Iran Agricultural Research 4: 89-97 (1985).

EVALUATION OF SIX COTTON CULTIVARS FOR THEIR RESISTANCE TO THRIPS AND LEAFHOPPERS[1]

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ABSTRACT

Six cotton cultivars were tested for their resistance to leafhoppers *(Empoasca spp.)* and thrips *(Thrips tabaci* Lindman*)* in Zarghan Research Station, Shiraz, Iran. The cultivars Darab I and II showed considerable resistance to both leafhoppers and thrips. Varamin cultivar was more susceptible to thrips than Darab I. Significant correlations were found between leafhopper and thrips infestation and the density of hairs and glands on the lower leaf surface. Leafhopper and thrips population densities were significantly lower on Darab I which is hairy and relatively glandless than Acala which is glandular and relatively glabrous.

تحقیقات کشاورزی ایران
(۱۳۶۴) ۹۷-۸۹:۴

ارزیابی شش رقم پنبه از لحاظ مقاومت به زنجره و تریپس

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خلاصه

شش رقم پنبه از لحاظ مقاومت به سه گونه زنجره از جنس *Empoasca* و تریپس توتون *(Thrips tabaci* Lindman*)* در مزارع تحقیقاتی زرقان شیراز مورد مطالعه قرار گرفتند. ارقام دارای I و II مقاومت قابل ملاحظه‌ای نسبت به این حشرات نشان دادند. رقم ورامین نسبت به دارای حساسیت بیشتری به تریپس نشان داد. آلوده شدن ارقام توسط زنجره و تریپس با تراکم مقدار مووغدد در سطح زیرین برگ ارتباط داشت. رقم دارای I که دارای تراکم بیشتر مووغده نسبتا "کمتری میباشد جمعیت کمتری از زنجره‌ها و تریپس را نسبت به آکالا دارا بود.

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1. Contribution from the Department of Plant Protection, College of Agriculture, Shiraz University, Shiraz Iran. Paper No. K-564-65. Received 4 May 1985.

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INTRODUCTION

Thrips and leafhopper infestations have been reported in most cotton *(Gossypium hirsutum* L.) growing provinces of Iran including the Fars Province (6, 9, 12). The insects can reach such high populations as to cause economic damage to cotton (12). They suck juices from the leaves and cause them to become curled, ragged and irregular (6). The injury retards the growth of leaves and stunts plant growth by reducing photosynthetic capacity. They are most injurious to young plants and are regarded as early season pests of cotton.

The use of insect resistant cultivars has been very successful in controlling insect pests and reducing the use of insecticides. It has been reported that if resistant cultivars in the United States were replaced with susceptible cultivars, a 37% (over 30 million kg) increase in the use of insecticides would be required to maintain the present level of control (17).

The relationship between hairiness of cotton leaves and the rate of leafhopper infestation has been noted by a number of investigators. According to Hosny and El-Dessouke (8) resistance to *Empoasca spp.* was related to the density and length of the leaf hairs. Infestation decreased with increase in hair density. Saad and Elkassaby (16) in Egypt found that the hairy cotton cultivar, Behtim-101, was highly resistant to *Empoasca decipiens* Paoli. May (12) reported that resistance to *Empoasca maculata* Evans. was due to inhibition of oviposition and this in turn was associated with degree of hairiness of the leaves.

Abdel-Gawaad and Soliman (2) conducted experiments on 19 cultivars of cotton and concluded that some cultivars were tolerant to *Thrips tabaci* Lindman and yield was high in spite of heavy infestation. Abdel-Bary *et al.* (1) found clear differences in thrips damage among cotton varieties when they were exposed to a high thrips population. An average

infestation from 0.217 to 6.667 thrips/seedling was also reported by Abdel-Gawaad *et al.*(3) when 16 cultivars of cotton were exposed to *T. tabaci* . Quisenberry and Rummel (15) stated that less damage by thrips occurred on the pubescent than glabrous cultivars.

Although the use of resistant cultivars can be an important aspect of cotton insect pest management in Iran, there is no report in this area. Among several cultivars planted in cotton producing areas, Acala, Sahel and Varamin are usually the most common. Approximately 90% of the cotton fields are planted with these cultivars and the remainder with others including Darab and Herat Yazd which are natives (4). The objective of this investigation was to find correlation between resistance to leafhoppers and thrips in cotton and the morphological structure of the leaf.

MATERIALS AND METHODS

Six cultivars of cotton were planted on May 5, 1978 each in five rows in plots of 10 x 3.5 m with four replications. The experiment was conducted in the Zarghan Research Station (35 km north of Shiraz with 52°, 41′ E longitude; 29, 47′ N latitude, and 1540 m altitude). The cotton cultivars tested were Acala, Varamin, Sahel, Herat (Mehriz) Yazd, and Darab I and II which were tested in a randomized block design. All cultivars received the same treatment with regard to irrigation, fertilization, etc.

Six plants from the three middle rows of each replicate were randomly chosen at 15-d intervals for 5 consecutive m. Counts were made of all stages of leafhoppers (three unidentified species of *Empoasca*) and thrips (*T. tabaci*) except the egg stage on 30 expanded leaves selected at random in each plot. Also, the number of hairs and glands were determined in 1 cm^2 of leaf on the lower surface. The first counting was done 4 wk after planting.

RESULTS AND DISCUSSION

Mean squares from separate analysis of variance for leafhoppers and thrips are shown in Table 1. There were significant differences in the preference of the tested insects

Table 1. Analysis of variance for leafhoppers and thrips resistance in six cotton cultivars.

Source	d.f.	Mean squares			
		Leafhoppers	Thrips	Glands	Hairs
Replications	3	351	137	41751	18322
Cultivars	5	709**	455**	51713**	128170**
Error	15	77	53	57055	59221
Total	23	250	151	53893	68875

**Significant at the 0.01% probability level.

for different cultivars. Means of the number of leafhoppers and thrips for each cultivar and also leaf hair and gland density are shown in Table 2. The average number of leafhoppers and thrips per cotton leaf for each cultivar varied from 1.25 to 6.95 and from 1.5 to 30, respectively. Darab I and II had lower populations than Acala and Sahel. Varamin showed a lower resistance to thrips than Darab I. Other cultivars showed no significant differences in leafhopper and thrips infestation. Significant differences were found among hair and gland density on the lower surface of the leaf in the tested cultivars. Herat Yazd, Varamin and Sahel did not differ significantly in hair and gland density.

Table 2. Mean of insect population and density of leaf hairs and glands on six cultivars of cotton.

Cultivar	Mean No. of insects per cotton leaf		No. per 1 cm^2 leaf (lower surface)	
	Leafhoppers	Thrips	Hairs	Glands
Darab I	1.25a	1.5a	189.33a	116.66a
Darab II	1.83ab	4.00ab	170.00a	147.33ab
Herat (Mehriz) Yazd	3.83abc	7.00ab	58.00b	156.00ab
Varamin	5.16abc	12.43bc	66.66b	148.66ab
Sahel	5.41c	13.50c	55.66b	148.66ab
Acala	6.95c	30.00c	83.66b	230.00b

*Means followed by the same letters are not significantly different at 1% probability level.

Acala is glandular and relatively glabrous in comparison with Darab I which is hairy and relatively glandless (Table 2). Acala also had higher population density of leafhoppers and thrips than Darab I and II. Therefore, a correlation existed between leafhopper and thrips density and hair and gland density on the lower surface of the leaf. Significant positive correlation existed between population density of the tested insects and the gland density, the correlation coefficients of 0.77 and 0.93 for leafhoppers and thrips, respectively. However, hair density was inversely correlated with leafhopper and thrips populations with correlation coeficients of -0.82 and -0.53, respectively. Observations on these cultivars showed that our glandless cultivars were more hairy.

This investigation confirmed the reports that high resistance to leafhoppers and thrips are correlated with the presence of short or long dense hairs on both surfaces of the cotton leaf, especially along the entire length of the midrib on the lower surface (8, 9, 12, 15, 18, 19). A direct effect of morphological characters on feeding is the inability of many leafhoppers to reach the epidermis. Cotton cultivars with more than 150 hairs cm^{-2} ranked high in resistance (14). Although both Darab I and II have a hair density above that reported by Painter (14) for high resistance, this resistance may not be only limited to the hair and gland density of the plants. Other morphological characteristics of the host plant such as succulence, roughness, pilosity, and presence of thorns or spines are regarded as permissive factors which may act as barriers to normal feeding or oviposition. Marvlott (11) stated that resistant plants are generally hairy, though all hairy plants are not resistant. Accordingly, multiple factors may be responsible for significant differences in non-preference of cottons to leafhoppers and thrips in this test.

Resistance to leafhoppers and thrips in cotton may be

related to presence of certain toxic substance in these plants. It was reported that resistance in cotton cultivars was due to naturally occurring gossypol in the plants (5). The hardness of plant tissue could also act as a resistance factor in cotton plants (5). Non-preference of some cotton cultivars to thrips and leafhoppers could be due to the thickness of the lower epidermis (3, 4, 19). Still other unknown morphological and physiological factors may be associated with resistance.

The present study shows that some of the cotton cultivars grown in Iran are resistant to leafhoppers and thrips. Although cotton grown in this country may be damaged by certain other pests, the use of these resistant cultivars may prove to be an important component of pest management in this crop.

ACKNOWLEDGEMENT

The author wishes to thank Dr. K. Izadpanah, Dr. J. Fatemi and Dr. H. Navvab Gojrati for their critical review of earlier drafts of this manuscript and Mr. G. Asadi for statistical analysis.

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