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Some Morphological Plant Factors Effecting Resistance in Cotton Against Thrips (*Thrips tabaci* L.)

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ABSTRACT

A study was conducted to find out the role of some morphological plants traits in various genotypes of cotton viz., CIM-109, Cyto-9/91, FH-900, FH-901, FH-925, IRCIM-448, IRFH-901, NIAB Karishma, VH-137 and VH-142 in developing resistance against thrips, *Thrips tabaci* (Lind.) All the genotypes of cotton significantly differed in relation to all the morphological plant traits. The results revealed that CIM-109 was comparatively susceptible to thrips population while Cyto-9/91 was resistant. Hair density on midrib played a positive and highly significant role towards thrips population. Length of hair on veins exerted negative and significant correlation with thrips population. Gossypol glands on midrib and veins were correlated significantly showing negative response to thrips population. While hair density on vein and leaf lamina, length of hair on midrib and leaf lamina, gossypol glands on lamina and thickness of leaf lamina showed non-significant correlation with the thrips population. The R2 values, computed together for multiple regression analysis for thrips population indicated that all the morphological plant traits cumulatively contributed 75.6% role towards resistance against thrips.

Key Words: Cotton; Morphology; Resistance; Thrips

INTRODUCTION

Cotton is a major fiber and cash crop of Pakistan and ranks at the top as foreign exchange earner. This crop provides livelihood to million of people engaged in its trade and textile industry. Moreover, it provides raw material for our local industry and stands at the top of our exports sharing 62.3% to our total export (Anonymous, 1999). But Thrips (*Thrips tabaci* Lind.) infestation has frequently caused serious injury to young cotton plant (David, 1958). Watts (1937) observed that 56% plants produced 40% more lint in the absence of thrips injury on account of a resistant variety. It has been reported *Thrips tabaci* as being the species – or one of the species – which causes most damage to cotton crop in Pakistan (Baloch & Soomro, 1980; Pan *et al.*, 1987). It was also reported that in some years *T. tabaci* was responsible for the loss of 50% of young cotton plants (Ghabn, 1948; Bournier, 1969).

Complete reliance has been made on pesticides for the control of this notorious pest which has created problems of health hazards not only to human and animal life but also aided to speed up environmental pollution in many parts of the world (Soerjani, 1988).

Host plant resistance is a major part of an IMP programme that protects the crop by making it less suitable for the pest or by making the crop tolerant to the pest. Syed *et al.* (1996) investigated the relative resistance of twenty cotton varieties and observed the highest and the lowest thrips population was observed on Super Okra and Riode Okra, respectively. Raza (2000) tested 10 genotypes of cotton viz., HR-107NH, HR-17H, HR-101, HR-102, HR-103, HR-Vol, FH-900, MNH-552, CIM-443 and FH-643 for resistance and reported that genotype HR-103(1.61) was found susceptible, whereas, HR-107 was resistant to thrips. Hairy varieties were reported to be susceptible to thrips population (Baloch *et al.*, 1982). Ali *et al.* (1995) reported that less number of hair on leaf midrib and leaf lamina were found to play a part in contributing resistance to thrips.

Raza (2000) reported negative correlation between hair density on leaf lamina and thrips population but positive correlation between gossypol glands and thrips population.

Keeping in view the work of above researchers, the present project was conducted on 10 available genotypes of cotton viz., CIM-109, Cyto 9/91, FH-900, FH-901, FH-925, IRCIM-448, IRFH-901, NIAB Karishma, VH-137 and VH-142 with the objective to find relation of hair density, length of hair, thickness of leaf lamina and gossypol glands on leaves and cotton resistance to thrips.

MATERIALS AND METHODS

The study was conducted to determine the role of some morphological plant factors viz., number of gossypol glands, hair density, length of hair and thickness of leaf lamina towards resistance against thrips (*Thrips tabaci* Lind.) in ten genotypes of cotton viz., CIM-109, Cyto 9/91, FH-900, FH-901, FH-925, IRCIM-448, IRFH-901, NIAB Karishma, VH-137 and VH-142. The experiment was sown following Randomized Complete Block Design (RCBD) and replicated thrice with plot size of 3.85 m x 8.87 m. Row to row and plant to plant distance was maintained as 76 and 23 cm, respectively. No plant protection measures were applied throughout the season. Experiment was conducted

Table I. Thrips population per leaf and various morphological plant traits in various genotypes of cotton

Genotypes	Thrips Population Leaf^{-1}	Hair Density			Length of Hairs (Mμ)			Gossypol glands			Thickness of Leaf lamina mμ
		Midrib cm^{-1}	Vein cm^{-1}	Lamina cm^{-2}	Midrib	Vein	Lamina	Midrib cm^{-1}	Vein cm^{-1}	Lamina cm^{-2}	
Niab-Karishma	2.62 cd	148.83 cde	144.06	213.44 ab	1.90 d	2.85cd	1.47 e	16.29 bc	18.08 b	27.40 de	0.53 b
Cyto-9/91	2.23 e	175.48 b	149.20bc	145.73 bc	3.95 a	3.85 a	2.35 a	16.45 bc	14.84 c	29.34 cd	0.54 b
FH-901	3.04 ab	112.45 f	158.61 b	198.61 abc	1.95 d	1.73 g	2.36 a	11.76 de	11.10 d	28.14 d	0.56 b
CIM-109	3.13 a	218.97 a	182.63 a	254.37 a	3.02 bc	2.16 f	1.72 d	24.24 a	20.14 a	42.14 a	0.76 a
IRCIM-448	2.60 cd	137.99 def	121.97	134.43 c	3.96 a	2.90 c	2.32 a	10.87 e	9.55 d	31.39 c	0.80 a
IR-FH-901	2.48 cde	126. ef34	133.16	165.11 bc	2.66 c	2.38 e	2.16 b	12.03 de	9.21 d	25.15 c	0.59 b
VH-137	2.42 de	140.3 de9	138.88	160.68 bc	1.80 d	3.16 b	2.40 a	18.34 b	14.29 c	22.52 f	0.73 a
VH-142	2.45 cde	167.48 bc	158.16 b	164.23 bc	3.61 b	3.96 a	1.94 c	17.96 b	21.05 a	37.55 b	0.23 c
FH-900	2.78 bbc	126.56 ef	136.27cd	139.11 c	2.84 c	1.00 h	2.19 b	14.34 cd	10.49 d	27.28 de	0.56 b
FH-925	2.69 cd	160.03bcd	115.55	182.50 bc	2.75 c	2.69 d	2.35 a	11.25 de	11.18 d	28.30 d	0.54 b
R. Values	-	0.483**	0.369	0.095	0.180	0.165d	-0.578**	0.410*	0.516**	0.366 *	-0.202

* = Significant at P= 0.05
** = Highly significant

Table II. Stepwise regression models between thrips population and various morpho-physical plant characters along with coefficient of determination values in different genotypes of cotton

Regression Models	R^2
Y = 3.4836 – 0.0053 X1	0.246
Y = 3.5932 – 0.0049 X1 – 0.0015 X2	0.249
Y = 3.5865 – 0.0053 X1 – 0.0030 X2 + 0.0019 X3	0.276
Y = 3.2797 – 0.0075 X1 – 0.0037 X2 + 0.0041 X3 + 0.1222 X4	0.317
Y = 3.6578 – 0.0052 X1 – 0.0040 X2 + 0.0026 X3 + 0.1362 X4 – 0.1744 X5	0.469
Y = 5.8781 – 0.0056 X1 – 0.0043 X2 – 0.0008 X3 + 0.1212 X4 –0.1945 X5 – 0.6644 X6	0.681
Y = 5.8928 – 0.0030 X1 – 0.0007 X2 – 0.0018 X3 + 0.0795 X4 –0.1898 X5 – 0.7291 X6 – 0.0287 X7	0.712
Y = 5.5888 – 0.0033 X2 – 0.0008 X2 – 0.0018 X3 + 0.0800 X4 –0.1907 X5 – 0.7264 X6 – 0.02884 X7 + 0.0004 X8	0.712
Y = 5.8755 – 0.0033 X1 – 0.0007 X2 – 0.0017 X3 + 0.0855 X4 –0.1932 X5 – 0.7227 X6- 0.02925 X7 + 0.0016 X8 – 0.0011 X9	0.712
Y = 6.3790 – 0.0027 X1 – 0.0028 X2 – 0.0009 X3 + 0.0580 X4 –0.1710 X5 – 0.7528 X6 – 0.0023 X7 – 0.0356 X8 + 0.0039 X9 – 0.6910 X10	0.756

Where, Y = Population of the pest, X1 = Hair density on midrib, X2 = Hair density on veins, X3 = Hair density on lamina, X4 = Length of hair on midrib, X5 = Length of hair on veins, X6 = Length of hair on lamina, X7 = Gossypol glands on midrib, X8 = Gossypol glands on veins, X9 = Gossypol glands on lamina, X10 = Thickness of leaf lamina

in the research area of Cotton Research Institute at Ayub Agricultural Research Institute (AARI), Faisalabad.

Data regarding adult and nymphal population of cotton thrips (*Thrips tabaci* Lind.) on per leaf basis were recorded early in the morning from July to September at weekly intervals. Fifteen leaves were selected from 15 randomly chosen cotton plants from each plot in such a sequence that first leaf from upper portion of the first plant, second leaf from middle portion of the second plant, third leaf from lower portion of the third plant and so on, were taken into account for recording the population data of thrips.

Three plants were selected at random from each plot and one leaf each from upper, middle and lower portion of each selected plant was taken to study number of gossypol glands, hair density, length of hair on midrib, veins and lamina from lower side of the leaves under a CARL ZEISS binocular microscope from three different places. The area from midrib and vein was one cm in length, whereas for lamina it was one cm^2. For this purpose an iron made dye of 1 cm^2 was used. A cross section of each leaf was cut with the help of fine razor and thickness of leaf lamina was determined from three different places of each leaf with the help of an ocular micrometer under a CARL ZEISS binocular microscope.

The data were also analyzed statistically to find the significance of the results within the genotypes and means were compared by DMR test at 5% probability. Simple correlation was worked out between population density of thrips and morphological characters of the plant. The combined effect of the factors viz., number of gossypol glands, hair density, length of hair and thickness of leaf lamina on the population of thrips was measured by developing stepwise multiple linear regression models. An IBM compatible computer was used for whole statistical analysis with M. Stat package.

RESULTS AND DISCUSSION

The data regarding thrips population per leaf and various morphological plant traits in various genotypes of cotton are presented in Table I. The results revealed that CIM-109 with maximum population of 3.13 per leaf appeared as susceptible genotype and was statistically at par with FH-901(3.04 per leaf). While cyto-9/91 with minimum

population of 2.23 per leaf showed a resistant response and was statistically similar to VH-137(2.42 per leaf), IRFH-901 (2.42 per leaf) and VH-142(2.45 per leaf). The present findings cannot be compared with those of Syed *et al*. (1996), Ali (1999) and Raza (2000) because they tested varieties/genotypes of cotton other than those included in the present studies.

The various morphological plant traits viz., hair density, length of hair and number of gossypol glands on midrib, veins and leaf lamina and thickness of leaf lamina differed highly significantly among various genotypes of cotton(Table I). As far as correlation between thrips population and morphological plant traits is concerned, correlation coefficient values (R-values) given in Table I revealed that hair density on midrib (0.496) showed positive and highly significant correlation and length of hair on veins and gossypol glands on veins and midrib showed negative but significant correlation while all other morphological traits expressed non significant correlation towards resistance against thrips population. The present findings are in partial agreement with those of Raza *et al*. (1999) who reported that varieties possessing higher gossypol glands showed susceptibility to thrips.

The results regarding stepwise multivariate regression analysis between morphological plant traits and thrips population are presented in Table II. It is evident from Table II that hair density on midrib showed 24.6% role in population fluctuation of thrips. With the addition of hair density on leaf veins, this contribution reached to 24.9%. Similarly, with the addition of hair density on leaf lamina the role these factors cumulatively reached to 27.6%. The length of hair on midrib did not show a significant increase in population fluctuation, but length of hair on veins and lamina resulted in a significant increase in population fluctuation (68.1%). All these traits cumulatively contributed to thrips population fluctuation to the tune of 75.6%.

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