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Chaudhari RJ
Pearl Millet Research Station, Junagadh Agricultural University, JAU, Jamnagar, Gujarat, India

Kelaiya DS
Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, Gujarat, India

Vyas UM
Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, Gujarat, India

Parmar SK
Pearl Millet Research Station, Junagadh Agricultural University, JAU, Jamnagar, Gujarat, India

Patel PR
Pearl Millet Research Station, Junagadh Agricultural University, JAU, Jamnagar, Gujarat, India

Corresponding Author:
Chaudhari RJ
Pearl Millet Research Station, Junagadh Agricultural University, JAU, Jamnagar, Gujarat, India

Screening of different cotton varieties/genotypes against *Alternaria* leaf blight

Chaudhari RJ, Kelaiya DS, Vyas UM, Parmar SK and Patel PR

Abstract
Cotton (*Gossypium* spp.) is one of the most ancient and important commercial crop next only to food grains and is the principal raw material for a flourishing textile industry. Cotton, although under pressure from synthetic fibers, has made resurgence worldwide and remains as the most improved crop species producing lint plus oil and meal from seed. The major cotton growing districts/area in Gujarat is Kutch, Saurashtra and North Gujarat; however, cotton is grown in almost all the districts of Gujarat. Though cotton is seriously affected by many diseases, leaf blight caused by *Alternaria macropora* Zimm, is an important destructive disease in all over in Gujarat and other part of country. Among different varieties/genotypes were screened against *A. macropsora* under natural conditions, none of the entries was found immune at 90 DAS, 31 entries showed resistant reaction, 18 showed moderately resistance or tolerant reaction and only one entries GBHV 241 was found moderately susceptible. Thirteen entries were showed resistant reaction, 25 entries showed moderately resistance or tolerant reaction and 12 entries found moderately susceptible. None of the entries was found highly susceptible at 120 DAS.

Keywords: Leaf blight, cotton, host resistance, screening

Introduction
In the present context, cotton farming in India is far from being a sustainable agricultural system. India is the second-largest producer of conventional cotton after China. More than 90% of the cotton is produced from genetically modified, pest-resistant, high yielding BT cotton varieties. Before 2002, cotton cultivation in India relied on natural or conventional farming techniques using indigenous seeds and some hybrid varieties. India is the largest producer of organic cotton and contributes about 70% of the world's supply. Through the review of literature on the impact of BT cotton and organic cotton from both farming and fashion and a textile industry perspective, research emphasizes the importance of organic cotton farming which is sustainable, eco-friendly and generates a healthy livelihood for farmers (Mohapatra and Saha, 2019) [13]. Cotton plays a significant role in various aspects of the economy of the major developing countries. In India, no crop can compete with cotton for value addition and processing (Hitchings, 1984) [10]. A large number of fungal, bacterial, viral and nematode diseases have been reported on cotton crop right from early stage to maturity. Among them, the economically most important ones are bacterial blight, *Alternaria* leaf spot, grey mildew, rust and vascular wilts which occur throughout the world (Kotasthane and Agrawal, 1970) [11]. *Alternaria* leaf blight and other leaf spotting fungi pose an alarming situation (Gholve *et al.*, 2012) [9]. In India, leaf spot of cotton (*Alternaria macrospora* Zimm.) was first reported by Uppal *et al.* (1935) [20] from Bombay and later it reported by Rane and Patel in 1956 [17] from Pune and Ahmednagar. Dastur *et al.* (1960) [8] however observed it later in large scale and subsequently, many researchers recorded its occurrence from various provinces of India (Chopra and Sharma, 1975; Padmanabhan and Narayanasamy, 1976) [6, 14]. Bashi *et al.* (1983) [2] reported that epidemics of *Alternaria* leaf spot in Israel decreased the yield of Pima-S-5 by 25 per cent. Dastur*et al.* (1960) [8] reported that disease was serious on three cotton varieties of *G. hirsutum*, the other cultivated species of *Gossypium* being resistant. *Alternaria* blight (*A. macrospora*) has been reported to cause about 20-30 per cent losses in seed cotton yield (Srinivasan, 1994; Chauhan *et al.*, 1997; Mayee and Mukewar, 2007) [19, 5, 12]. However, the production potential of the crop has not been fully exploited due to several biotic and abiotic factors. The crop suffers from many fungal diseases, of which foliar diseases take a heavy toll and among the diseases, *Alternaria* leaf spot causes yield losses up to 26 per cent (Chattannavar, *et al.*, 2006) [4]. Bacterial blight, *Alternaria* leaf spot and grey mildew were the major diseases on cotton identified in the central and southern parts of the country in 2004 (Ashok, 2005) [1].

Material and Methods

Leaf blight is the most devastating disease in cotton throughout India, causing considerable yield loss. So an experiment was conducted to identify the most resistance genotype to leaf blight because, host plant resistance is the cheapest, and most effective disease management strategy. In the present investigation 50 genotypes along with susceptible local checks were screened against leaf blight under natural conditions.

Different genotype and variety of cotton were sown at Pearl Millet Research Station, JAU, Jamnagar during *Kharif* 2021-22 and The disease incidence was recorded from 10 tagged plants on 0-4 scale given by given by Sheo Raj (1988) [18].

Table 1: Show the disease grade and symptoms

Disease grade	Symptoms
0	Immune, completely free from infection
1	Resistance, infection 0-10%
2	Moderately resistance, infection 11-20%
3	Moderately susceptible, infection 21-40%
4	Susceptible, infection >40%

The per cent disease intensity (PDI) were calculated as per given formula (Wheeler, 1969) [21].

$$\text{Disease intensity}(\%) = \frac{\text{Sum of total rating}}{\text{Total number of leaves observed}} \times \frac{100}{\text{Maximum disease rating}}$$

The weather parameters were correlated to weekly disease incidence by calculating the Karl Person's correlation coefficient(r). Correlation coefficient values were tested individually for their significance at 5% probability level using following formula;

$$t = \frac{r\sqrt{n-2}}{r\sqrt{1-r}}$$

Where,
T = Test of significance
R = Correlation coefficient and
N = Number of observations

Observations recorded

Observations on the intensity of *Alternaria* blight on each cotton genotypes/varieties/hybrids were recorded at 120 DAS. Five plants were selected from each entry for scoring the disease intensity. From each plant ten leaves from top, middle and bottom portions were randomly selected for recording disease intensity. The disease intensity was recorded in 0-4 scale (Table 2) given by Sheo Raj (1988) [18].

Table 2: The disease intensity score/scale table

Disease grade	Category	Symptoms
0	Immune or Disease Free (DF)	No infection
1	Resistant (R)	A few small spots less than 2 mm, scattered brown in colour, leaf area covered is less than 5 per cent
2	Moderately Resistant (MR)	Bigger spots up to 3 mm coalescing, brown in colour, 6-20 per cent leaf area covered
3	Moderately Susceptible (MS)	Spots increasing in size 3-5 mm and irregular in shape tending to coalescing and 21-40 per cent leaf area covered
4	Susceptible (S)	Spots coalescing to form bigger lesions, irregular in shape and size, more than 40 per cent leaf area covered

Result and Discussions

Screening of the cotton varieties/genotype against the *A. macrospora* would be a great help for breeding programmer to identification of disease resistant source. Since the pathogen is disseminated through air/seed, disease spreads very fast. The resistance identified cultivars consistently resulted in less disease than non-resistant cultivator in high pathogen population.

Field based assessment for plant resistant in promising fifty varieties/genotypes of cotton against *A. macrospora* were screened at Pearl Millet Research Station, JAU, Jamnagar during *Kharif* 2021-22. Observation was recorded on 90 and 120 DAS (Table 2 and Table 3).

Field evaluation is a useful and convenient method for identifying cotton genotypes with natural resistance against *Alternaria* leaf blight. Hence identification of resistant varieties/genotypes is one of the best management practices in development of IDM strategy.

Fifty varieties/genotypes were screened against *A. macrospora* under natural conditions. Among them, none of the entries found immune against *Alternaria* leaf blight.

Thirty-one entries showed resistant reaction with PDI ranging from 2 to 10 per cent, eighteen showed moderately resistance or tolerant reaction with PDI ranging from 11 to 20 per cent and only one entries GBHV 241 found moderately susceptible reaction with PDI of 21 per cent, none of the entries found highly susceptible in 90 DAS.

Observation recorded in 120 DAS entries showed that 13 entries found resistant reaction with PDI ranging from 7 to 10 per cent, 25 entries showed moderately resistance or tolerant reaction with PDI ranging from 12 to 20 per cent and 12 entries found moderately susceptible reaction with PDI of 21 to 37 per cent, none of the entries found highly susceptible in 120 DAS. Maximum disease intensity was recorded in the entry PHT 2006 and GJHV 589 (37.0%).

The management of the disease through host plants resistance is the best practice in developing IDM strategy. Besides this, these resistant cultivars conserve natural resources and reduce the cost, time and energy when compared with the other methods of disease management. From this studied, it was concluded that GISV 328, PHT 2001, GJHV 592, GJHV 587, GBHV 242, GTHV 19/33, GTHV 361, GISV 368, GHhv 14/2017, GTHV 19/6, GJHV 562, GN. Cot. 22 and GN. Cot. 32 varieties were resistant against *A. macrospora.* Similar work has been done by different scientists viz., Bhattiprolu and Prasad (2011) [3], Cia *et al*. (2016) [7], Bodhke *et al*. (2019), Patel *et al*. (2019) [15] and Rajesha *et al*. (2021) [16] against *Alternaria* leaf blight of cotton.

Table 3: Screening of different cotton varieties/genotype against *Alternaria* leaf blight

Sr. No.	Name of genotype/varieties	90 DAS		Grade	Reaction	120 DAS		Grade	Reaction
		Average score	PDI			Average score	PDI		
1	GISV-328	0	8	I	R	0	8	I	R
2	GJHV-595	1	15	II	MR	1	20	II	MR
3	PHT-2002	1	16	II	MR	1	17	II	MR
4	PHT-2004	0	2	I	R	1	17	II	MR
5	PHT-2006	0	12	II	MR	1	37	III	MS
6	PHT-2005	0	8	I	R	1	19	II	MR
7	PHT-2003	0	9	I	R	1	19	II	MR
8	PHT-2001	0	10	I	R	0	10	I	R
9	PHT-2008	0	2	I	R	1	15	II	MR
10	GJHV-592	0	7	I	R	0	9	I	R
11	GJHV-591	0	3	I	R	1	21	III	MS
12	GJHV-596	1	13	II	MR	1	20	II	MR
13	GJHV-598	1	20	II	MR	1	20	II	MR
14	GJHV-597	0	4	I	R	1	25	III	MS
15	PHT-2007	1	14	II	MR	1	17	II	MR
16	GJHV-589	1	16	II	MR	1	37	III	MS
17	GJHV-587	0	3	I	R	0	8	I	R
18	GJHV-575	1	15	II	MR	1	18	II	MR
19	GJHV-567	1	15	II	MR	1	22	III	MS
20	GBHV-241	1	21	III	MS	1	28	III	MS
21	GBHV-242	0	5	I	R	0	9	I	R
22	GBHV-232	0	10	I	R	1	19	II	MR
23	GBHV-253	0	10	I	R	1	17	II	MR
24	GJHV-564	0	10	I	R	1	28	III	MS
25	GTHV-19/33	0	7	I	R	0	10	I	R
26	GTHV-19/21	0	2	I	R	1	19	II	MR
27	GTHV-361	0	6	I	R	0	9	I	R
28	GTHV-19/27	0	6	I	R	1	19	II	MR
29	GISV-368	0	2	I	R	0	9	I	R
30	GTHV-19/18	0	6	I	R	1	21	III	MS
31	GSHV-242	0	10	I	R	1	18	II	MR
32	GSHV-245	1	15	II	MR	1	16	II	MR
33	GHhv-47/2017	0	12	II	MR	1	34	III	MS
34	GHhv-14/2017	0	6	I	R	0	8	I	R
35	GJHV-254	1	13	II	MR	1	31	III	MS
36	GSHV-223	1	18	II	MR	1	27	III	MS
37	GTHV-19/6	0	5	I	R	0	9	I	R
38	GJHV-560	0	4	I	R	1	19	II	MR
39	GSHV-191	0	10	I	R	0	12	II	MR
40	GJHV-562	0	5	I	R	0	9	I	R
41	GBHV-212	1	13	II	MR	1	18	II	MR
42	GTHV-18/6	0	11	II	MR	1	16	II	MR
43	GSHV-236	1	14	II	MR	1	22	III	MS
44	GTHV-19/7	1	16	II	MR	1	18	II	MR
45	G. Cot. Hy-14 (C)	1	13	II	MR	1	14	II	MR
46	G. Cot. Hy-12 (C)	0	4	I	R	1	20	II	MR
47	G. N. Cot-22 (C)	0	4	I	R	0	8	I	R
48	G. N. Cot-26 (C)	0	6	I	R	1	16	II	MR
49	G. Cot-20 (C)	0	9	I	R	1	16	II	MR
50	G. N. Cot-32 (C)	0	5	I	R	0	7	I	R

Table 4: Categorization of cotton varieties/genotype for resistance to *Alternaria* leaf blight

Disease severity grade	Disease reaction	Per cent leaf area covered	Number of entries	Entries @ 120 DAS
0	Immune	0.00	-	-
1	Resistant	0-10	13	GISV 328, PHT 2001, GJHV 592, GJHV 587, GBHV 242, GTHV 19/33, GTHV 361, GISV 368, GHhv 14/2017, GTHV 19/6, GJHV 562, GN. Cot. 22 and GN. Cot. 32
2	Moderately Resistant	11-20	25	GJHV 595, PHT 2002, PHT 2004, PHT 2005, PHT 2003, PHT 2008, GJHV 596, GJHV 598, PHT 2007, GJHV 575, GBHV 232, GBHV 253, GTHV 19/21, GTHV 19/27, GSHV 242, GSHV 245, GJHV 560, GSHV 191, GBHV 212, GTHV 18/6, GTHV 19/7, G. Cot. Hy.14, G. Cot. Hy.12, GN. Cot. 26 and G. Cot. 20
3	Moderately Susceptible	21-40	12	PHT 2006, GJHV 591, GJHV 597, GJHV 589, GJHV 567, GBHV 241, GJHV 564, GTHV 19/18, GHhv 47/2017, GJHV 254, GSHV 223 and GSHV 236

4	Highly Susceptible	>40	-	-
Total			50	

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