Pak. J. Bot. 33 (special issue) 2001

HOST PLANT RESISTANCE TO INSECTS IN COTTON AT CENTRALCOTTON RESEARCH INSTITUTE, SAKRAND SINDH PAKISTAN

ABDUL RAZAQUE SOOMRO, REHANA ANJUM AND GHULAM HUSSAIN MALLAH & M. A. LEGHARI

Central Cotton Research Institute, Sakrand Sindh Pakistan.

Abstract

Two host plant resistance trials were conducted at Central Cotton Research Institute. Sakrand Sindh during 1997 cotton season to assess in-built tolerance of sucking as well as bollworm complex in new varieties developed by different breeders of Pakistan. The results demonstrated minimum population per leaf of thrips and jassid on CRIS-7A the densely hairy variety, whereas minimum population per leaf of whitefly was recorded on CRIS-83 the glabrous variety proving negative correlation between jassid and hairiness. The maximum per leaf population of thrips, jassid and whitefly was observed on CRIS-105, CRIS-5A and CRIS-7A respectively. The maximum bollworm damage was noted in CRIS-56 and minimum in CRIS-5A. Highest seedcotton yield (2296 kg ha^{-1}) was produced by CRIS-9 whereas lowest (1435 kg ha^{-1}) by CRIS-78. Results of second trial revealed that thrips and whitefly population was below economic injury level and non-significant in all the varieties. However, jassid population was above economic injury level and significantly higher on MNH-427 variety whereas CRIS-82 recorded minimum. Variety MNH-465 recorded highest bollworm damage percent and CRIS-133 lowest. Highest seedcotton yield of 4555 kg ha^{-1} was produced by CRIS-134 whereas lowest (1531 kg ha^{-1}) by DNH-40.

Introduction

Cotton is attacked by a number of insect pests almost in all cotton producing countries and due to crop economic importance much attention has been given on its pest control. At present the researchers and the growers heavily depend upon the pesticide use to get best seedcotton yield and quality lint. Indiscriminate use of pesticides has brought many problems like resistance, resurgence and emergence of new pests as well as environmental pollution.

Resistant cultivars, even those with modern levels of resistance, are highly compatible with all other control tactics. They contribute stability and offer advantages to integrated pest management system. Genetic resistance is most likely to be used in concert with other pest control measures, which include cultural, biological and chemical approaches. Resistant cultivars may not require as many treatments or high rates of pesticide application to achieve adequate pest control. This results in reduced production costs, risks and increased profits. Resistance to insects is relative, thus cultivar differences can be utilized to the growers advantage.

There have been several recent studies and summarizations of host plant resistance in cotton (Jenkins, 1986, 1989, 1991; Smith, 1992; Jenkins and Wilson, 1994). The readers may consult their findings for detailed references to the literature in this field however, some references are discussed here:

Jenkins (1986) reviewed his research from the past 25 years, which identified *Gossypium hirsutum* race accessions with varying levels of resistance to tobacco budworm, pink bollworm, plant bugs and the boll weevil. He reported that 65 accessions have been identified as resistant to boll weevil, 61 resistant to Heliothis spp., 98 resistant to pink bollworm, 11 resistant to plant bugs, and 6 resistant to

spider mites. Resistance to more than one pest is common in these resistant accessions.

Jenkins (1989) opined that development of commercial cultivars resistant to Heliothis, pink bollworm, plant bugs and nematodes is on the way. These will be early, fast fruiting, short season cultivars that are similar or higher in yield to present cultivars. To use these to their optimum potential the growers and their advisors must recognize what the resistant lines can do and how to use each type and level of resistance to an optimum. He further added that physiological traits such as pest resistance, boll growth rates, leaf shapes, leaf size, fruit initiation rates are cultivar specific and these together with water regulation, nitrogen fertilizers and plant growth regulators can be used as crop management tools more effectively to utilize plant resistance potentials of cultivars for optimum economic production.

Host plant resistance (HPR) studies are the regular feature at CCRI, Sakrand Sindh. Entomology Section tests new strains developed by Plant Breeding Section of the Institute against major insect pests in insecticide free environment. Beside this, Pakistan Central Cotton Committee lays National Coordinated Varietal Trials (NCVT) to conduct host plant resistance studies at its Institutes (CCRI, Sakrand Sindh and Multan Punjab) to test the candidate varieties developed by different breeders engaged in cotton research in the country. These trials are also conducted without any insecticide spray. The objective of this study was to test the natural resistance/tolerance of advance strains of the Institute and candidate strains developed by different breeders of Pakistan against sucking and bollworm complexes in insecticide free environment.

Materials and methods

Two separate experiments were laid out during 1997 at CCRI, Sakrand farm to assess the in-built tolerance of varieties under unsprayed conditions. Both experiments were sown in Randomized Complete Block Design (RCBD) replicated four times in the second week of May. Experiment one (HPR) had 13 varieties all developed at CCRI, Sakrand whereas the second experiment (NCVT) consisted 16 varieties developed by the different breeders of Pakistan including four varieties of this Institute. All other agronomic practices were completed in time keeping in view the need of the trials. One bag per acre of DAP fertilizer was applied at the time of seedbed preparation while two bags per acre of urea were applied in three splits to both the experiments. Sucking pests were observed per leaf basis from a total of 20 leaves taken at random (upper, middle and bottom of the plant) from 20 plants of each variety each replication. Bollworms were sampled by standard method of pest scouting (52.25" sampling point). Observations on pest population were recorded fortnightly and finally averaged, analyzed and subjected to Duncan's Multiple Range test for comparison of means.

Besides these trials (HPR and NCVT) conducted by Entomology section on these varieties in un-sprayed conditions, Plant breeding section also tested these varieties for per hectare seedcotton yield (NCVT and Demonstration trial) in insect pest control conditions during the same year (1997). Both trials were sprayed twice against sucking and bollworm complex.

Results and discussion

The data regarding sucking and bollworm complex and seedcotton yield per hectare (both sprayed and un-sprayed) of HPR trial are depicted in Table-1, whereas of NCVT in Table-2. Accordingly, CRIS-7A being profusely hairy was recorded as jassid and thrips resistant (Table-1). However, maximum whitefly was recorded on this variety proving the negative correlation of hairiness and jassid attack (maximum the hairs, minimum will be jassid population). CRIS-134 was observed as second best in terms of thrips and jassid resistance. CRIS-5A and CRIS-52 showed susceptibility against jassid. Being glabrous, whitefly resistant varieties recorded were CRIS-107, CRIS-83 and CRIS-78 and are recommended for those areas where whitefly is major problem.

As regards bollworm damage percentage, non-significant differences were observed in all the varieties tested and almost equal bollworm damage was recorded. Maximum Earias live larvae were observed in CRIS-56 and minimum in CRIS-5A. This variety can tolerate the attack of Earias sp. where high population of this pest occurs, thus CRIS-5A may safely be recommended for that area.

The yield data of Table-1 demonstrated non-significant differences between the varieties in un-sprayed HPR trial. CRIS-9 produced highest yield closely followed by CRIS-105, CRIS-83 and CRIS-56. The lowest yield was produced by CRIS-78 although this variety showed non-preference against jassid and whitefly simultaneously. This may be due to varietal effect and greater preference by bollworm. When these varieties were tested in sprayed block receiving two sprays one for sucking and other for bollworm, highest yielding variety was CRIS-19 (4101 kg ha^{-1}) followed by CRIS-52 (3218 kg ha^{-1}). Out of thirteen varieties, eight showed greater yield margin between sprayed and un-sprayed treatments while rest of the five varieties showed somewhat little difference.

The data of another experiment (NCVT) regarding pest population and seed cotton yield (sprayed and un-sprayed) are presented in Table-2. In this experiment non-significant population of thrips and whitefly was recorded, while jassid population was significant and above economic threshold level in two varieties TH-41/83 and MNH-427. Bollworm damage percent by Earias sp. was also non-significant, while the presence of Earias live larvae was significant. High yielding variety recorded in both treatments (sprayed and un-sprayed) was CRIS-134 which clearly indicates that this variety can be grown without insecticidal spray with very little compromisation in yield as compared to sprayed treatment. This also holds good for CRIS-133, CRIS-82, BH-95 and TH-228/67. It is therefore suggested that varieties with host plant resistance/non-preference traits can be cultivated without making additional expenditure on insecticidal sprays, thus saving environmental as well as human health.

Table 1. Average of sucking and bollworm pest complex and seedcotton yield obtained from HPR trial at CCRI – Sakrand during 1997 cotton season.

Variety	Population of sucking pests per leaf			Population of bollworm E. Live		Yield (kg/ha) Unsprayed	Yield (kg/ha) Sprayed
	Thrips	Jassid	Whitefly	Damage %	Larvae %		
CRIS-7A	1.67 d	0.29 d	6.68 a	4.22 a	0.72 ab	2196 a	2538 c
CRIS-134	1.94 cd	0.56 c	3.34 ab	4.94 a	0.81 ab	2010 a	2379 c
CRIS-54	2.06 bc	1.60 c	4.42 ab	4.35 a	0.59 ab	2009 a	3036 b
CRIS-19	2.20 abc	1.68 bc	4.46 ab	4.69 a	0.71 ab	1722 a	4101 a
CRIS-82	2.10 bc	1.83 ab	3.35 ab	4.49 a	0.78 ab	2011 a	2833 bc
CRIS-52	3.32 abc	1.88 a	6.55 ab	4.24 a	0.38 ab	1722 a	3218 b
CRIS-56	2.35 ab	1.87 ab	5.47 ab	4.96 a	0.87 a	2290 a	3059 b
CRIS-105	4.52 a	0.87 ab	5.48 ab	4.76 a	0.36 ab	2293 a	2470 c
CRIS-5A	2.20 abc	2.00 a	2.29 ab	4.14 a	0.13 c	1722 a	2991 bc
CRIS-107	2.22 abc	1.64 c	1.14 b	4.48 a	0.70 ab	2009 a	2130 d
CRIS-83	3.40 ab	0.56 c	1.13 b	4.42 a	0.49 abc	2291 a	3127 b
CRIS-78	3.41 ab	0.56 c	1.18 b	4.27 a	0.56 abc	1435 a	2697 bc
CRIS-9	3.37 ab	0.57 c	2.26 ab	4.45 a	0.57 abc	2296 a	2379 c

Means followed by similar letters are not significantly different from each other according to DMR test.

Table 2. Average of sucking and bollworm pest complex and seed cotton yield obtained from NCVT trial at CCRI – Sakrand during 1997cotton season.

Variety	Population of sucking pests per leaf			Population of bollworm E. Live		Yield (kg/ha) Unsprayed	Yield (kg/ha) Sprayed
	Thrips	Jassid	Whitefly	Damage %	Larvae %		
CRIS-82	2.82 a	0.35 d	0.48 a	3.17 a	1.10 bcdef	3588 bc	4545 b
CRIS-19	2.47 a	0.46 cd	0.57 a	2.73 a	0.73 def	3109 cd	4784 b
CIM-435	2.55 a	0.53 cd	0.40 a	4.05 a	2.00 ab	2153 e	2201 f
CIM-448	2.48 a	0.52 cd	0.44 a	3.53 a	0.27 ef	2775 d	2488 ef
CRIS-133	2.96 a	0.93 abc	0.38 a	2.57 a	0.80 cdef	3827 b	4449 b
NIAB-78	2.63 a	0.65 bcd	0.30 a	4.70 a	0.63 ef	2870 d	3062 cd
BH-95	2.83 a	0.54 cd	0.43 a	4.47 a	1.27 abcde	3588 bc	2583 def
TH-228/67	2.54 a	0.63 bcd	0.26 a	5.01 a	1.73 abcd	3588 bc	2631 def
CRIS-134	2.73 a	0.42 d	0.69 a	4.23 a	1.03 bcdef	4555 a	4832 a
TH-41/83	3.19 a	1.04 ab	0.68 a	4.47 a	1.83 abc	2870 d	2822 de

MNH-427	2.55 a	1.17 a	0.78 a	3.70 a	1.03 bcdef	1626 f	3396 c
GH-9	2.63 a	0.81 abcd	0.59 a	4.63 a	1.03 bcdef	1770 ef	2727 def
DNH-40	3.03 a	0.47 cd	0.61 a	4.80 a	2.17 a	1531 f	3540 c
FS-643	2.39 a	0.47 cd	0.46 a	2.67 a	0.20 f	3396 bc	2240 ef
MNH-465	2.92 a	0.60 bcd	0.65 a	5.73 a	1.83 abc	1674 ef	2201 f
SLH-171	2.86 a	0.49 cd	0.51 a	5.37 a	1.27 abcde	1722 ef	3253 cd

Means followed by similar letters are not significantly different from each other according to DMR test

References

Jenkins, J. N. 1986. Host plant resistance: advances in cotton. pp. 34-41 In: Brown, J. M. (Ed.) Proceedings Beltwide Cotton Production Research Conferences. National Cotton Council of America. Memphis, TN.

Jenkins, J. N.; 1989. State of the art in host plant resistance in cotton. In: Green, M. B. and Lyon, D. J. de B. (Eds) Pest management in cotton. Ellis Horwood limited Publishers, Chichester, England. Pp. 53-69.

Jenkins, J. N. 1991. State of the art of host plant resistance to insects in cotton. pp. 627-633 In Herber, D.J. and Richter, D. A. (Eds) Proceedings Beltwide Cotton Production Research Conferences. National Cotton Council of America, Memphis, TN.

Jenkins, J. N. and F. D. Wilson. 1994. Host plant resistance. In Phillips, J. and King, E. (Eds) Cotton insects. Cotton Foundation Series, Cotton Foundation, Memphis, TN.

Smith, C. Wayne, 1992. History and stature of host plant resistance in cotton to insects in the United States. Advances in Agronomy, 48: 251-296.