Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences
Volume 1 Number 6: 705-707, 2002

Effect of Cotton Leaf Curl Virus Disease on Morphology, Yield and Fibre Characteristics of Susceptible Lines/cultivars of Cotton (*Gossypium hirsutum* L.)

Ghayour Ahmad, Saeed Ahmad Malik, Zahid Mamood, Muhammad Zaffar Iqbal,
Saghir Ahmad and Saeed Ahmad
Cotton Research Station, Old Shujabad Road, Multan, Pakistan

Abstract: Three local as well as exotic leaf curl virus susceptible lines/cultivars of cotton, i.e., S-12, Acala-1517-C and CIM-70 were evaluated for yield, yield components and fibre traits. This disease had adverse effect on morphological, yield and yield components and fibre quality of all varieties. The cv. CIM-70 exhibited the highest reduction (87.3 %) in seed cotton yield and staple length (7.1 %) due to cotton leaf curl virus disease. The extent of adverse effects of this disease was most prominent on ginning out-turn (-18.2 %) and fibre fineness (23.8 %) of S-12.

Key words: Cotton, cotton leaf curl virus, yield, yield components, fibre characteristics

Introduction

Cotton (*Gossypium hirsutum* L.) is one of the main cash crops and a major contributor to financial stability and economic viability of Pakistan. It is the backbone of economy of Pakistan. It feeds 503 textile mills, 1139 ginning factories and 5000 oil expellers (Mahmood, 1999). The oil extracted from cotton seed amounts to 85 % of the total edible oil production in the country (Riaz, 1997). In 1991-92, Pakistan achieved a record production of 12.8 million bales. During 1992-93 there was sharp reduction of 9.1 million bales in cotton production due to this disease and this downward trend in production, continued bringing about further decline to 7.9 million bales during 1994-95 (Anonymous, 1997). In other studies, Ahmad (1987) and Idris (1990) found the highest reduction in seed cotton yield due to cotton leaf curl virus disease. In farmers field 50 % loss in yield of cotton varieties, i.e., CIM109, CIM240, BH36 and FH-682) was recorded, whereas virus susceptible variety S-12 showed 85–90 % reduction in the same characteristics (Anonymous, 1992).

Mahmood *et al.* (1996) reported that in cotton cultivars the average reduction in plant height (40.6 %), boll weight (33.8 %), number of bolls per plant (72.5 %), ginning outturn (3.9 %), fibre length (3.4 %), fibre strength (0.7 %) and fineness due to cotton leaf curl virus disease.

Russell (1982) and Brown *et al.* (1987) found that boll weight of cotton plant was negatively affected by cotton leaf crumple virus infection but parameters relating to quality, I e., lint index, seed index, number of seeds per boll, fibre length, fibre strength and fibre fineness were not affected by this disease.

Keeping in view the importance of this disease, the present studies were carried out to assess the effects of cotton leaf curl virus on morphology, yield and fibre quality of cotton.

Materials and Methods

Three exotic as well as local cotton leaf curl virus susceptible lines/cultivars, i.e., S-12, Acala1517-C & CIM-70 of cotton were collected from Cotton Research Institute and Cotton Research Station, Multan during 2001. These were sown in the field in the month of May 15, 2001, at Cotton Research Station, Multan. There were six rows of each line/cultivars sown in simple fashion keeping row to row distance of 2.5 ft. and plant to plant distance of 1 ft. (Plot size 20 X 2.5 ft)

At the time of maturity, data were also recorded for the following parameters (ten plants of each variety):-

Morphological characteristics

Final height of main stem (cm): Individual plant height was measured from the first cotyledonary node to the apical bud when the apical growth of the plant almost ceased. These measurements were then averaged for the respective genotypes.

Number of sympodial branches per plant: The number of sympodial branches were counted and then averaged for the respective genotypes.

Number of monopodial branches per plant: Likewise number of monopodial branches were counted and then averaged for the respective genotypes.

Yield characteristics

Number of bolls per plant: Number of effective bolls were counted and then average for the respective genotypes.

Average boll weight (g): It was calculated by dividing the total weight of seed cotton by the number of bolls.

Seed cotton yield per plant (g): The total seed cotton of all the pickings from each plant was weighed on triple beam balance separately. The average seed cotton yield per plant was then computed for every genotype.

Fibre characteristics

Ginning out turn (%): The seed cotton for each plant was ginned separately with a single roller electric gin. The lint thus obtained was weighed and ginning out turn percentage was calculated by using the following formula:

$$\text{Ginning out turn}(\%) = \frac{\text{Weight of lint}}{\text{Weight of seed cotton}} \times 100$$

Staple length (mm): It was measured by using "Tuft method. The respective lint sample of each plant was made into a sliver and passed several times through a draw box until the fibres of the samples became parallel. These fibres then mounted on a set of metallic combs fixed on a stand. One end of sample was aligned with the help of a pair of tweezers and then two tufts were carefully drawn one by one from each sample. These tufts were placed on a velvet covered tuft board. After arranging these tufts on the boards, two lines were drawn one on the even and of the tuft just beneath the group mark of tweezers and other on the opposite end of the tuft where the visual density of the fibres was maximum. The distance between the two lines was measured in mm for each plant sample. The average staple length for each genotype was then worked out.

Fibre fineness: Fibre fineness is relatively measure of thickness or diameter, size or weight per unit length. It was determining with the help of "Micromat Tester" which gives mike. It comprises of electronic balance with interface, Micro Processor, Key boards and

Monitor for displaying the results for determination of fineness. First of all lint samples are blended thoroughly by SDL fibre blender. A sample between 3.8 and 4.2 g is accepted automatically by the Micromat. It is pushed into the sample chamber and closed the lid of the chamber. Automatic testing takes place in double compression chamber and the mike (fineness) results are displayed on the monitor.

Results

Morphological characters: Cotton leaf curl virus attack had an adverse effect on the plant height of all the susceptible lines/cultivars of cotton. A decrease of 31.8 % (Table 1) in the height (Av. of all lines/cultivars) of diseased plants was recorded compared with those of healthy plants. All susceptible lines/cultivars exhibited varying response towards cotton leaf curl virus disease attack. Acala 1517-C was severely affected showing 40.5 % decrease in height followed by CIM-70 and S-12 with the decreasing percentage values of 26.7 and 24.0 respectively.

A reduction of 25.1 and 22.2 % respectively in the sympodial and monopodial branches (Table 1) of disease affected plants was observed. A significant difference among the susceptible lines/cultivars for the two traits was also observed (Table 1) with maximum reduction of 35 % in sympodial branches of CIM-70 (Table 2) followed by S-12 (22.2).

Seed cotton yield and yield components: There was a drastic effect on the seed cotton yield of all the susceptible lines/cultivars of cotton, which showed a sharp decrease of 70.3 % (Table 1), though there was a significant variation in the yield of all the susceptible cultivars, which indicated differential behaviour of the lines/cultivars towards cotton leaf curl virus attack. The highest reduction in the yield was observed in CIM-70 (-87.3 %) followed by S-12 (-70 %) (Table 1).

Similarly number of bolls per plant also showed a sharp decline of 67.4 % (Table 1) due to cotton leaf curl virus disease attack in the susceptible lines/cultivars. The cultivar CIM-70 was the worst hit by CLCuV attack showing 86.0 % decrease in number of bolls over the healthy plants of the same cultivar (Table 1).

Besides cotton leaf curl virus attack also brought about a marked reduction (–38.5 %) in boll weight of all the susceptible lines/cultivars (Table 1). The boll weight of S-12 was more affected than the other lines/cultivars showing a decrease of 42.5 % over the healthy plants (Table 1).

Fibre characteristics

Ginning out turn: Negative effects of cotton leaf curl virus disease were also observed on ginning out-turn or lint %age of all the lines/cultivars (Table 1) which showed an overall decrease of 12.6 % (Table 1) for this characteristic. The highest reduction observed in S-12 (-18.2 %) but the other two lines/cultivars, i.e., Acala 1517-C and CIM-70 did not differ significantly.

Staple length (mm): The staple length of all the susceptible lines/cultivars was also affected due to the attack of cotton leaf curl virus disease, which brought about overall reduction of 4.5 % (Table 1). The variety CIM-70 showed the highest reduction of 7.1 % compared with healthy plants whereas the others lines/cultivars were almost at par in terms of decrease for this character.

Fibre fineness: Data (Table 1) depicted that the fibre fineness of all the susceptible lines/cultivars had shown decreasing trend due to cotton leaf curl virus attack (increasing value of micronaire means reduction in fibre fineness). There was an overall increase of 13.9 % in micronaire value. The variety S-12 showed the highest value of 23.8 % (more coarse) over the healthy plants followed by CIM-70 (11.9 %).

Table 1: Effect of ClCuV on morphology, yield and fibre characteristics of different susceptible cultivars/varieties

Characteristics	Status	S-12	Acala-1517-C	CIM-70	Average	% Decrease or increase over healthy
Final height of main stem (cms)	*Healthy	100	131	90	107	
	Diseased	76	78	66	73	
	Percentage decrease(-) over healthy	-24	-40.5	-26.7		-31.8
Number of sympodial branches per plant	*Healthy	18	17	20	18.3	
	Diseased	14	14	13	13.7	
	Percentage decrease(-) over healthy	-22.2	-17.6	-35.0		-25.1
Number of monopodial branches per plant	*Healthy	3	4.2	1.0	2.7	
	Diseased	2.7	2.5	1.0	2.1	
	Percentage decrease (-) over healthy	-10	-40.5			-22.2
Number of bolls per plant	*Healthy	35	53	50	46	
	Diseased	16	22	7	15	
	Percentage decrease (-) over healthy	54.3	-58.5	-86.0		-67.4
Average boll weight (g)	*Healthy	4.0	4.8	3.0	3.9	
	Diseased	2.3	3.0	1.9	2.4	
	Percentage decrease(-) over healthy	-42.5	-37.5	-36.7		-38.5
Seed cotton yield/plant (g)	*Healthy	140	134	150	141.3	
	Diseased	42	65	19	42.0	
	Percentage decrease (-) over healthy	-70	-51.5	-87.3		-70.3
Ginning outturn (%)	*Healthy	41.3	35.1	31.0	35.8	
	Diseased	33.8	32.1	28.0	31.3	
	Percentage decrease(-) over healthy	-18.2	-8.5	-9.7		-12.6
Staple length (mm)	*Healthy	28.2	29.6	29.6	29.1	
	Diseased	27.3	28.7	27.5	27.8	
	Percentage decrease(-) over healthy	-3.3	-3.1	-7.1		-4.5
Fibre fineness μg/inch	*Healthy	4.2	4.5	4.2	4.3	
	Diseased	5.2	4.7	4.7	4.9	
	Percentage increase (+)over healthy	+23.8	+4.4	+11.9		+13.9

*: Standard values ClCuV: Cotton leaf curl virus

Table 2: Production losses due to cotton leaf curl virus attack during 1988 to 2001

Years	Affected area (000 hectares)			Loss in production (000 bales)
	Partial	Complete	Total	
1988-89	-	0.06	0.06	0.3
1989-90	-	0.20	0.20	1.0
1990-91	-	0.80	0.80	4.0
1991-92	11.3	2.80	14.10	20.0
1992-93	364.0	121.0	485.0	750.0
1993-94	607.0	282.0	889.0	1880.0
1994-95	407.0	-	407.0	221.0
1995-96	882.0	-	882.0	447.0
1996-97	1630.9	137.40	1761.30	2100.0
1997-98	762.9	19.50	782.40	1118.1
1998-99	458.5	-	458.5	588.0
1999-00	289.1	-	289.1	370.5
2000-01	90.1	-	90.1	111.2
2001-02	66.6	-	66.6	82.3

Discussion

Cotton leaf curl virus disease is a big menace constituting a primary limit on the productivity of cotton. Concentrated efforts have been made to explore genetic sources for cotton leaf curl virus resistance. Successful breeding to solve this hazardous problem heavily lies on collecting information and studying the effect of this disease on the yield, yield components and fibre characteristics.

The susceptibility of Acala 1517-C, S-12 and CIM-70 towards cotton leaf curl virus is well established. However infestation varied with life cycle of plant growth, which corresponds to findings of Ali *et al.* (1992). Seed cotton yield was adversely affected due to cotton leaf curl virus attack which brought about 70.3 % decrease in yield. These studies are in accordance to the earlier findings of Lambert (1929), Moskovet (1940) and Tarr (1957) who reported 30-40 % decrease in seed cotton yield due to this disease. Ahmad (1987) and Idris (1990) also reported the highest reduction in yield due to cotton leaf curl virus disease. In farmers field 50 % loss in yield cotton of virus tolerant varieties (CIM109, CIM240, BH36 and FH-682) was recorded. However 85 – 90 % reduction was observed in virus susceptible variety S-12 due to cotton leaf curl virus disease (Ali *et al.*, 1992).

Likewise a sharp reduction in number of bolls per plant (67.4 %) due to cotton leaf curl virus disease corresponds to the findings of Andrew (1936) and Moskovet (1940) who also found a decrease of 48.6 and 55.0 % in the same parameter. Pronounced effects of cotton leaf curl virus disease were also observed on boll weight which showed 38.5 % decrease which is in accordance with the previous study of Andrew (1936) who investigated 48.6 % reduction in boll weight.

Another important aspect of the present study was to assess the effect of cotton leaf curl virus on fibre characteristics of cotton, because they play discriminatory role in distinguishing between cotton leaf curl virus resistant and cotton leaf curl virus susceptible cultivars/varieties. Cotton leaf curl virus adversely affected ginning out turn bringing about a considerable decrease in this character of all the cotton leaf curl virus susceptible cultivars/varieties.

Fibre length was also reduced due to attack. These studies leaf curl virus attack corresponds to early findings of Moskovet (1940) who reported 7 % decrease in fibre length due to cotton leaf curl virus attack. Cotton leaf curl virus disease played a very discriminatory role in making distinction between fine and coarse cotton. The fibre fineness of all the susceptible lines/cultivars was adversely affected due to cotton leaf curl virus attack.

It was concluded that cotton leaf curl virus disease had overall adverse effects on plant growth, yield and fibre quality. Therefore, it is always essential to recommend cotton leaf curl virus resistant varieties for general cultivation.

References

Ahmad, K.E., 1987. Field evaluation of selected strains of cotton for resistance to leaf curl virus disease and its effect on cotton yield and quality. Crop Sci., (Breeding), Faculty of Agric. Sci., Univ. of Gezira, Sudan.

Ali, M., Z. Ahmad, T. Hussain and M. Tanvir, 1992. Cotton leaf curl virus in the Punjab. Hoechst Pak. Ltd., pp: 33.

Andrew, F.W., 1936. The effect of leaf curl disease on the yield of cotton plant. Cotton. Gr. Rev., 13: pp: 287-93.

Anonymous, 1992. Annual Progress Report of Central Cotton Research Institute, Multan, pp: 56.

Anonymous, 1997. Economic Survey. Government of Pakistan, Finance Division, Islamabad, Pakistan.

Brown, J.K., J.D. Miahail and M.R Nelson, 1987 Effect of cotton leaf crumple virus on cotton inoculated different growth stages. Plant Disease, 71: 699-703.

Idris, A.M., 1990. Cotton leaf curl virus disease in Sudan. Med. Fac. Landbow, Rijksunir. Genet., pp: 55.

Lambert, A.R., 1929. A report of the mycologist. A Rep. Agric. Dept. Nigeria. In M.A. Siddique and L.C. Huges (Eds.), Cotton Growth in the Gezira Environment.

Mahmood T., M. Tahir, M. Tanveer and M.B. Mirza, 1996. Effect of cotton leaf curl virus on yield components and fibre properties of four commercial varieties. Pak. J. Phytophathol., 8 pp: 68-70.

Mahmood, N.T., 1999. cotton leaf curl virus disease and its stars in Pakistan. ICAC. CCRI. Reg. Consult. On insecticide Resist. Manag in cotton. Jun 28 – July 1, 1999 (CCRI, Multan (ABST., pp: 234).

Moskovet, N., 1940. Plant virus diseases and their control. Transactions of the conferance. Pl. Virus Dis. Moscow, 4:1-340. Leningard Acad. Sci. USSR.

Riaz, A., 1997. Combating cotton leaf curl virus in Pakistan. Pak. Cottons, Gr., 1: 12-13.

Russell, T.E., 1982. Effect of cotton leaf crumple disease (CLC) on stab and planted cotton. Cotton. Coll. Agric. Rep. Ser., pp:56. Coop. Ext. Serv./Agric. Exp. Stn. Univ. Ariz./US. Dep. Agric., pp: 170.

Tarr, S.A.J., 1957. Recent observations on disease of cotton in the Sudan, Gazira, FAO, Pl. Prot. Bull., 5: 85-88.