

SCREENING OF *GOSSYPIUM HIRSUTUM* ENTRIES/ BREEDING MATERIAL OF COTTON FOR RESISTANCE TO DIFFERENT DISEASES UNDER RAINFED CONDITION

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Abstract: A field experiment was laid out with the two replications in different entries of cotton (*G. hirsutum*) and two rows of each entries were sown of total thirty one (31) with one check (LRA 5166) at Regional Cotton Research Station (RCRS), NAU, Bharuch, Gujarat entitled as the Screening of *Gossypium hirsutum* entries/ breeding material of cotton for resistance to different diseases under rainfed condition. Differences in resistance to all the diseases were found in the material tested under natural condition. Results revealed that the entries may vary in grade respectively. This study concludes that screening of different entries of cotton for resistance to diseases is an important factor in developing varieties/hybrids with improved resistance to different diseases in cotton crop.

Keywords: Cotton, Screening, Bacterial leaf blight, *Alternaria*, Wilt, Diseases, Resistance

INTRODUCTION

Cotton – A natural fibre. Cotton is a soft, fluffy staple fiber that grows in a boll, or protective case, around the seeds of the cotton plants of the genus *Gossypium* in the family of Malvaceae. The fiber is almost pure cellulose. The plant is a shrub native to tropical and subtropical regions around the world, including the Americas, Africa, and India. Cotton is a white fibrous agricultural product that has a wide variety of uses, from textile production, to creating paper, to producing oil and food products. Cotton is grown all around the globe, and is traded internationally as well. The production is influenced by the repeated outbreaks of pest and diseases and these are the major factors responsible for lower yield of cotton in India. Out of 30 diseases known to occur in cotton crop from time to time, the bacterial blight is the most wide spread and destructive disease reported to cause yield losses of about 10 to 30 per cent (Bhatti and Bhutta, 1983, Kalpana *et al.*, 2004 and Sekhon *et al.*, 2008) and also affect the quality of lint (Sharma and Chauhan, 1985). Bacterial leaf blight, boll rots, wilts and leaf spots are the most destructive cotton diseases (Chopra, 1977, Sandipan *et al.*, 2016). Under natural, bacterial blight infection, boll yield losses up to 35 % have been reported (Sheo Raj and Verma, 1988). Leaf spots rank third among the diseases on cotton in India. Among the leaf spots, bacterial blight (*Xanthomonas campestris* pv. *malvacearum* (Smith), *Alternaria* leaf spot (*Alternaria macrospora* Zimm) and grey mildew (*Ramularia aereola*) have been reported to be damaging. Bacterial blight (BLB) of cotton caused by *Xanthomonas campestris* pv. *malvacearum* (Smith) Dye affects the entire aerial parts of cotton

plant *i.e.* necrosis of parenchymatous tissue in the local phase and blockage of xylem vessels in its systemic phase (Casson *et al.*, 1977). In north India, the cotton leaf curl virus disease (CLCuD) caused by a Gemini virus and transmitted by whitefly, *Bemisia tabaci* has become a major threat to cotton cultivation since its appearance in 1993 (Monga *et al.*, 2011).

Resistant varieties are the valid option in any disease management strategies. Control of the disease through chemicals, seed treatment or acid delinting is recommended but bactericide alone or in combination with fungicides does not eradicate the pathogen completely (Khan and Ilyas, 1999; Hussain and Tahir, 1993). Characterization of environmental factors conducive for bacterial blight disease may provide a basis to forecast the disease and issue advance warning to cotton growers for its timely management.

Agro meteorological condition of RCRS, Bharuch

An onset of monsoon commenced from mid of June with 30.3 mm rain during 24th and 25th Standard Meteorological Week but it was insufficient for sowing of *Kharif*, 2014-15. The regular monsoon was received after mid of July *i.e.* 157 mm in 29th Standard Meteorological Week, which facilitated sowing of cotton trials which was almost completed by last week of July. The germination was good and satisfactory plant populations were maintained by proper gap filling. During the season total 849.7 mm rain was received in 37 days which was nearly half than previous year (1465 mm in 67 days). There was no rain after 38th SMW, so in absence of late rainfall, the growth of cotton crop was affected little bit but was recovered after interculturing operations.

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Centre	Particulars	2014-15								Average	Total
		June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.		
Bharuch	RF (mm)	40.3	415.8	249.8	132.0	0.0	0.0	0.0	11.8	-	849.7
	RD	4	14	10	8	0	-	-	1	-	37
	Max. Temp.	36.8	33.4	31.8	32.0	36.8	34.0	29.8	28.9	32.9	-
	Min. Temp.	27.7	26.1	24.8	23.9	22.3	20.5	14.5	13.6	21.7	-
	RH (%) Mor.	78.5	83.9	86.5	85.4	66.8	65.8	60.7	70.5	74.8	-
	RH (%) Eve.	50.8	67.8	74.3	63.6	33.8	36.8	31.9	33.9	49.1	-
	Wind Speed	11.4	7.2	5.7	2.8	1.2	0.9	3.2	3.5	4.5	-
	Sunshine hrs.	7.7	4.6	4.5	5.3	8.4	7.9	8.2	8.2	6.9	-

MATERIAL AND METHOD

The susceptible cultivar LRA – 5166 were sown after each two entry in this experiment by dibbling method with the following experimental details (Table: 1). All the recommended agronomic practices were followed for raising the good crop. In each net plot of each treatment randomly tag 5 plants and score 5 lower and 5 middle leaves of each plant in terms of 0-4 grade and work out PDI as mentioned below by

using 0-4 scale as given by Sheoraj, 1988 and then these grades were converted into per cent disease incidence (PDI) by using the formula given by Wheeler, 1969 (Bacterial leaf blight and *Alternaria* leaf spot diseases). Here, in this experiment only grades were mentioned for BLB and ALS.

Disease incidence (%)
 = $\frac{\text{No. of infected plants (Numerical grades)}}{\text{No. of leaves observed} \times \text{Max. Grade}} \times 100$

For, Bacterial leaf blight (BLB) disease

Score	Description
0	DF= Immune, completely free from bacterial blight
1	R= Resistant, nearly 1 mm in diameter, not coalescing, reddish, not angular, veins free
2	MR= Moderately resistant, leaf area covered up to 2- 10 %
3	MS= Moderately susceptible, infection 11-20 %
4	S= Susceptible, infection more than 20 %

For, Alternaria leaf spot (ALS) disease

Score	Description
0	No infection
1	Few <2mm, scattered, brown spots, < 5 % leaf area
2	Spots bigger, 3 mm , not coalescing, brown and 6-20 % leaf area covered
3	Spots 3-5 mm, irregular in shape-coalescing,21-40% leaf area covered
4	Spots coalescing to form bigger lesions, irregular->40 % leaf area

For Alternaria disease, it is standard methodology of AICCIP, Cotton and similar disease scale was used by Anil, G. H. in his thesis on Studies on leaf blight of Bt cotton caused by *Alternaria* spp. in 2013 submitted to the University of Agricultural Sciences, Dharward and Hosagoudar *et al.*, 2008ab.

For, Wilt disease

Count diseased plants out of total plants assessed and work out per cent disease incidence and decide disease reaction by referring grade chart.

PDI= $\frac{\text{No of diseased plants}}{\text{No of plant assessed}} \times 100$

Score	Description
0	I=No infection
1	R= Slight yellowing and no defoliation, < 5 % wilting
2	MR=Yellowing and browning of leaves, 6-15 % plants showing wilting
3	MS= Yellowing, browning and discolouration of leaves, Some leaves fall off. Of late partial wilting may occur, 16-25 % plants showing wilting
4	S= In early infection seedlings wilt, adult plant show yellowing, browning and dropping off of the leaves, >25 % plants showing wilting

For wilt disease, it is standard methodology of AICCIP, Cotton.

Other scales used for wilting

Resistance has been evaluated in the field as well as in controlled environment based on several other parameters including disease incidence, disease severity, time from planting or inoculum to appearance of symptoms. Disease incidence given by

Wiles (1963) as 0-25%= susceptible, 26-50%= moderately susceptible, 51-75%= moderately resistant and 76-100%= resistant. To calculate disease severity on foliar symptoms, rating scales from 0-4 given by Wu *et al.*, 2003 or 0-5 by Ulloa *et al.*, 2006 as 0= no foliar symptoms, 1= chlorosis or

wilt restricted to cotyledons or first leaf, 2= chlorosis or wilt extending beyond the first leaf, 3= moderate to severe foliar symptoms usually based with some abscised leaves, 4= severe foliar symptoms on the entire plant and 5= dead plant and another similar 0-5 rating scale was used by Wang and Roberts 2006 as 0= no symptoms, 1= epinasty and slight dwarfing, 2= 1-30% chlorotic leaves, 3= 31-80% chlorotic leaves and severe stunting, 4= 81-100% chlorotic leaves and 5= plant death. Same rating scale was also used by Lopez-Lavalle *et al.*, 2012 in Australia as 0= no disease, 1- one wilted cotyledon, 2= two wilted

cotyledons, 3= first true leaf wilted, 4= whole plant wilted and 5= dead plant. In China, a 0-4 scale system was adopted as the national standard for rating leaf symptoms (Wu *et al.*, 2003 and Wang *et al.*, 2009) as 0= healthy, 1= 25.0% of the leaf surface exhibited disease symptoms, 2= 25.1-50.0% of the leaf surface exhibited disease symptoms or plant were slightly dwarfed in stature, 3= 50.1-75.0% of the leaf surface exhibited disease symptoms or plant obviously dwarfed in stature and 4= >75.0% of the leaf surface exhibited disease symptoms or plants completely defoliated or died.

Table 1. Details of experiment conducted at RCRS, NAU, Bharuch during 2014-15.

Sr. No.	Experiment	Location /Zone	Investigator	Treatments	Variety	Design	Replication	Plot size (m)		Spacing (cm)	Sowing Date	Fertilizers N kg/ha	Irrigation
								Gross	Net				
1	NP Patho. 1	SG II Bharuch	ARS (Ento.)	31+01	Diff. varieties/entries	RBD	2	4.50 x 2.40	3.60 x 2.40	120 x 45	21.07.2014	80 & 120	Rainfed

RESULT AND DISCUSSION

Unremitting efforts to locate resistant sources and their utilization in resistance breeding programme are imperative to manage the diseases in the long run. Screening was therefore undertaken to evaluate a number of cotton entries against the major diseases during *khariif* 2014. Total 31+01 (LC) entries of cotton *G. hirsutum* were evaluated under rainfed condition for their reaction against wilt, alternaria leaf spot and bacterial blight diseases. The results presented in Table 2 indicated that of, out of 31

entries of *G. hirsutum* cotton tested, 30 and 1 entries showed disease free and resistant reaction, respectively against wilt disease, whereas 13, 15 and 3 entries showed disease free, resistant and moderately resistant reaction, respectively against alternaria leaf spot disease, whereas 9, 16 and 6 entries showed disease free, resistant and moderately resistant reaction, respectively against bacterial blight disease under field condition. Among checks, LRA 5166 showed disease free, resistant and moderately resistant reaction, against wilt, alternaria leaf spot and bacterial blight disease, respectively.

Table 2.

Sr. No.	Entries (Code / Decode)		Wilt			Alternaria leaf spot		Bacterial blight	
			%	Grade	Reaction	Grade	Reaction	Grade	Reaction
MLT of <i>G. hirsutum</i> cotton									
1	1	GSHV-159	0.00	0	DF	0	DF	0	DF
2	2	GISV-216	0.00	0	DF	1	R	1	R
3	3	GISV-272	0.00	0	DF	1	R	2	MR
4	4	GBHV-170	0.00	0	DF	0	DF	1	R
5	5	GBHV-177	0.00	0	DF	1	R	1	R
6	6	GBHV-164	0.00	0	DF	1	R	1	R
7	7	GBHV-180	0.00	0	DF	0	DF	1	R
8	8	G.Cot-20 (CC)	0.00	0	DF	1	R	2	MR
9	9	G.N.Cot-22 (CC)	0.00	0	DF	0	DF	1	R
10	10	G.Cot-16 (LC)	0.00	0	DF	0	DF	1	R
LSVT of <i>G. hirsutum</i> cotton									
11	1	GSHV-172	0.00	0	DF	1	R	1	R
12	2	GSHV-173	0.00	0	DF	0	DF	0	DF

13	3	GSHV-175	0.00	0	DF	2	MR	1	R
14	4	GJHV-517	0.00	0	DF	1	R	0	DF
15	5	GJHV-519	0.00	0	DF	2	MR	1	R
16	6	GJHV-526	3.13	1	R	1	R	2	MR
17	7	GJHV-473	0.00	0	DF	0	DF	2	MR
18	8	GBHV-162	0.00	0	DF	1	R	1	R
19	9	GBHV-183	0.00	0	DF	0	DF	1	R
20	10	GBHV-184	0.00	0	DF	0	DF	0	DF
21	11	GBHV-185	0.00	0	DF	1	R	0	DF
22	12	GTHV-10/25	0.00	0	DF	1	R	1	R
23	13	GTHV-7/70	0.00	0	DF	2	MR	1	R
24	14	GTHV-10/28	0.00	0	DF	1	R	2	MR
25	15	G.Cot-20 (CC)	0.00	0	DF	1	R	2	MR
26	16	G.Cot-16 (LC)	0.00	0	DF	0	DF	0	DF
SSVT of <i>G. hirsutum</i> cotton									
27	1	GBHV-187	0.00	0	DF	1	R	0	DF
28	2	GBHV-193	0.00	0	DF	0	DF	0	DF
29	3	GBHV-195	0.00	0	DF	0	DF	1	R
30	4	GBHV-198	0.00	0	DF	1	R	1	R
31	5	GBHV-202	0.00	0	DF	0	DF	0	DF

Sr. No.	Cotton	Total entries	Wilt		Alternaria leaf spot				Bacterial blight			
			0	1	0	1	2	3	0	1	2	3
			DF	R	DF	R	MR	MS	DF	R	MR	MS
1	<i>G. hirsutum</i> {MLT, LSVT and SSVT}	31	30	1	13	15	3	-	9	16	6	-

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