

Screening of Genotypes against Cercospora Leaf Spot, Grey Mildew and Boll Rot Diseases in Cotton

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ABSTRACT: A study was done to identify the sources of resistance to *Cercospora* leaf spot, Grey mildew and Boll rot diseases in cotton. Screening was done at Regional Agricultural Research Station, Warangal, Telangana State, India under Cotton section. The experimental material consisted of 54 cotton germplasms /hybrids/varieties and 13 Bt cotton hybrids with a check and they were tested against to *Cercospora* leaf spot, Grey mildew and Boll rot diseases during Kharif-2017 at Regional Agricultural Research Station, Warangal. Out of 54 cotton germplasms, two entries viz., WGCV-26 and CPD-731-1 were found resistant to *Cercospora* leaf spot, nineteen entries namely Deltapine-66, Anjali, ADB-39, GJHV-97/29, CPT-571, CPD-7575, CPD-812, TCH-1716, NA-777, WGCV-29, WGCV-43, WGCV-26, GSHV-160, RS-2569, RS-2557, PRS-02, L-620, NDLH-1967 and WGCV-115 were found resistant to Grey mildew disease. Out of screened 13 Bt cotton hybrids against Boll rot disease, one entry AKIRA was found resistant to Boll rot disease.

Keywords: Germplasms, Cotton, resistant sources, Screening, *Cercospora* leaf spot disease, Grey mildew disease and Boll rot disease.

INTRODUCTION

Cotton is the most important commercial crops of in India. Cotton is referred to as “King of Fibers”, useful for multiple types of textile products and also for edible oil purpose. 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, grey mildew and boll rot are important diseases which result the lower yields. In India, foliar diseases have been estimated to cause yield losses up to 20 to 30 per cent (Mayee and Mukewar, 2007). Grey mildew caused by *Ramularia areola* is an important disease in Andhra Pradesh causing economic losses to the tune of 38.38 % (Bhattiprolu, 2012) and 29.20% in India (Monga *et al.*, 2013). Environmental conditions influence the pests and disease incidence in cotton (Kumar *et al.*, 2018). Various symptoms of boll rot are due to the existence of a complex of pathogens. Commonly, the bolls get soft and blackened or fail to crack open (Belot and Zambiasi 2007). 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, which in turn will be useful to the farming community in reducing the disease damage and fungicide consumption.

MATERIAL AND METHODS

Screening of the genotypes against the *Cercospora* leaf spot, Grey mildew and Boll rot diseases : Fifty four cotton germplasms /hybrids/varieties/genotypes were screened with LRA 5166 check against *Cercospora* leaf spot, Grey mildew and Boll rot diseases under field condition in Cotton section at RARS, Warangal during Kharif 2017. 13 Bt cotton hybrids were screened against to *Cercospora* leaf spot, Grey mildew and Boll rot diseases 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-629 were included after every 5 test rows for non Bt germplasms and Bt cotton respectively.

For recording disease intensity, standard disease scale was adopted.

Disease severity/PDI was assessed with 0-4 scale/grade as per the standard evaluation system followed in All India Co-ordinate Research Project on Cotton. It was expressed in Per cent Disease Index. Disease score was recorded on ten randomly selected plants in each entry and disease scale is detailed below (Sheo Raj, 1988).

1. *Cercospora* Leaf spot : 0-4 Scale
2. Grey mildew : 0-4 Scale

Data collected: Disease observations were noted from 10 tagged plants at random 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:

$$PDI = \frac{\text{(Sum of all the numerical ratings)}}{\text{(Total number of leaves scored} \times \text{Maximum disease grade)}} \times 100$$

Scale adopted for cotton Cercospora leaf spot disease:

Scale	Grade	Cercospora leaf spot % leaf area infected
0	Immune	Completely free from disease
1	Resistant	Leaf area covered up to 5%
2	Moderately resistant	Leaf area covered from 6 to 20 %
3	Moderately Susceptible	Leaf area covered from 21 to 40%
4	Susceptible	Leaf area covered >40 %

Scale adopted for cotton Grey mildew disease.

Scale	Grade	% leaf area infected Grey mildew
0	Immune	Completely free from disease
1	Resistant	Leaf area covered up to 5%
2	Moderately resistant	Leaf area covered from 6 to 20 %
3	Moderately Susceptible	Leaf area covered from 21 to 40%
4	Susceptible	Leaf area covered >40 %

Genotype categorization based on boll rot disease rating (Mayee and Datar, 1986).

Category	Reactions	Description
0	Absolute resistant (AR)	No symptoms on bolls
1	Highly resistant (HR)	1 % or less bolls exhibiting boll rot symptoms
3	Moderately Resistant (MR)	1-10 % of bolls exhibiting symptoms
5	Moderately Susceptible (MS)	11-20 % of bolls exhibiting symptoms
7	Susceptible (S)	21-50 % of bolls exhibiting symptoms
9	Highly susceptible (HS)	51 % or more bolls exhibiting symptoms

RESULTS AND DISCUSSION

Evaluation of cercospora leaf spot disease: Screening of 54 cotton germplasms against cercospora leaf spot disease revealed that only two entries viz., WGCV-26 and CPD-731-1 were found resistant to Cercospora Leaf spot (Table 1a).

Out of 13 Bt cotton hybrids screened against Cercospora leaf spot, four entries namely Ashirwad, Deta Pine 912, money maker and superb hybrids were found moderately susceptible and the remaining entries were susceptible (Table 2a).

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 found relatively resistant than commercial check

Mallika BGII, Jai BGII and NHH44 of Alternaria leaf spot disease under natural field condition for two seasons K 2015 and K 2016.

Total thirty one with one check (LRA 5166) were screened against for 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 of Alternaria leaf spot disease in cotton (Patel *et al.*, 2016).

Prashant *et al.* (2017), Total thirty nine entries including the checks were evaluated for their reaction against the ALS disease. Out of 39 entries, twenty one entries as disease free, sixteen entries as resistant and two entries as 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 were recorded susceptible reaction to Alternaria leaf spot disease (Bodhke *et al.*, 2019).

Rajesh *et al.*, 2021, total screened 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 showed resistant reaction, eleven genotypes were moderately resistant and seven showed susceptible reaction during 2019 in Tamilnadu.

Durga Prasad, N *et al.*, 2017, out of 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.

Alternaria leaf spot disease was 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 found moderately susceptible to Alternaria leaf blight in cotton.

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) are most resistant to alternaria leaf spot disease (Yi Zhu *et al.*, 2017).

Evaluation of Grey mildew disease: Screening of 54 cotton germplasm against Grey Mildew disease revealed that nineteen entries *viz.*, Deltapine-66, Anjali, ADB-39, GJHV-97/29, CPT-571, CPD-7575, CPD-812, TCH-1716, NA-777, WGCV-29, WGCV-43, WGCV-26, GSHV-160, RS-2569, RS-2557, PRS-02, L-620, NDLH-1967 and WGCV-115 were found resistant (Table 1a).

Screening of 13 *Bt* cotton hybrids against Grey Mildew disease revealed that three entries Moneymaker, Superb and Suvarna were found moderately resistant (Table 2a).

According to Hosagoudar *et al.* (2008), Eighty six non-*Bt* and nine *Bt* cotton hybrids/ varieties/genotypes were screened against Grey mildew disease. None of the varieties showed immune and highly resistant reaction to grey mildew and only four (ARBHA 35, JKCDH 501, CCHB 727 and PSCHB 901) showed moderately resistant reaction to Grey mildew 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 grey mildew disease, Among the 9 test entries, DCH 32, RAMSHH 7, GS HB 895, CCHB 2628, CCCHB 07-2, DHB 0782, NSPL 414, HAGHB 12 and Ajeet 999 were resistant to the grey mildew disease.

Among the screened 108 cultivated genotypes for resistance against grey mildew disease under field conditions, 64 genotypes showed immune reaction. Further, 07 genotypes were resistant, 03 genotypes were moderately resistant, 04 genotypes were susceptible and 03 showed the highly susceptible reaction to *Ramularia areola*. Out of twenty seven wild species 13 were disease free, 04 were resistant, 04 were moderately resistant, 02 were susceptible and 04 species showed the highly susceptible reaction to *Ramularia areola* (Poonam *et al.*, 2018).

Out of 25 *G. arboreum* lines, EIPSD-4 entry showed resistant reaction followed by moderately resistant in A-1 and A-4 entries and none of the entries were immune to grey mildew (Ramanagouda and Ashtaputre 2019).

WGCV -26 was found to be multiple disease resistant to Cercospora leaf spot and Grey mildew diseases (Table 1a).

10 entries namely H-1492, Delfos, CCH-3114, CPD-814, Akala-1512, LH-2153, JK-2602, WGCV-135, JK-5 and WGCV-92 were found moderately resistant to Cercospora leaf spot and Grey mildew diseases.

Evaluation of Boll rot disease: Out of screened 13 *Bt* cotton hybrids against Boll rot disease, one entry AKIRA was found resistant and three entries namely Ashirwad, Moneymaker and Superb were found moderately resistant.

Cotton 11 varieties (CB1 to CB-11) were screened against boll rot disease. Among 11 cotton varieties, disease severity of boll rot recorded from 0 to 6 (Shamsi and Naher 2014).

According to Nanda *et al.* (2020) One hundred and eighteen genotypes/ varieties/ hybrids belonging to all four species of *Gossypium viz.*, *G. arboreum*, *G. herbaceum*, *G. barbadense* and *G. hirsutum* were screened against boll rot complex disease during *Kharif* 2017 at Dharwad. Among 118 germplasm lines tested, one line of *Gossypium arboreum i.e.*, FDK 281 and two lines of *G. herbaceum* namely, ANGH-1607 and GShv 894/13 showed highly resistant reaction against Boll rot disease. In addition, five lines of *G. arboreum* (CNA 2031, DLSA 17, NDLA 3086, PBD 22, PSCANOI-46), eight lines each of *G. herbaceum* (DDh-11, DwDh-1601, DwDh-1602, GBhv-308, G Cot 23/ DDhc 11, GShv 898/13, GShv 907/13, Gvhv-767) and *G. barbadense* (ARBHB-1601, BCS-23-18-7, DB-1602, DHB-1601, GBHV-184, LAHB-1, RHB-1008, Suvin), five lines of *G. hirsutum* (ARBH- 813, LHDP 3, NNDC-10, NNDC-21, NNDC-55) and five intra *hirsutum* (ATM, Bindas, Dr. Brent, DHH- 11, DHH-263) hybrid lines showed moderately resistant reaction against boll rot disease.

Table 1a: Screening of germplasm against Cercospora leaf spot and Grey mildew diseases.

Sr. No.	Germplasm	Cercospora leaf spot per cent leaf area infection (PDI)	Scale (0-4)	Reaction	Grey mildew Per cent leaf area infection (PDI)	Scale (0-4)	Reaction
1.	Akala -629	30	3	MS	25	3	MS
2.	H-1492	20	2	MR	20	2	MR
3.	Bikanerinerma	25	3	MS	20	2	MR
4.	G-67	40	3	MS	20	2	MR
5.	Delfos	20	2	MR	20	2	MR
6.	Deltapine -66	25	3	MS	2.9	1	R
7.	CCH-3114	20	2	MR	15	2	MR
8.	CH-156	15	2	MR	35	3	MS
9.	CCH-1831	15	2	MR	25	3	MS
10.	CPD-814	20	2	MR	15	2	MR
11.	CPD-731	25	3	MS	25	3	MS
12.	RAH-902	25	3	MS	20	2	MR
13.	Anjali	40	3	MS	2.6	1	R
14.	AVISP	30	3	MS	15	2	MR
15.	ARB-8815	25	3	MS	20	2	MR
16.	GSHV-97/59	30	3	MS	25	3	MS
17.	GSHV-97/13	25	3	MS	20	2	MR
18.	Hartsvilly	30	3	MS	25	3	MS
19.	ADB-39	30	3	MS	2.5	1	R
20.	AV-3469	25	3	MS	25	3	MS
21.	GJHV-97/29	15	2	MR	2.8	1	R
22.	HS-271	25	3	MS	20	2	MR
23.	BS-30	25	3	MS	15	2	MR
24.	GJHV-502	20	2	MR	25	3	MS
25.	CPT-571	30	3	MS	3.9	1	R
26.	CPD-7575	20	2	MR	3.4	1	R
27.	CPD-812	20	2	MR	2.6	1	R
28.	TCH-1716	15	2	MR	3.6	1	R
29.	Akala-1512	20	2	MR	15	2	MR
30.	NA-777	15	2	MR	3.3	1	R
31.	NA-1568	30	3	MS	15	2	MR
32.	WGCV-29	15	2	MR	4.40	1	R
33.	WGCV-43	20	2	MR	3.84	1	R
34.	WGCV-26	2.3	1	R	3.9	1	R
35.	CPD-731-1	2.5	1	R	15	2	MR
36.	CNH-1025	20	2	MR	25	3	MS
37.	CSH-3167	25	3	MS	30	3	MS
38.	GSHV-160	20	2	MR	4.5	1	R
39.	RS-2569	30	3	MS	3.8	1	R
40.	RS-2557	20	2	MR	3.5	1	R
41.	WGCV-116	20	2	MR	25	3	MS
42.	LH-2153	20	2	MR	15	2	MR
43.	DS-28	25	3	MS	14.6	2	MR
44.	JK-2602	20	2	MR	16	2	MR
45.	JK-344	30	3	MS	18	2	MR
46.	PRS-02	20	2	MR	3.6	1	R
47.	WGCV-135	20	2	MR	20	2	MR
48.	JK-5	20	2	MR	15	2	MR
49.	L-620	25	3	MS	2.8	1	R
50.	NDLH-1967	30	3	MS	2.6	1	R
51.	RAH-221	25	3	MS	15	2	MR
52.	WGCV-92	20	2	MR	20	2	MR
53.	WGCV-115	25	3	MS	2.0	1	R
54.	LRA-5166 (SC)	58	4	S	50	4	S

[R-Resistant, MR-moderately resistant, S-Susceptible, MS-Moderately Susceptible]

Table 2a: Screening of Bt cotton hybrids against Cercospora leaf spot and Grey mildew diseases.

S. No.	Hybrids	Cercospora leaf spot Per cent leaf area infection (PDI)	Scale (0-4)	Reaction	Grey mildew per cent leaf area infection (PDI)	Scale (0-4)	Reaction
1.	Akira	50	4	S	25	3	MS
2.	Ashirwad	35	3	MS	22	2	MS
3.	Deta Pine 912	30	3	MS	25	3	MS
4.	Khazana	50	4	S	30	3	MS
5.	Money Maker	30	3	MS	20	2	MR
6.	Neo	45	4	S	30	3	MS
7.	Punnam 9	40	3	S	30	3	MS
8.	Rch 797	50	4	S	35	3	MS
9.	Rch 839	40	3	S	30	3	MS
10.	Superb	30	3	MS	20	2	MR
11.	Suvarna	50	4	S	20	2	MR
12.	Ujwal	45	4	S	30	3	MS
13.	Rch 929 (Sc)	50	4	S	45	4	S

Table 2b: Screening of Bt cotton hybrids against Boll rot disease.

Sr. No.	Hybrids	Boll rot scale (0-9)	Reaction
1.	Akira	1	HR
2.	Ashirwad	3	MR
3.	Deta Pine 912	5	MS
4.	Khazana	7	S
5.	Money Maker	3	MR
6.	Neo	5	MS
7.	Punnami 9	5	MS
8.	Rch 797	7	S
9.	Rch 839	5	MS
10.	Superb	3	MR
11.	Suvarna	7	S
12.	Ujwal	5	MS
13.	Rch 929	5	MS

CONCLUSIONS

Out of fifty four cotton germplasms, two entries viz., WGCV-26 and CPD-731-1 were found resistant to Cercospora leaf spot and nineteen entries viz., Deltapine-66, Anjali, ADB-39, GJHV-97/29, CPT-571, CPD-7575, CPD-812, TCH-1716,NA-777, WGCV-29, WGCV-43, WGCV-26, GSHV-160, RS-2569, RS-2557, PRS-02, L-620, NDLH-1967, WGCV-115 were found resistant to Grey mildew disease. Among 13 Bt cotton hybrids Moneymaker and Superb entries were moderately resistant to grey mildew and Boll rot diseases. WGCV-26, CPD-7575, CPD-812 and CPD-731-1 entries can be used in crossing programmes for development of high yielding and disease resistant/tolerant to cercospora leaf spot and Grey mildew diseases in Cotton.

FUTURE SCOPE

These promising Cotton germplasms are to be used in crossing programme for development of further resistance to Cercospora leaf spot, Grey mildew and Bollrot diseases. WGCV-26 and CPD-731-1 entries are to be preferred for development of disease resistance to Cercospora leaf spot disease in Cotton. Two hybrids namely Moneymaker and Superb will be used in crossing programmes for development of high yielding and disease resistant /tolerant to Grey mildew and Boll rot diseases in Cotton .

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Conflict of Interest. None.

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