| Sharmeeli | 0.12315 | 5.17231 | 3433.914 | 8485.201 |
| Local cultivar | 0.131516 | 5.52372 | 3667.024 | 9061.216 |

**Correlation of jassid population with weather factors**

Insects are poikilothermic organisms and their body metabolism is largely controlled by the environment they reside in. Therefore appropriately population of Jassid was also correlated with the environmental factors *i.e.,* temperature and relative humidity (Table-6). From the results it is clear that temperature had a negative correlation with the jassid population as with the increase in temperature, the number of jassid decreased. The relative humidity had a positive correlation with the jassid population in the early hours.

**Table-6.** Correlation of jassid population with temperature and humidity.

| S. No. | Factor | P-value | r-value |
|---|---|---|---|
| 1 | Temperature | 0.1027 | -0.1338 |
| 2 | Humidity | 0.0122 | 0.2043 |

(P=0.05)

It is clear from the results that a maximum jassid population was recorded as 13.422 jassid per leaf on 29 June 2015 with an average temperature of 32.6 °C and a relative humidity of 69.2% (Table-7).

**Table-7.** Weekly data of weather factors of Bahawalpur during 2015.

| S. No. | Date | Minimum Temperature (°C) | Maximum Temperature (°C) | Average Temperature (°C) | Avg. Relative Humidity (%) |
|---|---|---|---|---|---|
| 1 | 11-05-2015 | 25.3 | 39.5 | 32.4 | 70.1 |
| 2 | 18-05-2015 | 26 | 42.4 | 34.2 | 67.9 |
| 3 | 25-05-2015 | 24 | 43.6 | 33.8 | 70.8 |
| 4 | 01-06-2015 | 27.2 | 41 | 34.1 | 71 |
| 5 | 08-06-2015 | 26 | 41.2 | 33.6 | 69.1 |
| 6 | 15-06-2015 | 24.4 | 43.6 | 34 | 69.8 |
| 7 | 22-06-2015 | 28.5 | 40.7 | 34.6 | 71.7 |
| 8 | 29-06-2015 | 26 | 39.2 | 32.6 | 69.2 |
| 9 | 06-07-2015 | 25 | 39.4 | 32.2 | 75.6 |
| 10 | 13-07-2015 | 26.2 | 35.2 | 30.7 | 76.2 |

**Source:** Regional Agricultural Research Institute (RARI) Bahawalpur.

## DISCUSSIONS

The present study was conducted to evaluate five different okra genotypes against *Amrasca biguttula biguttula* and no pesticides or any other integrated pest management practices were used in this trial to control jassid. Population of jassid per leaf varied non-significantly on different tested varieties. On the other hand population of jassid varied on these varieties in descending order as Pusa swani > Local cultivar > Sharmeeli > Sabs pari > Green wonder as Pusa swani showed a maximum jassid per leaf population (6.256 ± 1.978) followed by Local cultivar (6.117 ± 1.934), Sharmeeli (5.689 ± 1.799) and Sabz pari (5.297 ± 1.675) respectively. These varieties differed with one another non-significantly however minimum per leaf jassid population was recorded on Green wonder (4.937 ± 1.561). These findings are in agreement with those of Iqbal *et al.* (2008), Hussain *et al.*(2014), Hooda *et al.*(2011) and Mastoi *et al.* (2013) who reported that okra variety Pusa swani was the most susceptible variety to jassid as maximum jassid population was found on it.

Host Plant Susceptibility Indices of different varieties were also calculated. HPSIs of Pusa swani was (23%), Local cultivar (21%), Sharmeeli (20%), Sabz pari (19%) and Green wonder (17%). These findings are again in line with that of Iqbal *et al.* (2008) who reported that HPSI was recorded maximum for the Pusa swani.

There was a significant difference in yield of different varieties and maximum yield was obtained from Green wonder (9074.997 kg/hectare) while for Pusa swani due to insect pest infestation comparatively low yield was recorded. These results are in agreement with that of Hussain *et al.* (2014) who found that Pusa swani gave low yield.

From these results it is clear that Pusa swani and Local cultivar were comparatively preferred by the jassid, *Amrasca biguttula biguttula*. Sharmeeli and Sabz pari were found intermediately resistant while Green wonder with lowest pest infestation was found most resistant to jassid.

Present results can be partially compared with the Khambete and Desai (1996) who studied different okra genotypes and found that Pusa swani was susceptible. However, these results cannot be compared with those of Taylo and Bernardo (1995) because genotypes tested were different than the present tested genotypes.

Insect pest population fluctuated with the rise and fall of temperature. Temperature showed a negative correlation with the jassid population and relative humidity was positively correlated with the jassid population. These findings are in agreement with that of Rehman *et al.* (2015) for these findings. Present result is important regarding screening of okra genotypes against jassid and can be employed in integrated management of this pest in okra crop.

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