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Genetic Studies on Resistance to Jassid (*Amrasca biguttula biguttula*) in Segregating F2 Population of Interspecific (*Gossypium hirsutum* L. X *Gossypium barbadense* L.) Cotton

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A B S T R A C T

Studies on the genetic basis for resistance to jassid (*Amrasca biguttula biguttula*) was done in F_2 segregating generation of one promising cross of interspecific cotton (*Gossypium hirsutum* L. X *Gossypium barbadense* L.) in the year 2015-16. The cross FQT-37 X SB-YF-425 segregated in the ratio of 13:3 for susceptibility and resistant. In the case of resistant type, all the plants were in grade II, implying moderate resistance. This gene action is called as inhibitory gene action. Here, one dominant gene produces the concerned phenotype, while its recessive allele produces contrasting phenotype. The second dominant gene, called inhibitory gene, has no effect of its own on the character in question; however, it can stop the expression of the dominant allele of the first gene. The development of high yielding jassid resistance genotypes has become more important in cotton cultivation today. Identification and use of a tolerant/resistant cultivar are of great relevance these days as it is eco-friendly and cost effective.

Introduction

Cotton, the "king of fibre", is an important cash crop having a profound influence on economics and social affairs of the country. It is also called "White Gold" due to its global importance in agriculture as well as the industrial economy. Indian economy as it contributes nearly 14 per cent to the total industrial production. In the recent years, the incidence of the sucking pest, *Amrasca biguttula biguttula* (jassids), also called *Amrasca devastans* (Dist.), has become serious not only in India (Singh and Agarwal, 1988) but also in Pakistan, Bangladesh, Thailand and other South East Asian countries. The pest is prevalent from the vegetative to reproductive phase of the crop growth. Nymphs and adults of this insect cause damage by sucking the cell sap from the leaves which result in yellowing, reddening and drying of leaves characteristic of phytotoxaemia, called "hopperburn" (Painter, 1951; Uthamasamy, 1985) leading to significant yield loss. Host plant resistance is an effective tool for controlling insect pest and is the key component of integrated pest management because it enables plants to avoid, tolerate or recover from the effects of insect pest attack (Painter, 1951). Hence, the development of high yielding jassid tolerant genotypes becomes important. Selection in

the early segregating generations is desirable for varietal development in cotton. Genetics analysis of resistance gives the idea of inheritance pattern of resistance in cotton for respective insect pest. Information on the inheritance of resistance is useful to the breeder in deciding what breeding methodology and breeding strategies to adopt.

Materials and Methods

In the year 2015-16, jassids reaction in the F_2 population of the most productive interspecific cotton hybrid (FQT-37 X SB-YF-425) was assessed in the place of Agricultural Research Station, Hebbali Farm, UAS, Dharwad. The F_2 population was sown in10 rows and each parent was sown in 2 rows with 90 X 20 cm spacing. Genetics of resistance to jassids were calculated based on the jassid injury grade in the hybrid F_2 population's data. Observations were recorded at 60, 90 and 120 days after sowing to take the grades. Observations for jassid damage recorded based on the symptoms and 1-4 grades given by ICCC (Sikka *et al.,* 1966 and Rao, 1973) used to score the symptoms caused by jassids as follows:

Grade	Symptom	Degree of susceptibility
I	Leaves will be normal/ little downward curling.	Resistant
II	Crinkling, curling, slight yellowing in few leaves on lower portion of the plant	Moderately Resistant
III	Crinkling, curling, yellowing, browning and bronzing in the middle and lower portion.	Susceptible
IV	Extreme crinkling, curling, yellowing, browning, bronzing and drying of leaves, defoliation and stunted growth.	Highly Susceptible

The chi-square test can be used to evaluate whether deviations between observed and expected numbers are likely to be due to chance or due to some other significant factor. The chi-square (χ^2) value was calculated by using respected formula and data was interpreted.

Results and Discussion

Genetic analysis can reveal the inheritance pattern of genes responsible for resistance. It can reveal the number of genes working in the resistance mechanism. Segregating populations are used to decipher the genetics of traits. The inheritance pattern was identified in the population. A total of one hundred and eighty-nine F_2 plants in the cross involving resistant and susceptible parents were screened for jassid reaction under unprotected condition. Individual plants were grouped by using 1 to 4 grading scale which is standard grades for cotton leafhopper infestation. Results are presented in Table 1. In the F_2 segregating population of cross FQT-37 X SB-YF-425, 27 plants showed resistance in a total of 189 plants, it was the observed value. After that different epistasis ratio was compared and found that it was fitting satisfactorily into the 13:3 segregation ratio (13 susceptible to 3 resistant type of plants), where chi-square value (2.46) was less than table chi-square value (3.41) at level of significance (0.05) with degree of freedom (1) indicated the nonsignificant result. It revealed that observed and expected ratio were same *i.e.* no significant difference. In the case of resistant type, all the plants were

in grade II, implying moderate resistance. This gene action is called as inhibitory gene action. Here, one dominant gene produces the concerned phenotype, while its recessive allele produces contrasting phenotype. The second dominant gene, called inhibitory gene, has no effect of its own on the character in question; however, it can stop the expression of the dominant allele of the first gene. As a result, when the two dominant genes are present together, they produce the same phenotype as that produced by the recessive homozygote of the first gene.

Table.1 Segregation pattern for reaction to jassids in F2 population of cross FQT-37 X SB-YF-425 under unprotected condition

Cross	Number	Reaction to leafhopper			Ratio	Chi-square value	P
	F_2						
Cross		Susceptible (Grade III & IV)	Resistant (Grade I & II)	Total			
FQT-37 X SB-YF-425	Observed	162.00	27.00	189	13:3	2.46	0.2 - 0.1
	Expected	153.56	35.43				

N.B: Level of Significance = 0.05; Degree of Freedom = 1

A 13:3 ratio was found as per grades which revealed the digenic nature of the gene action. It is the inhibitory type of gene action suggesting dominant genes with epistatic gene action responsible for the expression of resistance to jassids in the interspecific cotton hybrids. It can be concluded that observed frequency of plants in F_2 population fitted into expected ratio of 13 susceptible and 3 resistant with non-significant chi-square value at 5% level. Certain genes have the ability to suppress the expression of a gene at a second locus. Gene A (dominant form) confers resistance. Gene B in its dominant form can suppress this gene A (dominant form) to confer susceptibility. Therefore, $A^- B^-$ (9): A^-bb (3): aaB^- (3): aabb (1), the normal phenotypic digenic ratio will show the reaction pattern of Susceptible (9): Resistance (3): Susceptible (3): Susceptible (1). It will be 13:3, Susceptible: Resistant, ratio. This is the Inhibitory gene action or also called, Dominant Suppression Epistasis. Similar kinds of result were obtained by Sikka and Singh (1953), Mahal (1978), Sharma and Gill (1984), Radhika *et al*., (2004), Pushpam and Raveendran (2005), Murugesan and Kavitha (2010), Zhang *et al.,* (2013) and Venkatesha (2014).

Inheritance studies revealed that the F_2 plants in cross FQT-37 X SB-YF-425 showed a 13:3 segregation ratio, suggesting that two genes with epistatic gene action were responsible for the expression of jassid resistance. Hence, from the present study, it can be said that jassid resistance in interspecific (*G. hirsutum* L. X *G. barbadense* L.) cotton is controlled by a dominant gene with the inhibitory type of gene action. This result may help in further development of jassid resistance varieties in cotton.

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