Sindh Univ. Res. Jour. (Sci. Ser.) Vol.48 (2) 271-280 (2016)

SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)

Effect of Cotton Leaf Morphological Characters on Incidence of *Amrasca* (*Devastans* Dist.) *Biguttula Biguttula* (Ishida)

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Received 29th June 2015 and Revised 12th April, 2016

Abstract The aim of the study was to compare the effects of different gamma radiation doses e.g., 150, 200 and 250 Gy on leaf nectarines, leaf length, leaf width, trichome density and their length in relation to jassid population. The results showed highly susceptible, moderately susceptible and high resistance in parents and their gamma irradiated cotton lines against jassid populations during, 2008 and 2009. There was leafing length had non-significant and negative correlation with jassid populations in parents, 200 and 250 Gy, while, the leaf width and the leaf nectarines spots in parents and 150 Gy cotton lines. However, leaf length were non-significant and positive correlations in 150 Gy, whereas, the leaf width and the leaf nectarines spots in parents, 200 and 250 Gy lines during both years study. Trichome density and their length had negative and non-significant correlation with jassid populations in all parents and their gamma irradiated lines. Further liner regression coefficients results indicated that decrease in jassid population with leaf length, trichome density and their length; however, the population increased by leaf width on all parents and their gamma irradiated cotton lines during both year study periods. It is concluded that, plant leaf characters, i.e., leaf length, trichomes density and trichomes size are essential features to minimize jassid populations in cotton crop. The cotton seed irradiated at gamma doses 200 and 250 Gy were the most advantageous to develop resistance potential in cotton crops.

Keywords: Resistance, Susceptible, Leaf length, Leaf Nectarines, Trichome Density

1. INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is a desirable food for insect pests, during full growing season, (Abbas, 2001) has estimated 148 insect pests span their life on cotton crop. The jassid *Amrasca* (*devastans* Dist.) *biguttula biguttula* (Ishida) is one of them and caused by severe damage to cotton plants. However Bhat *et al*. (1986) have calculated jassid damage in cotton crop an about 25-45% and Ali (1992) reported 19.0% decreased yield singly by jassid. Meanwhile growers of the country, minimizing damage percent of insect pests; those were gradually increased by the applications of insecticides. It is calculated approximately 70-90% insecticides of multinational and national insecticide companies were sprayed on cotton crop in Pakistan (Eavy *et al*., 1995; Chaudhry, 1995; Yousaf *et al*., 2004). Integrated Pest Management (IPM) strategies were reduced the pest population below economic injury levels (Khooharo *et al*., 2006). The resistant crop varieties are less suitable for the pest colonization due to scarcity of food (Eigenbrode and Trumble, 1994; Calhoun and Jones, 1994; Calhoun, 1997; Salman *et al*., 2011; Saleem *et al*., 2013). The insect pests predict their suitable food depend on their feeding behavior to respond the plant Physio-morphological characters (Hagenbucher, *et al*., 2013).

The plant morphological and physiological characters, attributed as a self-plant defense mechanism against herbivores (Elegbede *et al*., 2014). However, Iqbal *et al*. (2011) reported that the okra plant's bottom leaves areas are encouraged to jassid populations. While, the Murugesan and Kavitha (2010) reported that the cotton leaf area deter to jassids for oviposition. The cotton host plant resistance/susceptibility depended on the trichomes density on cotton leaves, jassid avoid egg laying and feeding on highly dense and elongated trichomes in the lower side of the leaf (Butler *et al.,* 1991; Meagher *et al.,* 1997; Ali *et al.,* 1999; Murugesan and Kavitha, 2010).

The present research work was conducted on three parent and their gamma irradiated 150, 200 and 250 Gy cotton lines with the objective to find out the effect of gamma irradiation on leaf length, leaf width, trichomes density, trichomes length and leaf nectarines spots on the leaves in relations to cotton host plant resistance against jassid infestation.

2. MATERIAL AND METHODS

The experiment was conducted in the experimental field of the Agricultural Research Institute (ARI), Tandojam Sindh, Pakistan, to conclude the role of some leaf morphological characters viz., leaf length and leaf

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width, trichome density, trichome length and leaf nectarines to resistance against jassid *Amrasca* (*devastans* Dist.) *biguttula biguttula* (Ishida). The demonstrative seeds of three parent cotton lines, i.e., St-7, BNT and B-3 were irradiated (150, 200, and 250 Grays "Gy") and the result of new mutagenic genotypes viz St-7*, BNT* and B-3* were totaled twelve cotton lines examined on the M4 and M5 generations during 2008 and 2009. The experiment was laid out in randomized complete block design (RCBD) with four replications. The distance was maintained at 75 cm in row to row, after thinning 30 cm plants to plants uniformly space was maintained. All the recommended agronomic practices were completed within time.

Screening of jassid, *Amrasca devastans* (Dist.) population

The observations on jassid population (adult and nymph) was recorded collectively, five plants per cotton lines and five leaves per plant from each mutant and parent lines were randomly selected. The jassid population was counted from two lower, two middle leaves and one leaf from the top portion of the plants. The cotton plant resistance level to jassid population assessed as suggested by (Hormchan, *et al*., 2001) i.e. 0.1-1.0 highly resistance, 1.1-2.0 moderately resistance, 2.1-3.0 susceptible and 3.1-4.0 highly susceptible.

Morphological Characters

Morphological characters were recorded for the effect of different gamma irradiation dosages on leaf length, leaf width and leaf nectarines in field conditions. Fifteen fully expanded uniformly sizing leaves were collected per cotton line from field grown plants at the peak blooming stage. To count number of trichome on the leaves, one cm^2 stopper cutter/borer was used to punch in a fixed area of leaf from one side of the midrib. The stopper was used to trace on a leaf. The number of trichome within one cm^2 was counted. The counting of trichomes was done under the microscope with the aid of 10x lens and objective on microscope 10/0.25-160/0.17 Kyowa optical Co. Ltd. Japan. Trichome selecting for length measurement was made from the midrib of the central portion of the leaf blade. The data were analyzed statistically general (ANOVA) by using Statistix software 8.1 (Analytical Software, USA), to find out the significance differences within the cotton lines and means was compared with LSD test at 0.05% probability. Simple correlation and linear regression models were worked out amongst jassid population and leaf morphological characters.

3. RESULTS

Analysis of variance showed significant and non-Significant (P< 0.05) differences in parent and their gamma irradiated cotton lines amongst jassid population and leaf morphological characters during 2008 and 2009 **(Fig. 1.0 to 6.0).**

1.0: *Jassid Population*

The results in (Fig. 1.0) indicated that the mean number of jassid among different cotton lines significantly differences (F=9.74; df=2; P< 0.0001) and (F=19.74; df=2; P< 0.0000) generated in the general analysis of variance during 2008 and 2009, respectively. The minimum jassid population per leaf was recorded on cotton line B-3* (250 Gy) followed by B-3*, St-7*, BNT* (200 Gy) and parent cotton lines B-3, St-7 found highly resistant against jassid. However, moderately resistance was observed in BNT* (150 Gy), BNT parent and St-7* (250 Gy). Whereas the maximum number of jassid in B-3* (150 Gy), BNT* (250 Gy) and St-7* (150 Gy) was recorded highly susceptible cotton lines against jassid during 2008 and 2009, respectively.

2.0: *Leaf length*

There were significant differences (P< 0.05) in leaf length in parents and their gamma irradiated cotton lines (F=692.75; df=2; P<0.0000) and (F=686.55; df=2; P<0.0000) during the study, respectively. The Fig. 2.0 shows that the leaf length increased in B-3* (200 Gy), while decreasing in St-7*, BNT* and B-3* (150, 200 and 250 Gy) during study periods, respectively. Correlation coefficients and linear regression models worked out among the jassid population and cotton leaf length with parents and their gamma irradiated 150, 200 and 250 Gy cotton lines. The results in **(Table-1.0)** indicated that (r) value of jassid population with leaf length was non-significant and negatively correlated with parents (-0.463 and -0.252), 200 Gy (-0.71 and-0.767) and 250 Gy cotton lines (-0.902 and -0.95), while non-significant and positive in 150 Gy lines (0.227 and 0.213) during 2008 and 2009, respectively. Regression studies based on regression analysis by taking jassid population (y) as a dependent variable and leaf length (x) as independent variables following equations were fitted for the year 2008 and 2009. The results indicated that the jassid populations decreased with increasing leaf length of all parents and their gamma irradiated cotton lines.

3.0: *Leaf width*

The (**Fig. 3)** shows the leaf width of different cotton lines was significant differences (F=1343.46; df= 2; P<0.0000) and (F=1104.04; df=2; P<0.0000) during 2008 and 2009, respectively. The leaf width data are presented in (Table-5) showed that decreased leaf width in B-3* (200 Gy) cotton line as compared to their parent B-3 line, and increased in St-7* and BNT* (150, 200 and 250 Gy) cotton lines as compared to their parent lines during 2008 and 2009, respectively. The correlation results for leaf width and jassid population in (Table-2.0) revealed that leaf width was non-significant and positive

correlation with jassid population on parenthood, 200 and 250 Gy cotton lines. Whereas non-significant and negative correlations with jassid on gamma treated 150 Gy cotton lines. The regression equations concealed that jassid population increased by leaf width.

4.0: *Trichomes density*

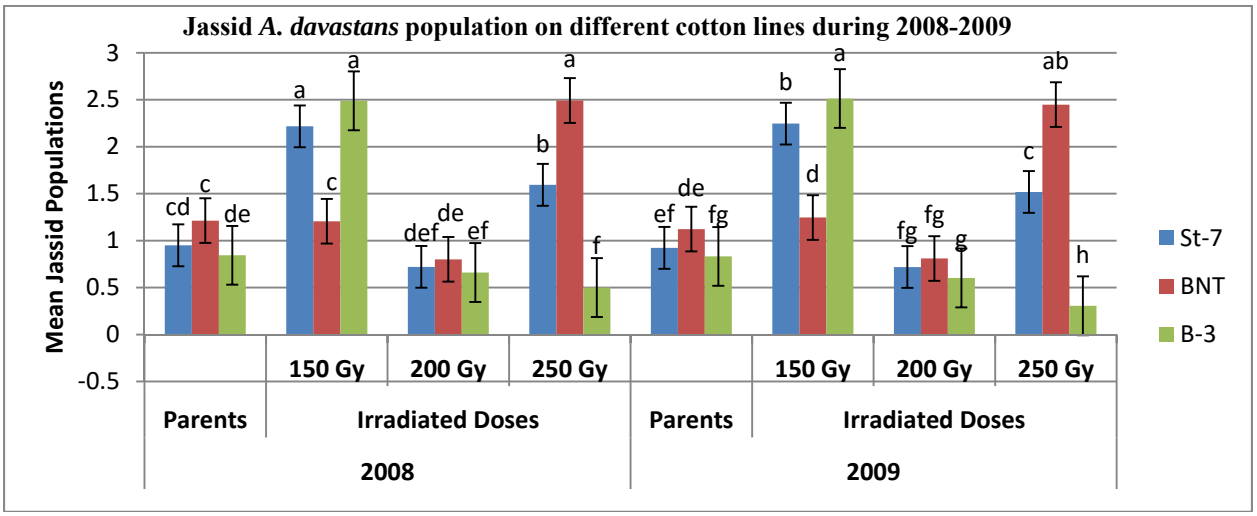
Results in **(Fig. 4)** shows trichome density, significant (P<0.05) difference found amongst parents and their gamma irradiated cotton lines. The maximum trichomes was observed in highly resistant against jassid cotton lines B-3* 250 Gy (665.77±2.446 and 667.49±1.815) and B-3* 200 Gy (662.98±0.402 and 664.07±0.857) and a minimum trichomes density was found in highly susceptible cotton lines against pest, i.e., BNT* 250 Gy (122.04±0.576 and 131.90±0.307) and B-3* 150 Gy (54.91±1.082 and 52.88±0.993) during the study periods. Correlation coefficients results in **(Table 3)** indicated that jassid population found non-significant and negative correlation with a trichome density of parents (-0.983 and -0.976), 150 Gy (-0.869 and -0.873), 200 Gy (-0.776 and -0.832) and 250 Gy cotton lines (-0.982 and -0.984) during 2008 and 2009, respectively. The trichome density revealed that cotton lines had more number of trichomes density, leaf/cm² and had minimum jassid populations.

5.0: *Trichomes Length*

The trichomes size amongst cotton lines were found significant differences (P<0.05). The **(Fig. 5)** shows a maximum trichomes size in B-3* 250 Gy (0.375±0.011 and 0.376±6.662E-03) and B-3* 200 Gy (0.368±0.12 and 0.366±7.945E-03) were found highly resistant against jassid; and minimum size was calculated in BNT* 250 Gy (0.233±4.919E-03 and 0.242±5.419E-03) and B-3* 150 Gy (0.203±5.901E-03 and 0.204±6.089E-03) which was highly susceptible cotton lines against jassid infestations during both years, respectively. The correlation results for trichomes length and jassid population in different parents and their gamma irradiated cotton lines revealed that trichomes size had negative and non-significant correlation with jassid infestation in all parents and their gamma irradiated 150 and 200 Gy lines. Whereas, jassid population was found a significant and negative correlation with trichomes size in 250 Gy cotton lines **(Table-4)**.

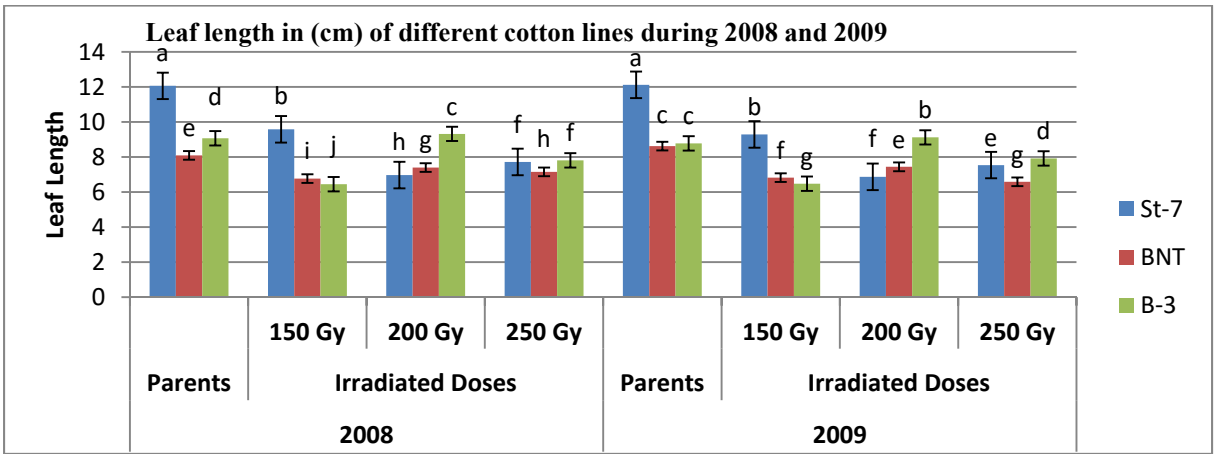
6.0: *Leaf Nectarines*

The **(Fig. 6)** shows that one nectarines spot was found underside the leaves of parents St-7 and BNT and some mutant lines treated with 150, 200 and 250 Gy; while, the two nectarines spots were calculated in parent B-3, BNT* 150 and 250 Gy cotton lines. The correlation coefficients results in **(Fig. 7-14)** revealed that jassid population with leaf nectarines were found non-significant and negative correlation of parents (-0.722 and -0.741), 150 Gy cotton lines (-0.98 and -0.98), while, non-significant and positive correlation with 200 Gy (0.997 and 0.993) and 250 Gy cotton lines (0.836 and 0.853) during the study. The leaf nectarines concealed that cotton lines cover more number of nectarines had less jassid population and those having less nectarines spots underside the leaves had more *A. devastans* populations.



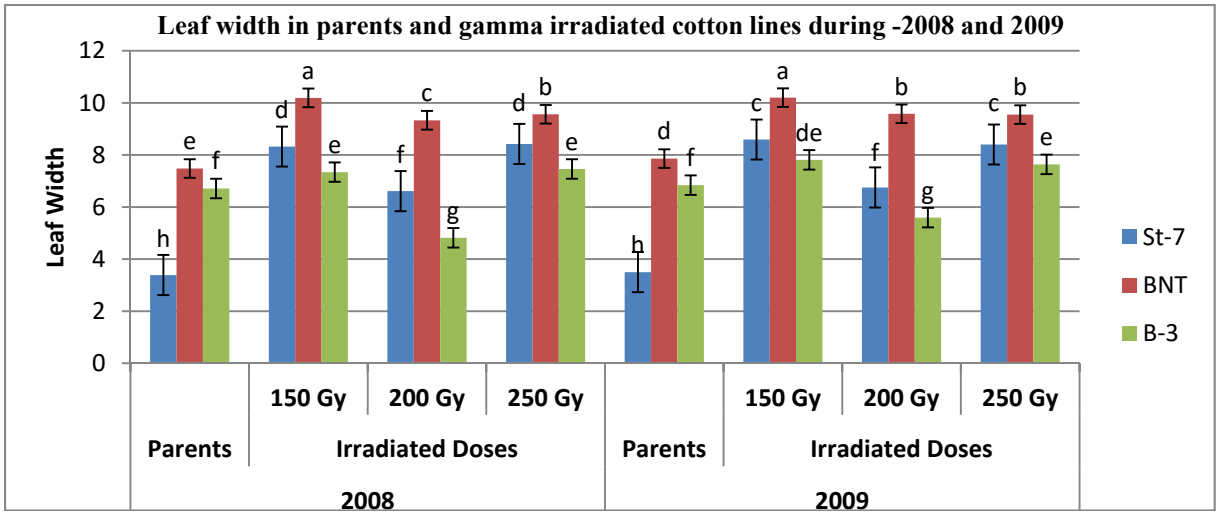
Mean±S.E followed by same letters are not significantly different from each other, (P< 0.05; LSD)

Fig. 1: Jassid *A. davastans* population on parents and gamma irradiated cotton lines during 2008-2009



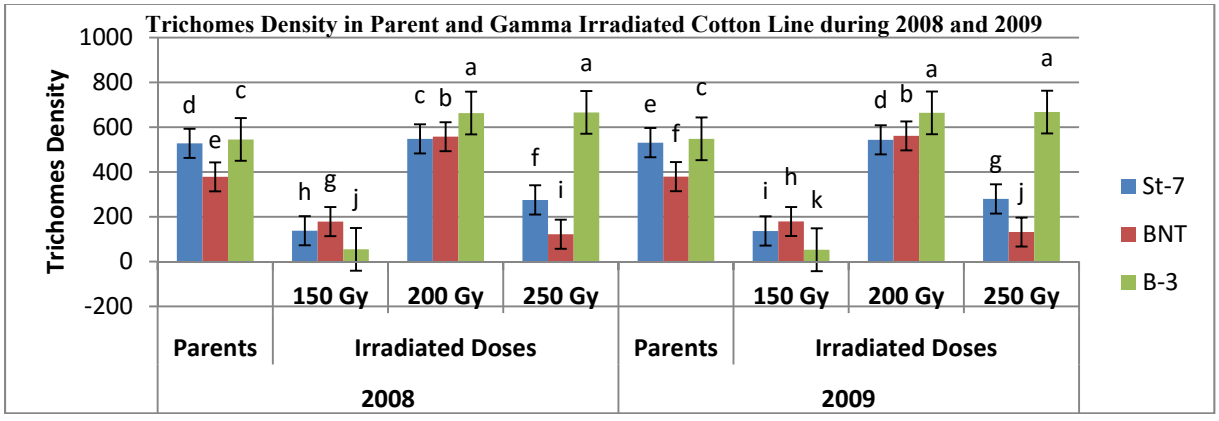
Mean± S.E followed by same letters are not significantly different from each other, (P< 0.05; LSD)

Fig.2: Leaf length (cm) of different cotton lines during 2008 and 2009



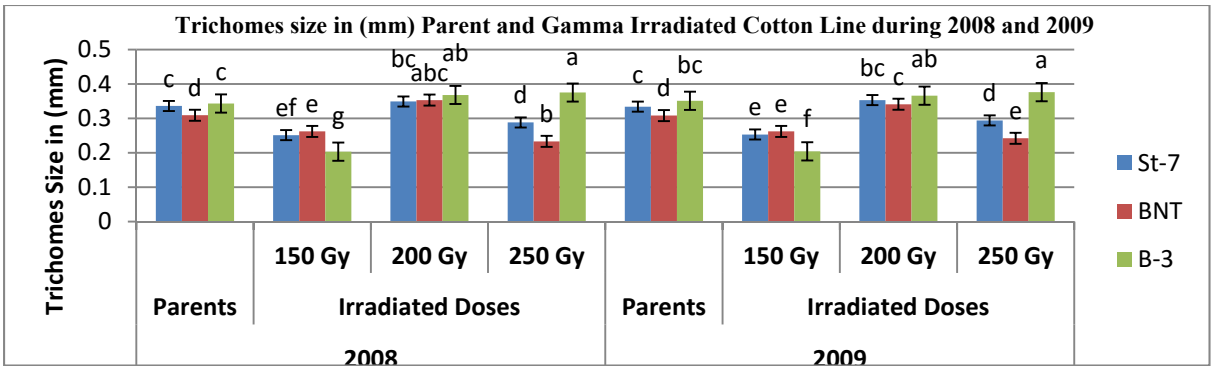
Mean± S.E followed by same letters are not significantly different from each other, (P< 0.05; LSD)

Fig. 3: Leaf width in untreated (parent) and gamma irradiated cotton lines during -2008 and 2009



Mean± S.E followed by same letters are not significantly different from each other, (P< 0.05; LSD)

Fig. 4: Trichomes Density in Parent and Gamma Irradiated Cotton Line during 2008 and 2009



Mean ±S.E followed by same letters are not significantly different from each other, (P< 0.05; LSD)

Fig. 5: Trichomes size in (µ) Parent and Gamma Irradiated Cotton Line during 2008-09

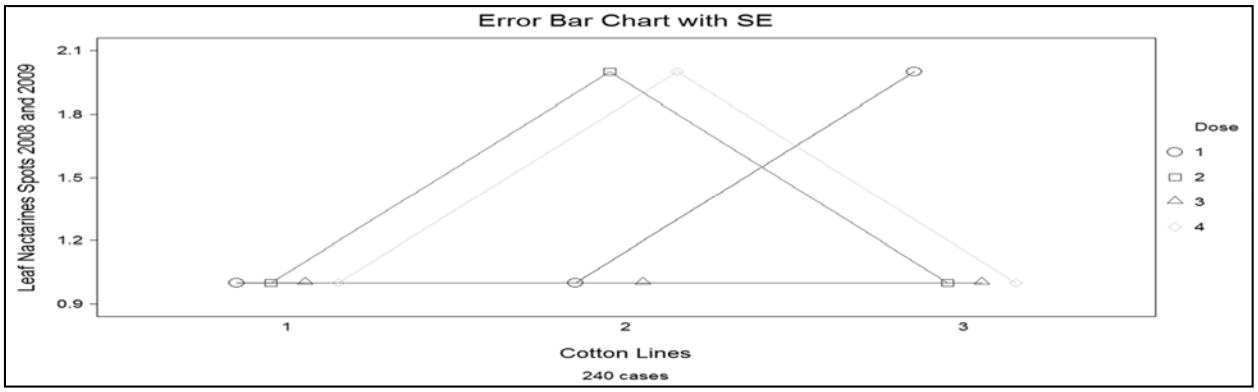


Fig. 6.0: Error Bar Chart with S.E of Leaf Nectarines on different cotton lines during-2008 and 2009

Fig. 7.0:

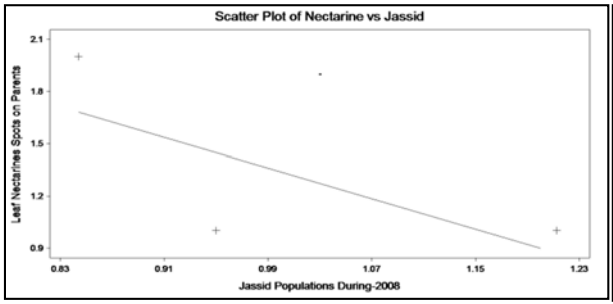


Fig. 8.0

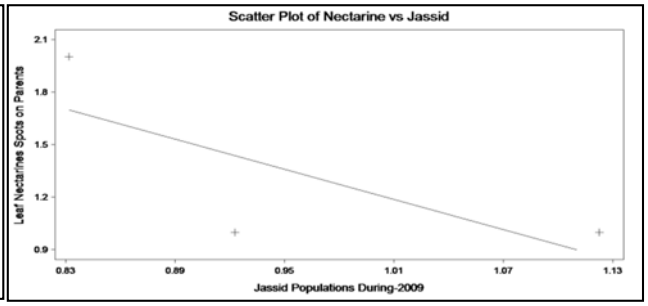


Fig. 9.0

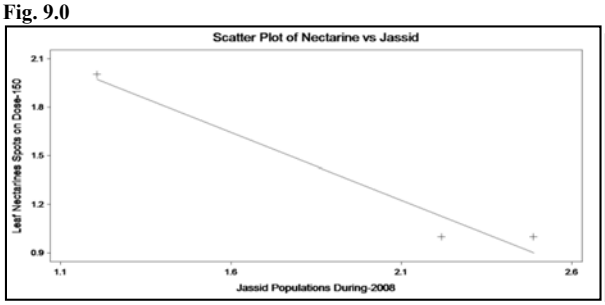


Fig. 10.0

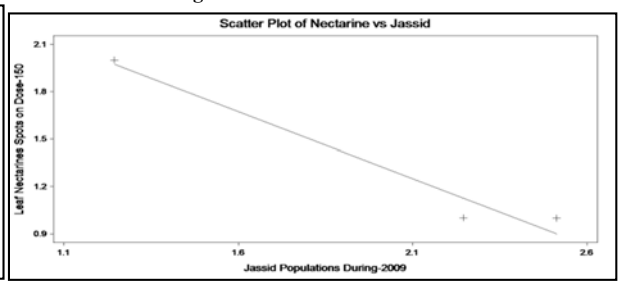


Fig. 11.0

Fig. 12.0

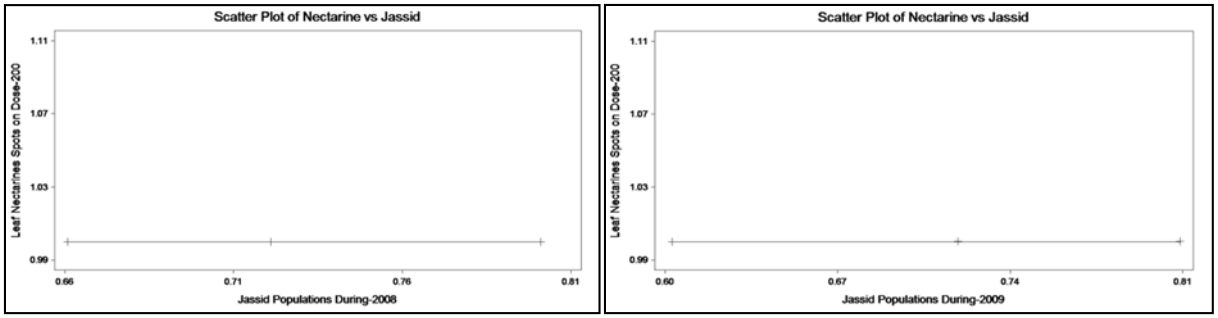


Fig. 13.0 **Fig. 14.0**

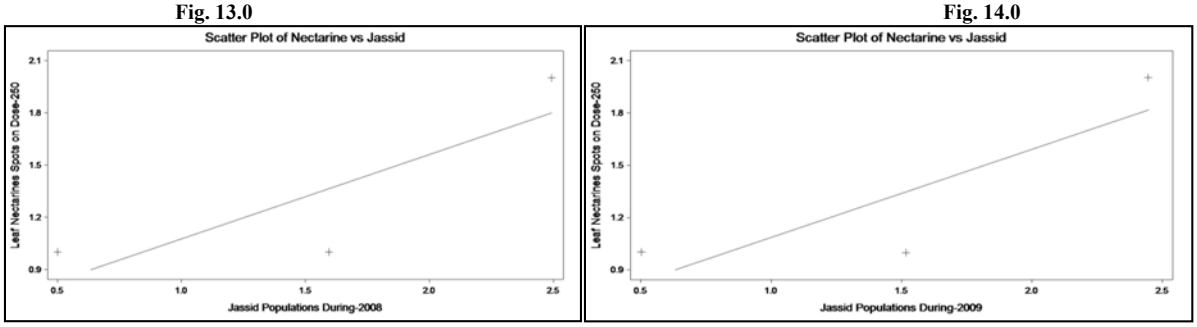


Fig. 7.-14.: Scatter plots Leaf Nectarines vs jassid populations on different cotton lines during-2008 and 2009

Table-1: Pearson's correlation coefficients and the Liner regression r² value, among leaf length with jassid population on parents and their gammas irradiated cotton lines in field trial during 2008 and 2009

Parameter	r- Value	P- Value	Linear Regression		R²
			y	x	
2008					
Leaf length vs Jassid Population on Parents	-0.463	0.694	1.416	-0.043	0.214
Leaf length vs Jassid Population on Dose-150	0.227	0.855	1.296	0.089	0.051
Leaf length vs Jassid Population on Dose-200	-0.71	0.497	1.043	-0.039	0.505
Leaf length vs Jassid Population on Dose-250	-0.902	0.284	20.58	-2.52	0.814
2009					
Leaf length vs Jassid Population on Parents	-0.252	0.837	1.14592	-0.01897	0.0635
Leaf length vs Jassid Population on Dose-150	0.213	0.863	1.30379	0.09266	0.045
Leaf length vs Jassid Population on Dose-200	-0.767	0.444	1.239	-0.0677	0.588
Leaf length vs Jassid Population on Dose-250	-0.95	0.203	12.3612	-1.48907	0.902

Table-2: Pearson's correlation coefficients and the Liner regression r² value, among leaf width with jassid population on parents and their gammas irradiated cotton lines in field trial during 2008 and 2009

Parameter	r- Value	P- Value	Linear Regression		R²
			y	x	
2008					
Leaf width vs Jassid Population on Parents	0.407	0.733	0.794	0.035	0.165
Leaf width vs Jassid Population on Dose-150	-0.989	0.092	5.933	0.459	0.979
Leaf width vs Jassid Population on Dose-200	0.999	0.024	0.514	0.0309	0.999
Leaf width vs Jassid Population on Dose-250	0.994	0.068	-6.483	0.945	0.989
2009					
Leaf width vs Jassid Population on Parents	0.425	0.721	0.791	0.028	0.18
Leaf width vs Jassid Population on Dose-150	-0.993	0.078	6.821	-0.544	0.985
Leaf width vs Jassid Population on Dose-200	0.952	0.197	0.36	0.048	0.907
Leaf width vs Jassid Population on Dose-250	0.981	0.123	-7.926	1.096	0.963

Table-3: Pearson's correlation coefficients and the Liner regression r² value, among trichomes density with jassid population on parents and their gammas irradiated cotton lines in field trial during 2008 and 2009

Parameter	r- Value	P- Value	Linear Regression		R²
			y	x	
2008					
Trichomes Density vs Jassid Population on Parents	-0.983	0.119	1.99	-0.002	0.965
Trichomes Density vs Jassid Population on Dose-150	-0.869	0.329	3.12	-0.0093	0.755
Trichomes Density vs Jassid Population on Dose-200	-0.776	0.435	1103.3	-706.27	0.602
Trichomes Density vs Jassid Population on Dose-250	-0.982	0.121	2.77	-0.0035	0.964
2009					
Trichomes Density vs Jassid Population on Parents	-0.976	0.139	1.72	-0.0015	0.953
Trichomes Density vs Jassid Population on Dose-150	-0.873	0.325	3.12	-0.0091	0.762
Trichomes Density vs Jassid Population on Dose-200	-0.832	0.375	960.77	-522.45	0.692
Trichomes Density vs Jassid Population on Dose-250	-0.984	0.113	2.8	-0.0038	0.969

Table-4: Pearson's correlation coefficients and the Liner regression r² value, among trichomes length with jassid population on parents and their gammas irradiated cotton lines in field trial during 2008 and 2009

Parameter	r- Value	P- Value	Linear Regression		R²
			y	x	
2008					
Trichomes Length vs Jassid Population on Parents	-0.996	0.055	0.424	-0.094	0.993
Trichomes Length vs Jassid Population on Dose-150	-0.784	0.426	0.310	-0.036	0.615
Trichomes Length vs Jassid Population on Dose-200	-0.692	0.514	0.428	-0.099	0.478
Trichomes Length vs Jassid Population on Dose-250	-0.997	0.046	0.408	-0.072	0.995
2009					
Trichomes Length vs Jassid Population on Parents	-0.996	0.059	0.469	-0.145	0.991
Trichomes Length vs Jassid Population on Dose-150	-0.764	0.447	0.311	-0.036	0.584
Trichomes Length vs Jassid Population on Dose-200	-0.999	0.029	0.439	-0.12	0.998
Trichomes Length vs Jassid Population on Dose-250	-0.999	0.034	0.393	-0.063	0.997

4. DISCUSSION

The host plant resistance is a main component of integrated pest management (IPM), through cotton host plant resistance, enhance seed cotton yield with minimum applications of pesticides and to reduce environmental pollution. The results of the present studies on relative resistance, susceptibility and tolerance of different cotton untreated and different gamma irradiated lines against jassid agreement with those of Walha *et al.* (1998); Soomro *et al.* (2001); Nizamani *et al.* (2002); Shamsuzzaman *et al.* (2003); Abro *et al.* (2004); Amjad *et al.* (2009); Murugesan and Kavitha (2010); Khan (2011) and Salman *et al.* (2011) recorded transgenic, conventional and mutant different cotton varieties were found susceptible, resistant and tolerant to jassid infestation.

The present results of experiments partially agreed with those of Murugesan and Kavitha (2010) who reported that cotton leaf area was negative and non-significantly correlated with jassid population. Whereas, Iqbal *et al*. (2011) reported that bottom leaves of okra were negative and significantly correlated with jassid population. Similarly, Ullah *et al.* (2012) reported that leaf area of okra was negative and non-significantly correlated with jassid. Similarly, Eittipibool *et al*. (2001) reported that small leaf area did not play significant role in jassid infestation. Though Chakravarthy *et al*. (1985) reported jassid population was positive and significantly correlated with leaf area of *Arboreum* and *Hirsutum* cotton varieties.

The correlation studies of the jassid population with trichome density and their length in field experiments showed a negative and non-significant correlation with parents and their gamma irradiated 150, 200 and 250 Gy cotton lines, while trichome length observed in gamma irradiated (250 Gy) lines was significant and negatively correlated with jassid population. The results of present study are in conformity with those of (Ali *et al*., 1999; Aheer *et al*., 1999; Bashir *et al*., 2001; Ahmed *et al*., 2005; Ashfaq *et al*., 2010; Murugesan and Kavitha 2010; Naveed *et al*., 2011; Ullah *et al*., 2012 and Rustamani *et al*., 2014) who recorded that the jassid population could be managed with cotton varieties of moderately to highly dense trichomes; however, these varieties showed highly significant negative correlation with jassid population.

The leaf nectarines are attractive to beneficial insects, although these insects may be predators, or parasites. The present results are in partial agreements with those of Portilloa, *et al.* (2012) reported that several natural enemies survive on leaf nectar and flower pollen grains. Perez, *et al.* (2012) evaluated several plant species to produce extrafloral nectarines and generate nectar for hosting the natural enemies against harmful insects.

5. CONCLUSION

The present studies indicated that the all plant leaf characters are important factors to manage jassid population in cotton crop. The leaves characters are the

main tactics for plant botanist's in future breeding programs to reduce the pest infestation. The gamma irradiation doses of 200 and 250 Gy were the best to improve the resistance ability in cotton plants.

6. ACKNOWLEDGMENTS

The authors are highly thankful to Ex-Cotton Botanist ARI, Tandojam presently Professor Dr. Gul Muhammad Baloch, Department of Plant Breeding and Genetics, Sindh Agriculture University, Tandojam, for providing required space in the experimental field.

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