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Studies on Host Plant Resistance to Evaluate the Tolerance/Susceptibility Against Cotton Pests

Mushtaque Ali Leghari, Ali Muhammad Kalroo and Allah Bux Leghari
Central Cotton Research Institute Sakrand, Sindh, Pakistan

Abstract: Studies were carried out to determine natural resistance of cotton varieties against insect pests. Population of thrips reached above threshold levels from 1st week to 3rd week of July in all the strains/varieties (CRIS-120, CRIS-126, CRIS-133, CRIS-134, CRIS-9 and NIAB-78) and needs to be sprayed to protect the crop from economic loss. CRIS-134 showed more tolerance against bollworm damage followed by CRIS-133. Maximum seed cotton yield was obtained from CRIS-120, followed by NIAB-78 and CRIS-126 respectively. Regular pest scouting should be carried out in the field and when pest populations reach at threshold levels, the crop should be sprayed with appropriate pesticides accordingly.

Key words: Host plant resistance (HPR), economic loss and benefit and varieties/strains

Introduction

Cotton has been prey to a number of pests, which have affected its production from time to time whenever it is grown. Besides other factors, the insect pest complex of cotton inflicts heavy losses to the cotton crop by reducing yield and quality of seedcotton (Amer *et al.*, 1999). Ahmed (1999), reported that, about 20-40% loss is caused due to different pests of cotton in Pakistan. In the country usually pesticides are used to control the pests. However, host plant resistance studies offer many advantages towards the suppression/control of cotton pests. Host Plant Resistance (HRP) involves research on the relationships between the plant and its pests. The goal of HPR is to change the plant genetically in a manner to shift these relationships to a more favourable balance for the plant and often to the disadvantage of the pests.

In the process of HPR many mechanisms have been suggested for insect resistance in cotton, some of which have proved to give economic benefits in the field. Some of the genetic markers/characters are known to play a role to suppress the pest population i.e., Ferego bract, Nectrilessness, Hairy leaf, Smooth leaf, High gossypol, Okra leaf, Red leaf, and Early maturity etc. Breeding programmes in tropical Africa came to recognize that plant hairiness conferred resistance to jassids and the character was then routinely selected to the point where jassids could be disregarded as a serious pest (Reed, 1974). However, there is some evidence that hairy leaves sacrifice some resistance to the bollworms (Bhat *et al.*, 1986). The whitefly *Bemisia tabaci* (Gennadius) has long caused serious economic damage to the Sudanese cotton crop and breeding has been using okra leaf and super okra leaf to confer resistance (Khalifa and Gameel, 1883). Some resistance to bollworms in USA has been demonstrated in *Heliothis zea* (Boddie) and *Heliothis virescens* F. from frego bract and nectriless (Shepherd *et al.*, 1986). High gossypol in squares can reduce the feeding of larvae to the point where some resistance is conferred and in combination with smooth leaf up to 80% of larvae may be suppressed (Lukefahr *et al.*, 1975). In Africa the pink boll worm *Pectinophora gossypella* (Saund.) is most readily controlled by the strict enforcement of close season when cotton can not be grown. This prevents the pests from over-wintering in plant trash or rattooned cotton. Combinations of nectarilessness and smooth leaf have similar effect to that in *Heliothis* (Wilson, 1986), but again on a commercial scale the total effect is small in comparison with maintaining an effective close season. Therefore, keeping in view the importance of the topic, research studies were carried out at Central Cotton Research Institute, Sakrand. To determine natural resistance of new strains.

Materials and Methods

Four promising strains i.e., CRIS-120, CRIS-126, CRIS-133 and CRIS-134 were compared with two standards NIAB-78 and CRIS-9. Experiment was conducted under un-sprayed conditions and laid in Randomized Complete Block Design with three replications in plot size of 60.0′ x 12.5′. Data was analyzed according to Duncun (1970). Crop was sown on 6-5-2000 and harvested on 9-10-2000 and 6-11-2000. Population of pests was recorded at weekly intervals. To note the population of sucking pests, observations were recorded from 15 leaves per treatment randomly observed from top, middle and bottom portions of the plants. For bollworms, stick sample of 52.25" per treatment was used.

Results and Discussion

Results indicate that thrips and whitefly made their appearance from 3rd week of June in all the strains/varieties (Table 1). Population of jassid appeared from 1st week of July in CRIS-120, CRIS-126, CRIS-134, CRIS-9 and NIAB-78. Whereas on CRIS-133 (jassid) appeared a week latter during 2nd week of July. Population of jassid and whitefly remained below threshold level on all the strains/varieties during the season. While thrips population remained above economic threshold levels from 1st week of July to 3rd week of July (population ranged between 9.2/leaf to 14.1/leaf, Table 1) in all the strains/varieties and needed to be sprayed to protect the crop from economic losses and maximize the yield. Economic injury levels of different cotton pests are presented in Table 1a. Mohyuddin and Qureshi (1999) mentioned that, sprays based on threshold levels give satisfactory control of cotton pests. If no control measures are taken, yield is reduced by almost 50%.

Bollworm started to damage the crop from 2nd week of July in CRIS-120, CRIS-126, CRIS-9 and NIAB-78. Whereas bollworms appeared a week latter on CRIS-133 and CRIS-134. Population of bollworm damage% reached threshold level during 1st week of September in all the strains/varieties under trial except in CRIS-134 during mid of September. Results indicate that, CRIS-134 showed more tolerance against bollworm damage followed by CRIS-133. Seasonal average of sucking and bollworm pests and yield obtained from different strains/varieties is summarized in Table 2. Varietal differences for pest incidence and yield data were statistically non-significant. However, numerically the highest seed cotton yield

Table 1: Weekly population of sucking and bollworm pest complexes recorded from the host plants resistance studies in un-sprayed condition.

Name of variety	Name of pests	Observations recorded during: Week of June		Week of July				Week of August				Week of September				Week of October
		1	2	1	2	3	4	1	2	3	4	1	2	3	4	1
CRIS-120	Thrips/leaf	2.2	2.4	9.5	11.7	13.0	6.9	6.0	3.0	1.5	2.1	1.1	1.2	0.9	0.7	0.6
	Jassids/leaf	0.0	0.0	0.1	0.1	0.2	0.2	0.1	0.1	0.3	0.4	0.3	0.3	0.3	0.2	0.4
	White fly/leaf	1.5	1.3	2.5	2.1	3.0	1.5	0.7	0.9	0.8	1.0	1.0	0.9	0.8	0.8	1.5
	Bollworm D%			0.7	6.3	2.2	3.5	4.7	3.9	4.7	6.2	7.1	6.9	7.0	6.6	
CRIS-126	Thrips/leaf	2.5	2.2	9.2	10.7	11.0	5.5	4.7	3.6	1.9	2.2	0.7	0.8	0.5	0.5	0.5
	Jassids/leaf	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.1	0.2	0.1	0.1	0.4
	White fly/leaf	1.6	1.0	3.3	2.2	2.3	0.7	0.8	0.2	0.8	1.2	0.6	0.7	0.7	0.5	1.9
	Bollworm D%			1.6	5.7	2.7	3.2	6.1	4.3	6.2	5.1	6.2	6.8	6.3	6.2	
CRIS-133	Thrips/leaf	2.6	3.1	10.5	14.1	11.3	5.3	6.3	2.1	1.7	2.5	0.9	0.6	0.5	0.6	0.6
	Jassids/leaf	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.2	0.4	0.2	0.1	0.2	0.1	0.3
	White fly/leaf	2.3	1.1	2.6	2.8	2.1	0.9	1.1	0.9	0.7	1.3	0.7	0.6	0.5	0.9	1.7
	Bollworm D%			0.0	7.2	1.2	2.7	6.1	4.1	4.8	5.9	4.9	6.6	5.6	6.7	
CRIS-134	Thrips/leaf	2.8	2.1	9.5	10.9	10.9	3.9	4.4	1.8	1.1	1.4	0.8	0.9	0.5	0.4	0.4
	Jassids/leaf	0.0	0.0	0.1	0.1	0.3	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.3
	White fly/leaf	3.2	1.2	4.3	2.4	3.9	0.9	0.6	0.8	0.7	0.9	0.8	0.7	0.8	0.6	1.6
	Bollworm D%			0.0	8.2	1.6	3.6	5.3	3.3	3.6	4.8	4.5	6.4	6.8	6.8	
CRIS-9	Thrips/leaf	2.1	1.9	9.6	12.0	12.6	8.6	5.3	2.9	2.4	2.3	1.1	0.8	1.0	0.6	0.5
	Jassids/leaf	0.0	0.0	0.1	0.1	0.4	0.2	0.2	0.2	0.5	0.5	0.1	0.2	0.3	0.1	0.3
	White fly/leaf	2.1	1.0	3.8	2.5	3.8	2.1	0.6	1.0	1.0	1.6	0.8	0.8	0.7	0.7	1.6
	Bollworm D%			2.5	7.9	1.4	3.2	5.2	3.9	5.5	5.8	4.5	5.9	6.3	7.9	
NIAB-78	Thrips/leaf	1.4	1.8	10.3	12.4	13.5	7.4	3.8	2.1	1.3	1.1	0.7	0.8	0.6	0.6	0.7
	Jassids/leaf	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.2	0.2	0.1	0.3
	White fly/leaf	1.7	1.2	3.1	2.9	2.4	1.0	0.6	0.9	0.4	0.8	0.9	0.9	0.7	0.6	1.9
	Bollworm D%			1.2	6.7	3.0	3.5	5.2	4.2	4.3	6.5	6.1	7.0	7.0	7.2	

Table 1a: Economic Injury levels of different cotton Pests

Common names	Scientific names	Economic injury level
Jassid	*Amrasca devastans* (Dist.)	3-2 nymphs/adults/leaf
White fly	*Bemisia tabaci* (Gen.)	4-5 nymphs/adults
Thrips	*Thrips tabaci* (Lind)	8-10 thrips/leaf
Mites	*Tetranychus urticae* (Keeh)	10-15 mites/leaf
Pink bollworm	*Pectinophora gossypiella* (Saund)	August 1-15 (15% infested bolls)
Spotted bollworm	*Earias insulana* (Stoll.)	August 16-30 (10% infested bolls)
American bollworm	*Helicoverpa arrmigera* (Hb.)	Sept. on wards (5% infested bolls)
American bollworm	*Helicoverpa arrmigera* (Hb.)	5 brown eggs/25 plants or 5 larvae/25 plants

Adopted from Anonymous (2000-01)

Table 2 : Host plant resistance of new cotton strains against sucking and bollworm pest complex in un-sprayed conditions.

Varieties	Sucking pest population per leaf: Thrip	Jassid	Whitefly	Bollworm damage%	Yield kg ha^{-1}
CRIS-120	4.2	0.2	1.4	5.1	1388
CRIS-126	3.8	0.2	1.3	5.1	1053
CRIS-133	4.2	0.2	1.3	4.7	1005
CRIS-134	3.4	0.2	1.6	4.7	910
CRIS-9	4.2	0.2	1.6	5.1	814
NIAB-78	3.9	0.2	1.3	5.3	1244

Table 3: Insect resistance characteristics in cotton.

Traits	Boll Weevil	*Heliothis* Sp.	*Lygus* spp.	Cotton fleahopper	Spider mites	Pink bollworm	*Emposaca* spp.	Thrips	Aphids	Cotton leaf Perforator	Whitefly
Frego bract	R	N	S	S	N		S	S	N		
Nectrilessness	N	R	R	R		R	R	N	N		
Glabrousness	N	R	?	R (?)		R	S	S	?		
Terpenoids (high square) gossypal, heliocides	N	R	R	R			R	S	R (?)		S
Heavy pubescence	R	S	(?)	R	N	R	R	(?)	(?)	R (?)	(?)
Red plant colour	R	N	N	N					N		
Okra leaf	N										R
Oviposition-suppression factor	R										
Plant bug suppression factor			R	R.							
Early-rapid fruiting	E	E			E						

R= Resistant, S= Susceptible, E= Escape, N= Neutral, (?)= Conflicting evidence or not varified. Adopted from Niles (1980).

was obtained from CRIS-120 (1388 kg ha^{-1}) followed by NIAB-78 (1244 kg ha^{-1}) and CRIS-126 (1053 kg ha^{-1}).

Morphological characters of the strains/varieties are summarized as follows: CRIS-120 (medium height, early maturing, normal sympodial branches, leaves semi-hairy, gossypol glands normal on whole plant). CRIS-126 (plants medium tall, medium on maturity, medium-long sympodial branches, leaves semi-hairy, normal gossypol glands, bolls elongated with long beak). CRIS-133 (somewhat short statured, early maturing and high yielding) and CRIS-134 (plant height ranged between 100 to 110 cm, leaves darker green, high yielding, early maturing and heat tolerant).

Niles (1980) out lined some morphological characters that confer resistance to various insect pests (Table 3). Chaudhry and Arshad (1989) reported that, resistant varieties offer an inexpensive preventive measure generally compatible with other methods of pest control. Depending upon the level of resistance they can either be used as the principal method of control or can be combined with other methods in developing appropriate pest management systems. Wherever possible, the use of resistant varieties appears to be the most practical method of pest and disease control. It also avoids environmental pollution.

Experimental results/data clearly indicates the potentiality of new strains and different characters showed some tolerance against sucking as well as bollworms pest complex. However, it is suggested that, crop should regularly be visited/scouted to note the population of different pests and when the, population of any pest reach a threshold level then, any curative method should be employed to protect the crop and get the maximum yields. Jenkins (1989) mentioned that, host plant resistance involves the research on relationships between plant and its pests. The goal of host plant resistance is to change the plant genetically in a manner to shift these relationships to a more favourable balance for the plant and often to the disadvantage of the pests.

It is also a high time to carry out more fundamental/applied research to develop new varieties which should not only be pest resistant, but should have heat and drought resistance, early maturing, high yielding with other fiber qualities, to meet the challenge of new century.

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