International Journal of Cell & Molecular Biology (IJCMB)
Accepted on 16 November, 2010, Vol. 1 (3), pp 285-291, 1st December, 2010
Available online at http://www.ijcmb.yolasite.com/archive.php
ISSN (2220-7589) 2010

Research article

EFFECT OF LEAF MORPHOLOGY ON THE INCIDIENCE OF SUCKING INSECT PESTS IN SOME COTTON GENOTYPES (VARIETIES)

Irfan Mustafa[1*], Iram Mumtaz[1], Abu Bakar Muhammad Raza[2], Kafeel Ahmad[1], Zafar Iqbal Khan[1]and Noshin Arif[1]

[1]Department of Biological Sciences, University of Sargodha, Sargodha
[2] University College of Agriculture University of Sargodha

The present study was conducted to formulate the effect of leaf morphology on the incidence of sucking insect pests on five cotton genotypes viz, BT-121, BT-456, FH-216, FH-160 and Desi. Whitefly adult had negative correlation with gossypol glands on midrib, vein, lamina and number of hairs on lamina which is -0.118, -0.002, -0.098 and -0.032 respectively while it showed positive correlation with number of hairs midrib (0.381), vein (0.221) and length of hair (0.392). Whitefly nymph had negative correlation with gossypol glands on midrib (-0.001) and vein (0.007) while it had positive correlation with gossypol glands on lamina, number of hair on midrib, vein and lamina and length of hair which is 0.031, 0.098, 0.057, 0.207 and 0.381 respectively. Jassid adult had negative correlation with gossypol glands on midrib (-0.050) whereas it was correlated positively with gossypol glands on vein (0.448), lamina (0.321), number of hair on midrib (0.277), vein (0.051) and lamina (0.207) and length of hair (0.023). Jassid nymph was negatively correlated with gossypol glands on midrib (-0.226), vein (-0.010), lamina (-0.129), number of hairs on midrib (-0. 114) and vein (-0.160) and length of hair (-0.202) while it had positive correlation with number of hairs on lamina (0.082). Thrips had negative correlation with gossypol glands on midrib (-0.023), vein (-0.076), lamina (-0.240), number of hairs on midrib (-0.117) and vein (-0.068) and length of hair (-0.007) whereas it was correlated positively with number of hairs on lamina (0.077).

Key words: Insect pests, Cotton, Genotypes, gossypol glands, lamina, midrib, whitefly.

Introduction

Cotton (*Gossipium hirsutum*) commonly known as silver fiber, is backbone of Pakistan (Tayyib et al., 2005). It is one of the most important cash crops of Pakistan. It contributes about 68% to the foreign exchange earning of Pakistan (Khan and Khan 1995). Pakistan ranked 4th position in the world as for as cotton production is concerned (Mahboob, 2005) . Cotton contributes 8.2 percent to the agriculture and about two percent to GDP (GOP 2004) . There are a number of constrains which presently cotton crop is facing. Insects pest are the main threat to cotton production. About 96 insects and mites pest species have been recorded on cotton (Yunus et al., 1980). Every year five to ten percent cotton yield is lost due to the cotton pests (Huque, 1972).

Cotton is handicapped by both, sucking insects and chewing insects. Sucking insect pests weakened the plant by sucking sap from leaves and other tender parts of cotton plants. Sucking insect pests may include is whitefly, jassid, aphid and thrips etc (Haq, 1970; and Nizamani et al., 2002). Attack of sucking insect pests start right from the crop sowing and continue till its maturity. About 40 -50% of crop is damage due to sucking insect pests (Naqvi, 1976) . To control the sucking insect pest farmers used chemical insecticides (Soomro et al., 2000) . To save their crops and to get higher yield formers rely more on use of pesticides. In cotton about 76 percent of the pesticides are used in

**Correspondence author Email: irfan_mustafa@hotmail.com*

Pakistan (Yousaf et al. 2004). The excessive use of insecticides may result in the development of insect resistance and resurgence of secondary pest (Soomro et al., 2000). Biodiversity of pests is greatly influenced by insecticides (Bashir et al., 2001; and Raza et al., 2000). Therefore alternate methods are needed to be used to control this problem (Soomro et al., 2000). To control of insect pests it is seriously needed to develop a long lasting strategy and a reasonable approach towards this is the use of resistance varieties (Hassan et al., 2000). The method of controlling pests based on physical characteristics of plants is safe, economical and environment friendly. Leaf hairiness influences host plant selection by whitefly. Physical barrier (Duffey, 1986) as well as favorable microclimate for pathogens can be provided by hair (Khalifa and El Khidir, 1964; and Willmer 1986). The feeding of insects is hindered by leaf thickness and toughness (Thorsteinson, 1960).
The present study was conducted with the objectives of (1) The comparative resistance and susceptibility of different cotton cultivars against sucking insect pests of cotton (whitefly, jassid and thrips). (2) To determine correlation of different cotton plant factors viz i. hairiness, ii. Hair length and iii. Number of gossypol glands against cotton whitefly, jassid and thrips. (3) To determine the overall contribution of different cotton plants factors against cotton sucking insect pests.

Materials and Methods

The present study was conducted to determine the effect of morphological traits such as number of gossypol gland, hairiness and length of hair on the incidence of whitefly, jassid and thrips. Five genotypes of cotton viz, BT-121, BT-456, FH-160, FH-216 and Desi are selected. Experiment was conducted by following randomize complete block design (RCBD) and replicated three time (thrice) in a field .Experiment was conducted during September 2008 through October 2008 at chak no 122 NB, chak 85 NB and chak 48 NB in Sargodha. Data on per leaf adult and nymph population of whitefly and jassid and only adults of thrips was recorded early in the morning at weekly basis. From each field from three cotton plants were randomly chosen. From upper, middle, and lower portion of each plant Population of jassid, whitefly and thrips was counted.
Leaf from each selected plant was used to study hairiness, and number of gossypol gland on three different places of midrib, lamina and vein each, from lower side of leaf. From midrib, vein and lamina of each leaf hair density/cm^2 were recorded under binocular microscope by using $1/2cm^2$ iron made dye. From three different places of each leaf cross section were cut with help of fine razor and length of hair (mm) was measured under binocular micrometer. Statistically the data was analyzed and simple correlation was calculated between leaf morphologic characters and sucking insect pests to establish their relationships and determine the significance of results within selected genotypes of cotton.

Results

The results (table 1) showed that all genotypes have highly significant difference against sucking insect pests population. All the genotypes were highly susceptible to whitefly and resistant to jassid. As the response of these genotypes to whitefly is concern, Desi genotype was most susceptible having 1.482 whitefly per leaf while FH-160 was least susceptible having 0.67 whitefly per leaf. As the response of these genotypes to jassid is concern, genotype FH-216 was most susceptible having 0.46 jassid per leaf while Desi genotype was least susceptible having 0.02 jassid per leaf. As the response of these genotypes to thrips is concern, Desi genotype was most susceptible having 0.63 thrips per leaf while BT-456was least susceptible having 0.32 thrips per leaf. Plants characters viz, hairiness/cm^2 (hair density/cm^2), number of gossypol glands/cm^2 and length of hair (mm) on leaf lamina, midrib and vein differed highly significantly among all genotypes of cotton (table 2). Genotype FH-160 had 99 while genotype FH-216 had lowest number of gossypol glands 24 on midrib. FH-216 genotype had highest number of gossypol glands 19 on vein while Desi genotype had lowest number of gossypol glands 2 on vein. FH-160 had highest number of gossypol glands 96 on lamina while FH-216 had lowest number of gossypol glands 59 on lamina. Genotype BT-121 has highest hairs density 312 on midrib while FH-216 had lowest hairs density 88 on midrib. BT-121 had highest hair density 162 on vein while Desi genotype had lowest hair density 51 on vein. Genotype FH-216 had highest number of hair 207 on lamina while BT-456 genotype had lowest hair density 57 on lamina. Genotype BT-121 has highest hairs length 33 mm on midrib while BT-456 had lowest hairs length 25 mm on midrib. Desi genotype had highest hair length 31 mm on vein while FH-160 genotype had lowest hair length 19 mm on vein. Genotype BT-121 had highest length of hair 28 mm on lamina while BT-456 genotype had lowest hair length 18 mm on lamina.

Table 1: mean population of sucking insect pests on different genotypes of cotton

Genotypes	Whitefly		Jassid		Thrips
	Adults	nymphs	Adults	nymph	Adults
Desi	0.314	1.142	0	0.02	0.63
BT-456	0.1	0.78	0.164	0.064	0.32
FH-216	0.12	1.21	0.22	0.24	0.37
BT-121	0.61	1.63	0.1	0.3	0.41
FH-160	0.1	0.57	0.04	0.06	0.61

Table 2: physico-morphic characters on different genotypes of cotton

Genotypes	Gossypol glands			Hair density			Length of hair		
	Leaf lamina/ cm	Leaf midrib/ cm	Leaf vein /cm	Leaf lamina/ cm	Leaf midrib/ cm	Leaf vein /cm	Leaf lamina/ mm	Leaf midrib/ mm	Leaf vein /mm
Desi	83	32	2	190	90	51	27	28	31
BT-456	91	49	10	57	154	69	18	25	22
FH-216	59	24	19	207	88	88	23	27	23
BT-121	80	35	9	187	312	162	28	33	28
FH-160	96	99	14	180	174	150	19	26	19

As correlation (table 3) of whitefly adults with plants morphological factors is concern it had negative and week correlation with gossypol glands on midrib and gossypol gland on lamina which were -0.118 and -0.098 respectively while it had negative and very week correlation -0.002 with gossypol glands on vein. Whitefly adults had positive but week correlation with number of hairs on midrib and number of hairs on vein that was 0.381 and 0.221 respectively while it had negative but week correlation -0.032 with number of hairs on lamina. Whitefly adults had positive and week correlation 0.392 with length of hair.As correlation of whitefly nymph with plant morphological factors is concern it had very week but negative correlation with gossypol glands on midrib and also with gossypol glands on vein and that correlation was -0.001 and -0.007 respectively while whitefly nymph had positive but week correlation 0.031 with gossypol glands on lamina. Whitefly nymph had positive but week correlation with number of hairs on midrib (0.098), with number of hairs on vein (0.057) and also with number of hairs on lamina (0.207) respectively. Whitefly nymph had positive and week correlation 0.381 with length of hair.

As correlation between jassid adults and plants morphological factors is concern it had negative and week correlation -0.050 with gossypol glands on midrib while it had positive and very week correlation 0.448 with gossypol glands on vein had and with gossypol glands on lamina 0.321. It had positive but week correlation with number of hairs on midrib (0.277), with number of hairs on vein (0.051) and with number of hairs on lamina (0.207). Jassid adults had positive but week correlation with length of hair which was 0.023. As correlation of jassid nymph with plant morphological factors is concern it had very week but negative correlation with gossypol glands on midrib (-0.226), with gossypol glands on vein (-0.010) and also with gossypol glands on lamina (-0.129). Jassid nymph had negative but week correlation with number of hairs on midrib (-0.114) and with number of hairs on vein (-0.160) while it was correlated positively and weekly with number of hairs on lamina 0.082. Jassid adults had negative and week correlation -0.202 with length of hair.

Table 3: correlation coefficient values between population of sucking insect pests and morphologic factors of plant in various genotypes of cotton

		GGMR	GGV	GGL	NHOM	NHOV	NOHL	LOH	WF(A)	WF(N)	J(A)	J(N)	T(A)
GGMR	Pearson Correlation												
	Sig. (2-tailed)												
	N	45											
GGV	Pearson Correlation	.433(**)											
	Sig. (2-tailed)	.003											
	N	45	45										
GGL	Pearson Correlation	.656(**)	.400(**)										
	Sig. (2-tailed)	.000	.006										
	N	45	45	45									
NHOM	Pearson Correlation	.287	.189	.461(**)									
	Sig. (2-tailed)	.056	.214	.001									
	N	45	45	45	45								
NHOV	Pearson Correlation	.505(**)	.483(**)	.396(**)	.689(**)								
	Sig. (2-tailed)	.000	.001	.007	.000								
	N	45	45	45	45	45							
NOHL	Pearson Correlation	.313(*)	.287	.364(*)	.316(*)	.372(*)							
	Sig. (2-tailed)	.036	.056	.014	.035	.012							
	N	45	45	45	45	45	45						
LOH	Pearson Correlation	-.082	-.078	.080	.279	.180	.383(**)						
	Sig. (2-tailed)	.591	.612	.602	.064	.237	.009						
	N	45	45	45	45	45	45	45					
WF(A)	Pearson Correlation	-.118	-.002	-.098	.381(**)	.221	-.032	.392(**)					
	Sig. (2-tailed)	.441	.987	.520	.010	.144	.833	.008					
	N	45	45	45	45	45	45	45	45				
WF(N)	Pearson Correlation	-.001	-.007	.031	.098	.057	.207	.381(**)	.431(**)				
	Sig. (2-tailed)	.995	.964	.839	.522	.712	.172	.010	.003				
	N	45	45	45	45	45	45	45	45	45			
J(A)	Pearson Correlation	-.050	.448(**)	.321(*)	.277	.051	.207	.023	-.152	.074			
	Sig. (2-tailed)	.745	.002	.031	.065	.740	.172	.880	.320	.630			
	N	45	45	45	45	45	45	45	45	45	45		
J(N)	Pearson Correlation	-.226	-.010	-.129	-.114	-.160	.082	-.202	-.136	.008	.310(*)		
	Sig. (2-tailed)	.135	.948	.398	.457	.294	.593	.184	.375	.958	.038		
	N	45	45	45	45	45	45	45	45	45	45	45	
T(A)	Pearson Correlation	-.023	-.076	-.240	-.117	-.068	.077	-.007	.099	-.079	-.238	.148	
	Sig. (2-tailed)	.882	.620	.112	.445	.659	.616	.961	.516	.607	.116	.332	
	N	45	45	45	45	45	45	45	45	45	45	45	45

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

GGMR: Gossypol glands on midrib. **GGV:** Gossypol glands on vein.
GGL: Gossypol glands on lamina. **NHOM:** Number of hairs on midrib.
NHOV: Number of hairs on vein, **NOHL:** Number of hairs on lamina.
LOH: Length of hair. **WF (A):** Whitefly adult
WF (N): Whitefly nymph **J (A):** Jassid adult
J (N): jassid nymph **T (A):** Thrips adult

As correlation of thrips adults with plants morphological factors is concern it had negative and week correlation with gossypol glands on midrib (-0.023), with gossypol glands on vein (-0.076) and also with gossypol glad on lamina(-0.240).Thrips adults had negative but week correlation with number of hair on midrib (-0.117), with number of hair on vein (-0.068) while it had positive but week correlation with number of hair on lamina (0.077). Thrips adults had week but negative correlation (-0.007) with length of hair.

Discussion

Whitefly adult population was negatively correlated with gossypol glands on midrib and vein. These results are not in conformity with Raza et al. (2000) who reported the positive correlation between whitefly adult and gossypol glands on midrib and vein. Whitefly adult had negative correlation with gossypol glands on lamina. Whitefly adults had positive correlation with number of hairs on midrib these results are in conformity with Ahmad (1980), Chu et al. (1999), Mansoor-ul-Hassan et al. (1999), Soomoro et al. (2000) and Aslam et al. (2001). They reported that hair density on midrib is positively correlated with whitefly population. While these results are in contradiction with results of Raza et al. (2000) who showed the negative correlation of population of whitefly adults with hair density on midrib. Whitefly adult had positive correlation with hair density on vein. This result is similar with that of Aslam et al. (2001). They also reported the positive correlation between whitefly adults and hair density on vein. Whitefly adults had negative correlation with number of hairs on lamina. This result is in contradiction with Ahmad (1980) who concluded that hair density on lamina contributes susceptibility to whitefly population. This result also in contrast with Aslam et al. (2001) who reported positive correlation between number of hairs on lamina and whitefly. But these results are in conformity with Raza et al. (2000) who also reported negative correlation of whitefly adult and hair density on lamina.

Whitefly nymph had negative correlation with gossypol glands on midrib and vein. These results are against the findings on Ahmad (1980) and Raza et al. (2000) who find that whitefly nymph had positive correlation with gossypol glands on midrib and vein. Whitefly nymphs were correlated positively with gossypol glands on lamina. Whitefly nymph had positive correlation with hair density on midrib, vein and lamina. These results are in conformity with Ahmad (1980), Chu et al. (1999), Mansoor-ul-Hassan et al. (1999) and Aslam et al. (2001). All these findings positive correlation between whitefly and hair density in midrib, vein and lamina while against the results of Raza et al. (2000) who find the negative correlation of whitefly nymph with hair density on midrib and lamina. Whitefly nymph had positive correlation with length of hair. Results are in agreements with Ahmad (190), Aslam et al. (2001) and Bashir et al. (2001). Who showed that whitefly nymph had positive correlation with length of hair.

Jassid adults had negative correlation with gossypol glands on midrib. This result is in contradiction with Ali et al. (1995) who reported that gossypol gland on midrib are not important for jassid. Jassid adults had positive correlation with gossypol glands on vein and lamina. These results are contradiction with Raza et al. (2000) who reported that jassid adults are negatively correlated with gossypol glands on lamina and vein. But these results similar with that of Ali et al. (1995) who find positive correlation between them. Jassid adults had positive correlation with number of hairs on midrib, vein and lamina. These results are in contradiction with Ahmad (1980), Hussain (1984), Ali et al. (1995), Abro et al. (1996), Mansoor-ul-Hassan et al. (1999), Raza et al. (2000) Aslam et al. (2001) and Ahmad et al. (2004). They all reported negative correlation between jassid adults and hair density on midrib, vein and lamina. These results are also in contradiction with Ali and Saeed (1999) who reported negative correlation of jassid adults with hair density on midrib, vein and lamina. Jassid adults had positive correlation with length of hair. This result is in contradiction with the findings of Ahmad (1980), Hussain (1984) and Aslam et al. (2001), who find that length of hair is negatively correlated with population of jassid adult. This result is also against the results of Ahmad et al. (2004) and Ali et al. (1995) who reported that length of hair has no effect on jassid population.

Jassid nymph had negative correlation with gossypol glands on midrib, vein and lamina. These results are in contradiction with Ali et al. (1995) who reported positive correlation between jassid and gossypol glands on vein. Thrips adults had negative correlation with gossypol glands on midrib, vein and lamina. These results are in agreement with Arif et al. (2004) who reported that gossypol glands on midrib and vein have negative correlation with thrips population. While these results are in contrast with the results of Raza et al. (2000) who reported positive correlation between thrips adults population and gossypol glands on midrib, vein and lamina. Thrips had negative correlation with hair

density on midrib and vein. Results are in contradiction with the results of Ali et al. (1995), Aslam et al. (2001), who reported positive correlation between thrips adults population and hair density on midrib and vein. These results are also against the findings of Arif et al. (2004) who find that hair density on midrib and vein had no significant correlation with thrips adult population. Thrips population is negatively correlated with the length of hair on leaf. This result is against the findings of Ali et al. (1995) who find that thrips population is not effected by length of hair. This result is in contradiction with the results of Aslam et al. (2001) who reported the positive correlation between length of hair and thrips population. While this result is in line with findings of Arif et al. (2004) who find that thrips population is negatively correlated with length on hair.

Conclusion of results and discussion is:

- Gossypol glands have negative effect on population of whitefly adults, whitefly nymphs and jassid nymphs and thrips adults while it has positive effect on jassid adults population.
- Hairiness has positive effect on whitefly adults, whitefly nymphs and jassid adults population while it has negative effect on jassid nymphs and thrips adults population.
- Effect of length of hair is positive on the population of whitefly adults, whitefly nymphs and jassid adults while it has negative effect on population of jassid nymphs and thrips adults.

It can also be concluded that sucking insect pests population might be influence by number of other factors; these factors can be phy sico-morphological, climatic, environmental or biochemical. These factors may have some positive or negative correlation in combination with sucking insect pests population. Or they may also influence the population of sucking insect pests in auto correlation.

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