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Threats from Emerging and New Diseases in Indian Cotton with Required Pest Risk Analysis

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A current and burgeoning challenge for the discipline of plant pathology is the emergence or re-emergence of new pathogens and the introduction and spread of pathogens to new locations against a background of climate change. Among various biotic stresses in cotton crops, diseases constitute a significant proportion. The disease scenario undergoes a continuous change over time due to various factors like cultivars on the ground, weather factors and evolving pathogens. Among diseases that occur on cotton crop in India, about half a dozen are of economic importance and thereby create problems in

achieving the full potential yields of hybrids and varieties.

Mainly indigenous diploid cotton cultivars were grown in the fifties. *Fusarium* wilt, root rot, seedling blight, anthracnose and grey mildew were the major problems during that period. With the large-scale cultivation of tetraploid upland cotton (*Gossypium hirsutum*), bacterial blight became the major problem during the 1970s. *Verticillium* wilt appeared in Tamil Nadu during 1967 and remained restricted mainly to the South Zone only. *Alternaria* blight is prevalent almost everywhere in the three cotton-growing

zones of the country. In North India, the *Cotton Leaf Curl Virus* disease caused by different strains and recombinants of monopartite *Begomovirus* (Family *Geminiviridae*) with alpha and beta satellites and transmitted by whitefly (*Bemisia tabaci*, genetic group Asia II-1) in a persistent-circulative and non-propagative manner has become a major threat to cotton cultivation since 1993. The disease was initially reported in areas bordering Pakistan in the states of Punjab and Rajasthan during 1993-94 and its appearance was attributed to passive movement of its viruliferous vector whitefly across the border and causing an infection on cotton crop on this side. Presently, more than 90% of the cotton cultivation area comes under BG II hybrids (Cry1Ac and Cry2Ab) in the country, and change in disease scenarios along with the emergence of new diseases has been observed.

Target spot or leaf fall caused by *Corynespora cassiicola* (Berk. & Curt.) Wei and internal boll rot caused by single or the combination of bacterial species like *Pantoea agglomerans*, *P. ananatis*, *P. dispersa*, *P. anthophila*, *Erwinia uredovora*, *X. c. pv. malvacearum*, and fungi *Nigrospora oryzae*. *Cotton Leaf Crumple Virus* (CLCrV), a bipartite begomovirus transmitted by whitefly in a persistent manner, is an important problem in the new world and was reported in India too (Mali, 1977). In addition to that, cotton blue disease caused by the *Cotton Leafroll Dwarf Virus* (CLRDV), a serious problem in cotton cultivation in South America, has also been reported here in India (Mukherjee et.al., 2012). Other diseases like black root rot caused by *Thielaviopsis basicola* (Berk. & Br.) Ferr, *Phymatotrichum* Root Rot were reported from different countries but have not yet been reported in India.

Few of the diseases referred above are discussed below in brief along with actions and precautions that need to be undertaken to contain the emerging diseases and also the measures required to check the entry of those diseases which are yet not present in the country.

Emerging Diseases

Target spot

The *Corynespora* target leaf spot disease likely went unnoticed upto 2012 in India on cotton due to dry conditions, but it was observed in Dhule, Jalgaon and Nandurbar Districts of North Maharashtra in the year 2012- 2014 and in Nagpur

district of Maharashtra and Guntur of Andhra Pradesh in 2017(Shirsath et al. 2016; AICRP on cotton 2017). Frequent erratic rain events in the south and central cotton growing zone including Andhra Pradesh, Gujarat, Maharashtra in the last few years provided ideal conditions for disease development and it became an emerging disease. Recently, the scattered and low disease incidence has also been noticed in the North cotton growing zone of India (SK Sain, personal communication).

On cotton, it begins as small brick-red spots which then leads to the formation of large, circular to irregular-shaped spots with the target pattern (Fig 1). Infection commonly occurs in the lower

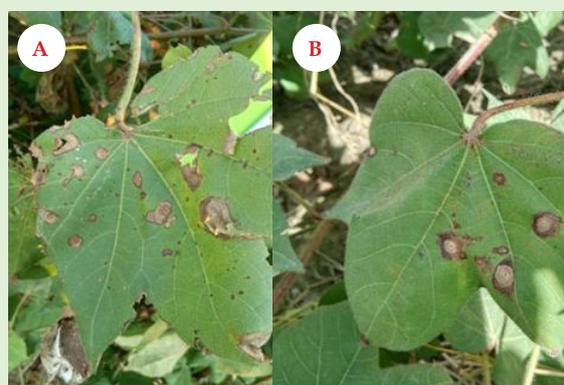


Photo - Dr SK Sain, ICAR- CICR Regional Station, Srisa, India

Fig. 1. Symptoms of target leaf spot disease caused by *Corynespora cassiicola* (A-B)

canopy and causes premature defoliation when disease severity is high due to the coalesce of several lesions. *Corynespora* spores spread from one plant to other through wind and rain splash. A hot and humid climate encourages disease and symptom development. The fungus *Corynespora cassiicola* is primarily found in the tropics and subtropics and is widely diverse in substrate utilisation and host association. More than 530 plant species from 380 genera, including monocots, dicots, ferns, and one cycad are reported to support the growth of *C. cassiicola* (Dixon et al. 2009). Appropriate measures for monitoring and management of the disease need to be strengthened.

Internal Boll Rot

Bacterial seed and boll rot were first observed in South Carolina, USA in 1999; China in 2008 Pakistan in 2013 and in Central India in 2020 (Nagrle et al. 2020). Early diagnosis of the disease is very difficult as the boll seems to be healthy with no symptoms on the outer surface. The disease can only be observed when bolls are cross-sectioned or opened. The immature

diseased locule is attributed as a “hard lock” having rotted seeds with brown dense lint. At harvesting time, partially opened infected bolls either drop or are not picked efficiently (Hudson 2000).

Continuous rains, cloudy weather, high relative humidity, an infestation of piercing-sucking bugs/insects during buds and bolls development and early crop sowing, are some of the major factors which lead to internal boll rot infection. After flowering, pathogens may invade the developing ovary (boll) via wounds associated with insect feeding, especially stink bugs and drizzling rains. However, the developing boll is susceptible to these piercing/sucking insects for only about the first three weeks. The immature seeds, fibers and lint in locules of immature unopened green bolls initially appear discoloured, light yellow, pink-red to brown coloured with slimy presence. The infected seeds may be swollen and rotted. Occasionally, minute black spots may be seen in some cases indicating feeding signs of hoppers, bugs and other piercing-sucking insects transmitting bacteria to the carpel layer of developing bolls (Fig 2). Infections of

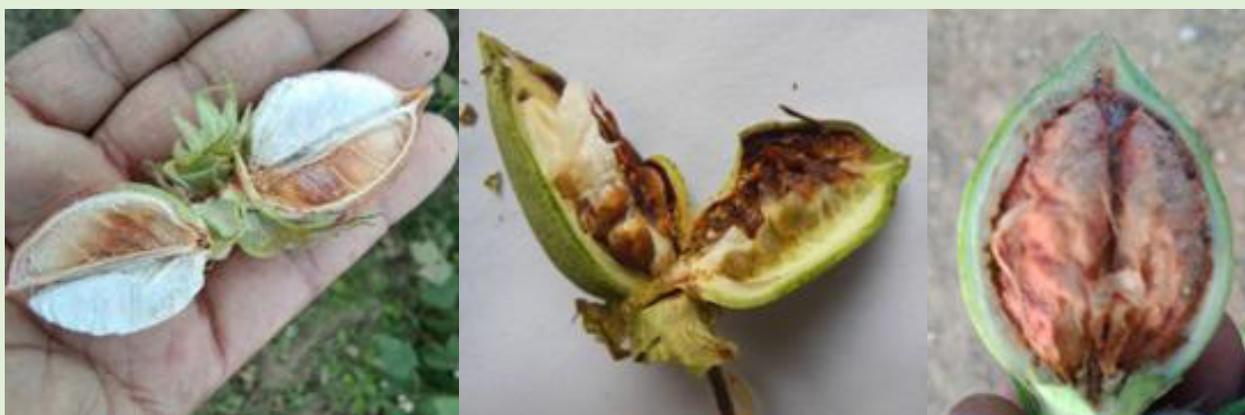


Fig. 2. Symptoms of internal boll rot disease

the pathogen by the insect vector may cause rotting of the entire locule making internal carpel wounds incurred by insect feeding. The seed rot generally does not affect the whole green boll and is restricted mostly to one or two locules. In some cases, pathogens cause severe necrosis and rot of flowering buds, young bolls and seeds within older bolls. However, in case of severe infection, whole locules of immature green bolls get diseased and headlocks may be formed. The incidence of this disease must be regularly monitored and appropriate prophylactic treatment sprays at early boll development stages may be applied as per the experts' advice.

New Disease Reports from India

Cotton Leaf Crumple Virus

Cotton Leaf Crumple Virus disease (CLCrD) produces characteristic foliar discoloration and venial hypertrophy leading in puckering, crumpling, downward leaf curling and shortening of internodes along with stunting of the host (Fig.3). CLCrD mainly occurs in California, Arizona, Texas (USA) and Mexico. Mali (1977) has reported the occurrence of the disease in the Marathwada region of Maharashtra in India.



Fig. 3. Symptoms of cotton leaf crumple virus disease

However, no further confirmation about its occurrence and spread has been noticed. Cotton Leaf Crumple Virus (CLCrV) is a bipartite DNA genome of begomovirus and is transmitted by whitefly. It is a widespread disease of cotton *G. hirsutum* in the Sonoran Desert of Arizona and Sonora, Mexico, southern California, the Rio Grande Valley of Texas, and Guatemala (Brown 1992). Severe outbreaks of CLCrD may be exacerbated by ratooning; a practice in which cotton is pruned and allowed to regrow the following year.



Fig. 4. Virescence symptoms at various growth stages; A & B- Malformation of floral parts into leaves
C & D: plants showing virescence symptoms- yellowing, reddening and stunting.

Cotton Virescence

Among arthropod-borne diseases, cotton virescence associated with phytoplasmas was recorded from Burkina Faso, Ghana, Ivory Coast, southwest Mali. Virescence infected plants exhibit symptoms that vary according to growth stage and time of infection. Infection at an early stage of growth results in cessation of internode elongation, reduction in leaf size, and stunting (to about two-thirds of normal plant height). The entire inflorescence is converted into twisted reduced leaves closely arranged on the top of the stem, with very short internodes (Fig 4).

The jassids/leafhopper *Orosius cellulosus* (Lindberg), breeding mainly on *Sida cordifolia* L. and *Mitracarpus scaber* Zucc, has been identified as the vector of the cotton virescence phytoplasma and two species of the genus *Sida*, family Malvaceae, act as phytoplasma reservoirs (Laboucheix et al., 1973). Infections that occurred later in the season caused characteristic symptoms, such as witches' broom. So far, cotton virescence has been found to cause losses only in Western Africa, but this disease represents a threat to other cotton-growing areas around the

world since weeds of the genus *Sida*, potential reservoirs, are widespread and leafhoppers of the genus *Orosius* are present throughout Asia (from Middle to the Far East), Australia and Pacific Region.

Cotton and luffa plants with little leaf symptoms were observed during February 2010 in New Delhi, India. Sequence comparisons showed homology with the members of 'Candidatus Phytoplasma asteris', group 16SrI (Kumar et al 2010). However, no records of the disease in cotton-growing areas of the country were observed. Moreover, the nature of similarity between this reported phytoplasma disease in India and the cotton virescence disease reported elsewhere is still to be ascertained.

(To be continued.....)

(The views expressed in this column are of the author and not that of Cotton Association of India)

CAI Releases Cotton Arrivals and Monthly Balance Sheet for November 2021

CAI has released the November month arrivals and the monthly cotton balance sheet.

CAI has estimated cotton arrivals for the month of November 2021 at 77.76 lakh bales of 170 kgs. each (equivalent to 82.62 lakh running bales of 160 kgs. each).

In its monthly balance sheet for November 2021, the CAI has estimated total cotton supply at 154.76 lakh bales of 170 kgs. each (equivalent

to 164.43 lakh running bales of 160 kgs. each), which consists of the arrivals of 77.76 lakh bales of 170 kgs. each, imports of 2 lakh bales of 170 kgs. each (equivalent to 2.13 lakh running bales of 160 kgs. each) during the month of November 2021 and Opening Stock of 75 lakh bales of 170 kgs. each (equivalent to 79.69 lakh running bales of 160 kgs. each) at the beginning of the season on 1st October 2021.

Further, the CAI has estimated cotton consumption for the months of October and

CAI's Estimates of Cotton Crop for the Season 2021-22 and 2020-21

(in lakh bales of 170 kg.)

State	Production Estimate				Arrivals as on 30th November 2021	
	2021-22		2020-21		2021-22	
	In running b/s of 160 Kgs. each	In lakh b/s of 170 Kgs. each*	In running b/s of 160 Kgs. each	In lakh b/s of 170 Kgs. each	In running b/s of 160 Kgs. each	In lakh b/s of 170 Kgs. each
Punjab	10.70	10.07	11.16	10.50	2.42	2.28
Haryana	17.64	16.60	23.91	22.50	3.84	3.61
Upper Rajasthan	15.50	14.59	20.72	19.50	5.83	5.49
Lower Rajasthan	12.84	12.08	13.81	13.00	4.78	4.50
Total North Zone	56.67	53.34	69.59	65.50	16.87	15.88
Gujarat	103.05	96.99	97.22	91.50	20.61	19.40
Maharashtra	91.86	86.46	86.06	81.00	18.17	17.10
Madhya Pradesh	21.78	20.50	19.66	18.50	6.04	5.68
Total Central Zone	216.70	203.95	202.94	191.00	44.82	42.18
Telangana	48.78	45.91	46.75	44.00	7.81	7.35
Andhra Pradesh	15.19	14.30	17.00	16.00	3.83	3.60
Karnataka	27.15	25.55	25.50	24.00	7.23	6.80
Tamil Nadu	10.63	10.00	7.97	7.50	0.37	0.35
Total South Zone	101.75	95.76	97.22	91.50	19.23	18.10
Orissa	4.34	4.08	3.19	3.00	0.80	0.75
Others	3.19	3.00	2.13	2.00	0.90	0.85
Total	382.64	360.13	375.06	353.00	82.62	77.76

* Loose cotton production figures are as per the survey report of Sardar Vallabhbhai Patel International School of Textiles and Management for a non-covid year

November 2021 at 55.83 lakh bales of 170 kgs. each (equivalent to 59.32 lakh running bales of 160 kgs. each) while export shipment of cotton during the months of October and November 2021 is estimated at 7.00 lakh bales of 170 kgs. each (equivalent to 7.44 lakh running bales of 160 kgs. each).

Stock at the end of November 2021 is estimated at 91.93 lakh bales of 170 kgs. each (equivalent to 97.68 lakh running bales of 160 kgs. each). The cotton stock held by mills in their godown on 30th November 2021 is estimated at 56.00 lakh bales of 170 kgs. each (equivalent to 59.50 lakh running bales of 160 kgs. each). The mills have on an average 60 days stock in their godown. The CCI, Maharashtra Fedn., MNCs, Ginners, Traders and Exchanges are estimated to have a total stock of about 35.93 lakh bales of 170 kgs. each (equivalent to 38.18 lakh running bales of 160 kgs. each) as on 30th November 2021. Thus, the total stock held by Spinning mills and stockists including the stock of cotton

sold but not lifted on 30th November 2021 with CCI and Maharashtra Fedn. as estimated by the CAI works out to 91.93 lakh bales of 170 kgs. each (equivalent to 97.68 lakh running bales of 160 kgs. each).

As may be recalled, the CAI has estimated cotton crop for the entire cotton season 2021-22 beginning from 1st October 2021 at 360.13 lakh bales of 170 kgs. each (equivalent to 382.64 lakh running bales of 160 kgs. each). The state-wise cotton crop and the yearly cotton balance sheet, which were notified earlier by the CAI vide its Press Release dated 30th October 2021 remain unchanged. The CAI crop estimate for the cotton season 2021-22 containing state-wise break-up of the crop and November arrivals now released by the CAI, monthly cotton balance sheet for the month of November as well as the yearly cotton balance sheet for the entire cotton season 2021-22 with the corresponding data for the previous year are given below:-

The Balance Sheet drawn by the Association for 2021-22 and 2020-21 is reproduced below:-
(in lakh bales of 170 kg.)

Details	2021-22	2020-21
Opening Stock	75.00	125.00
Production	360.13	353.00
Imports	10.00	10.00
Total Supply	445.13	488.00
Mill Consumption	292.00	292.00
Consumption by SSI Units	25.00	25.00
Non-Mill Use	18.00	18.00
Total Domestic Demand	335.00	335.00
Available Surplus	110.13	153.00
Exports	48.00	78.00
Closing Stock	62.13	75.00

Balance Sheet of 2 months i.e. from 1.10.2021 to 30.11.2021 for the season 2021-22

Details	In lakh b/s of 170 kg.	In '000 Tons
Opening Stock as on 01.10.2021	75.00	1275.00
Arrivals upto 30.11.2021	77.76	1321.92
Imports upto 30.11.2021	2.00	34.00
Total Available	154.76	2630.92
Consumption	55.83	949.11
Export Shipments upto 30.11.2021	7.00	119.00
Stock with Mills	56.00	952.00
Stock with CCI, Maha. Fedn., MCX, MNCs, Ginners, Traders & Exporters	35.93	610.81
Total	154.76	2630.92



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The Cotton Association of India (CAI) is respected as the chief trade body in the hierarchy of the Indian cotton economy. Since its origin in 1921, CAI's contribution has been unparalleled in the development of cotton across India.

The CAI is setting benchmarks across a wide spectrum of services targeting the entire cotton value chain. These range from research and development at the grass root level to education, providing an arbitration mechanism, maintaining Indian cotton grade standards, issuing Certificates of Origin to collecting and disseminating statistics and information. Moreover, CAI is an autonomous organization portraying professionalism and reliability in cotton testing.

The CAI's network of independent cotton testing & research laboratories are strategically spread across major cotton centres in India and are equipped with:

- State-of-the-art technology & world-class Premier and MAG cotton testing machines
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Current locations : • **Maharashtra :** Mumbai; Yavatmal; Aurangabad; Jalgaon • **Gujarat :** Rajkot; Ahmedabad • **Andhra Pradesh :** Adoni
 • **Madhya Pradesh :** Khargone • **Karnataka :** Hubli • **Punjab :** Bathinda • **Telangana :** Warangal, Adilabad



COTTON ASSOCIATION OF INDIA

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UPCOUNTRY SPOT RATES								(Rs./Qtl)					
Standard Descriptions with Basic Grade & Staple in Millimetres based on Upper Half Mean Length [By law 66 (A) (a) (4)]								Spot Rate (Upcountry) 2020-21 Crop December 2021					
Sr. No.	Growth	Grade Standard	Grade	Staple	Micronaire	Gravimetric Trash	Strength /GPT	13th	14th	15th	16th	17th	18th
3	GUJ	ICS-102	Fine	22mm	4.0 – 6.0	13%	20	10461 (37200)	10461 (37200)	10461 (37200)	10461 (37200)	10461 (37200)	10461 (37200)
								Spot Rate (Upcountry) 2021-22 Crop					
1	P/H/R	ICS-101	Fine	Below 22mm	5.0 – 7.0	4%	15	12626 (44900)	12626 (44900)	12626 (44900)	12626 (44900)	12626 (44900)	12626 (44900)
2	P/H/R (SG)	ICS-201	Fine	Below 22mm	5.0 – 7.0	4.5%	15	12795 (45500)	12795 (45500)	12795 (45500)	12795 (45500)	12795 (45500)	12795 (45500)
3	GUJ	ICS-102	Fine	22mm	4.0 – 6.0	13%	20	-	-	-	-	-	-
4	KAR	ICS-103	Fine	23mm	4.0 – 5.5	4.5%	21	-	-	-	-	-	-
5	M/M (P)	ICS-104	Fine	24mm	4.0 – 5.5	4%	23	14116 (50200)	14172 (50400)	14229 (50600)	14285 (50800)	14397 (51200)	14313 (50900)
6	P/H/R (U) (SG)	ICS-202	Fine	27mm	3.5 – 4.9	4.5%	26	16928 (60200)	16984 (60400)	17041 (60600)	17097 (60800)	17209 (61200)	17125 (60900)
7	M/M(P)/SA/TL	ICS-105	Fine	26mm	3.0 – 3.4	4%	25	-	-	-	-	-	-
8	P/H/R(U)	ICS-105	Fine	27mm	3.5 – 4.9	4%	26	17069 60700	17125 60900	17181 61100	17238 61300	17350 61700	17266 61400
9	M/M(P)/SA/TL/G	ICS-105	Fine	27mm	3.0 – 3.4	4%	25	-	-	-	-	-	-
10	M/M(P)/SA/TL	ICS-105	Fine	27mm	3.5 – 4.9	3.5%	26	-	-	-	-	-	-
11	P/H/R(U)	ICS-105	Fine	28mm	3.5 – 4.9	4%	27	17378 (61800)	17434 (62000)	17491 (62200)	17547 (62400)	17659 (62800)	17575 (62500)
12	M/M(P)	ICS-105	Fine	28mm	3.7 – 4.5	3.5%	27	-	-	-	-	-	-
13	SA/TL/K	ICS-105	Fine	28mm	3.7 – 4.5	3.5%	27	-	-	-	-	-	-
14	GUJ	ICS-105	Fine	28mm	3.7 – 4.5	3%	27	-	-	-	-	-	-
15	R(L)	ICS-105	Fine	29mm	3.7 – 4.5	3.5%	28	17434 (62000)	17491 (62200)	17547 (62400)	17603 (62600)	17716 (63000)	17631 (62700)
16	M/M(P)	ICS-105	Fine	29mm	3.7 – 4.5	3.5%	28	18222 (64800)	18278 (65000)	18334 (65200)	18390 (65400)	18503 (65800)	18419 (65500)
17	SA/TL/K	ICS-105	Fine	29mm	3.7 – 4.5	3%	28	18278 (65000)	18334 (65200)	18390 (65400)	18447 (65600)	18559 (66000)	18475 (65700)
18	GUJ	ICS-105	Fine	29mm	3.7 – 4.5	3%	28	18306 (65100)	18362 (65300)	18419 (65500)	18475 (65700)	18587 (66100)	18503 (65800)
19	M/M(P)	ICS-105	Fine	30mm	3.7 – 4.5	3.5%	29	18615 (66200)	18672 (66400)	18728 (66600)	18784 (66800)	18897 (67200)	18812 (66900)
20	SA/TL/K/O	ICS-105	Fine	30mm	3.7 – 4.5	3%	29	18700 (66500)	18756 (66700)	18812 (66900)	18868 (67100)	18981 (67500)	18897 (67200)
21	M/M(P)	ICS-105	Fine	31mm	3.7 – 4.5	3%	30	19093 (67900)	19150 (68100)	19206 (68300)	19262 (68500)	19375 (68900)	19290 (68600)
22	SA/TL/K/TN/O	ICS-105	Fine	31mm	3.7 – 4.5	3%	30	19178 (68200)	19234 (68400)	19290 (68600)	19346 (68800)	19459 (69200)	19375 (68900)
23	SA/TL/K/TN/O	ICS-106	Fine	32mm	3.5 – 4.2	3%	31	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)	N.A. (N.A.)
24	M/M(P)	ICS-107	Fine	34mm	2.8 - 3.7	4%	33	31213 (111000)	31213 (111000)	31213 (111000)	31213 (111000)	31213 (111000)	31213 (111000)
25	K/TN	ICS-107	Fine	34mm	2.8 - 3.7	3.5%	34	31494 (112000)	31494 (112000)	31494 (112000)	31494 (112000)	31494 (112000)	31494 (112000)
26	M/M(P)	ICS-107	Fine	35mm	2.8 - 3.7	4%	35	32057 (114000)	32057 (114000)	32057 (114000)	32057 (114000)	32057 (114000)	32057 (114000)
27	K/TN	ICS-107	Fine	35mm	2.8 - 3.7	3.5%	35	32900 (117000)	32900 (117000)	32900 (117000)	32900 (117000)	32900 (117000)	32900 (117000)

(Note: Figures in bracket indicate prices in Rs./Candy)