

EFFECT OF ENVIRONMENTAL FACTORS IN RELATIONSHIP TO BACTERIAL LEAF BLIGHT (BLB) DISEASE DEVELOPMENT UNDER SOUTH GUJARAT OF INDIA

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Abstract: Cotton (*Gossypium spp.*) is one of the most important economic products of the group of fibers due to volume and value of production. Its cultivation is also of great social importance, due to the number of jobs generated directly or indirectly. The fiber, the main product of cotton has many industrial applications. Examples are manufacturing of yarn for weaving of various kinds of fabrics, cotton batting for hospital use, felt clothing, blankets and upholstery, photographic films and plates for radiography and others. The Main objective of present study is to study the progress of the Bacterial blight disease of cotton (BLB), caused by *Xanthomonas campestris* pv. *malvacearum* (Smith) Dye, in relation to the weather factors. It is a common disease affecting the growth, development and the yield of cotton crop under this region. A field trial was laid to study and to determine the influence of environmental factors viz., rainfall, rainy days, temperature and humidity on development of disease. The disease was first appeared in the third week of July (2.0 % PDI) i.e. in 29th Met. week. The incidence of Bacterial blight disease (BLB) was noticed from 29th to 51st standard week with the maximum disease intensity in the second week of October (42.5% PDI) i.e. in 41th Met. week. Bacterial leaf blight (BLB) has positive correlation with the maximum temperature and sunshine hour for the disease development.

Keywords: Bacterial blight, *Xanthomonas campestris* pv. *malvacearum*, Weather factors

INTRODUCTION

Cotton (*Gossypium spp.*) is one of the most important fiber crops playing a key role in economic and social scenario of the globe. It provides employment and sustenance to a population of nearly 42 Million people, who are involved directly or indirectly in cotton production, processing, textiles and related activities. This cotton is the back bone of national economy. Cotton possesses the most miraculous fiber under the sun, since 8,000 years. No other fiber has quality like cotton fibre. The fiber of a thousand faces and almost as many uses, cotton is noted for its versatility, appearance, performance and above all, its natural comfort.

The most common cotton diseases reported in India are Wilt (*Fusarium oxysporum* f. sp. *vasinfectum* (G.F. Atk.) W.C. Snyder & H.N. Hansen), Root rots (*Rhizoctonia bataticola* (Taubenh.), *Verticillium wilt* (*Verticillium dahliae* Kleb.), Anthracnose (*Colletotrichum gossypii* Southworth. or *C. capsici* (Syd.) Butler & Bisby), Grey mildew (*Ramularia areola* G.F. Atk.), Blackarm (*Xanthomonas campestris* pv. *malvacearum* (Pammel) Dowson), Leaf blight (*Alternaria macrospora* Zimm), Leaf curl (Cotton leaf curl virus), Corynespora leaf blight (*Corynesporacassicola* (Berk. & M. A. Curtis) C. T. Wei), Boll rot and physiological disorders as Para wilt, Leaf reddening and sometimes leaf elongation

due to improper use of weedicides etc. The bacterial blight is the widest spread and destructive disease reported to cause yield losses of about 10 to 30 per cent (Kalpana *et al.*, 2004 and Sandipan *et al.*, 2015) (Photograph: 1, 2, 3 and 4).

Angular leaf blight incited by *Xanthomonas* spp. (*Xanthomonas axonopodis* pv. *malvacearum*) is one of the most destructive diseases of cotton that causes severe qualitative and quantitative losses in most cotton growing areas of the world (Abdo-Hasan *et al.*, 2008).

Bacterial leaf blight (BLB) of cotton caused by *Xanthomonas campestris* pv. *malvacearum* (Smith) Dye (synonyms *Xanthomonas malvacearum* (E. F. Sm) Dowson) is the most important and serious disease of cotton, prevalent in cotton growing areas of the world and they cause the yields losses of 30 per cent (Chidambaram and Kannan, 1989), 26 per cent (Chattannavaret *et al.*, 2006) and 30 per cent (Ramapanduet *et al.*, 1979), respectively. Similarly, *Xanthomonas citrisubsp. malvacearum* is also one of the prevailing diseases affecting cotton worldwide (Bayles and Verhalen, 2007) and may cause losses as high as 20-30% (Delannoy *et al.*, 2005) and the infection is favored by environmental conditions (Suassuna *et al.*, 2006, Nunes *et al.*, 2009). Under natural condition, bacterial blight infection, boll yield losses up to 35 % have been reported (Sheo Raj and Verma, 1988).

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The disease is found in four phases depending on the plant parts *viz.*, seedling blight (on seedling), angular leaf spot (on leaves), black arm lesions (on stem and petioles) and the boll rot gummosis (on bolls).

Seedling blight

Initially water soaked, circular to irregular spots were appeared on the margins of the ventral side of cotyledons which, extended inward later the cotyledons distorted and growing tip were invaded resulted into death of the seedlings.

Angular leaf spot

The disease appeared as dark green and water-soaked lesions on the leaf lamina. The most common and striking symptoms appeared on the leaves with a few to numerous, spots initially appeared on ventral surfaces of young leaves but later the lesions were noted on both surfaces of the lamina. The angular raised lesions increased in size up to 5 mm. The spots turned brown then black and formed angular dead areas with reddish or purplish border bounded by veinlets. Vein blight symptoms were observed on the leaves, lesions extended along the edges of the veins forming a black border with an irregular margin. Slimy ooze on lower surface of infected leaves during humid weather conditions in the form of dried shiny crust was noticed.

Black arm lesions

The lesions on the petioles and stems appeared elongated grayish to sooty black. Bacterial oozing was observed under humid weather on the infected portion of the plants. In advance stage lesion girdled the stem and branches, later on became necrotic, liable to break.

Boll rot

Boll rot was observed as water soaked oily lesions which developed in to small, circular raised spots on bolls. The spots became enlarged, possessing irregular shape and covered entire boll. Later on it turned brown black and sunken at the centre.

All the four phases of the disease *viz.*, seedling blight, angular spot, black arm and boll rot were recorded and described by Patel and Kulkarni (1950), Ebbels (1976), Verma (1986), Hillocks (1992).

History and Geographical distribution and pattern

Bacterial blight of cotton is believed to have originated in India (Knight, 1948). Bacterial blight of cotton was first recorded in Alabama (USA) in 1891. However, the disease was introduced in India through exotics in the middle of 19th century because the indigenous cottons were resistant while the exotics were susceptible to the disease (Patel and Kulkarni, 1950). The disease was first reported at Rajaplayam in Southern Tamil Nadu of India in 1918. Several epiphytotic occurred during 1948-1952 and the disease was well established in the 1960's. Holeý and Wangikar (1976) reported angular leaf spot was one of the serious diseases of hirsutum cotton in Vidharbha region (MH). Bacterial blight incited by *Xanthomonasmalvacearum* (Smith) Dowson was a major disease of cotton in Sriganganagar district of Rajasthan (Rajpurohit and Lodha, 1981). Bacterial blight is most serious disease of cotton in India and outside (Minton and Garber, 1983). The disease was found appear in epidemic form resulting in considerable losses to cotton yield (Beuraet *al.*, 1997).

Symptoms showing the infection of Bacterial leaf blight (BLB), Photograph: 1, 2, 3 and 4



Resistant varieties are the true option for any disease management strategies. Environmental factors for bacterial blight disease may provide a basis to forecast the disease in time and which ultimately helps the cotton growers for its timely management. Keeping in view, a study was conducted at Main Cotton Research Station (MCRS), Surat (Gujarat) during *kharif*, 2021 to know the effect of environment parameters on the disease development of Bacterial leaf blight disease.

MATERIALS AND METHODS

The experiment was laid by dibbling method with the following experimental details (Table: 1). All the recommended agronomic practices were followed for raising the good crop. The observations on disease development were recorded at weekly interval from 20 randomly selected tagged plants and 5 leaves from lower part and 5 leaves from middle/ plant were selected by using 0-4 scale as used by Sandipan *et al.*, 2015.

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

Table 1. Experimental detail as below:

	Objective	: To know the disease progress in relation to weather parameters
1	Location	: Main Cotton Research Station, Surat
2	Year of commencement	: 1998 (24 th year) – Year 2021
3	Experimental details	
4	Design	: Single block
5	Treatment	: Single
6	Replication	: Non-Replicated (NR)
7	Spacing	: 120 x 45 cm

8	Plot size	:	12.0 x 67.0 m
9	Name of the varieties	:	G. Cot. Hy. 12 (Non Bt)
10	No. of rows/ plot	:	10
11	No. of dibbles/row	:	149
12	Expt. area in ha.	:	804.6 sq. meter (0.08 ha)
13	FYM t/ha	:	-
14	Fertilizer dose NPK kg/ha	:	240:40:00
15	Previous crop	:	-
16	Date of sowing	:	20.06.21
17	Date of germination	:	26.06.21
18	Date of gap filling	:	13.07.21 & 22.07.21
19	No. of plant protection	:	Unprotected for disease
20	No. of irrigation	:	As & when required
21	Date of harvesting	:	-

For, Bacterial leaf blight (BLB) disease

Scale	PDI	Grade	Symptoms
0	0.0	Immune	No Infection
1	1-25%	R	Few spots, scattered, 1mm in dia, no coalescing, reddish, no angular, veins free, around 5% leaf area covered
2	26-50%	MR	Spots initially wet but rapidly drying, several, larger 2 mm in dia, no coalescing, reddish brown, veins and veinlets free or with dry lesions, 10% leaf area covered
3	51-75%	MS	>2mm dia lesions, angular, turning brown and black, coalescing, spreading linearly along the small veins, or water soaked vein infection along the main veins, 11-20% leaf area cover
4	>75%	S	Larger lesions, water soaked, coalescing, or veins infected and extended up to pulvinus and petioles, larger lesions turning to brown black, in severe cases branches and stem also attacked and covering more than 20% leaf area

It is the standard methodology of AICRP Cotton for foliar disease rating.

The weather data of the corresponding period was obtained from the Meteorological observatory of MCRS, Surat (Gujarat). The data were compiled to standard weeks and subjected to correlation equations (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Bacterial blight disease (BLB) progress was recorded with its first appearance and subsequently at weekly

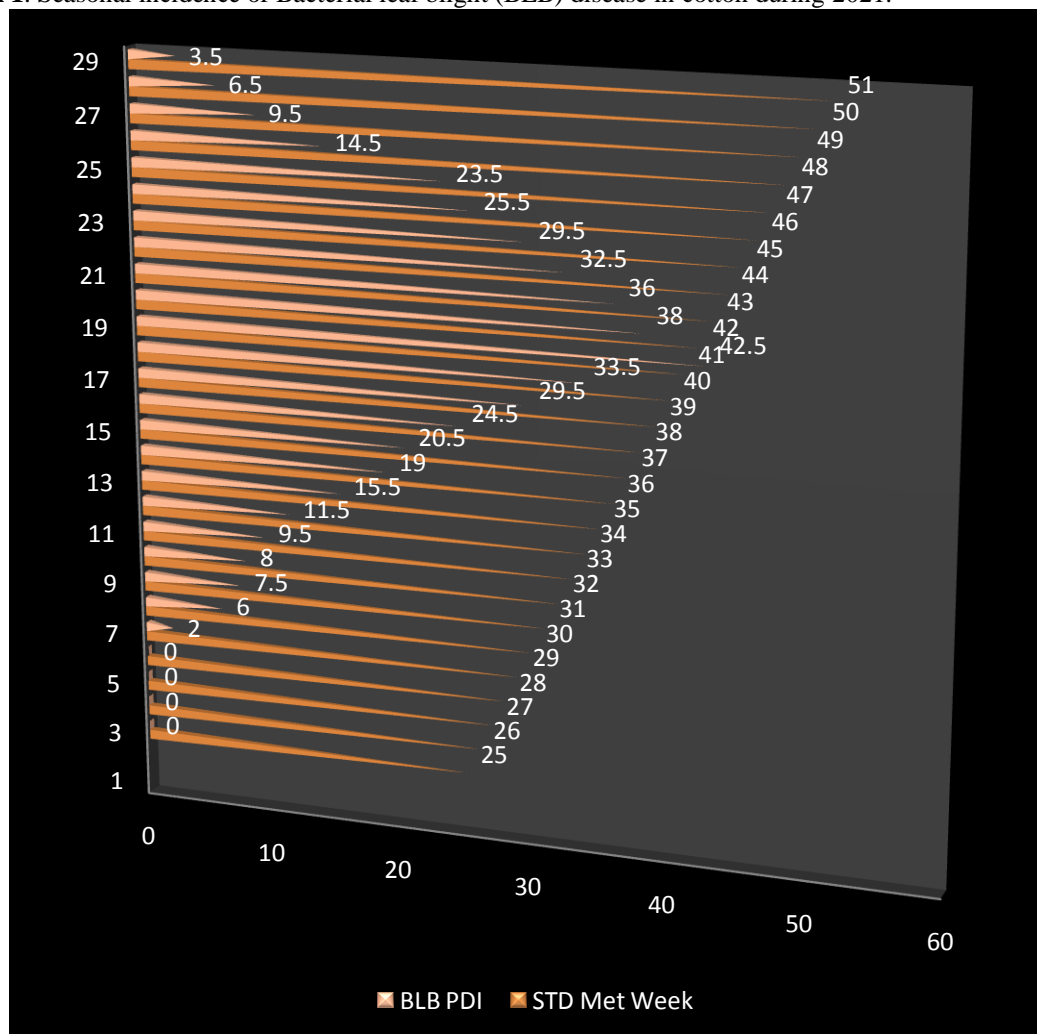
interval till it prevailed on G. Cot. Hy. 12 (Non Bt) on Research farm. The result presented in Table P 2, which indicated that the disease was first appeared in the third week of July (2.0 % PDI) *i.e.* in 29th Met. week. The incidence of Bacterial blight disease (BLB) was noticed from 29th to 51st standard week with the maximum disease intensity in the second week of October (42.5% PDI) *i.e.* in 41th Met. week. Bacterial leaf blight (BLB) has positive correlation with the maximum temperature and sunshine hour for the disease development.

Table 2. Occurrence of Bacterial blight on G. Cot. Hy. 12 in relation to different weather parameters at MCRS, NAU, Surat (2021).

Sr. No	STD Met Week	Period	BLB PDI	Weather parameter, 2021						
				Temp		Humidity		Sunshine hour	Rain fall	Rainy days
				Max	Min	Morning	Evening			
1	25	19-06-21	0.0	32.2	26.1	96	71	1.3	198.5	7
2	26	25-06-21	0.0	33.6	27.4	94	65	1.5	34.5	2
3	27	02-07-21	0.0	35.1	28.2	86	53	3.3	0	0

4	28	09-07-21	0.0	33.1	23.6	94	68	1.3	49.5	6
5	29	16-07-21	2.0	31.4	26.5	98	78	1.1	96.5	7
6	30	23-07-21	6.0	30.7	27.4	93	78	0.1	15	4
7	31	30-07-21	7.5	30.8	26.8	93.4	75.7	0.72	19	5
8	32	06-08-21	8.0	32.3	26.9	94	67.9	2.87	13	4
9	33	13-08-21	9.5	31.3	24.8	95.7	72.7	1.82	66	3
10	34	20-08-21	11.5	31	24	98	74.4	3.67	31	3
11	35	27-08-21	15.5	31.1	22.8	97	72	2.54	48	5
12	36	03-09-21	19.0	31.4	26.1	98.7	76.7	2.77	245.5	6
13	37	10-09-21	20.5	30.3	25.8	99	80.6	1.2	117.5	7
14	38	17-09-21	24.5	31.6	26.4	98.1	72.1	3.1	15.5	7
15	39	24-09-21	29.5	31	25.4	100	76.6	1.94	185.15	7
16	40	01-10-21	33.5	33.9	26.1	99	63	4.9	7.5	2
17	41	08-10-21	42.5	34.3	23.4	100	60.7	4.7	14.5	3
18	42	15-10-21	38.0	34.5	20.8	95.1	32	8.1	0	0
19	43	22-10-21	36.0	33.5	21.2	92.5	36.1	7.1	0	0
20	44	29-10-21	32.5	34.4	21.2	66	28	7.4	0	0
21	45	05-11-21	29.5	33.4	22.7	62	28	5.7	0	0
22	46	12-11-21	25.5	33.4	22.6	61	37	5.5	0	0
23	47	19-11-21	23.5	33.8	24.4	90	47	6.2	4.5	1
24	48	26-11-21	14.5	23.9	14.5	81	49	4.8	56	2
25	49	03-12-21	9.5	30.7	20.2	92	89	4.4	0	0
26	50	10-12-21	6.5	29.3	20	82	78	5.7	0	0
27	51	17-12-21	3.5	29.6	15.6	82	93	7.1	0	0
Correlation matrix				0.3300	-0.1757	-0.1193	-0.5783	0.5776	-0.1404	-0.2270

*significant at 5 % ($r=0.381$) and ** 1% ($r=0.487$) level of significance at $n-2$ degree of freedom

Graph 1. Seasonal incidence of Bacterial leaf blight (BLB) disease in cotton during 2021.

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