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Dilbar Hussain
Department of Zoology, Wildlife & Fisheries, Government College University Faisalabad, Pakistan

Salma Sultana
Department of Zoology, Wildlife & Fisheries, Government College University Faisalabad, Pakistan

Tayyba Sultana
Department of Zoology, Wildlife & Fisheries, Government College University Faisalabad, Pakistan

Farhat Jabeen
Department of Zoology, Wildlife & Fisheries, Government College University Faisalabad, Pakistan

Muazzma Akhter
Department of Zoology, Wildlife & Fisheries, Government College University Faisalabad, Pakistan

Amjad Ali
Entomological Research Institute, Faisalabad, Pakistan

Correspondence:
Dilbar Hussain
Department of Zoology, Wildlife & Fisheries, Government College University Faisalabad, Pakistan

Antibiosis Studies on okra genotypes against *Amrasca biguttula biguttula* (Ishida).

Dilbar Hussain, Salma Sultana, Tayyba Sultana, Farhat Jabeen, Muazzma Akhter and Amjad Ali

ABSTRACT
The antibiosis studies on selected genotypes of Okra against jassid were conducted under semi natural conditions. The data on antibiosis (mating period, number of nymphs emerged, nymphal period, number of nymphs reaching to adult stage and survival of nymphs (%), antixenosis (preference/non preference) and tolerance studies based on fruit yield per plant were conducted. The genotype Pusa Swani showed highest mating period (19.67 minutes), number of nymphs emerged (19.33 per female), number of nymphs reaching to adult stage (17.67), nymphal survival (91.36%) and the lowest nymphal period (7.33 days) proved to be comparatively susceptible and the genotype Sanum was found to be comparatively resistant which showed mating period of 11.67 minute, number of nymphs emerged per female 8.00 per female, nymphal period 10.67 days, number of nymphs reaching to adult stage 3.33 and nymphal survival of 41.66%. Lower trend of jassid after feeding on genotype, Sanum observed individuals in the range of 2.67 per plant whereas, Pusa Swani was found to be the most preferred having 9.67 individual per plant. Tolerance study revealed that Sanum resulted in the highest fruit yield (148.73 g/plant) and was statistically at par with those of recorded on Sanum (145.13 g/plant) and Okra-7080 (143.74 g/plant). The genotype Pusa Swani resulted in minimum yield i.e. 112.92 g/plant.

Keywords: Okra, Host plant resistance, Antibiosis, jassid, Tolerance.

1. Introduction
Okra, *Abelmoschus esculentus* (L.) Monech, belongs to family Malvaceae. Okra is the traditional vegetable of Pakistan and its cultivation seasons are Kharif and Rabi. The crop is entirely handled by the small farmers, while its economic importance is well established in local trade. However, the yield of the crop is still low in Pakistan as compared to other counties of the world. Like other Malvaceae, a large number of pests attack Okra leading to significant economic loss. Due to favorable environmental conditions *Amrasca biguttula biguttula* is key pest in the tropics and subtropics. Jassid is amongst the most important sucking insects that attack and cause heavy loss to okra crop [14, 12, 7, 4, 6] Okra' expected the highest quantity of leaf hoppers eggs and is the most appropriate mass for the survival and feeding of its nymph [2, 7]. Host plant resistance is a potential and more bio-rational approach of integrated pest management component which can suppress insect pest populations [8, 1, 11]. Cultivation of resistant varieties is one of the most effective, economical, and eco-friendly tactics which proves to be the most promising method to enhance okra production [9]. The cultivars having higher hair density were found resistant; whereas, those having lower hair density were susceptible to jassid. The length of hair had significant effect on the population of jassid. Host plant resistance is safe and important component of Integrated Pest Management, unfortunately in Pakistan very little research work was done on the host plant resistance. So this study was conducted to minimize the population of jassid on okra by using less use of pesticides.

2. Materials and Methods
The study on mechanism of resistance in 9 selected genotypes of Okra viz. Sabz Pari, Lush green, Green Star, JK-Tetra-6, Sanum, Pusa Swani, Okra-7080, MD-02S and Clean spineless (3 susceptible, 3 intermediate and 3 resistant) against jassid was conducted during 2012 in semi natural conditions under wire gauze chambers measuring 6X6X4 feet at Entomological research institute, Faisalabad. The seeds of selected genotypes were obtained from the vegetable research institute, Faisalabad. Different components of host plant resistance were studied which are described as under.

2.1. Antixenosis (non -preference)
Nine selected genotypes of okra were included in the experiment. There were three pots for each treatment, each pot containing one plant. The pots were kept at random in rearing chamber at 28±2 ºC and 60±5% RH with 12:12 hrs day: night regime making three circles. Each circle was considered as a replication, containing one plant of each genotype of okra under treatment. Experiment was laid out in complete randomized design. Two hundred nymphs, each of 2nd instars were employed for each circle and was kept in the circle for 10 days. Leaves were changed daily until instars reached the adults stage. The data was recorded regarding preference by counting the number of nymphs.

2.2. Antibiosis
Seeds of nine selected genotypes of okra (replicated thrice) were sown in 27 earthen pots with one plant in each pot. The pots were kept at random in rearing chamber and the plant parts were covered with plastic rearing envelop. Semi-natural conditions were maintained at 28±2 ºC and 60±5% RH with 12:12 hrs day: night. Antibiosis studies were initiated after 45 days of germination. Data was recorded on total number of nymphs emerged and their survival.

2.3. Tolerance
Nine screened genotypes of okra were sown in 45 earthen pots. The size of each earthen pot was 1X1.5 ft. Each genotype was grown in 5 earthen pots. Two months old plants were shifted to wire gauze chambers and one earthen pot containing okra plant of each genotype was shifted to the chambers. Second instar nymphs of jassid (obtained from rearing stock) were released on each leaf of plant in four rearing chambers and all the leaves in each chamber were covered with muslin's cloth cum plastic envelop cage. The population of each pot was maintained throughout the crop season till maturity. The adult of the pest were replaced with2nd instar nymph.

2.4. Statistical Analysis
The data were analyzed for analysis of variance to determine the significance of treatments. The means were compared by Duncan's Multiple Range Test (DMRT) at P = 0.05. IBM compatible computer was used for analyzing the data, with M-State package [16]. Means were separated by Duncan's New Multiple Range Test (DMRT) [5].

3. Results
3.1 Antibiosis
Comparative studies on various biological parameter like mating period, number of nymphs emerged, nymphal period, number of nymphs reaching to adulthood and survival percentage of nymphs of jassid on various selected genotypes of okra viz. Sabz Pari, Lush green, Green Star, JK-Tetra-6, Sanum, Pusa Swani, Okra-7080, MD-02S and Clean spineless were conducted under semi natural conditions for antibiosis resistance. The fruit yield data were also recorded in different selected genotypes of Okra. The results are presented under the following sub-sections.

3.2 Mating Period
The results (Table 1) revealed that genotypes differed significantly among each other. The maximum mating period was observed to be 19.67 minutes on Pusa Swani and found to be the most susceptible. The minimum mating period was recorded to be 11.67 minutes on Green Star and found to be the comparatively resistant genotype and did not show significant difference with those of recorded on JK-Tetra-6, Sanum and Sabz Pari showing 12.33, 12.33 and 12.67 minutes mating period, respectively. The mating period of 15.33 minutes was recorded on the leaves of Clean spineless which showed an intermediate trend and was statistically at par with those of recorded on Okra 7080 showing 14.00 minutes mating period. From these results it is concluded that Pusa Swani was found to be the most susceptible where the mating period was prolonged while the genotype Green star was found comparatively resistant with minimum mating period.

3.3 Nymphal Emergence
The results (Table 1) revealed significant difference among genotypes of Okra regarding number of nymph's emergence per female of jassid. The maximum number of nymphs emerged was recorded to be 19.33/female in genotype Pusa Swani and found to be the most susceptible. The minimum number of nymphs emerged was recorded to be 8.00 on Sanum and was at par statistically with those of recorded on Green Star and Okra-7080 showing 8.67 and 10.00 nymphs emerged per female and these genotypes was found to be the resistant. The genotype Sabz Pari, JK-Tetra-6 and Clean Spineless were appeared to be as intermediate with 12.33, 13.33 and 13.00 nymphs emerged per female, respectively.

3.4 Nymphal Period
The results revealed significant difference ($P < 0.01$) among genotypes. The means were compared by DMR Test at P=0.05 (Table 1). It is evident from the results that the highest nymphal period was recorded to be 10.67 days each on genotype Green Star and Sanum. The lowest nymphal period was recorded to be 6.67 days on Lush Green and found at par statistically with those of recorded on Pusa Swani and MD-02S with 7.33 and 7.67 days, respectively. The genotypes Sabz Pari, JK-Tetra-6 and Clean Spineless showing 9.33, 9.00 and 9.33 days nymphal period, respectively did not show significant difference with each other and also was at par statistically with those of recorded on Okra-7080 with 9.67 days nymphal period.

3.5. Number of nymphs reaching to Adulthood
The results regarding number of nymphs reaching to adulthood on different selected genotypes of Okra reveal significant difference ($P<0.01$) among genotypes (Table 1). It is clear from the results that maximum number of nymphs reaching to adult stage was recorded to be 17.67 on Pusa Swani. The minimum number of nymphs reaching to adult stage was recorded to be in Sanum 3.33 and was at par statistically with those of recorded on Green Star and Okra-7080 with 4.33 and 5.00 number of nymphs reaching to adulthood. These genotypes were found to be comparatively resistant. The genotype Sabz Pari, JK-Tetra-6 and Clean Spineless showed intermediate trend with 8.00, 7.33 and 7.67 number of nymphs reaching to adulthood, respectively and did not differ significantly with each other.

3.6 Nymphal Survival
Significant difference was found to exist among genotypes of Okra regarding nymphal survival of jassid (Table 1, and column E). The results showed that maximum nymphal survival was recorded as 91.36% on Pusa Swani which was appeared to be the most susceptible and did not show significant difference with those of recorded on MD-02S and Lush Green with 87.27 and 85.67% nymphal survival, respectively. The genotype Green Star appeared as comparatively resistant showing minimum nymphal survival i.e. 41.68% t and did not differ significantly with those of recorded on Sanum and Okra-7080 with 46.30 and 50.03% nymphal survival, respectively. The nymphal survival was recorded to be 65.11 percent on Sabz Pari and did not differ significantly from those of

recorded on Clean Spineless (62.39%) and JK-Tetra-6 (57.49%).

3.7. Antixenosis

The results regarding antixenosis of jassid on different elected genotypes of Okra are given in (Table 1). The results revealed significant difference among genotypes. The genotypes MD-02S and Pusa Swani showed maximum preference *i.e.* 9.67 individual existed in each genotype and did not show significant with one another as well as with those of recorded on Lush Green showing 9.00 jassid per plant. These genotypes were found comparatively susceptible. The minimum number of jassid preferred was 2.67 on Sanum and did not show significant variation with those of recorded on Okra-7080, Green Star, Sabz Pari and JK-Tetra-6 with 3.33, 3.33, 3.67 and 4.00 nos/ per plant, respectively and these genotypes did not show significant difference with each other and appeared as comparatively resistant. The genotypes clean Spineless and JK-Tetra-6 showing 6.00 and 4.00 individual per plant, respectively did not differ significantly with each other and appeared as intermediate.

3.8. Tolerance

The data regarding tolerance studies in term of yield per plant on different genotypes of Okra reveal significant difference among genotypes (Table 1). The results revealed that the genotype Sanum showed maximum yield *i.e.* 148.73 g per plant and found to be comparatively resistant to jassid. This genotype showed non-significant difference compared to Green Star and Okra-7080 having 145.13 and 143.74 g/plant fruit yield, respectively. The minimum fruit yield i.e. 105.55 g per plant was recorded on Lush Green which proved to be the most susceptible to jassid and did not show significant difference with those of recorded on Pusa Swani having 112.92 g per plant fruit yield.

Table 1: Means Comparison of The Data, Regarding Comonents of Resistance of Selected genotypes of Okra, (*Abelmoschus esculentus* L.)

Genotypes	Antibiosis										Antixenosis		Tolerance	
	Mating period (Minutes)		No of nymphs emerged (per female)		Nymphal period(days)		No of nymphs reaching to adults		Survival of nymphs (%)		(Non-Preference)		Yield	
	A		B		C		D		E		F		G	
Sabz Pari	12.67	cd	12.33	b	9.33	b	8.00	b	65.11	b	3.67	c	123.84	b
LushGreen	18.33	a	18.67	a	6.67	c	16.00	a	85.67	a	9.00	a	105.55	d
Green Star	11.67	d	8.00	c	10.67	a	3.33	c	41.68	d	2.67	c	148.73	a
JK-Tetra-6	12.33	cd	13.33	b	9.00	b	7.33	b	57.49	bc	4.00	bc	121.65	b
Sanum	12.33	cd	8.67	c	10.67	a	4.33	c	46.30	d	3.33	c	145.13	a
PusaSwani	19.67	a	19.33	a	7.33	c	17.67	a	91.36	a	9.67	a	112.92	cd
Okra-7080	14.00	bc	10.00	c	9.67	ab	5.00	c	50.03	cd	3.33	c	143.74	a
MD-02S	18.67	a	18.67	a	7.67	c	16.33	a	87.27	a	9.67	a	120.15	bc
CleanSpineless	15.33	b	13.00	b	9.33	b	7.67	b	62.39	b	6.00	b	128.18	b
LSD at 5%	1.869		2.289		1.166		2.145		9.881		2.184		7.826	

4. Discussion

Antibiosis refers to the adverse effect of the host plant on the physiology (survival development and reproduction) of the insects and their progeny. All the parameters relating to antibiosis study, antixenosis and tolerance showed significant difference among genotypes.

The genotype Pusa Swani showing maximum mating period (19.67 minutes), number of nymphs emerged (19.33 per female), number of nymphs reaching to adult stage (17.67), nymphal survival (91.36%) and minimum nymphal period (7.33 days) proved to be comparatively more susceptible and was found at par statistically with those of recorded on Lush Green and MD-02S with 18.33 and 18.67 minutes, 18.67 and 18.67 per female, 16.00 and 16.33, 85.67 and 87.27% and 6.67 and 7.67 days, respectively. The present findings are supported by the results of Singh [15] and Mahal *et al.* [10] they stated that the survival of nymphs of jassid reduced and prolonged development on resistant okra genotype viz. IC-7194 and New Selection than Pusa Swani. Our findings are conflicting to Barroga and Bernardo [2] Similarly Sharma and Sharma [12, 13] IC-7194 as compared to cvs, MR-12, MR-10-1 and Pusa Swani,

Sanum was the least preferred genotype showing minimum individuals i.e. 2.67 per plant and was at par statistically with Sabz Pari, Green Star Okra-7080 and JK-Tetra-6 with 3.67, 3.33, 3.33 and 4.00 individual per plant, respectively However, Pusa Swani was found to be the most preferred having 9.67 individual per plant and was at par statistically with those of MD-02S and Lush Green with 90.67 and 9.00 individuals per plant, respectively. The present findings are partially comparable to those of Uthamasamy [12] who reported that okra AE-22 is less preferred for oviposition and feeding while Pusa Swani was preferred the most by jassid.

5. Conclusion

From these results it is concluded that Pusa Swani was found to be comparatively susceptible whereas Sanam as resistant genotype regarding the jassid attack.

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