
RESEARCH

STATUS OF WILT DISEASE OF COTTON CAUSED BY *FUSARIUM OXYSPORUM* F. SP. *VASINFECTUM* (FOV)Twinkle D. Manavadria^{1*}, Prashant, B. Sandipan², R. K. Patel, P. S. Patel, Pushpa Ruwali, Navya Sharma and Payal J. Kodavala¹ Department of Plant Pathology, N. M. College of Agriculture, Navsari Agricultural University, (NAU), Navsari, Gujarat, India.² Main Cotton Research Station (MCRS), Navsari Agricultural University (NAU), Surat 395 007 (Gujarat), IndiaEmail: twinklemanavadariya25@gmail.com

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Abstract: Cotton (*Gossypium hirsutum* L.) is a major fiber crop that contributes significantly to global economic and social development. It is often referred to as "The White Gold" or "The King of Fibers". Survey was conducted in the cotton growing regions of Surat, Bharuch and Narmada districts of South Gujarat in the year 2023-2024 to know the presence of the *Fusarium oxysporum* f. sp. *vasinfectum* on cotton plants and to record the observations on per cent disease incidence (PDI). The maximum disease incidence was found in Bharuch district with 9.89 PDI while, the least disease incidence was found in Surat district with 4.33 PDI. However, the maximum disease incidence was observed in Ranipura village of Amod taluka of Bharuch district with 18.00 PDI while, no disease was observed in the Amkhuta village of Mangrol taluka and MCRS farm of Choryasi taluka of Surat district. At seedling stage, drooping of leaves and cortical decay of seedlings were observed. In case of young plants, leaves turned yellow followed by wrinkling and drying, loss of turgidity with brownish discoloration of stem near soil base, roots became soft and browning of vascular bundles was observed. The vascular discoloration of stem extended throughout the plant. When the roots of such infected plants were split opened and examined, the brownish black discoloration of vascular system was observed.

Keywords: Cotton, Survey, *Fusarium*, Intensity, Wilt disease

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is a major fiber crop that contributes significantly to global economic and social development. It is often referred to as "The White Gold" or "The King of Fibers". Cotton is a major cash crop in our country and belongs to the family Malvaceae (Anonymous, 2017). Cotton is a historically important commercial commodity, next to food grains, and serves as the primary raw material for the thriving textile industry. Cotton production, processing, textiles, and allied industries employ approximately 42 million people and sustain their livelihoods (Manickam and Sankaranarayanan, 2013).

India is the leading country in terms of area under cotton, which cultivates cotton in around 125 lakh hectares, which is around 39 per cent of the world cotton area. At the global level, though India occupies 39 per cent of the area, but able to produce just 22 per cent of the global cotton production (Anonymous, 2024a). Indian cotton scenario has been highly fluctuating due to biotic as well as abiotic stresses and competition from other crops in recent years. The cotton production in India during 2023-24 estimated to produce 323.11 lakh bales of 170 kg from 124.69

lakh hectares with a productivity of 441 kg lint/ha as estimated by the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, New Delhi. The area under cotton in the current year in the country decreased by 3.67 per cent and cotton production decreased by 4.18 per cent compared to last year. In Gujarat, cotton is cultivated in an area of 26.83 lakh ha and the production of 89.65 lakh bales with the productivity of 568 kg/ha. (Anonymous, 2024b). Among them wilt, root rot and verticillium wilt are soil borne diseases of cotton and anthracnose, grey mildew, black arm and leaf blight are foliar diseases of cotton (Ramod, 2016). Among these diseases, *Fusarium* wilt caused by *F. oxysporum* f. sp. *vasinfectum* (FOV) is one of the most important and serious diseases. It was the first vascular wilt described by Atkinson in (1892) and this disease is still causing enormous yield losses in several parts of the world and remains a threat to cotton production (Feng *et al.*, 2000). The disease is responsible for serious losses to the crop in the central and western India on a large scale and on almost all the cultivated varieties of both *G. arboreum* and *G. herbaceum*, the two indigenous species, especially in black cotton soils of Maharashtra, Madhya Pradesh, Karnataka and Gujarat. At present, the most of cultivated cultivars

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are susceptible to wilt disease (*F. oxysporum* f. sp. *vasinfectum*) and caused 54-60 per cent yield loss (Anonymous, 2003) because of reduced stand, stunted growth, small balls and poor lint quality. *Fusarium* wilt of cotton (*Gossypium hirsutum* L. and *Gossypium barbadense* L.) caused by *Fusarium oxysporum* f. sp. *vasinfectum* W.C. Snyder & H.N. Hansen (FOV), is an important and widespread disease affecting nearly all cotton growing regions of the world. FOV is both seedborne and soilborne, and colonizes the roots and vascular system of susceptible cotton cultivars, causing root and vascular discoloration vascular wilt (Chen *et al.*, 1985, Hillocks, 1992, Patel *et al.*, 2021a and Davis *et al.*, 1996). Discrete symptoms vary with pathogen genotype, inoculum density, cotton cultivar and plant age (Hao *et al.*, 2009).

Symptoms of this wilt may appear at any stage of crop development (generally from 30 to 120 DAS), depending on inoculum density, temperature and host susceptibility. At very high inoculum density or the very beginning of infection, plants may be killed at the seedling stage itself. Usually, the first symptoms in the field appear 30-60 days after planting generally, on the onset of flowering. The pathogen colonizes in plant roots and grows systemically into the vascular tissues and proliferates within the xylem vessels eventually spreading throughout the plant. It grows out of the vascular tissues and after the death of the host, sporulates on crop residues. The disease can be recognized at the seedling stage with symptoms first appearing on the cotyledons as the darkening of veins, followed by peripheral chlorosis and necrosis before they drop. In older plants, the infection occurs as

yellowing at the margin of one or more of the lower leaves. As the disease progresses within the plant more leaves develop chlorosis, which characteristically appears in patches between the main veins, the rest of the leaf remains green. Under optimal conditions, all the leaves of affected plants succumb and shed before the stem dries out (Sain *et al.*, 2023). There are six nominal races of FOV, 1, 2, 3, 4, 6 and 8 known to affect cotton worldwide (Holmes *et al.*, 2009).

MATERIALS AND METHODS

SURVEY OF COTTON WILT DISEASE IN THE DISTRICTS OF SOUTH GUJARAT

The random roving survey for cotton wilt disease was carried out in the cotton growing areas of Surat, Bharuch and Narmada district of Gujarat, during 2023-2024 in August to December. For this purpose, three talukas from each district were taken and in each taluka three villages were taken randomly for the disease assessment.

Calculation of Per cent Disease Incidence

Randomly select 5 locations in each field a total 100 plants were assessed and work out per cent disease incidence.

Disease incidence is calculated by the formula given by Wheeler (1969).

$$PDI = \frac{\text{Total no. of wilted/ diseased plants}}{\text{Total no. of germinated/ assessed plants}} \times 100$$

Score	Description	Grade
0	No infection	I=Immune
1	Slight yellowing and no defoliation, < 5% wilting	R=Resistant
2	Yellowing and browning of leaves, 6-15% plants showing wilting	MR=Moderately resistant
3	Yellowing, browning and discolouration of leaves, some leaves fall off. Late partial wilting may occur, 16-25% plants showing wilting	MS=Moderately susceptible
4	In early infection seedlings wilt, mature plant show yellowing, browning and dropping off of the leaves, >25% plants showing wilting	S=Susceptible

RESULTS AND DISCUSSION

SURVEY OF COTTON WILT DISEASE IN THE DISTRICTS OF SOUTH GUJARAT

A roving survey was carried out during year 2023-2024 to know the presence of wilt pathogen on the cotton plants and recorded the observations on per cent disease incidence (PDI) in the cotton growing regions of South Gujarat. In South Gujarat region three districts were selected viz., Surat, Bharuch and Narmada. In each district, three talukas were taken

and in each taluka three villages were taken for the disease assessment. Five places/ spot within each field were chosen in order to observed the disease incidence. Total 100 plants were assessed. Initial yellowing and wilting were the symptoms that were seen in relation to the occurrence of wilt disease. A 0-4-point disease rating scale was used to calculate the disease incidence. The survey was carried out to know the disease incidence, distribution and spread as the result is given in the chapter.

The data collected from the roving survey in randomly chosen fields across various villages of South Gujarat are presented in Table: 1, Fig.: 1 and Photo: 1.

During the survey the pathogen was collected and its pure culture was prepared (Photo: 2) and further microbial identification of the pathogen was done by using ITS gene and the fungus showed high similarity with *Fusarium oxysporum* f. sp. *vasinfectum* based on nucleotide homology and phylogenetic analysis.

Data clearly show that the disease was prevalent throughout South Gujarat's cotton growing regions with the incidence ranging from 0.00 to 18.00 per cent at different location surveyed. The wilt disease incidence in Surat district ranged between 0.00 to 9.00 per cent. The maximum disease incidence was observed in Chokhvada village of Umapada taluka with 9.00 per cent disease incidence followed by Hathoda village of Mangrol taluka with 8.00 per cent disease incidence and Umargot village of Umapada taluka with 7.00 per cent disease incidence. While, no disease was observed in the Amkhuta village of Mangrol taluka and MCRS farm of Choryasi taluka of Surat district.

In Bharuch district, wilt disease incidence was ranged between 5.00 to 18.00 per cent. The maximum disease incidence was observed in Ranipura village of Amod taluka with 18.00 per cent disease incidence followed by Kelvikuva village of Netrang taluka with 13.00 per cent disease incidence and Malkinapura village of Amod taluka with 12.00 per cent disease incidence.

In Narmada district, wilt disease incidence was ranged between 3.00 to 13.00 per cent with maximum disease incidence 13.00 per cent in Kundiamba village of Dediapada taluka followed by Ghankhetar and Jargam village of Dediapada with 11.00 and 9.00 per cent disease incidence.

Among all the three districts surveyed, the highest mean disease incidence 9.89 per cent was recorded in Bharuch district followed by Narmada district with 7.33 per cent. In Surat district, the lowest mean incidence 4.33 per cent disease was recorded (Table: 1).

The present work conducted survey of cotton disease on farmer's field as well as on research farm. Bacterial leaf blight incidence varied from 0.0 to 22.5 per cent PDI Alternaria leaf spot disease varied from 0.0 to 12.00 per cent PDI in different cultivar/hybrid on research farm and 2.00 to 3.00 per cent Fusarium wilt was observed when the cotton plant attains the age of 50 to 60 days.

Patel *et al.* (2021b) a field survey was conducted to collect the information on the severity of wilt of cotton in selected districts of South Gujarat region viz., Surat, Bharuch and Narmada, respectively. The maximum incidence of wilt disease was found in the Bharuch district ranged from 8.00 to 21.00 PDI with

the maximum per cent disease incidence 21.00 per cent was observed in Ranipura village of Amod Taluka of South Gujarat.

The survey was conducted on farmer's field as well as on Research farm by the Main Cotton Research Station, Surat. In farmer's field, a roving survey was carried out on BG II hybrids. The bacterial leaf blight, alternaria leaf blight and wilt (in Desi) were observed as major diseases. All these diseases were observed during the flowering stage and the PDI of bacterial leaf blight (BLB), alternaria leaf blight (ALB) and wilt were recorded to be in the range of 0.0-14.5, 0.0-3.5 and 0.0-5.5 per cent, respectively. During the boll developing stage the PDI of bacterial leaf blight, alternaria leaf blight and wilt was recorded in the range of 0.0- 20.5, 0.0-5.0 and 0.0-8.5 per cent, respectively. Overall, in these districts, the average PDI of bacterial leaf blight, alternaria leaf blight and wilt were recorded as 4.1, 1.8 and 4.2 per cent at the boll developing stage, respectively. When compared to the PDI in the popular hybrids, the highest bacterial leaf blight (20.5%) and wilt (5.5%) were recorded in the hybrids BG II and desi cotton in the Bharuch district (Anonymous., 2021a).

The survey was conducted in the major cotton growing districts of Bhavnagar, Rajkot and Junagadh of Gujarat on the Per cent disease incidence (PDI) of wilt, root rot (RR), boll rot (BR), alternaria leaf spot (ALS), corynespora leaf spot (CoLS), cercospora leaf spot, anthracnose, bacterial leaf blight, grey mildew (GM) and phoma were recorded on the hybrid RCH-2 and G. Cot-8 (BGII) in the Cotton Research Station, JAU. The highest incidence of wilt (3.1%) and boll rot (20.4%) were observed in the susceptible cultivated viz., G. Cot. 8 (BGII) in the month of August and October. (Anonymous., 2021b).

The survey was conducted in the major cotton growing districts viz., Guntur, Krishna and Kamool of Andhra Pradesh on different diseases namely alternaria leaf spot, corynespora leaf spot, cercospora leaf spot, myrothecium leaf spot, bacterial leaf blight, root rot, wilt, boll rot, grey mildew and rust in different cotton hybrids from July to December. Wilt incidence was recorded from 0.0 to 3.0 per cent. (Anonymous, 2023).

The survey was conducted in the major cotton growing districts (Guntur, Krishna and Prakasam) of Andhra Pradesh for observation of different diseases namely alternaria leaf spot, corynespora leaf spot, myrothecium leaf spot, bacterial leaf blight, root rot, wilt, boll rot, grey mildew and rust in different cotton hybrids were recorded during the survey conducted from July to December, 2023. Wilt and root rot were recorded to the tune of 1.0-2.0 per cent at Pondugala village of Amaravati mandal.

Table 1. Survey for cotton wilt disease incidence in different villages under South Gujarat during the year 2023-24

Sr. No.	District	Taluka	Village	Name of variety/ hybrid	GPS Location	Total no of plant examined	Total no of infected plant	Per cent Disease Incidence (PDI)	Mean disease incidence of Taluka (%)
1	Surat	Mangrol	Bhilvada	BG II	21.48°21' "N 73.21°02' "E	100	3	3.00	3.66
			Amkhuta	BG II	21.41°44' "N 73.21°91' "E	100	0	0.00	
			Hathoda	BG II	21.42°53' "N 72.99°09' "E	100	8	8.00	
		Choryasi	Bhesan	BG II	21.21°07' "N 72.75°22' "E	100	5	5.00	2.00
			MCRS farm	BG II/ Desi variety	21.17°04' "N 72.80°31' "E	100	0	0.00	
			Deladva	BG II	21.14°71' "N 72.89°51' "E	100	1	1.00	
		Umarpada	Pinpur	BG II	21.44°54' "N 73.48°35' "E	100	6	6.00	7.33
			Umargot	BG II	21.43°79' "N 73.52°29' "E	100	7	7.00	
			Chokhvada	BG II	21.43°33' "N 73.54°39' "E	100	9	9.00	
District mean									4.33
2	Bharuch	Vagra	Muler	Desi variety	21.87°64' "N 72.69°02' "E	100	6	6.00	6.33
			Pisad	Desi variety	21.82°16' "N 72.82°75' "E	100	8	8.00	
			Sutrel	Desi variety	21.81°76' "N 72.80°47' "E	100	5	5.00	
		Netrang	Netrang	BG II	21.63°29' "N 73.36°81' "E	100	9	9.00	10.00
			Kelvikuva	BG II	21.39°00' "N 73.21°00' "E	100	13	13.00	
			Kambodiya	BG II	21.60°00' "N 73.36°04' "E	100	8	8.00	
		Amod	Ranipura	Desi variety	21.72°39' "N 73.15°26' "E	100	18	18.00	13.03
			Manjola	Desi variety	22.06°84' "N 73.05°69' "E	100	10	10.00	
			Malkinpura	Desi variety	21.97°35' "N 72.96°34' "E	100	12	12.00	
District mean									9.89
3	Narmada	Rajpipla	Vavadi	BG II	21.85°73' "N 73.55°50' "E	100	6	6.00	6.00
			Gurudeshwar	BG II	21.89°17' "N 73.65°09' "E	100	4	4.00	
			Akteshwar	BG II	21.89°01' "N 73.64°51' "E	100	8	8.00	
		Dediyapada	Jargam	BG II	21.55°23' "N 73.61°88' "E	100	9	9.00	11.00
			Kundiamba	BG II	21.52°36' "N 73.63°09' "E	100	13	13.00	
			Ghankhetar	BG II	21.60°24' "N 73.59°77' "E	100	11	11.00	
		Sagbara	Mota Doramba	BG II	21.51°81' "N 73.75°07' "E	100	8	8.00	5.00
			Rozdev	BG II	21.50°75' "N 73.76°57' "E	100	4	4.00	
			Nana kakdiamba	BG II	21.50°83' "N 73.71°77' "E	100	3	3.00	
District mean									7.33

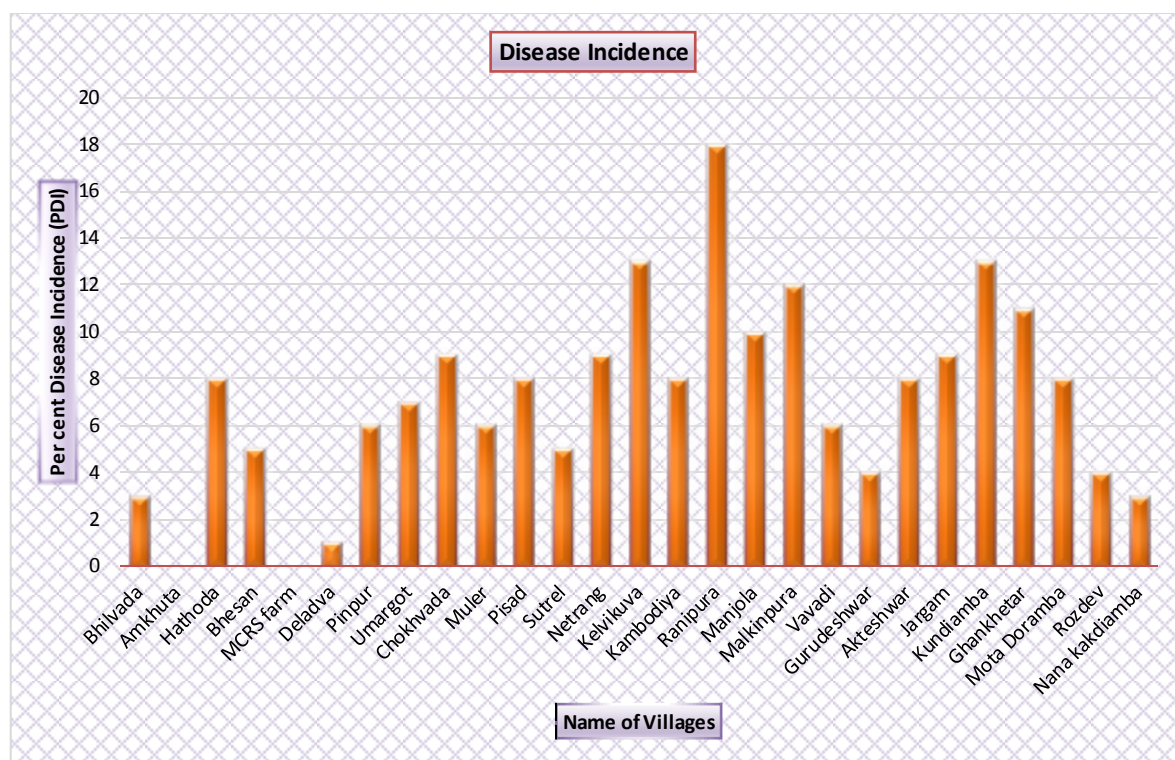


Fig. 1. Disease incidence of wilt disease of cotton in different villages of South Gujarat during the year 2023-24

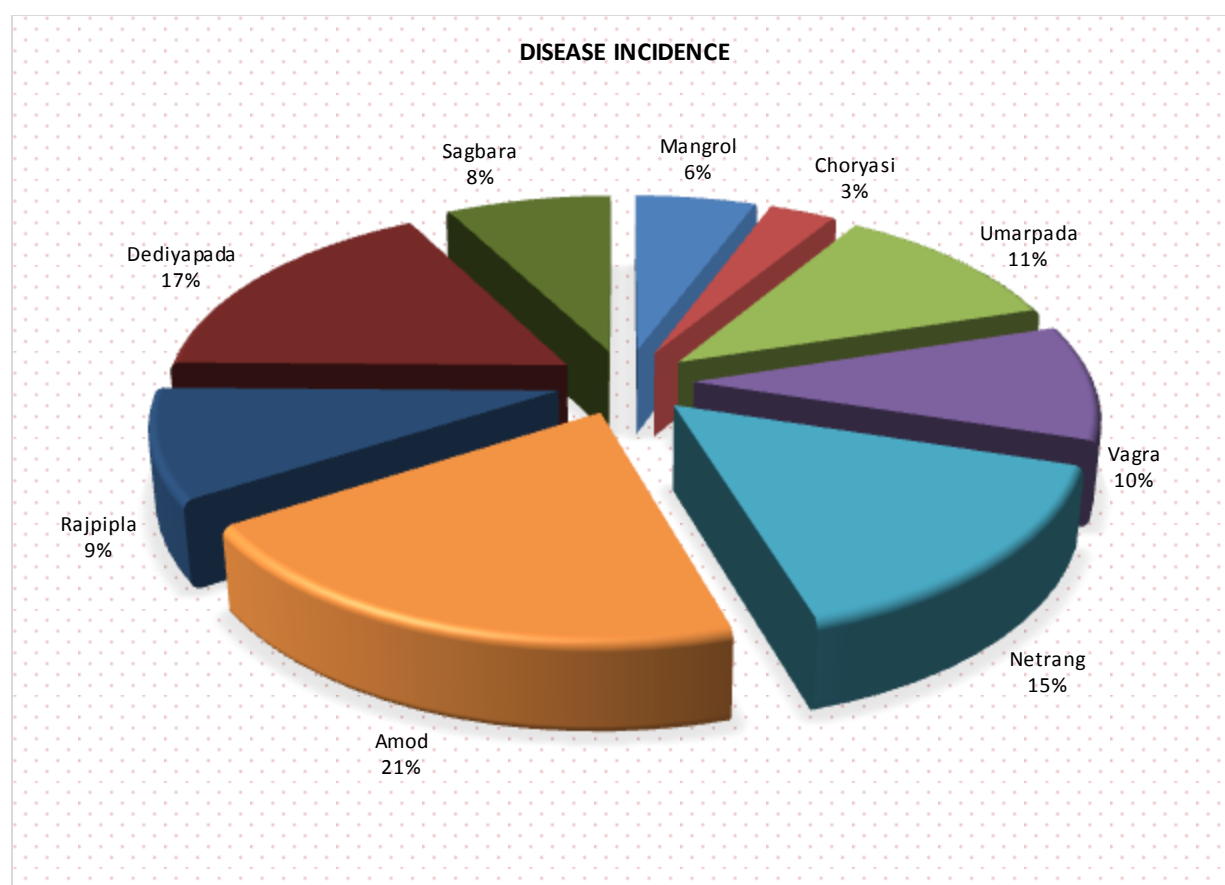
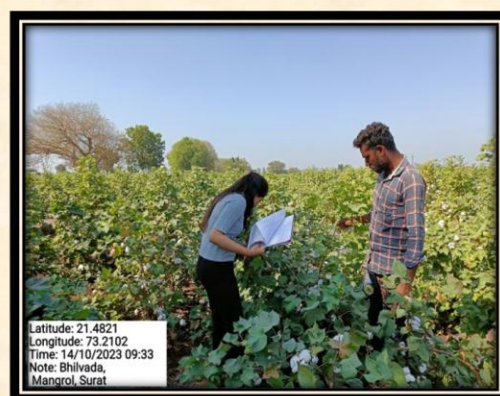


Fig. 2. Disease incidence of wilt disease of cotton in different taluka of South Gujarat during the year 2023-24



MCRS, Choryasi, Surat



Bhilvada, Mangrol, Surat

Mota Doramba, Sagbara,
NarmadaGurudeshwar, Rajpipala,
Narmada

Sutrel, Vagra, Bharuch



Ranipura, Amod, Bharuch

Photo 1. Survey of wilt disease in cotton crop in different villages of South Gujarat during the year 2023.



Photo 2. Pure culture of *Fusarium oxysporum* f. sp. *vasinfectum* isolated from the infected cotton roots

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