Research Article

# Preference of Cotton Jassid, *Amrasca Devastans*, Towards Different Okra Cultivars Having Variable Physio-morphic Characteristics

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**Abstract** | Five cultivars of Okra viz., Sabz Pari, Shakti Hybrid, NS-810, OK Advanta-803 and NS-801 were tested for resistance against *Amrasca devastans* (Dist.) at the farm area of Vegetable Research Institute, Ayub Agricultural Research Institute (AARI), Faisalabad in 2018-19. Observations regarding the population of *A. devastans* were recorded from 20 leaves per treatment at random (upper, lower, middle leaves), Physio-morphic characters viz., plant height, number of branches, area of leaf lamina, hair density on midrib, chlorophyll contents and moisture percentage were also evaluated for the tested varieties. Among the tested varieties, OK Advanta-803 was most resistant to the jassid (13.36/leaf), whereas NS-810 was most susceptible to the *A. devastans* (23.93/leaf). *A. devastans* population showed a significant and positive correlation (r = 0.8573*) with area of leaf lamina and moisture percentage (r = +0.7192*). As leaf area of NS-810 (184.34 $cm^2$) was larger; therefore, this variety showed maximum susceptibility to *A. devastans* while OK Advanta-803 showed minimum *A. devastans* population per leaf due to its smaller leaf area (91.04 $cm^2$) compared to other varieties. Similarly, *A. devastans* population was maximum in NS-810 due to its higher moisture contents (66.07%), while it was minimum in OK Advanta-803 due to lesser moisture contents (52.17 %) in this variety. However, all other physio-morphic characters viz., plant height, number of branches, hair density on midrib, and chlorophyll contents showed a non-significant correlation with *A. devastans* population.

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## Introduction

In Pakistan and various other geographical regions, okra (*Abelmoschus esculentus* L.) is one of the chief vegetable crops. It is very delicious food and its immature fruit is eaten eagerly in the sub-continent, especially in Pakistan (Aziz *et al.*, 2011). Various vitamins such as A, B, and C; food components, e.g., fats, proteins, carbohydrates and minerals such as iodine and iron, are significant constituents of okra (Norman, 1992).

Okra plants suffer from severe quality and yield losses due to damage by different insect pests at various stages of crop development. However, the losses incurred to the okra crop vary depending upon the variety, time

of the year, environmental conditions and success or failure of control tactics applied (Dhamdhera *et al*., 1984). Pests of significant importance are hadda beetle *Epilachna vigintioctopunctata* Fab, jassid *Amrasca devastans* (Distant), whitefly *Bemisia tabaci* (Gennadius) and fruit borer *Earias vittella* (Fab.). Still, among these pests, *A. devastans* is regarded as a severe sucking pest of Okra (Mahmood *et al*., 1990). *Amrasca devastans* lays eggs on the midrib of the leaves. The nymphal and adult stages of this pest deprive the plant of some of its important nutrients due to uptake of cell sap from the phloem, resulting in which leaves become pale yellow and curl downward. During feeding activity, insects also transmit toxic substance into the leaf veins. As a result, leaves become necrotic from the periphery and fell to the ground in severe cases (Taylo and Bernardo, 1995).

One of the vital pesticide-free tools for controlling crop pests is the cultivation of resistant genotypes whose morphological and physiological characteristics deter oviposition and feeding by insect pests. Such characters also make plants less attractive to different insect pests. The use of host plant resistance (HPR) by synthesis of resistant varieties with desired characters is an integral part of integrated pest management (IPM) (Gaikwad *et al*., 1991). In the resistant varieties, the detection of morphological and physiological characteristics may help to develop new resistant varieties with desired genotypes.

The resistant genotypes were found to be hairier as compared to susceptible ones. Trichomes are present in large number on leaves and many plants use these morphological structures as a defence to halt the feeding of various herbivorous insects (Uthamasamy, 1985). In a study conducted by Taylo and Bernardo (1995), a significant negative correlation was found between populations of *A. devastans* with the trichomes density. We assessed the impact of various morphological and physiological features of different okra cultivars on the population dynamics of *A. devastans* and a correlation of the population was also established with these physio-morphic features of different cultivars. The study will help to evaluate the degree of susceptibility and resistance of cultivars against the infestation of *A. devastans.*

## Materials and Methods

### *Cultivars and research area*

Five cultivars of Okra viz., Shakti Hybrid, NS-810, OK Advanta-803, Sabz Pari, and NS-801 were evaluated for resistance against *Amrasca devastans* (Dist.). These cultivars were grown at research farm area of Vegetable Research Institute (VRI), Ayub Agricultural Research Institute (AARI), Faisalabad (31.4504° N, 73.1350° E), Pakistan (30.3753° N, 69.3451° E) during 2018-19.

### *Research design and layout*

All varieties were grown in five (5) replicates using a randomized complete block (RCB) design in the sowing season. The size of each plot was maintained as 5 × 2 $m^2$ while plant to plant (P × P) and row to row (R × R) distances were 9 and 10 m, respectively. In all the plots, the same agricultural practices such as weeding, hoeing, irrigation, and fertilizer application were done throughout the season.

### *Population estimation and physio-morphic parameters studied*

Data recording was commenced instantly after the appearance of *A. devastans* on the crop. Twenty leaves of each cultivar (treatment) were selected randomly from the upper, middle and lower portion to count the jassid population. All the chosen cultivars were also studied at the crop maturity regarding different physio-morphic characters such as chlorophyll contents, moisture percentage, plant height, area of leaf lamina, number of branches, and hair density on leaf midrib. To evaluated various characteristics of cultivars, leaves were collected and shifted to the laboratory for analysis in transparent white plastic bags. Each character was assessed using the following methodology:

### *Hair density*

For each genotype (cultivar) five plants were selected randomly from each replication (total replications were 5) to count the hair density on mid-rib (trichomes) under a stereomicroscope in the laboratory.

### *Number of branches*

Ten plants from each replicate ($n$ = 5) of every genotype were randomly chosen in the field to count the number of primary branches and their means/plant were determined from each replication.

### *Area of leaf lamina ($cm^2$)*

From each replication of the genotype understudy, five plants were randomly selected and leaves from the top, middle, and lower portions were used to estimate leaf lamina area ($cm^2$) using leaf area meter.

*Plant height (inches)*

The height of the plant (inches) was measured from ground level to the top of the canopy with the help of a meter rod. Ten (10) plants from every replication of each cultivar (total 50 plants) were randomly selected to measure the plant height.

*Moisture percentage in leaves*

Fresh leaves weighing 10 g were taken randomly from the top, middle and lower portion of different plants of each cultivar from every plot. With the help of muslin cloth, these leaves were cleaned and weighed. Afterwards, these were placed inside the drying oven for 72 h at 65°C. After the lapse of three days, leaves were taken out from the oven, weighed and transferred to the same oven again. The oven was operated again at 65°C for another six hours. After that, the leaves were removed from the oven and placed in desiccators for 10 min and weighed. The moisture level (%) was determined using the following equation when the dry material became constant:

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

*Data analysis*

The data regarding the jassid population and physio-morphic characteristics of each cultivar were analyzed by statistical analysis by Statistix software (version 8.1) using RCBD. Mean values for each treatment were compared for significance using Tukey's test. A pair-wise correlation (r) analysis was also performed between the jassid population/leaf and different characteristics of each selected okra cultivar using the same software.

## Results and Discussion

*Average jassid population*

The mean population of jassid observed at each genotype is given in Table 1. The maximum population of jassid per leaf (23.93/leaf) was observed in NS-810 as compared to other genotypes, i.e. NS-801 (17.13/leaf), sabz pari (16.86/leaf), shakti hybrid (14.73/leaf) and OK Advanta-803 (13.34/leaf).

*Physio-morphic characteristics*

Data of plant height, no. of branches, area of the leaf, chlorophyll contents, moisture % and hair density on mid-rib for different okra varieties is given in Table 2. Plant height was significantly higher in Shakti Hybrid (27.67 inches) and Sabz Pari (27.13 inches) compared to NS-801 and OK Advanta-803, i.e. 21.33 inches and 22.80 inches, respectively. The number of branches did not differ significantly among all cultivars. A considerably higher leaf area (184.34 $cm^2$) was recorded in NS-810 and NS-801 (141.30 $cm^2$). However, Shakti Hybrid showed significantly less leaf area (91.04 $cm^2$) compared to all cultivars. The leaf area of Sabz Pari (104.74 $cm^2$) and OK Advanta-803 (107.11 $cm^2$) was significantly similar but higher than Shakti Hybrid (91.04 $cm^2$). Chlorophyll contents were substantially higher in Shakti Hybrid than all other genotypes tested. The rest of the genotypes were significantly similar in chlorophyll contents. Moisture (%) was considerably higher in NS-810 than Shakti Hybrid and NS-801, but it was pretty identical to Sabz Pari and OK Advanta-803. Maximum hair density on the mid-rib of the leaf was recorded for OK Advanta while it was least for Sabz Pari and NS-801.

**Table 1:** *Average population (per leaf) of jassid at different cultivars of okra.*

| Varieties/ genotypes | Population of jassid /leaf±SE |
|---|---|
| Sabz pari | 16.86±0.48b |
| Shakti hybrid | 14.73±0.24b |
| NS-810 | 23.93±1.35a |
| OK advanta-803 | 13.34±0.56b |
| NS-801 | 17.13±0.86b |
| LSD | 4.08 |

*Average values with similar letters are not different statistically (P>0.05); SE: Standard Error.*

*Correlation between jassid population/leaf and physio-morphic characteristics*

Table 3 illustrated the correlation coefficient between the jassid population/ leaf and physio-morphic characteristics of different okra cultivars. Results showed that plant height, no. of branches, area of the leaf ($cm^2$), mid-rib hair density and moisture % exhibited r values of 0.0492, 0.3128, 0.8573, 0.3608, 0.7192 and 0.8102, respectively. A positive and significant correlation was obtained between the area of leaf and leaf moisture %. While a non-significant and negative correlation was established between plant height and chlorophyll contents and no. of branches also showed non-significant correlation, it was positive. However, midrib hair density was negatively and significantly correlated with the population of jassid.

**Table 2:** *Characteristics of cultivars studied.*

| Genotypes | PH (inches)±SE | NB±SE | LA±SE | CC±SE | M±E | HDM/cm±SE |
|---|---|---|---|---|---|---|
| Sabz pari | 27.13±0.56a | 7.13±0.59a | 104.74±0.87c | 51.56±1.89b | 55.72±0.26ab | 3.66±0.33c |
| Shakti hybrid | 27.67±0.58a | 6.53±0.17a | 91.04±1.13d | 66.80±0.23a | 52.71±2.64b | 7.0±1.00b |
| NS-810 | 24.40 ±0.20b | 7.27±0.78a | 184.34±2.62a | 52.73±2.76b | 66.07±3.38a | 1.33±0.34d |
| OK advanta-803 | 22.80 ±0.30bc | 6.00±3.55a | 107.11±1.33c | 53.76±0.84b | 56.75±3.38ab | 9.67 ±0.33 a |
| NS-801 | 21.33± 0.56c | 5.067 ±0.35a | 141.30±1.47b | 49.80±1.11b | 61.30±0.97b | 3.00± 1.00c |
| LSD | 2.24 | 2.72 | 8.23 | 8.64 | 13.16 | 1.61 |

*Average values with similar letters are not different statistically (P>0.05); S.E: Standard Error; PH: Plant Height (inches); NB: Number of Branches; LA: Leaf Area (cm²); CC: Chlorophyll contents; M: Moisture (%): HDM: Hair Density on Mid-rib.*

**Table 3:** *Correlation coefficient analysis between physio-morphic features of okra cultivars and jassid population per leaf.*

| Physio-morphic parameters | r-values |
|---|---|
| Plant height (inches) | -0.0492ns |
| No of branches | +0.3128ns |
| Area of leaf lamina (cm²) | +0.8573* |
| Chlorophyll contents | -0.3608ns |
| Moisture % | +0.7192* |
| Mid-rib hair density/cm | -0.8102* |

**Significant at P ≤ 0.05; ns stands for non-significant.*

The current research revealed that physio-morphic characters (number of branches, plant height, area of leaf lamina, mid-rib hair density, chlorophyll contents and moisture percentage) of different genotypes impact the jassid population. The primary factor contributing to genotype resistance is the number of hair on the leaf's midrib. Jassid infestation (13.34/leaf and 14.73/leaf) was minimum in genotypes OK Advanta-803 and Shakti Hybrid having more hair density on the midrib, i.e., 9.67/cm 7.0/cm, respectively. The hairiness character in varieties tested appears to confer resistance against jassid due to intricacy in feeding and less fitness for oviposition. Less preference of OK Advanta-803 and Shakti Hybrid also implies that this variety had more hairiness on the midrib, which is less preferred for oviposition by jassid. Earlier, Mahal and Singh (1979) also reported results similar to our studies. They found that nymphs emergence in jassid and the number of trichomes on the mid-rib of leaves were inversely (negatively) related to each other.

Similarly, a significantly negative correlation between the emergence of jassid nymphs and the number of trichomes on Okra and eggplant was reported (Taylo and Bernardo, 1995). In another study, the higher density of trichomes in Okra significantly led to a reduction in oviposition. It thus supported a deficient jassid population compared to cultivars with fewer trichomes/leaf (Lokesh and Singh, 2005). Hairiness on the leaf surface not favoring jassid showing oviposition interruptions reported by Naqvi *et al.* (2008), Lit and Bernardo (1990) and Taylo and Bernardo (1995) as they revealed in their experiments that there is significant reduction in adult oviposition by jassid on hairy varieties. Our results are also in accordance with (Iqbal *et al.*, 2011; Ullah *et al.*, 2012) who reported that hair density on mid rib have significant and negative impact on the population fluctuations of jassid in okra.

The second character which had an impact on the jassid population/leaf was the leaf area. The maximum jassid population was observed in genotype NS-810, which has maximum leaf area compared to other varieties tested. This implies that the larger the leaf area, the more susceptible the variety will be to insect attack. Similar to our results, there was a highly significant and positive correlation between the jassid population and lower leaves of different okra cultivars. However, this relationship was positively and negatively non-significant in upper and middle leaves, respectively (Iqbal *et al.*, 2011).

In this study, a positive and significant correlation was established between moisture contents (%) in leaves and jassid population, which is in line with the outcomes of Singh and Agarwal (1988), who reported that higher moisture content in okra cultivar AC-302 supported more oviposition (162 eggs/leaf) as compared to another cultivar o Acala 4-42 (57 eggs/leaf) whose moisture contents were significantly lower. A negative and non-significant correlation between the jassid population with plant height and a positive but non-significant correlation with the number of branches was discovered, indicating that these plant characteristics might not have imparted a crucial role in determining the resistance or susceptibility status

of okra cultivars for jassid infestation. However, plant height was significantly higher in Sabz Pari and Shakti hybrid than other cultivars; however, the number of branches remained statistically similar among all okra cultivars in this study. Taylo and Bernardo (1995) studies were partially in line with our findings. They depicted that plant height and no. of branches did not differ significantly among resistant and susceptible varieties of Okra and eggplant. These characters also showed a non-significant correlation with the jassid population.

## Conclusions and Recommendations

It can be concluded from these findings that preference of jassid towards different cultivars of Okra vary depending upon the plant morphological and physiological characteristics such as leaf area, number of trichomes on leaves mid-veins and moisture contents. Plant moisture contents and mid-rib hair density or number trichomes on leaf midvein are the most critical parameters to determine the resistance and susceptibility status of host plants of choice. Okra growing farmers are recommended to sow cultivars with more trichomes on leaf mid-vein, lower moisture contents and less leaf surface area.

## Novelty Statement

Okra growing farmers are recommended to sow cultivars with more trichomes on leaf mid-vein, lower moisture contents and less leaf surface area.

## Author's Contribution

**Naima Din:** Performed the experiment and collected data.
**Muhammad Farooq:** Helped in paper write up.
**Muhammad Rizwan:** Overall managed the article and gave technical input.
**Misbah Ashraf:** Collected the literature.
**Muhammad Babar Shahzad Afzal:** Concluded the research.
**Hafiz Ghazanfar Abbas:** Helped in data analysis.
Farrukh Ilahi and Muhammad Ahsin Ayub: managed references.
**Amir Hameed:** Performed the statistical analysis.
**Qurban Ali:** Supervised the study.

*Conflict of interest*

The authors have declared no conflict of interest.

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