Original Research Article

Identification Of New Sources Of Resistance Against CercosporaLeaf Spot and Fusarium Wilt Diseases In Cotton

ABSTRACT

A study was done to identify the sources of resistance to Cercospora leaf spot and wilt diseases in cotton.Screening was done at Regional Agricultural Research Station, Warangal, Telangana State, India. The experimental material consisted of 52cotton germplasms and 13Bt cotton hybrids with a check. They were tested againstCercospora leaf spot and Fusarium wilt diseases during *Kharif*-2016 at Regional Agricultural Research Station,Warangal.Out of 52 cotton germplasms, 14 entries viz.,HYPS-152,H-1250,SA-434,KH-2244N,KH-134,MRK-38,LH-2170,AKH-2822,LH-900, JK-2764,NH-615,GBHU-164, RAH-100 and HOC-5 were found resistant to Cercospora leaf spot and nine entries namely MCU-13,HYPS-152,H-1250,RAH-4,RCH -2,JK-2764,CCH1071,SCS-101, CCH-11were found resistant to Fusarium wilt disease.Out of screened 13 Bt cotton hybrids against Cercospora leaf spot and Fusarium wilt diseases, one entry Ankur-3224 was found resistant to Cercospora leaf spot disease and three entries namely First class, Ankur -3224 and RCH-812 were found moderately resistant to Fusarium wilt disease.

Keywords: Germplasms, Cotton, Resistant sources, Screening, Cercospora leaf spot disease and Fusarium wilt disease.

1. INTRODUCTION

Cotton crop suffers from several diseases. The increasing pattern of leaf spots and observed Fusarium wilt disease are emerging threats to cotton cultivation**.** Cotton is the most important commercial crop in India. India is the largest cotton growing country in the world followed by United States and China. It is cultivated in about 80 countries of the world over an average area of 31.4 million hectares with 111.7 million bales (420 lb) production at rate of 775 kg lint per hectare productivity (Prashanth et al. 2022).Cotton crop is affected by fungal, bacterial and viral diseases. Among fungal diseases,Cercospora leaf spot and Fusarium wilt are important diseases which result the lower yield.

Fusarium wilt (FW), caused by the fungal pathogen *Fusarium oxysporum f. sp. vasinfectum*, is a significant economic constraint to cotton production. Breeding and utilizing Fusarium wilt-resistant cultivars had proven to be the most cost-effective control method. In India,Foliar diseases have been estimated to cause yield losses up to 20 to 30 per cent(Mayee and Mukewar 2007). Environmental conditions influence the pests and disease incidence in cotton (Kumar *et al*. 2018).Hence, it is imperative to identify resistant genotypes so as to utilize them in breeding programs to evolve resistant varieties/hybrids. Identification of sources of resistance facilitates to evolve resistant genotypes/varieties/hybrids will be useful to the farming community in reducing the disease damage and fungicide consumption.

2.MATERIALS AND METHODS

2.1 Screening of the genotypes against the Cercospora leaf spot andFusarium wilt diseases :

Fifty two cotton germplasms were screened with LRA 5166 susceptible check against Cercospora leaf spot and Fusarium wilt diseases under field condition in Cotton section at RARS ,Warangal during *Kharif* 2016. ThirteenBt cotton hybrids were screened against to Cercospora leaf spot and Fusarium wiltdiseases to identify the source of resistance**.**Each genotype was planted in two rows of 10 meter length with a row spacing of 90 cm and the distance between plants is 60cm. The trial was laid out in RBD with two replications. Susceptible checks,LRA 5166 and RCH-929 were included after every 5 test rows for non Bt germplasms and Bt cotton respectively.

Standard disease scale was adopted for recording the disease intensity.

1. Cercospora Leaf spot : 0-4 Scale
2. Fusarium wilt disease : 1-5 Scale

Data collected:

Disease observations were noted from 10 tagged plants randomly from each entry during the crop season.Three leaves at bottom, four in the middle and three at the top of each plant thus total 10 leaves were collected from a tagged plant. Disease scored at peak intensity was observed by using disease grades. Depending on the scores collected, per cent disease intensity (PDI) was calculated by using the formula by Wheeler 1969 as given below:

(Sum of all the numerical ratings)

PDI = ——————————————————— X 100

(Total number of leaves scored x Maximum disease grade)

List 1 :**Scale adopted for cottonCercospora leaf spot disease**

Scale (0-4)	**Cercospora leaf spot % leaf area infected**	**Reaction**
0	Completely free from disease	Immune(I)
1	Leaf area covered up to 5%	Resistant(R)
2	Leaf area covered from 6 to 20 %	Moderately Resistant(MR)
3	Leaf area covered from 21 to 40%	Moderately Susceptible(MS)
4	Leaf area covered>40 %	Susceptible(S)

List 2 :Grading system for Fusarium wilt of Cotton

Scale (1-5)	**Fusarium wilt disease-PDI**	**Reaction**
1	No infection	Immune (I)
2	Slight yellowing and no defoliation. Less than 5 % plants showing wilting	Resistant (R)
3	Yellowing and browning of leaves. 6- 15 % plants showing wilting	Moderately Resistant (MR)
4	Yellowing, browning and discolouration of leaves. Some leaves fall off. late partial wilting may occur16- 25 % plants showing wilting	Moderately Susceptible (MS)
5.	In early infection seedlings wilt, adult plants show yellowing, browning and dropping off the leaves, finally plant wilt, above 25 % plants showing wilting	Susceptible (S)

3. RESULTS ANDDISCUSSION

3.1 Evaluation of Cercospora leaf spot disease:

Screening of 52 cotton germplasms against cercospora leaf spot disease revealed that 14 entries viz.,HYPS-152,H-1250,SA-434,KH-2244N,KH-134,MRK-38,LH-2170,AKH-2822,LH-900,JK-2764,NH-615,GBHU-164,RAH-100 and HOC-5 were found resistant,18 entries were found moderately resistant, 16 entries were moderately susceptible and 4 entries were susceptible to Cercospora leaf spot diseases(Table1 a).

Out of 13 Bt cotton hybrids screened against Cercospora leaf spot, one entry Ankur-3224 was found resistant, three entries namely First class, ACH-155 and RCH-812 were found moderatelyresistant, five entries were moderately susceptible and 4 entries were susceptible to Cercospora leaf spot disease (Table2b).

According to Hosagoudar *et al*.2008, Eighty six non-Bt and nine Bt cotton hybrids/ varieties/genotypes were screened against Alternaria leaf blight disease, none of the genotypes showed immune and highly resistant reaction to it .Only one was moderately resistant (JKCDH 501) to the Alternaria leaf blight disease in under field conditions during *Kharif* 2006-07 at Agricultural Research Station,Dharwad.

Chattannavar*et al.* 2009,196 cotton hybrids/cultivars/genotypes were screened for resistance to Alternaria blight disease. Among 9 test entries, DCH 32, RAMSHH 7, GSHB 895, CCHB 2628, CCCHB 07-2, DHB 0782, NSPL 414, HAGHB 12 and Ajeet 999 were resistant to the Alternaria blight disease.

According to Murumkar*et al.*2015,49 genotypes with 3checks were evaluated for Alternaria leaf spot at Aurangabad. He noticed that after pooled analysis of two years data of PDI, five crosses C10346B BGIIXR11, C10346G BGIIXR11, C10346A BGII XR11, C10026A BGIIXR14 & C10346B BGII XR14 were found relatively resistant than commercial check Mallika BGII, Jai BGII and NHH44 of Alternaria leaf spot disease under natural field condition for two seasons *Kharif*- 2015 and *Kharif*-2016.

Total thirty oneentries with one check (LRA 5166) were screened against resistance to Alternaria leaf spot disease under rain fed condition. Thirteen entries(GSHV-159 , GBHV-170, GBHV-180,

G.N.Cot-22(CC), G.N.Cot-16(LC), GSHV-173, GJHV-473, GBHV-183, GBHV-184, GBHV-187, GBHV-193, GBHV-195 and GBHV-202 were immune to Alternaria leaf spot disease in cotton (Patel*et al.* 2016**)**.

Prashant *et al*. 2017, thirty nine entries including checks were evaluated for their reaction against the ALS disease. Out of 39 entries, twenty one entries weredisease free, sixteen entries were resistant and two entries were moderately resistant against Alternaria leaf spot disease.

According to Bhattiprolu *et al*. 2017 , Ninety two Bt and five Non Bt cotton hybrids were evaluated against foliar diseases at Regional Agricultural Research Station, Guntur.Tulasi-118 BG-II was free from cercospora leaf spot while seven hybrids viz.,ABCH-1020 Bt, GK-207 Bt, RCH-368 Bt, Dhruv Bt, ACH-33-1 Bt, NCS-854 BG-II and NHH-44 Bt recorded resistant reaction; RCH-530 BG-II was resistant , 38 entries were moderately resistant to Helminthosporium leaf spot and 28 hybrids showed moderately resistant reaction to Myrothecium leaf spot.

Among the evaluated thirteen varieties against Alternaria leaf blight of cotton, two varieties viz., AKH-2013-3, AKH-8828 showed resistant reaction, two varieties viz., AKH-09-5, AKH-13-0-1 recorded moderately resistant reaction and remaining nine varieties recorded susceptible reaction to Alternaria leaf spot disease (Bodhke*et al*.2019).

Rajesha*et al*. 2021, on screening of 39 entries against the Alternaria leaf blight disease, twenty-one(Br.03a (ZT)1301,Br.03a (ZT)1302,Br.03a (ZT)1303,Br.03a (ZT)1306,Br.03a (ZT)1307,Br.03a (ZT)1308,Br.03a (ZT)1309,Br.04a (ZT)1313,Br.04a (ZT)1314,Br.04a (ZT)1317,Br.04a (ZT)1316, Br.04a (ZT)1318,Br.05a (ZT)1321,Br.05a (ZT)1323,Br.05a (ZT)1324,Br.05a (ZT)1326,Br.15a (ZT)1351,Br.15a (ZT)1352,Br.15a (ZT)1353,Br.15a (ZT)1354,Br.15a (ZT)1357 Br.03a (ZT)1304,Br.03a (ZT)1305,Br.04a (ZT)1311,Br.04a (ZT)1312,Br.04a (ZT)1315) genotypes were resistant, eleven genotypes were moderately resistant and seven showed susceptible reaction during 2019 in Tamilnadu.

Durga Prasad N *et al*. 2017,one hundred and forty three Bt cotton hybrids were evaluated against Alternaria leaf spot disease during *kharif*, 2012. Two hybrids viz., Tulasi-144 (Prachanda Bhaskar) BG-II (3.75PDI) and U5-SS-33 BG-II (4.38PDI) recorded resistant reaction while 127 hybrids were moderately resistant to Alternaria leaf spot.

160 Upland cotton genotypes were tested against Alternaria leaf spot, two glandless cotton genotypes (NuMex COT 15 GLS and NM 13P1117), three commercial cultivars (FM 1830GLT, FM 2484B2F, and PHY 444 WRF) were most resistant to Alternaria leaf spot disease (Yi Zhu *et al*. 2017).

Alternaria leaf spot disease appeared during the second week of August and reached peak of 29.71 PDI under HDPS as against 27.81 PDI under NPS during boll maturity stage (Yamuna *et al.* 2021).

Among 50 genotypes, thirteen entries were showed resistant reaction, 25 entries showed moderately resistance and 12 entries were found moderately susceptible to Alternaria leaf blight in cotton (Chaudhari *et al*. 2022).

Out of 54 cotton germplasms, two entries viz., WGCV-26 and CPD-731-1 were found resistant to Cercospora leaf spot disease (Vijaya Bhaskar 2022)

3.2 Evaluationof Fusarium wilt disease:

Screening of 52 cotton germplasmsagainst Fusarium wilt disease revealed that nine entries namely MCU-13,HYPS-152,H-1250,RAH-4,RCH-2,JK-2764,CCH1071,SCS-101 and CCH-11 were found resistant to Fusarium wilt disease, 9 entries were found moderately resistant, 3 entries were moderately susceptible and 31entries were susceptible to Fusarium wilt disease (Table 2a).

Screening of 13 Bt cotton hybrids against Fusarium wilt disease revealed that three entries namely First class, Ankur -3224 and RCH-812 were found moderately resistant to Fusarium wilt disease (Table 2c).

Asran*et al*. 2018 study included 50 of Upper Egypt experimental genotypes and 875 families of six commercial cultivars.The majority of the tested genotypes (48%) were very highly resistant while 22% were very highly susceptible. Five commercial cultivars Giza 90, Giza 95, Giza 86, Giza 87, and Giza 88 were very highly resistant to Fusarium wilt disease.

268 upland cotton genotypes were screened against verticillium (*Verticillium dahliae*kleb.) Wilt disease in field. Most of the genotypes were tolerant in field trial in terms of disease severity that was the lowest for STN K311 genotype. The highest seed cotton yield was obtained in genotypes BA119, Okra 204, H-23, Gedera-5, PI 528420 and Acala Royale, which were moderately tolerant to the wilt disease (Sadettin çelik*et al*. 2019).

Out of fifty two cotton germplasms, fourteen entries viz.,HYPS-152,H-1250,SA-434,KH-2244N,KH-134,MRK-38,LH-2170,AKH-2822,LH-900,JK-2764,NH-615,GBHU-164,RAH-100 and HOC-5 were found resistant to Cercospora leaf spot andnine entries namely MCU-13,HYPS-152,H-1250,RAH-4,RCH -2,JK-2764,CCH1071,SCS-101 and CCH-11were found resistant to Fusarium wilt disease.Among 13 Bt cotton hybrids against Cercospora leaf spot and Fusarium wilt diseases, one entry Ankur-3224 was found resistant to Cercospora leaf spot disease and three entries namely First class,Ankur -3224 and RCH-812 were found moderately resistant to Fusarium wilt disease.HYPS-152, H-1250 and JK-2764entries can be used in crossing programmes for development of high yielding and disease resistant/tolerant to Cercospora leaf spot and Fusarium wilt diseases in Cotton.

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Table 1a:Screening of Cotton germplasms against Cercospora leaf spot disease

Sl.	Germplasms	Cercospora leaf spot per cent	Scale	Reaction

no.		**leaf area infection (PDI)**	**(0-4)**	
1	MCU-13	25.33	3	MS
2	HYPS-152	4.2	1	R
3	H-1250	3.7	1	R
4	SA-434	1.1	1	R
5	SA-53-1	12.5	2	MR
6	RAH-912	16.2	2	MR
7	RAS-3438	27.0	3	MS
8	RHH-101	21.0	3	MS
9	RAH-216	49.5	4	S
10	RAH-4	7.5	2	MR
11	KH-2244N	3.4	1	R
12	TCH-1020	19.0	2	MR
13	KH-134	2.9	1	R
14	TCH-1649	11.7	2	MR
15	G-CO-12	18.3	2	MR
16	NH-557	32.32	3	MS
17	JK-354	35.80	3	MS
18	IH-08	39.0	3	MS
19	ICMF-23	18.7	2	MR
20	ICMF-20	22.2	3	MS
21	PH-1008	22.7	3	MS
22	TCH-724	8.3	2	MR
23	K-3409	29.8	3	MS
24	NA-640	16.6	2	MR
Sl. no.	**Germplasms**	**Cercospora leaf spot per cent leaf area infection (PDI)**	**Scale (0-4)**	**Reaction**

25	BS-37	23.0	3	MS
26	RCH-2	23.33	3	MS
27	JK-205	10	2	MR
28	CNK-1094	11.3	2	MR
29	CSH-3118	9.3	2	MR
30	MRK-38	3.2	1	R
31	BRS-23	6.0	2	MR
32	BWR-44	15.7	2	MR
33	F-2089	27.0	3	MS
34	LH-2170	4.0	1	R
35	L-389	21.32	3	MS
36	AKH-2822	2.9	1	R
37	LH-900	4.0	1	R
38	SA-1004	13.0	2	MR
39	ARB-8901	34.32	3	MS
40	GBHB-170	36.0	3	MS
41	BB-2	70.3	4	S
42	G-COT-10	40.0	3	MS
43	JK-2764	3.7	1	R
44	NH-615	4.0	1	R
45	D-6	14.08	2	MR
46	CCH1071	8.0	2	MR
47	SCS-101	54.7	4	S
48	GBHU-164	3.1	1	R
49	CCH-11	8.0	2	MR
Sl. no.	**Germplasms**	**Cercospora leaf spot per cent leaf area infection (PDI)**	**Scale (0-4)**	**Reaction**

50	RAH-100	5.3	1	R
51	HOC-5	5.3	1	R
52	LRA-5166 (SC)	58	4	S

[R-Resistant, MR-Moderately Resistant, S-Susceptible, MS-ModeratelySusceptible]

Table 2a: Screening of Bt Cotton hybrids against Fusarium wilt disease

Sl.no.	Germplasms	Fusarium wilt disease-(PDI)	Scale(1-5)	Reaction
1	MCU-13	4.3	2	R
2	HYPS-152	2.4	2	R
3	H-1250	5.2	2	R
4	SA-434	32.0	5	S
5	SA-53-1	7.6	3	MR
6	RAH-912	56.34	5	S
7	RAS-3438	64.64	5	S
8	RHH-101	37.3	5	S
9	RAH-216	8.0	3	MR
10	RAH-4	2.3	2	R
11	KH-2244N	45.32	5	S
12	TCH-1020	34.42	5	S
13	KH-134	75	5	S
14	TCH-1649	33.33	5	S
15	G-CO-12	38.36	5	S
16	NH-557	63.32	5	S
17	JK-354	35.63	5	S
18	IH-08	43.22	5	S
19	ICMF-23	80.64	5	S
20	ICMF-20	42.34	5	S
21	PH-1008	84.26	5	S
22	TCH-724	43.34	5	S
23	K-3409	10	3	MR
24	NA-640	35.23	5	S
Sl.no.	**Germplasms**	**Fusarium wilt disease-(PDI)**	**Scale(1-5)**	**Reaction**
25	BS-37	44.68	5	S

26	RCH-2	1.0	2	R
27	JK-205	20.0	4	MS
28	CNK-1094	64.32	5	S
29	CSH-3118	15.20	3	MR
30	MRK-38	23.34	4	MS
31	BRS-23	27.54	5	S
32	BWR-44	28.66	5	S
33	F-2089	29.12	5	S
34	LH-2170	36.34	5	S
35	L-389	65.43	5	S
36	AKH-2822	19.90	4	MS
37	LH-900	54.23	5	S
38	SA-1004	33.33	5	S
39	ARB-8901	32.84	5	S
40	GBHB-170	36.26	5	S
41	BB-2	48.22	5	S
42	G-COT-10	39.32	5	S
43	JK-2764	5.7	2	R
44	NH-615	6.0	3	MR
45	D-6	8.7	3	MR
46	CCH1071	3.2	2	R
47	SCS-101	2.6	2	R
48	GBHU-164	8.9	3	MR
49	CCH-11	2.6	2	R
50	RAH-100	10	3	MR
Sl.no.	**Germplasms**	**Fusarium wilt disease-(PDI)**	**Scale(1-5)**	**Reaction**
51	HOC-5	9.3	3	MR

52	LRA-5166 (SC)	88.56	5	S

[R-Resistant, MR-Moderately Resistant,MS-ModeratelySusceptible, S-Susceptible]

Table 2b: Screening of Bt Cotton hybrids against Cercospora leaf spot disease

Sl. no.	Hybrids	Cercospora leaf spot per cent leaf area infection (PDI)	Scale (0-4)	Reaction
1	Bhakti	45.2	4	S
2	Balhwan	52	4	S
3	Raja	56.4	4	S
4	Akka	25.4	3	MS
5	Khushi	28.0	3	MS
6	Ankur -3224	5.2	1	R
7	First class	8.4	2	MR
8	ACH-155	15.6	2	MR
9	ACH-199	26.4	3	MS
10	RCH-836	30.8	3	MS
11	RCH-812	6.8	1	R
12	ATM	32.5	3	MS
13	RCH 929(SC)	50	4	S

[R-Resistant, MR-Moderately Resistant, MS-ModeratelySusceptible, S-Susceptible]

Table 2c: Screening of Bt Cotton hybrids against Fusarium wilt disease

Sl. no.	Hybrids	Fusarium wilt (PDI)	Scale (1-5)	Reaction
1	Bhakti	19.8	4	MS
2	Balhwan	22.4	4	MS
3	Raja	25.4	5	S
4	Akka	28.2	5	S
5	Khushi	23.4	4	MS
6	Ankur -3224	14.2	3	MR
7	First class	12.4	3	MR
8	ACH-155	17.6	4	MS
9	ACH-199	27.2	5	S
10	RCH-836	28.4	5	S
11	RCH-812	12.8	3	MR
12	ATM	22.5	4	MS
13	RCH 929(SC)	50	5	S

[R-Resistant, MR-Moderately Resistant, MS-ModeratelySusceptible, S-Susceptible]