Role of Morpho-physical Plant Factors Imparting Resistance in Cotton Against Thrips, *Thrips tabaci Lind* (Thripidae: Thysanoptera)

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Abstract

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Studies were conducted to find the role of some morpho-physical plant characters of various cotton genotypes viz., BH-118, CIM-443, CIM-448, FH-634, FH-87, HR-129, VH-142, SLS-1, HRVO and Okra-170 in developing resistance against thrips, *Thrips tabact* (Lind.). All cotton genotypes significantly differed in their responses toward thrips as well as in all the morphological plant traits. The results revealed that CIM-448 was comparatively susceptible to thrips, while HRVO was resistant. Environmental conditions during the last week of July, August and September were favorable and peak thrips population was observed, and all cotton genotypes significantly differed in relation to all the morphological plant traits. Hair density on midribs and veins of upper leaves showed significant and negative correlation with thrips population. The length of hair on midrib of upper leaves, midrib and lamina of middle leaves and midrib, veins and lamina of bottom leaves played a negative and significant role in relation to thrips population. Number of ‘Gossypol glands on midrib, veins and lamina of upper middle and bottom leaves were correlated significantly and showed negative response to thrips population. All other morpho-physical traits expressed non-significant correlation in relation to resistance against thrips population.

Key words: Morpho-physical plant factors; resistant; cotton thrips

Introduction

Cotton (*Gossypium hirsutum* L.) produces the most important textile fiber in the world and it provides raw material for cotton industry and stands at the top of our exports sharing 62.3% of our total export (3). Among various factors responsible for the lower cotton yield, insect pests are one of the most important factors causing 30 to 40% yield losses in Pakistan (10). Sucking insect pests are injurious to cotton crop. Among these cotton thrips cause the leaves to turn brown on the upper side and silvery on the under side before shedding (11) and ultimately terminal bud is killed (7). Thrips (*Thrips tabaci* Lind.) infestation has frequently caused serious injury to young cotton plants (8). Watts (20) observed that 56% of cotton plants produced 40% more lint in the absence of thrips injury on account of a resistant variety.

Pesticides use for the control of this notorious pest has not only created health hazards to human and animal life but has also aided to speed up environmental pollution in many parts of the world (18).

Host plant resistance when available, is a major component of an IPM programme. Syed *et al.* (19) investigated the relative resistance of twenty cotton varieties and observed the highest and the lowest thrips population on Super Okra and Riode Okra, respectively. Raza (12) tested ten 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 the 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 (5). Ali *et al.* (1) reported that less number of hairs on leaf midrib and leaf lamina were found to play a role in increasing resistance to thrips. Raza (12) reported negative correlation between hair density on leaf lamina and thrips population but positive correlation between number of gossypol glands and thrips population.

Keeping in view the work of above researchers, the present project was conducted on 10 available new genotypes of cotton viz., BH-118, CIM-443, CIM-448, FH-634, FH-87, HR-129, VH-142, SLS-1, HRVO and Okra-170 with the objectives to investigate the role of hair density, length of hair, thickness of leaf lamina and number of gossypol glands on leaves in relation to resistance to thrips and selecting the highly resistant variety/varieties to be used as a source of thrips resistance in breeding programs or for the production of genetically modified cotton resistant 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 in ten genotypes of cotton viz., BH-118, CIM-443, CIM-448, FH-634, FH-87, HR-129, VH-142, SLS-1, HRVO and Okra-170. The experiment was sown following randomized complete block design (RCBD) and replicated three times with plot size of 4.57 x 7.64 m, 0.76 m between rows and 0.30 m between plants. No plant protection measure was applied throughout the season. Experiment was conducted in the research area of Cotton Research Institute at Ayub Agricultural Research Institute (AARI), Faisalabad, Pakistan during the year 2002-2003.

Data regarding population of cotton thrips/leaf was recorded early in the morning 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 measuring the population of thrips.

Three plants were selected at random from each plot and one leaf from upper, middle and lower part of each selected plant was harvested to study number of gossypol glands, hair density, length of hairs on midrib, veins and Lamina from lower side of the leaves under a Stereoscope binocular microscope from three different places. The midrib and veins were one cm in length, whereas for area of lamina 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 3 different sites in each leaf with the help of an ocular micrometer under a CARL ZEISS binocular microscope.

The data was 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 calculated between population density of thrips and morphological characters of the plant. An IBM compatible computer was used for statistical analysis, using the M. Stat package.

Results and Discussions

The thrips population data per leaf at various dates of observations on different genotypes of cotton are presented in Figure 1-A and Figure 1-B). Multiple comparison of mean values of different morpho-physical plant characters on different leaves of different genotypes of cotton against thrips population are presented in Table 1. The results revealed that CIM-448 with maximum population of thrips (9.6 per leaf) appeared as susceptible genotype and was statistically at par with CIM-443 (8.6 per leaf). While HRVO, with minimum population of thrips (0.07 per leaf) showed a resistant response and was statistically similar to Okra-170 (0.180 per leaf). The present findings could not be compared with earlier reporters (2, 4, 6, 12, 14, 15, 16, 19) because they tested varieties/genotypes of cotton other than those included in the present studies.

The results regarding dates of observation (figure-1B) showed that maximum number of thrips was 18.41 per leaf on August 24, 2003 and was the peak of the season. There were two other peaks, on July 30, 2003 with 7.26 per leaf population and on September 25, 2003 with 8.17 per leaf population of thrips. The population on most of the dates of observations was below economic threshold level which is 10 thrips/leaf (9, 17). The present findings are not in conformity with those of Rehman (14), Anonymous (4) and Salman (15) who reported different thrips population peaks on different periods as those recorded in the present study due to differences in tested varieties, climatic conditions and agronomic practices followed.

The various morphological plant traits viz., hair, density, length of hairs and number of gossypol glands on midrib, veins and leaf lamina and thickness of leaf lamina differed highly significantly among various cotton genotypes (Table 1). As for as correlation between thrips population and morphological plants traits concerned. The correlation coefficient values presented in Table 1 suggest that hair density on midrib and veins of upper leaves showed significant and negative correlation with thrips population due to the interruption in their movement. The length of hairs on midrib of upper leaves, midrib and lamina of middle leaves and midrib, veins and lamina of bottom leaves played a negative and significant role towards thrips population. Gossypol glands on midrib, veins and lamina of upper, middle and bottom leaves were correlated significantly with negative response to thrips population, while hair density on lamina of upper leaf, midrib, veins and lamina of middle and bottom leaves, hair length of lamina of upper leaves, veins of middle leaves and thickness of leaf lamina of upper, middle and bottom leaves showed non-significant correlation with the thrips population. The present findings are in partial agreement with those of Raza *et al.* (13) who reported that varieties possessing higher gossypol glands were susceptible to thrips and are not in agreement with the findings of Raza (12) and Ali *et al.* (1).

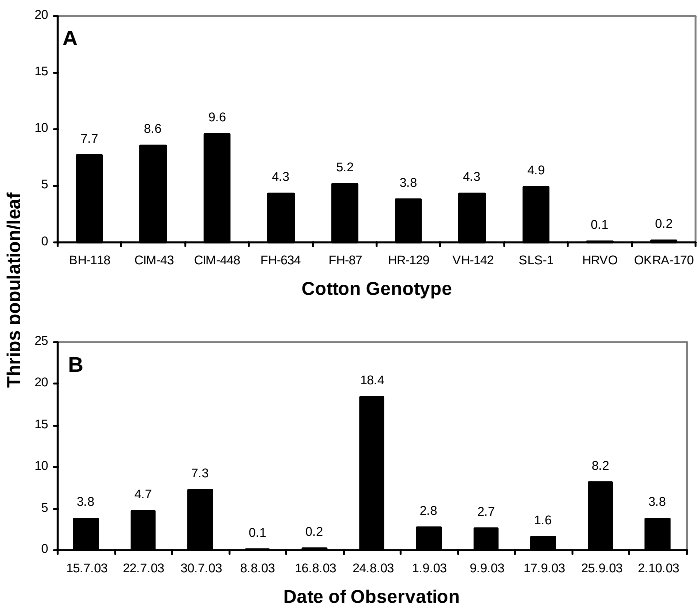

Figure 1. Thrips population per leaf in different genotypes of cotton (A) and at various dates of observations (B).

Table 1. Multiple comparisons of mean values of different morpho-physical characters of upper, middle and lower leaves of different genotypes of cotton and their correlation to thrips population.

	Hair Density			Length of Hair			Number of Gossypol Glands			Thikness of Lamina (um)
	Midrib (cm-1)	**Vein (cm-1)**	**Lamina (cm-2)**	**Midrib (cm-1)**	**Vein (cm-1)**	**Lamina (cm-2)**	**Midrib (cm-1)**	**Vein (cm-1)**	**Lamina (cm-2)**	
					Upper Leaf					
BH-118	169.67 c	149.0 cd	513.0 b	29.0 c	23.0 ef	22.0 c	24.0 b	16.0 cde	96.7 b	20.3 a
CIM-443	95.00 f	90.0 f	355.7 d	19.3 f	23.0 ef	21.0 cd	19.3 cd	17.0 bcd	42.3 cd	19.0 a
CIM448	155.00 d	127.0 e	325.7 e	29.0 c	34.7 a	32.0 a	21.3 cd	18.3 bc	65.3 bc	10.0 de
FH-634	89.67 f	83.3 f	251.7 g	28.3 c	26.3 d	27.7 b	22.7 bc	14.0 de	45.0 cd	12.0 cd
FH-87	153.67 d	140.3 de	359.0 d	25.0 d	19.7 g	19.0 d	23.0 b	21.0 b	94.0 b	11.0 d
HR-129	127.33 e	159.7 c	279.7 f	23.3 e	31.0 c	23.0 c	18.0 de	19.1 bc	53.3 cd	8.7 e
VH-142	135.67 e	128.7 c	344.7 de	20.3 f	22.0 f	21.0 cd	21.0 bcd	16.0 cde	61.7 bc	10.0 de
SLS-1	283.67 d	243.0 b	385.7 c	25.7 d	24.0 e	26.0 b	21.3 bcd	12.7 e	22.0 d	12.0 cd
HRVO	463.53 a	381.7 a	1007.3 a	32.0 b	33.0 b	21.0 cd	15.7 e	12.0 e	89.3 b	13.3 c
Okra-170	82.67 f	90.3 f	133.7 h	40.0 a	26.0 d	31.3 a	63.0 a	79.7 a	318.0 a	17.0 b
correlation factor	-0.362	-0.425	-0.237	-0.505	-0.085	0.027	-0.413	-0.451	-0.516	0.142
					Middle Leaf					
BH-118	320.30 a	146.44 c	599.7 b	27.1 e	21.3 cd	17.0 c	12.0 f	9.0 e	17.3 e	18.0 b
CIM-443	98.00 ef	76.33 g	368.3 d	23.0 f	16.0 e	13.3 d	26.3 bc	20.3 bc	85.0 bc	18.0 b
CIM448	132.70 d	122.33 d	285.7 f	23.0 f	30.0 a	24.7 b	23.3 bcd	13.7 d	66.7 bc	12.0 d
FH-634	84.70 fg	74.67 g	221.0 g	24.0 f	18.7 de	25.0 b	24.7 bc	20.0 bc	43.2 bc	11.0 d
FH-87	154.00 c	100.33 c	336.3 e	30.3 d	21.3 cd	23.3 b	23.0 bcd	18.0 c	229.3 a	11.0 d
HR-129	107.50 e	86.20 f	133.4 h	38.2 a	27.3 ab	19.3 c	19.1 de	18.0 c	49.3 bc	11.0 d
VH-142	79.30 gh	126.00 d	285.0 f	23.3 bc	27.3 ab	26.0 b	15.0 ef	21.7 b	86.0 bc	10.3 d
SLS-1	282.00 b	232.67 b	387.7 c	30.67 cd	24.3 bc	29.0 a	22.0 cd	11.0 de	22.7 bc	11.0 d
HRVO	323.70 a	353.43 a	30.7 cd	26.9 e	23.7 bc	31.7 a	27.7 b	18.3 bc	97.4 b	14.3 c
Okra-170	65.30 h	53.00 h	123.3 h	33.3 b	27.0 ab	24.3 b	95.3 a	77.0 a	250.7 a	24.2 a
correlation factor	-0.029	-0.306	-0.001	-0.516	-0.146	-0.571	-0.534	-0.561	-0.432	-0.184
					Lower Leaf					
BH-118	151.50 bc	156.87 c	657.3 b	20.7 e	19.3 e	14.7 ef	26.0 c	14.7 de	72.0 b	16.0 b
CIM-443	96.70 c	66.67 f	334.7 e	14.0 f	15.0 f	14.0 f	28.0 b	19.3 c	42.3 d	19.0 a
CIM448	142.30 bc	100.33 d	317.3 ef	29.0 bc	23.0 d	21.0 b	23.0 cde	23.0 b	54.7 c	11.7 c
FH-634	181.70 bc	147.67 c	387.3 d	30.3 b	26.0 c	20.3 bc	29.0 b	17.0 cd	71.0 b	9.7 d
FH-87	142.30 c	99.00 d	292.3 g	25.0 cd	19.0 e	19.0 bcd	25.7 bcd	14.3 de	55.7 c	11.0 cd
HR-129	83.90 c	84.20 e	97.8 h	35.7 a	28.3 b	18.0 cd	21.3 de	12.5 e	26.3 e	15.0 b
VH-142	121.30 c	91.33 de	308.0 fg	21.0 de	22.0 d	17.0 de	15.7 f	12.0 e	55.7 e	11.0 cd
SLS-1	281.30 ab	239.33 b	406.7 c	30.0 b	28.0 bc	27.7 a	20.3 e	12.0 e	17.0 f	11.3 cd
HRVO	331.30 a	305.00 a	1021.1 a	38.0 a	23.7 d	25.7 a	21.7 cde	13.0 e	43.7 d	16.0 b
Okra-170	68.70 c	57.00 g	109.3 h	38.0 a	36.0 a	26.0 a	72.7 a	75.7 a	252.0 a	20.0 a
correlation factor	-0.254	-0.31	-0.143	-0.715	-0.624	-0.59	-0.422	-0.385	-0.439	-0.194

الملخص

عريف، م.ج.، م.د. جوجي و غ. أحمد. 2006. دور العوامل المورفولوجية–الفيزيائية للنبات التي تسهم في مقاومة القطن لحشرات التربس *Thrips tabaci* Lind. (Thripidae: Thysanotera). مجلة وقاية النبات العربية. 24: 57–60.

أجريت دراسات لمعرفة تأثير بعض المواصفات المورفولوجية–الفيزيائية لأصول وراثية متنوعة من القطن (BH-118، CIM-443، CIM-448، FH-634، FH-87، HR-129، VH-142، SLS-1، HRVO و Okra-170) في تطوير مقاومة إزاء حشرات تربس القطن *Thrips tabaci* (Lind). وقد اختلفت كافة أصناف القطن معنوياً، وأظهرت النتائج أن الأصل الوراثي CIM-448 كان حساس نسبياً، في حين كان الأصل الوراثي HRVO مقاوماً. كانت الظروف البيئة خلال الأسبوع الأخير من تموز/يوليو، آب/أغسطس وأيلول/سبتمبر ملائمة ولوحظت أعلى كثافة للتربس في هذه الأصناف. وأظهرت كثافة الشعيرات على العرق الأوسطي والأوراق العليا ارتباطاً معنوياً وسلبياً مع عشائر التربس. وأسهم طول الشعيرات على العرق الرئيسي للأوراق العليا، وعلى العرق الرئيس والنصل للأوراق المتوسطة، والعرق الرئيس والعروق الثانوية للأوراق السفلى دوراً سلبياً ومعنوياً فيما يخص كثافة عشائر التربس. كما ارتبط عدد غدد "الجوسيبول gossypol" على العرق الرئيس، والعروق الثانوية ونصل الورقة للأوراق العليا، المتوسطة والسفلية معنوياً وأبدت ردوداً سلبية إزاء عشائر التربس. في حين لم يكن ارتباط المواصفات المورفولوجية–الفيزيائية الأخرى معنوياً.

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