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Present status and prevalence of Alternaria leaf spot disease of cotton in India

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Abstract : A detailed survey was conducted to know the present status and prevalence of Alternaria leaf spot/blight disease of cotton in India during the crop seasons 2018-2019 and 2019-2020. Alternaria leaf spot and blight symptoms were observed in surveyed cotton growing areas of India. Disease incidence was recorded at farmer's fields. Forty nine cotton fields have been surveyed in Tamil Nadu covering five districts namely Coimbatore (22), Perambalur (13), Ariyalur (6), Salem (2) and Virudhunagar (6). Moderate disease incidence (7.0 – 10.0 PDI) was recorded among varieties and hybrids in Coimbatore district (Annur, Kinathukkadavu and Coimbatore blocks). Less disease incidence (<5.0 PDI) was observed among varieties in Senthurai block of Ariyalur district. Severe Alternaria leaf blight incidence was recorded in Perambalur (Veppanthattai and Perambalur blocks) and Salem (Valappadi and Peddanaickenpalayam blocks) districts specifically on hybrid cotton. Venganur and Esani villages of Perambalur district recorded 40.0 and 25.0 PDI, respectively in hybrid cotton. Forty fields were surveyed covering nine major cotton growing districts of Karnataka namely Raichur (5), Yadagiri (3), Kalaburagi (3), Ballary (1), Dharwad (10), Haveri (5), Gadag (2), Vijayapura (4) and Belagavi (7). Percent Disease Index (PDI) ranged from 2.0 to 28.0 PDI with an average of 7.0 PDI. Maximum was recorded in Vannahalli village of Dharwad district. Thirty fields were covered such as Warangal, Karim Nagar, Mahabubabad and Peddapalli districts of Telangana. Disease incidence varied from 4.0 to 26.0 with an average of 9.3 PDI. Maximum was observed in Jammikuntataluk of Karim Nagar district. Thirteen fields were surveyed in Kurnool and Guntur districts Andhra Pradesh. Disease incidence ranged from 7.0 to 12.0 PDI with an average of 8.6 PDI and maximum was recorded in Mandepudi village of Guntur district. Nanded district of Maharashtra, Junagadh region of Gujarat and Khandwa of Madhya Pradesh recorded moderate disease incidence of 7.0 to 13.0 PDI.

Key words: Alternaria leaf spot/blight, cotton, present status, survey

Cotton is affected by several diseases from seedling to maturity by various agents like fungi, bacteria and viruses. Among them Alternaria leaf spot, bacterial blight, grey mildew, rusts and vascular wilts occurs throughout the world. Alternaria leaf spot has become the most common foliar disease of cotton worldwide. This disease, caused by Alternaria macrospora and Alternaria alternata is the major leaf spot disease which occur entire cotton growing zones of India. A. macrospora is the major pathogen which attacks the cotton. Alternaria leaf spot causes 20-30 per cent seed cotton yield loss in India (Chauhan et al. 1997, Mayee and Mukewar, 2007). Under favourable environmental conditions, the disease can cause yield losses up to 26.59 per cent (Monga *et al.* 2013) and 38.23% (Bhattiprolu and Prasada Rao, 2009).Alternaria blight was the major disease observed in farmer fields of central zone and the disease intensity ranged between 2.16 to 24.12 per cent irrespective of variety/hybrids and locations (AICCIP Annual report 2016-2017). Alternaria blight was found to be major disease (5-30%) in early stages of the crop growth in Dharwad regions (AICCIP annual report 2016-2017). The AICCIP annual reports reveal that, Alternaria leaf spot of cotton is major foliar disease causing >20 per cent yield loss every year in central and south zones especially in Nanded, Dharwad, Guntur and Coimbatore regions. In this context a detailed survey was conducted to know the

current status and prevalence of Alternaria leaf spot/blight disease along with disease incidence in the major cotton growing States of India.

MATERIALS AND METHODS

The survey on the incidence of Alternaria leaf spot/blight disease of cotton was carried out in major cotton growing states of India namely Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Gujarat and Maharashtra during the crop seasons of the year 2018-2019 and 2019-2020.Alternaria leaf spot as well as leaf blight symptoms were recorded during the survey in maturity stage of the crop, specifically 120 days after sowing. Few places, spots were observed on boll bracts also. The Alternaria leaf spot/blight scoring was performed using 0-4 disease rating scale according to Sheo Raj (1988). The Per cent disease index (PDI) was calculated using the following formula.

$$\text{Per cent Disease Index (PDI)} = \frac{\text{Sum of all numerical ratings}}{\text{Total number of leaves observed}} \text{ X } \frac{100}{\text{Maximum grade}}$$

RESULTS AND DISCUSSION

Among the cotton diseases, Alternaria is most important foliar pathogen which causes considerable yield losses in all the three cotton growing regions of India. Among the foliar diseases infecting cotton, Alternaria blight caused by *Alternaria macrospora* was the serious disease which appears every year and has major threat to cotton production and yield (Chattannavar *et al.*, 2001). Among the fungal diseases of cotton, Alternaria blight was the predominant one causing economic loss to the cotton production in India (Johnson *et al.*, 2013). The average PDI of leaf, twig and boll infections of Alternaria blight were 21.76 in protected and 50.52 per cent in unprotected treatments (Chattannavar *et al.*, 2001). During the survey the following symptoms were observed in cotton fields. Both Alternaria leaf spot as well as leaf blight symptoms were recorded in the visited fields. Initially, small circular lesions were observed on the leaf lamina. Margins of the lesions had purple or dark grey in colour. In advanced stage, lesions expanded and coalesced, turned in to dull grey to dark grey with irregular or round in shape. Later, the spot cracked and exhibited a shot-hole symptom. Under severe infestation, heavy defoliation was observed in few fields though all the bolls were not matured. Under high moisture conditions, tissues in leaf spot area appeared as dead and dry with black, production of sooty masses of spores.

Alternaria leaf spot is mainly caused by two species *viz. A. macrospora* and *A. alternata*. Among the foliar diseases infecting cotton, Alternaria blight caused by *Alternaria macrospora* was the serious disease which appears every year and has major threat to cotton production and yield (Chattannavar *et al.*, 2001). *Alternaria macrospora* was the most prevalent pathogen during early growing season of cotton and *Alternaria alternata* was more prevalent towards end of the cotton growing season (Bhuiyan *et al.*, 2007). Although *A. macrospora* was considered to be the causal agent of leaf blight in Pima cotton (*G. barbadense*), and *A. alternata* was considered to be causal agent of leaf blight in Acala cotton (*G. hirusutum*) (Bashan and Hernandez-Saavedra, 1992), there was evidence that Alternaria blight is a disease complex of both pathogens (Rotem *et al.*, 1988). Alternaria leaf blight symptoms were observed in the fields where the severe infestation of leaf hoppers was recorded. In Tamil Nadu, cotton fields surveyed in Coimbatore districts recorded moderate disease incidence. Highest disease incidence was recorded in Salem

Table 1. Percent Disease Index (PDI) of Alternaria leaf spot recorded in different districts of Tamil Nadu during survey

S. No	Place of collection		Hybrid	ALS (PDI)
	Taluk	Village		
Coimbatore district				
1	Annur	Rudriyampalayam	Mahyco BGII	6.5
2	Annur	Rudriyampalayam	DCH 32	5.0
3	Annur	Mathireddipalayam	Mahyco BGII	7.0
4	Annur	Mathireddipalayam	Mahyco BGII	5.0
5	Annur	Mathireddipalayam	RCH 2 BG II	4.5
6	Annur	Thimmanaickenpudur	RCH 2 BG II	8.5
7	Kinathukkadavu	Kallapuram	Ankur HB 2110	6.0
8	Kinathukkadavu	Vadapudur	MRC 6918XXL	5.0
9	Kinathukkadavu	Sikkalampalayam	Mahadev BGII	4.0
10	Kinathukkadavu	Solavampalayam	Ankur HB 2110	5.0
11	Kinathukkadavu	Singaiyanpudur	Ankur HB 2110	9.0
12	Coimbatore	TNAU Cotton	Suvin (V)	10.5
13	Coimbatore	TNAU Cotton	MCU 5 (V)	11.0
14	Coimbatore	TNAU Cotton	RCH 2 BG II	14.0
15	Coimbatore	TNAU Cotton	Co 14 (V)	10.5
16	Coimbatore	TNAU Cotton	TCH 1819	7.0
17	Coimbatore	CICR RS	Subhiksha (V)	5.0
18	Coimbatore	CICR RS	Suraj (V)	13.0
19	Coimbatore	CICR RS	Supriya (V)	15.0
20	Coimbatore	CICR RS (New area)	MRC 7918 BG II	12.0
21	Coimbatore	CICR RS (New area)	NCS 954 BG II	14.0
22	Coimbatore	CICR RS (New area)	Mallika BG II	11.0
Perambalur district				
23	Veppanthattai	CRS, TNAU	SVPR 2 (V)	7.0
24	Veppanthattai	CRS, TNAU	F2 -8635 (V)	9.0
25	Veppanthattai	CRS, TNAU	TCH 1819 (H)	11.5
26	Veppanthattai	CRS, TNAU	KC 3 (V)	15.0
27	Veppanthattai	CRS, TNAU	SVPR 3 (V)	8.0
28	Veppanthattai	CRS, TNAU	Entry 653(V)	9.0
29	Veppanthattai	CRS, TNAU	Suraj (V)	14.5
30	Veppanthattai	CRS, TNAU	Ankur (H)	35.0
31	Veppanthattai	CRS, TNAU	Entry 154 (V)	17.5
32	Veppanthattai	CRS, TNAU	Suraj (V)	12.0
33	Veppanthattai	CRS, TNAU	SVPR 4 (V)	10.0
34	Perambalur	Esanai	RCH 2 BG II (H)	25.0
35	Veppanthattai	Venganur	RCH 2 BG II (H)	40.0
Ariyalur district				
36	Senthurai	Aanadhavaadi	Suraj (V)	4.5
37	Senthurai	Aanadhavaadi	Suraj (V)	3.0
38	Senthurai	P. Aanadhavaadi	RCH 659 BGII	4.0
39	Senthurai	P.Aanadhavaadi	Suraj (V)	4.0
40	Senthurai	P.Aanadhavaadi	Suraj (V)	2.5
41	Senthurai	P. nathapuram	Suraj (V)	3.0
Salem district				
42	P.naickenpalayam	Thalavaipatti	RCH 2 BG II (H)	25.0
43	Valappadi	Valappadi	RCH 2 BG II (H)	45.0
Virudhunagar district				
44	RRS,APK-TNAU	Aruppukottai	Variety	7.5
45	RRS, APK	Aruppukottai	Variety	9.0
46	RRS, APK	Aruppukottai		5.0
47	RRS, APK	Aruppukottai	Variety	4.5
48	Aruppukottai	Aruppukottai	Hybrid	6.0
49	Aruppukottai	Aruppukottai	Hybrid	5.0

Table 2. Percent Disease Index (PDI) of Alternaria leaf spot recorded in different districts of Karnataka during survey

S.	Place of collection			Hybrid	ALS	S.	Place of collection			Hybrid (H)	ALS
No.	District	Taluk	Village		(PDI)	No.	District	Taluk	Village		(PDI)
1	Raichur	Devadurga	Sulthanpur	Jaadoo BG II	10.0	20	Haveri	Savanur	Yaluvigi	Ajeet 155 BGII	10.5
2	Raichur	Devadurga	Amrapur	Jaadoo BG II	4.5	21	Gadag	Lakshmeshwar	Govanal	7067 BGII	5.5
3	Raichur	Devadurga	Yerrabandi	Bindaas BGII	5.5	22	Gadag	Lakshmeshwar	Ramagiri	MRC 7353BGII	4.5
4	Raichur	Raichur	Kerebudur	Kaveri Paras BGII	3.5	23	Dharwad	Kundagol	Shirur	Ajeet 155 BGII	3.5
5	Vijayapura	Talikot	Kodekal	Dr Brent BGII	3.0	24	Dharwad	Dharwad	Garag	Yuva BGII	4.5
6	Vijayapura	Vijayapura	Hadagli	Lakshmi Gold BGII, Jaadoo BGII	5.0	25	Dharwad	Dharwad	Tadakod	Jaadoo BGII	10.0
7	Vijayapura	Indi	Salotagi	KaveriManik BGII	2.0	26	Dharwad	Dharwad	Kotabagi	Ajeet 155 BGII	5.0
8	Vijayapura	Indi	Salotagi	Jaadoo BGII	2.0	27	Dharwad	Dharwad	Uppinbetagiri	RCH BGII	5.0
9	Kalaburagi	Jevargi	Jevargi K	Ajeet BGII, Jaadoo BGII, ATM BGII	10.5	28	Dharwad	Dharwad	Amminabhavi	Ajeet 155 BGII	4.0
10	Kalaburagi	Jevargi	Kalura	7065 BGII, Raja (NCS 954 BGII)	5.5	29	Dharwad	Navalagund	Iyatti	Ajeet 155 BGII	4.0
11	Kalaburagi	Jevargi	Sigarthahalli	Yodha BGII, Raja BGII	10.0	30	Dharwad	Navalagund	Shirur	Airawata BGII	10.5
12	Yadagiri	Yadagiri	Kursinigi	Ankur 5642 BGII (Sabari)	10.0	31	Dharwad	Dharwad	Vannahalli	Jaadoo BGII	28.0
13	Yadagiri	Wadagere	Birrannahalli	Khiladi BGII	5.5	32	Belagavi	Bailahongal	Balavadi	TIERRA 3669 BGII	15.0
14	Yadagiri	Wadagere	Gadasur	Jaadoo BGII	5.5	33	Belagavi	Bailahongal	Balavadi	Ajeet 155 BGII	10.0
15	Ballary	Ballary	P.D. halli	Jaadoo BGII	4.5	34	Belagavi	Saundatti	Sutagatti	Neelam, Kuber, Yuva,	10.5
16	Haveri	Siggaon	Siggari	MRC 7353 BGII	3.0	35	Belagavi	Bailahongal	Kanganur	First Class BGII	3.0
17	Haveri	Siggaon	Baad	MRC 7353 BGII	3.0	36	Belagavi	Bailahongal	Sanikoppa	Utham BGII	9.0
18	Haveri	Siggaon	Bankapur	RCH 659 BGII	15.0	37	Belagavi	Belagavi	Bakewadi	Kuber BGII	6.5
19	Haveri	Savanur	Savanur	Ajeet 155 BGII	12.0	38	Belagavi	Belagavi	Bakewadi	Acess, Moneymaker	7.5

Table 3. Percent Disease Index (PDI) of Alternaria leaf spot recorded in different districts of Telangana during survey

S.	Place of collection			Hybrid (H)	ALS	S. No	Place of collection			Hybrid	ALS
No	District	Taluk	Village		(PDI)		District	Taluk	Village		(PDI)
1	Warangal rural	Parvathagiri	Enugal	RCH 659BGII	10.0	16	Karimnagar	Jammigunta	Shampunipally	ATM	14.5
2	Mahabubabad	K. Samudram	Korukondapalli	-	9.5	17	Peddapalli	Odela	Gumpula	RCH 659 BGII	8.5
3	Mahabubabad	K. Samudram	K. Samudram	RCH 659BGII	12.5	18	Peddapalli	Odela	Gudem	Jabbli	4.0
4	Mahabubabad	K. Samudram	Mahamad	RCH 659BGII	14.0	19	Peddapalli	Odela	Indurthi	Bindaas	10.0
5	Mahabubabad	K. Samudram	Engurthy	RCH 659BGII	10.5	20	Karimnagar	Ilanthakunda	Terakurthi	—	13.0
6	Warangal rural	Dhamera	Dharmera	GHH029 BGII	12.5	21	Karimnagar	Ilanthakunda	Sainaagar	RCH 659 BGII	10.0
7	Warangal rural	Dhamera	Lodella	Jungi BGII	16.0	22	Karimnagar	Ilanthakunda	Manivanupalli	RCH 659 BGII	12.0
8	Warangal rural	Dhamera	Pulakurthi	RCH 659 BGII	5.0	23	Karimnagar	Ilanthakunda	Sirsedu	—	11.5
9	Warangal rural	Shyampet	Gattlakamaparthi	—	5.0	24	Mahububabad	Gudur	Hamu Thanda	Sadanand	7.5
10	Warangal rural	Parkal	Vellampally	—	7.0	25	Mahububabad	Gudur	Rajannapalli	RCH 659 BGII	6.5
11	Warangal rural	Parkal	Narsapalli	Namcot BGII	8.0	26	Mahububabad	Gudur	Upperapalli	Anees (Ank.)	8.0
12	Warangal urban	Kamalapur	Sonigaram	Moneymaker	9.5	27	Mahububabad	K. Samudram	Irukurthy	New hybrid	5.0
13	Karimnagar	Jammikunta	Ankushapur	—	5.5	28	Mahububabad	K. Samudram	Tarasingh Bavi Thanda	—	5.0
14	Karimnagar	Jammikunta	Shayampet	Sadanand-Veda	4.0	29	Mahububabad	Thorur	Madipally	RCH 659 BGII	4.0
15	Karimnagar	Jammigunta	Gundrapalli	RCH 659 BGII	26.0	30	Mahububabad	Thorur	Velikaatta	—	10.0

Table 4. Percent Disease Index (PDI) of Alternaria leaf spot recorded in different districts of Telangana during survey

S. No.	Place of collection			Hybrid (H)	ALS (PDI)
	District	Mandal	Village		
1	Kurnool	Manthralayam	Kalludevakunta	Jaadoo BG II	8.0
2	Kurnool	Manthralayam	Chikaladona	Jaadoo BG II	9.5
3	Kurnool	Nandavaram	Dharmapuram	RCH 659 BGII	7.5
4	Kurnool	Yemmiganur	Yemmiganur	Raja BGII	6.5
5	Kurnool	Adoni	Adoni	Yuva BGII	11.0
6	Guntur	Tadikonda	Tadikonda	RCH 659 BG II	11.0
7	Guntur	Tadikonda	Ponnekallu	Jaadoo BGII	7.5
8	Guntur	Tadikonda	Ravela	Jaadoo BGII	9.5
9	Guntur	Amaravathi	Mandepudi	RCH 659 BG II	12.0
10	Guntur	Thullur	Thullur	ATM BGII	8.0
11	Guntur	Tadikonda	Nidumukkala	Raja BGII	7.0

district under irrigated conditions followed by Perambalur district. The highest disease incidence (45.0 PDI) was recorded in hybrid RCH2 BGII in Valappadi village of Salem followed by Ankur hybrid in CRS (TNAU), Veppanthattai of Perambalur recorded 35.0 PDI (Table 1). Aryialur and Virudhunagr districts recorded less disease incidence which were under rainfed conditions.

In Karnataka, per cent disease index (PDI) ranged from 2.0 to 28.0 PDI with an average of 7.0 PDI (Table 2). Villages in Dharwad (28.0 PDI), Belagavi (15.0 PDI) and Haveri (15.0 PDI) districts recorded high disease incidence followed Yadagiri (10.0 PDI) district. These fields were mostly under irrigated conditions. Cotton fields in Telangana recorded moderate to high disease incidence varied from 4.0 to 26.0 with an average of 9.3 PDI (Table 3). Jammikuntamandal of Karim Nagar district recorded highest disease incidence (26.0 PDI) followed by Damera Mandal (16.0 PDI) of Warangal rural and K. Samudram Mandal (14.0 PDI) of Mahabubabad district. In Andhra Pradesh, Tadikonda and Amaravati mandals of Guntur district and Adonimandal of Kurnool district recorded more than 10.0 PDI. Disease incidence ranged from 7.0 to 12.0 PDI with an average of 8.6 PDI (Table 4) and maximum was recorded in Mandepudi village of Guntur district. The Alternaria blight disease incidence was recorded as 30.03 per cent in the cotton growing districts of Nanded, Parbhani, Beed and Osmanabadof Marathwada region of Maharashtra. The *A. macrospora* was the pathogen responsible for the disease (Jagtap *et al.*, 2013).

During the survey it was observed that the *Alternaria* pathogen was infecting cotton plants in two major conducive conditions. First, the plants with heavy foliage and dense canopy grown under irrigated conditions with closer spacing were highly susceptible. Secondly, the weaker plants with low immunity due to water stress or pest incidence showed yellowing and drooping of leaves. These plants were highly susceptible to *Alternaria* pathogen infection. Most of the places, severe leaf hopper incidence led to marginal yellowing of leaves invited the pathogen attack. The marginal leaf was infested with *Alternaria* and showing blighted appearance. *Alternaria* is opportunistic pathogen, it can infect the cotton plant in healthy plants in favourable weather conditions and as saprophyte in weaker plants. Under water or nutrient stress situations, the entire field was infected with pathogen and slow and complete drying of leaves from top to bottom observed. Heavy infection of *Alternaria* pathogen in leaves may completely defoliate the plant, which may be the main cause of yield loss due to *Alternaria* leaf blight (Bashi *et al.*, 1983). Compared to all the leaf spot diseases, Alternaria leaf spot is still major disease in south zone.

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